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Aknowledgement

The provenience of the materials included in this handbook is from the Learning Zone on the official site of
“European Society of Regional Anesthesia and Pain Therapy”.

http://www.esra-learning.com/

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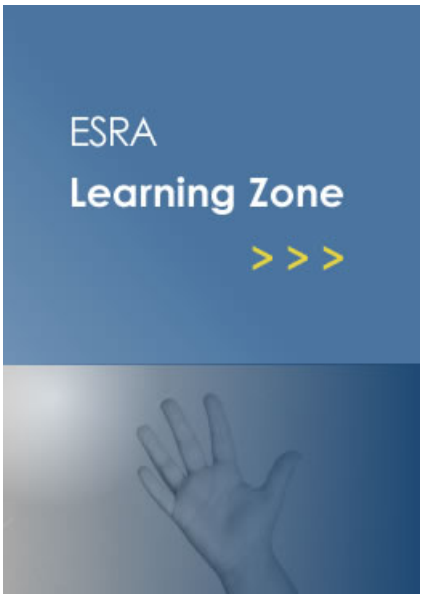

HEAD & NECK

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HEAD & NECK

INTRACRANIAL SURGERY

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In intra-cranial neurosurgery, scalp infiltration aims to prevent systematic and cerebral hemodynamic variations, contemporary of skin incision. The potential morbidity of these hypertension-tachycardia episodes, even in patients profoundly anaesthetized, is secondary in the increase of the cerebral blood flow and in its deleterious consequences on intra-cranial pressure in these compromised patients. Several studies report sometimes different but always convergent results, leaving in the current state of the literature no doubt about the utility of skull block in craniotomy.

INNERVATION OF THE SCALP

The innervation of the scalp is complex, depending on several nerves.

Regional anesthesia of the scalp (skull block or infiltration) allows realizing a local anesthesia of the skin, the subcutaneous tissues and muscles, the external periosteum of the bones of the skull. The internal periosteum and the dura, innervated by nerves satellites of the meningeal vessels, are not blocked by this infiltration. However, they are considered as only little sensitive.

Several algogenic or reflexogenic events should be considered during a craniotomy: insertion of the cranial pins of the Mayfield head holder, incision of the scalp, craniotomy, and dural incision. Regional anesthesia of the scalp aims to blunt the hemodynamic reactions associated with all these events.

LITERATURE

Hillman et al. have first reported the benefits of the scalp infiltration with 20 mL of 0,5 %, bupivacaine, showing heart rate stability and only very little variation in blood pressure during the various stages of craniotomy. Engberg et al. showed that the infiltration of the scalp with 20 mL of 0,25 % bupivacaine assured a relative stability of cerebral DavO2, witnessing the absence of rough variation of cerebral blood flow at the time of incision in patients having benefited from this infiltration of the scalp.

Positioning the 3-point Mayfield head holder, whose pointed pins are inserted through the dermis in the cranial periosteum, usually increases blood pressure.

Three different studies yield the interest of the local anesthesia of the scalp to block or to reduce this hypertensive reaction.

Levin et al. showed the efficiency of local anesthesia of the contact points of the pins of the head holder. Large infiltration of the scalp is more effective than blocking only the 3 pins of the head holder.
In children Hartley et al. showed that the infiltration of the scalp with 0,125 % bupivacaine with epinephrine (1/400.000) can prevent hemodynamic variations associated with incision.

Pinosky et al. reported finally than blocking all the nerve that innervate the scalp, including the greater and the lesser occipital nerves, the supraorbital, the supratrochlear nerve, the zygomaticotemporal nerve, the auriculotemporal nerve and the greater auricular nerves is more effective than local or large infiltrations.

The study of Bloomfield is the only one to moderate these results. He reported significant effects, but suggested these results are moderate and of a limited clinical interest. However, it does not contradict the other studies.

Epinephrine is usually added to local anesthetic solutions. It lowers bleeding at the time of incision and prolongs duration of the local anesthesia. However Phillips et al. reported a 20 % drop in systemic blood pressure in approximately 50 % of the patients when using 0,5 % lidocaine with epinephrine (1/200.000). With volumes as large as 20 mL of 0,125 % or 0,25 %, bupivacaine, blood levels are far from toxicity.

Any craniotomies should benefit from a local anesthesia of the scalp or a skull block. During evacuation of subdural hematoma under local anesthesia, the quality of the block guarantees the feasibility of the intervention.

PERFORMANCE

The infiltration can be realized by the anaesthetist. However, this infiltration should be better realized by the surgeon, in an already anaesthetized patient, after skin preparation, before drapping (bupivacaine) or just before incision (lidocaine). If a Mayfield head holder is used, infiltration would be realized before its implementation, and would concern the entire scalp.

Even when a head holder is not used, regional anesthesia of the scalp is useful for surgical drainage of a chronic subdural hematoma.

All local anesthetics can be used; 0,25 % bupivacaine with epinephrine (0,125 % in children) is widely used. It allows consequent postoperative analgesia. In case of very long duration surgery, it is possible to perform another infiltration at the time of skin closure, as soon as the dura mater is closed.

There is no report on the use of ropivacaine in this indication. However, with a 0,2 %, concentration, it should be as effective as bupivacaine. Futhermore, its intrinsic vasoconstrictor effect allows to avoid epinephrine. This would be clinically relevant in patients with compromise cerebral hemodynamics, by lowering the risk of systemic hypotension.

HEAD & NECK — EYE BLOCKS

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Middlesbrough - United Kingdom

Intraconal (retrobulbar) block involves injection of local anaesthetic agent into the part of the orbital cavity behind the globe.

Extraconal (peribulbar) block refers to the placement of needle tip outside the muscle cone.

A combination of intraconal and extraraconal blocks is described as combined retroperibulbar block.

Sub-Tenon's block refers to the injection of local anaesthetic agent beneath the Tenon capsule. This block is also known as parabulbar block, pinpoint anaesthesia and medial episcleral block.

ANATOMY

The orbit is an irregular four-sided pyramid with its apex placed posteromedially and its base facing anteriorly bounded by the orbital margins.

Four rectus muscles arise from the annulus of Zinn at the back of the orbit and inserted into the globe just anterior to its equator forming an incomplete cone.

Optic nerve, trunk of ophthalmic artery, ciliary ganglion and nerves to the muscles are in the cone.

Superior rectus, levator palpebrae, medial rectus, inferior rectus and inferior oblique muscles are supplied by the oculomotor nerve.

Lateral rectus is supplied by abducent nerve.

Superior oblique is supplied trochlear nerve which runs outside the cone.

Sensory innervation is very complex.

Corneal and perilimbal conjunctival and superonasal quadrant of the peripheral conjunctival sensation are mediated through the nasociliary nerve. The remainder of the peripheral conjunctival sensation is supplied through the lacrimal, frontal, and infraorbital nerves coursing outside the muscle cone, hence intra-operative pain may be experienced if these nerves are not blocked.

Tenon capsule is a thin membrane that forms a socket for the eyeball.

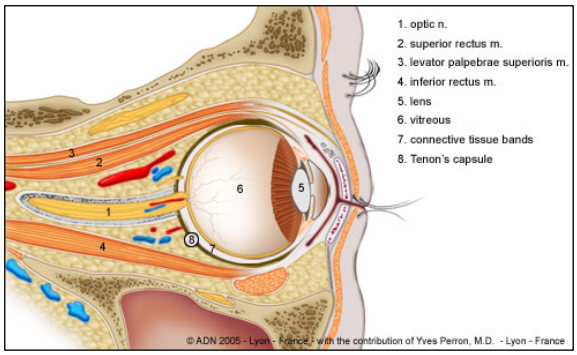
The inner surface is smooth and shiny and is separated from the outer surface of the sclera by a potential space called the episcleral space.

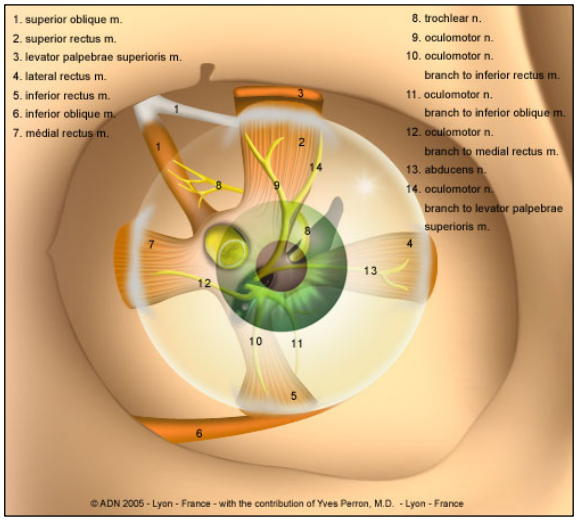
Crossing the space and attaching the fascial sheath to the sclera are numerous delicate bands of connective tissue.

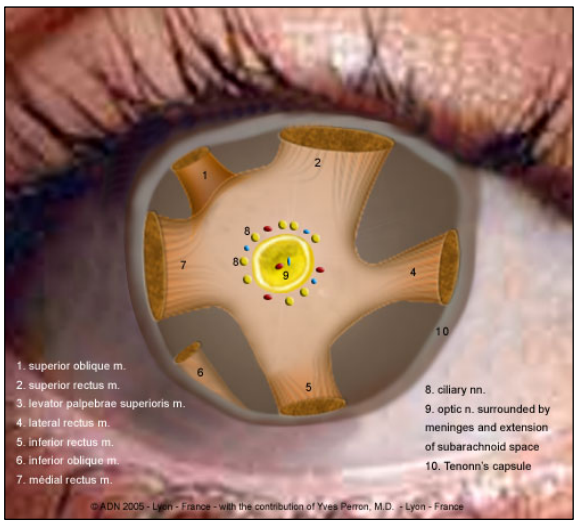
Anteriorly the fascial sheath is firmly attached to the sclera about 1.5cm posterior to the corneoscleral junction.

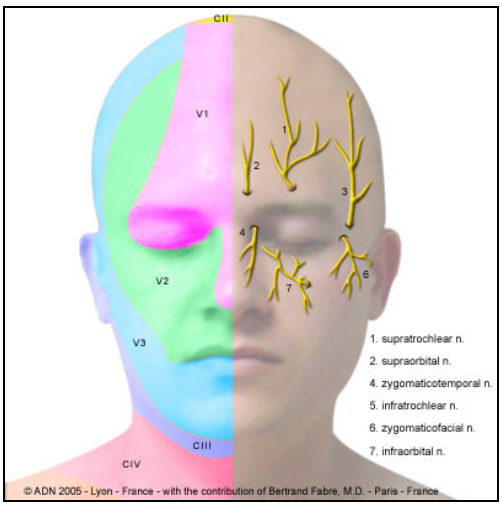
Posteriorly, the sheath fuses with the meninges around the optic nerve and with the sclera around the exit of the optic nerve.

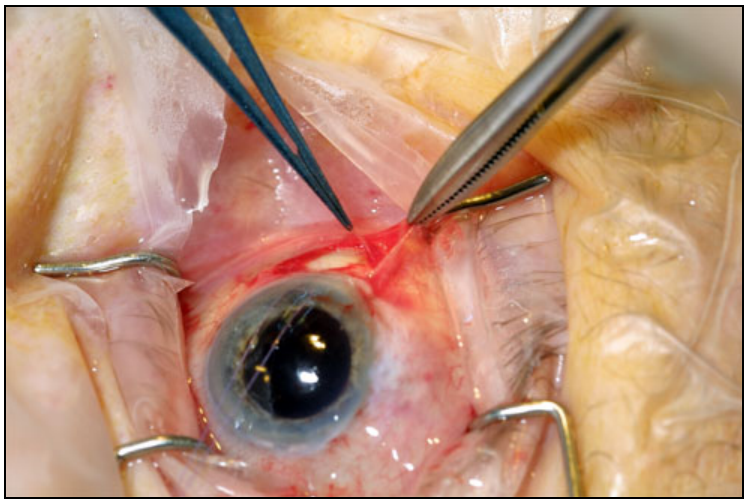
The tendons of all six extrinsic muscles of the eye pierce the sheath as they pass to their insertion on the eyeball. At the site of perforation the sheath is reflected along the tendons of these muscles to form on each a tubular sleeve.







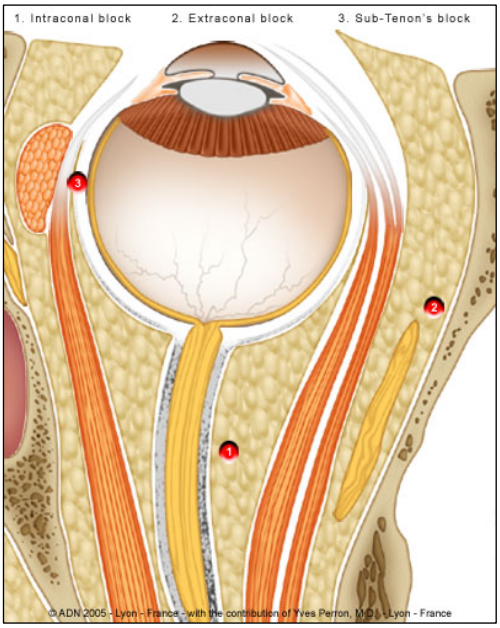


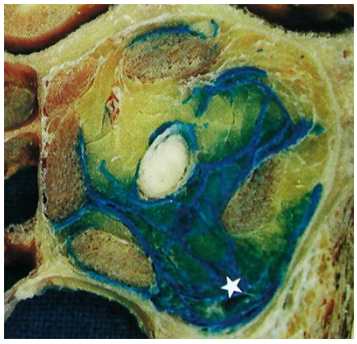


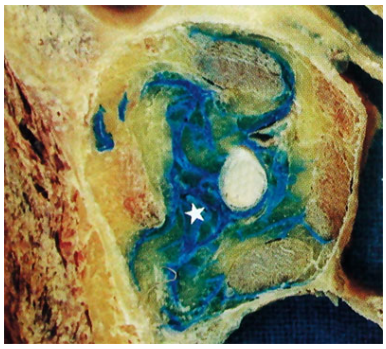
LOCALIZATION OF ANAESTHETIC AGENTS AFTER INJECTION

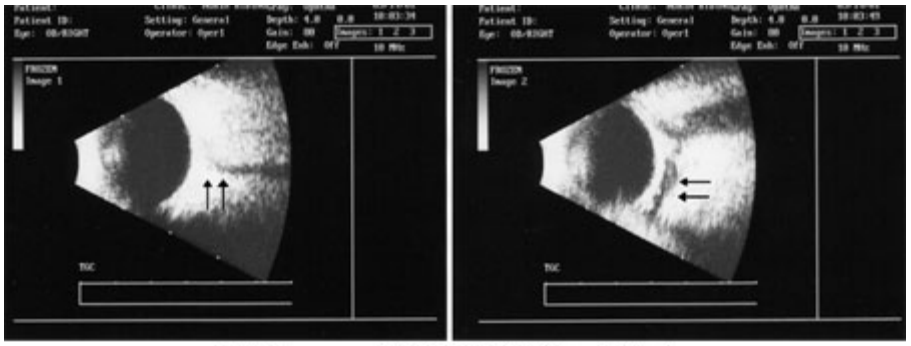
Local anaesthetic agent diffuses from one compartment to other during needle blocks.

Sub-Tenon's space opens during injection giving a characterstics T-sign and local abnaesthetic diffuses into the retrobulbar space.









INDICATIONS

Local anaesthetic technique is choice for eye surgery except when contraindicated.

Limiting factors are the ability of the patient to lie comfortably and still for the requisite time.

SPECIFIC CONTRAINDICATIONS

- Children
- Patient's refusal
- Infected orbit
- Uncontrolled body movements (Severe Parkinson's, severe chronic obstructive airway disease)
- Uncontrolled sneezing or coughing
- Serious psychiatry problems

PREPARATION OF PATIENTS

Preoperative preparation and assessment vary worldwide.

Routine investigations are not essential as they do not improve health or outcome of surgery.

Tests can be done to improve general health of the patient if required.

There is an increased risk of haemorrhage in p atients receiving anticoagulants. Patients are advised to continue medications. Clotting results should be within the recommended therapeutic range. Currently there is no recommendation for patient receiving antiplatelet agents.

Knowledge of axial length is essential before needle block. Patients with long eyes have thinner sclera and outpouching of sclera (staphyloma) and have increased incidence of globe damage following needle block.

Patients are usually not starved and are encouraged to take their usual medications.

Patients should receive adequate explannations regarding anaesthesia and complications.

MONITORING DURING THE BLOCK

A pulse oximeter, electrocardiograph and blood pressure recorder should be used. Intravenous access should be secured and full resuscitation equipment and drugs should be available .

SEDATION

Sedation is common during topical anaesthesia.

Routine use of sedation during akinetic block is discouraged because of increased intra-operative events.

When sedation is administered, a means of providing supplementation oxygen, equipment and skills to manage any life-threatening events must be immediately accessible.

NEEDLE BLOCK

Retrobulbar and peribulbar techniques are considered as separate techniques but the injection is made into the same adipose tissue compartment and the difference is merely a matter of needle direction and depth of insertion.

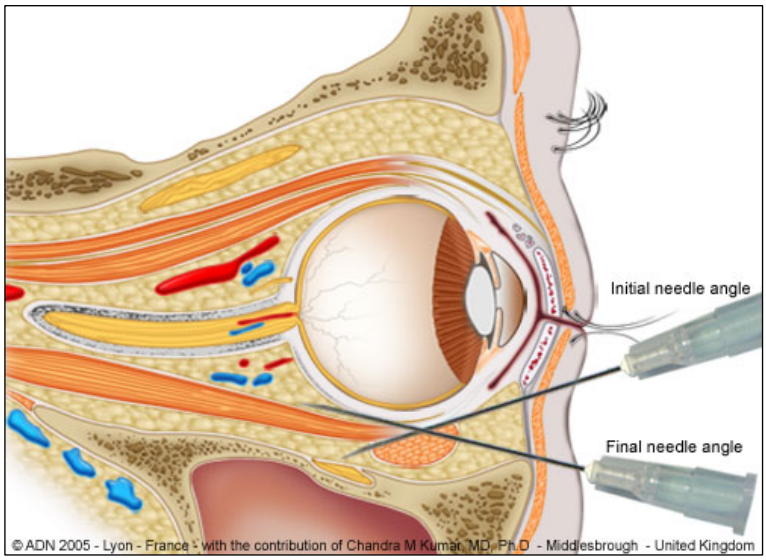
EQUIPMENTS

- Intravenous cannula
- Proxymetacaine 0.5% or benoxinate 0.4% or tetracaine 1% and 5% povidone eye drop
- 2% lidocaine
- Hyaluronidase
- 27 G , 1.2 cm needle for dilute local injection
- 27 G , < 3.1 cm long needle for main injection
- Balanced Salt Solution (15 ml vial)
- Gauge swab

RETROBULBAR TECHNIQUE

While the patient supine and looking straight ahead, the conjunctiva is anaesthetised with topical local anaesthetic drops.

Dilute painless local solution is prepared by adding 2ml of concentrated local anaesthetic agent to 13 ml of Balanced Salt Solution (BSS). 1.5-2 ml of this dilute solution is injected via 27G, 1.2cm needle through the conjunctiva under the inferior tarsal plate in the inferotemporal quadrant.



A sharp 27G, needle <3.1cm is inserted through the conjunctiva or skin in the inferotemporal quadrant as far lateral as possible below the lateral rectus muscle while the patient is looking in the primary gaze position.

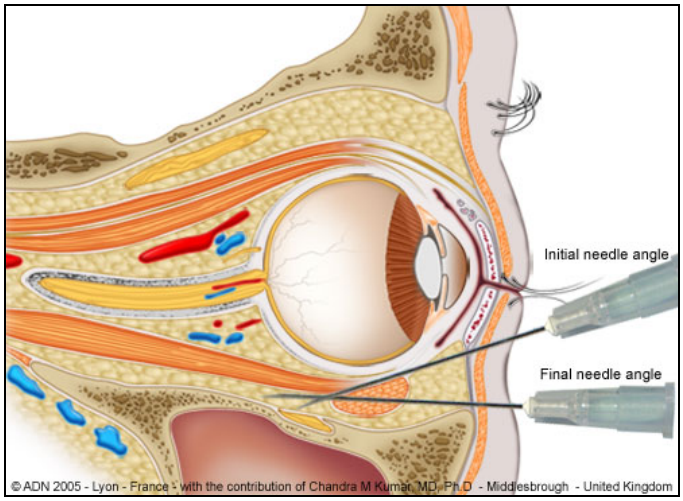
Initial direction of the needle is tangential to the globe, then passes below the globe and once past the equator as gauged by axial length of the globe, is allowed to go upwards and inwards to enter the central space just behind the globe.

The globe is continuously observed during the needle placement. 4-5 ml of local anaesthetic agent is injected.

INFEROTEMPORAL PERIBULBAR TECHNIQUE

A sharp 25G, 3.1cm long needle is inserted through the conjunctiva as far lateral as possible in the inferotemporal quadrant while the patient is looking in the primary gaze position. Once the needle is under the globe, it is not directed upward and inward, but is directed along the orbital floor.

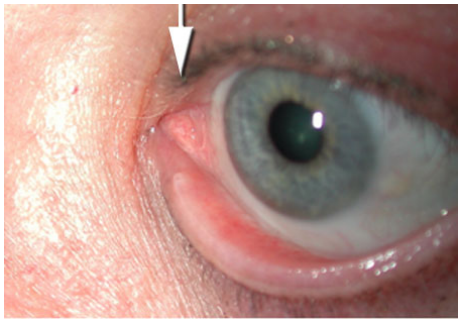
A volume of 5ml of local anaesthetic agent is injected. Many patients require supplementary injection.

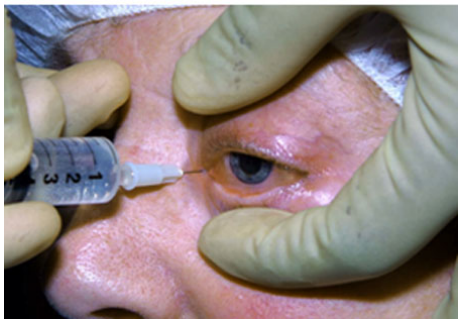


MEDIAL PERIBULBAR TECHNIQUE

This is usually performed to supplement inferotemporal retrobulbar or peribulbar injection particularly when akinesia is not adequate. A 25G or 27G needle is inserted in the blind pit between the caruncle and the medial canthus to a depth of 15-20mm. 3-5ml of local anaesthetic agent is usually injected.

Some use medial peribulbar as a primary injection technique for anaesthesia particularly in patients with longer axial lengths.





AUTHOR'S PREFERRED TECHNIQUE

Movie of akinetic block using a short needle

SPECIFIC COMPLICATIONS

Complications of needle blocks range from simple to serious and could be limited to the orbit or systemic.

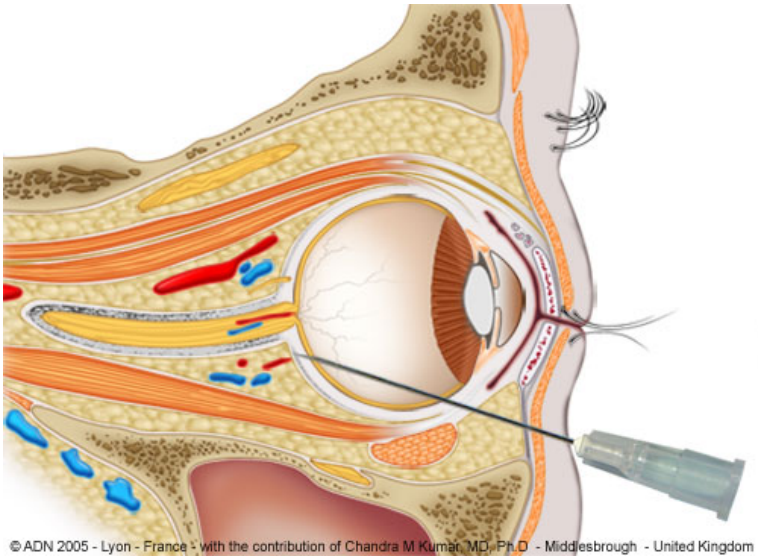
Orbital complications include :

- failure of the block,
- corneal abrasion,
- chemosis,
- conjunctival haemorrhage,
- vessel damage leading to retrobulbar haemorrhage,
- globe perforation,
- globe penetration,
- optic nerve damage
- and extraocular muscle damage.

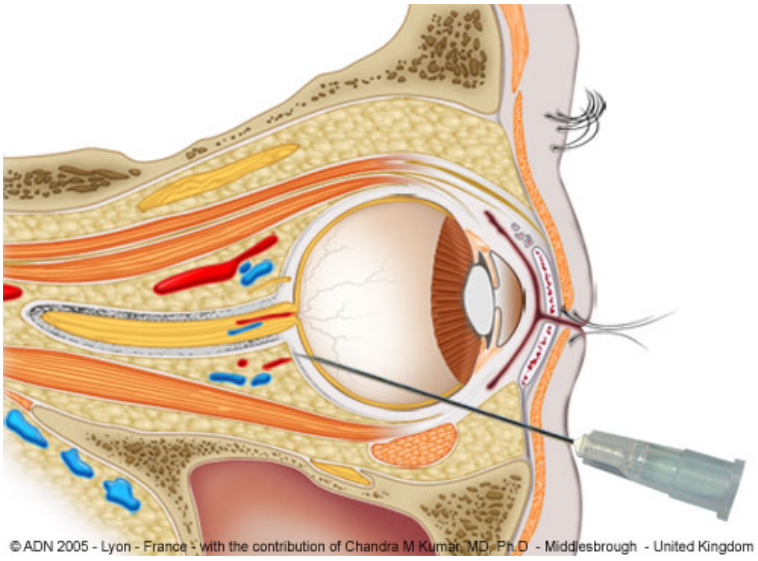
The systemic complications such as local anaesthetic agent toxicity, brainstem anaesthesia, cardiorespiratory arrest may be due to injection or spread or misplacement of drug in the orbit during or immediately after injection.

Retrobulbar Hemorrhage

Perforation of globe



Penetration of globe

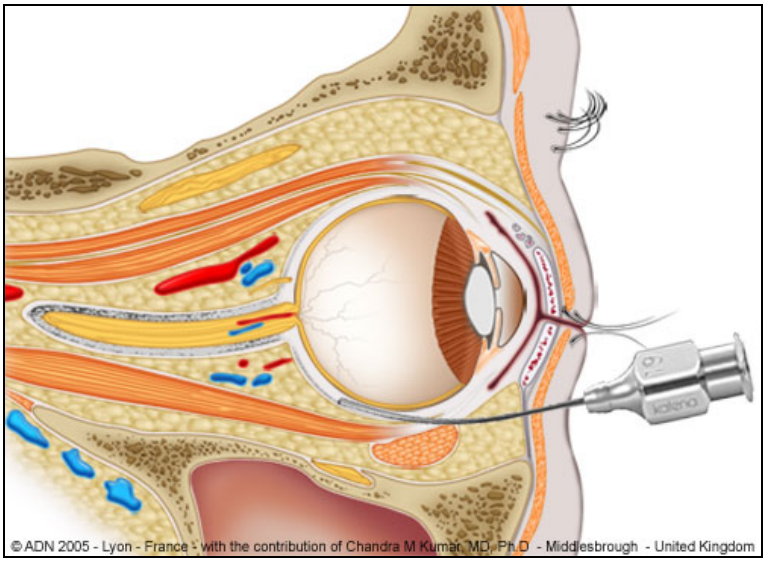


SAFER ALTERNATIVE TECHNIQUE

SUB-TENON'S BLOCK

This block was re-introduced into the clinical practice as a simple, safe and effective technique because of continuing concerns over rare but serious complications of sharp needle blocks.

The technique involves gaining access to the sub-Tenon's space by cannula and administration of local anaesthetic agent into the sub-Tenon's space.

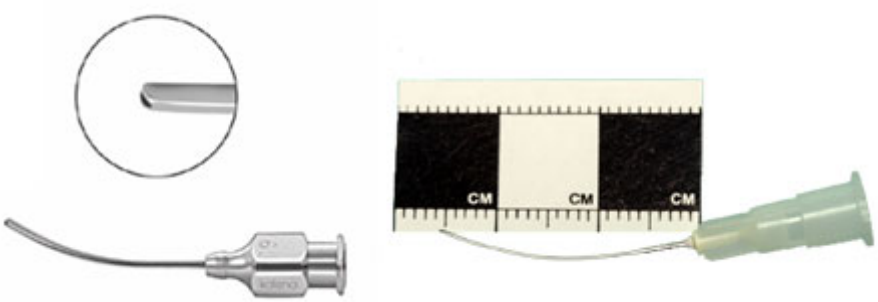


Injection of local anaesthetic agent under the Tenon capsule blocks sensation from the eye by action on the short ciliary nerves as they pass through the Tenon capsule to the globe and akinesia by direct blockade of motor nerves.

The sub-Tenon's technique involves obtaining surface anaesthesia, instillation of antiseptic, access to the sub-Tenon's space, insertion of cannula and subsequent administration of local anaesthetic agent into the sub-Tenon's space.

EQUIPMENTS

- Intravenous cannula
- Proxymetacaine 0.5% or benoxinate 0.4% or tetracaine 1%, 5% povidone eye drop
- 2% lidocaine
- Hyaluronidase
- Eye speculum
- Westcott Scissors
- Moorfields Forceps
- 5 ml syringe
- Gauge swab
- Sub-Tenon's cannula



TECHNIQUE

Surface anaesthesia is achieved by instilling topical local anaesthetic.

5% povidone iodine eye drop is instilled before dissection.

An eye speculum is applied or an assistant retracts the lower eyelid.

Patient is asked to look upwards and outwards to expose the inferonasal quadrant.

The conjunctiva is grasped with non-toothed forceps.

A small button hole incision is made with blunt spring scissors about 5-10mm from the limbus in the inferonasal portion of the conjunctiva and Tenon's capsule.

Bare sclera is seen.

Conjunctival is held up with the forceps.

Blunt curved cannula is passed into the sub-Tenon's space following the curve of the globe.

If a resitance is felt, small amount of local anaesthetic is injected. If injection is not possible, it is better to reinsert the cannula.

3-5ml of local anaesthetic is injected.

While the eyelids are closed, a gentle pressure is applied on the globe.

The block is asessed for akinesia after 5 minutes.

AUTHOR'S PREFERRED TECHNIQUE OF SUB-TENON'S BLOCK

Movie of the author's preferred technique of sub-Tenon's block

USES OF SUB-TENON'S BLOCK

- Cataract surgery
- Viteroretinal surgery
- Panretinal photocoagulation
- Strabismus surgery
- Trabeculectomy
- Optic nerve sheath fenestration
- Delivery of drugs

SPECIFIC COMPLICATIONS OF SUB-TENON'S BLOCK

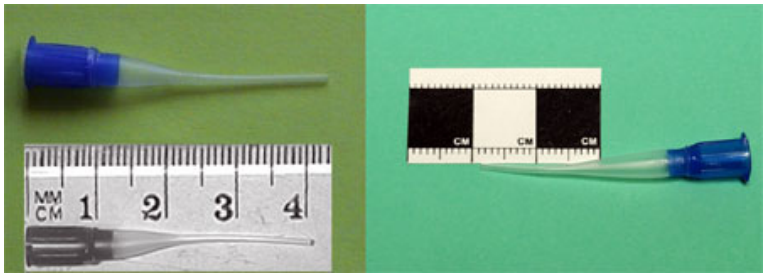
Minor complications such as pain during injection , chemosis, conjunctival haemorrhage and over spilling of local anaesthetic are common. Akinesia is variable and volume dependent.

Major complications include

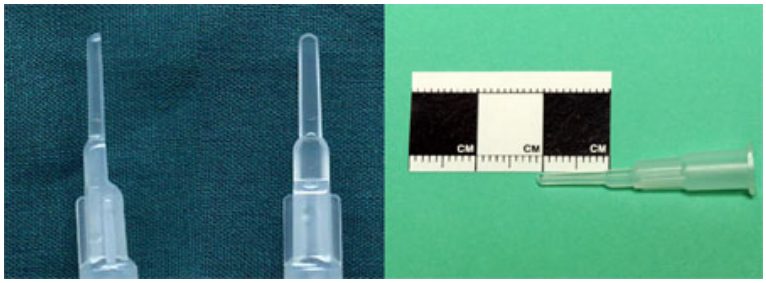
- rectus muscle paresis and trauma,
- orbital and retrobulbar haemorrhage globe perforation,
- central spread of local anaesthetic,
- orbital cellulitis and others.

Most complications have occurred following the use of 2.54cm metal cannula. Smaller and flexible cannulae appear to be safer but the incidence of minor complications increase.

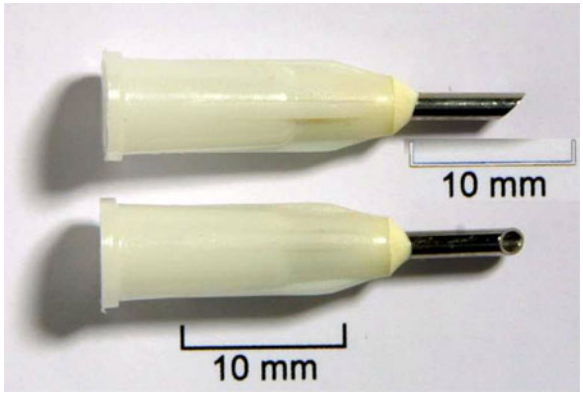
Mid sub-Tenon's cannula



Anterior sub-Tenon's cannula



Ultra-short sub-Tenon's cannula



CHOICE OF LOCAL ANAESTHETIC AGENT

All the modern, full potency local anaesthetic agents are suitable for ophthalmic block.

Studies have shown little difference in quality of anaesthesia, analgesia and akinesia. Concentration up to but not exceeding 2% lidocaine is commonly used.

VASOCONSTRICTOR

Vasoconstrictor (epinephrine and felypressin) are commonly mixed with local anaesthetic solution to increase the intensity and duration of block, and minimise bleeding from small vessels.

Epinephrine may cause vasoconstriction of the ophthalmic artery compromising the retinal circulation.

The use of epinephrine containing solution should be avoided in elderly patients suffering from cerebrovascular and cardiovascular diseases.

HYALURONIDASE

Hyaluronidase is known to improve the effectiveness and the quality of needle block.

Its role in sub-Tenon's block is controversial.

The amount of hyaluronidase should not be used more than 15 IU.ml -1. pH alteration

Alkalinisation has shown to decrease the onset and prolong the duration after needle blocks.

Its role in sub-Tenon's block has not been fully investigated.

OTHERS

Addition of clonidine, muscle relaxant and other chemicals are known to increase the onset and potency of orbital block but their use is not routine.

CATHETER INSERTION TECHNIQUE

Prolonged anaesthesia and analgesia are obtained by inserting a catheter in the retrobulbar or sub-Tenon's space.

BLOCK ASSESSMENT

There is no objective method of assessing anaesthesia following eye block.

Dense motor block (akinesia) is a good predictor of anaesthesia.

INTRAOPERATIVE CARE

The patient should be comfortable and soft pads are placed under the pressure areas.

Patients should be monitored with pulse oximetry, ECG, non-invasive blood pressure measurement and maintenance of verbal contact. Patients should receive an oxygen-enriched breathing atmosphere to prevent hypoxia.

RESCUE ANAESTHESIA

Rescue analgesia is provided by supplemental topical local drops but repeat injection may be necessary to achieve good anaesthesia and akinesia Caution is required during repeat injection as the anatomy of the orbit is altered by previous injection.

SELECTION OF ANAESTHESIA

Anaesthetic requirements for ophthalmic surgery are dictated by the nature of the proposed surgery, the surgeon's preference and the patient's wishes.

Needle block is the most popular technique practised around the world but sub-Tenon's block is preferred in many countries.

Needle block is not suitable for inexperienced anaesthetists, long eye, previous extensive eye surgery and altered anatomy of the eye.

Sub-Tenon's block may be difficult in patients who had previous eye surgery in the same eye, orbital trauma and infection of the globe.

CONCLUSION

Eye blocks provide excellent anaesthesia for ophthalmic surgery and success rates are high. Satisfactory anaesthesia and akinesia can be obtained with both needle and cannula. Although rare, orbital injections may cause severe local and systemic complications. Knowledge of orbital anatomy and training are essential for the practice of safe orbital regional anaesthesia.

HEAD & NECK — FACE ANATOMY

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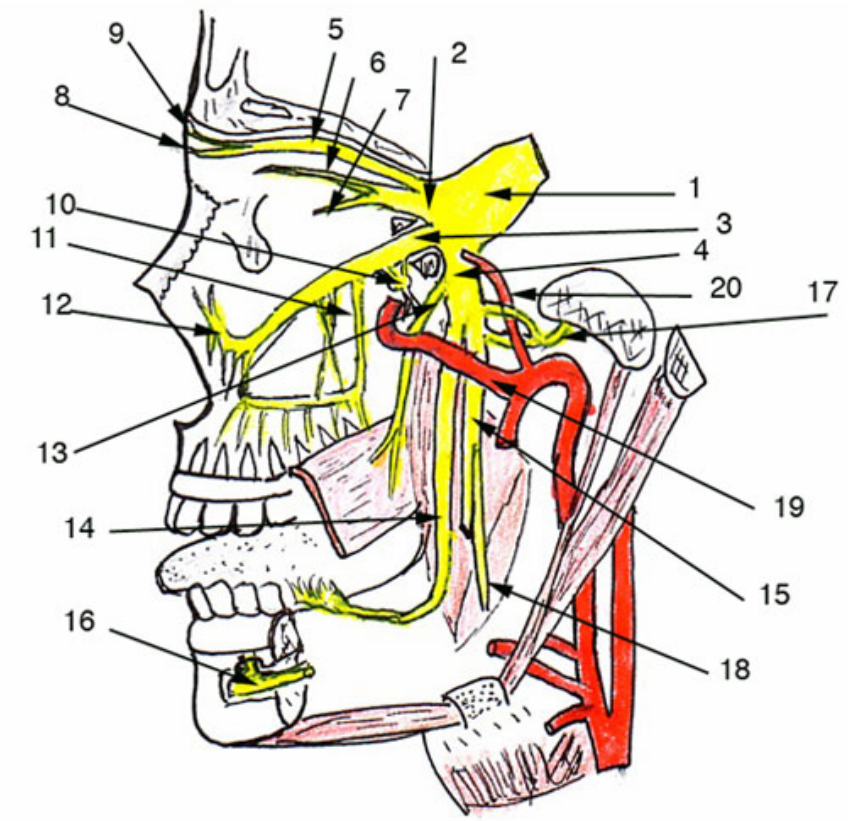
Nice - France

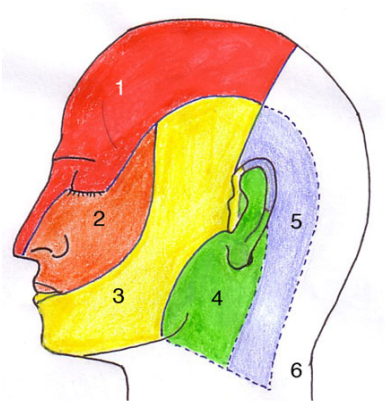
All the sensitive innervation of the face is under the dependence of the trigeminal nerve (5th cranial pair or V) and of the superficial cervical plexus.

The intracranial origin of the trigeminal nerve is the ganglion of Gasser which will emit three sensitive nervous trunks to which comes to be added a motor root which will accompany the inferior branch, mandibular. From top to bottom as follows one finds:

Ophthalmic nerve or V1, Maxillary nerve or V2, Mandibular nerve or V3 with its motor root; each nerve determining a sensitive territory corresponding.



Trigeminal Nerve, general systematization
1- Trigeminal nerve
2 - Ophtalmic nerve
3- Maxillary nerve
4- Mandibular nerve
5- Frontal nerve
6- Lacrimal nerve
7- Nasociliary nerve
8- Supraorbital nerve
9- Supratrochlear Nerve
10- Palatin Nerve
11- Superior alveolar nerves: posterior and middle
12 -Infraorbital nerve
13- Motor Branches of the mandibular
14- Lingual nerve
15- Inferior alveolar nerve
16- Mental nerve-
17- Auriculotemporal nerve
18- Mylohyoid nerve
19- Maxillary artery -
20- Meningeal artery



Cutaneous territories of the trigeminal nerveand superficial cervical plexus.
1- Ophthalmic
2- Maxillary
3- Mandibular
4- Great auricular C3
5- Lesser occipital C2
6-Other branches of the cervical plexus.

OPHTHALMIC NERVE OR V1

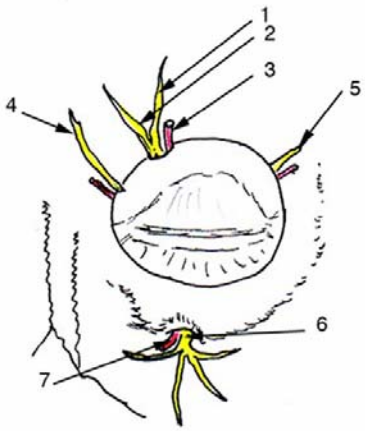
It approaches the face by the superior orbital fissure and gives in the orbit three branches which are of inside outwards:

- Nasociliary nerve giving the ciliary nerve; the infratrochlear nerve; the anterior ethmoidal nerve (or nasal nerve) and internal nasal branches;
- Frontal nerve which is divided into, supratrochlear nerve moving towards the medial orbital angle, and supraorbital nerve which leaves the orbit by the supraorbital foramen;
- Lacrimal nerve.

SUPRAORBITAL NERVE

Is the largest terminal branch of the frontal nerve [1,4]; it leaves the orbit trough the supraorbital foramen or incisure [1,4], to emerge onto the forehead; it goes up on the face accompanied by its supraorbital artery and is divided into two trunks [2], medial superficial and more provided [3] and lateral deeper. It supply the forehead zone until the coronal linea excluded the medial zone above the root of the nose, under the dependence of the supratrochlear nerve.

It supply also the superior eyelid.



Orbital Nerves.
1- Supraorbital nerve, lateral branches
2 -Supraorbital nerve, medial branches
3- Supraorbital artery
4- Supratrochlear nerve and artery
5- Lacrimal nerve (and artery)
6- Infraorbital nerve
7- infra-orbital artery

SUPRATROCHLEAR NERVE

It is the medial branch of the frontal nerve. It gives a descending branch to the infratrochlear nerve. Ascends onto the forehead through the frontal notch, in the fronto-nasal angle and goes up with its artery about the middle of the face above the nose for supply the teguments until coronal linea and the medial part of the superior eyelid. It complemente thus medialy the supraorbital territory.

LACRIMAL NERVE

It is smallest and external of the branches of V1. It moves towards the side and superior area of the orbit. It supply the skin covering the lateral part of the upper eyelid [1]. The lacrimal nerve communicates with the zygomaticotemporal nerve (V2) in connection with the maxillary nerve [4, 5, 1].

NASOCILIARY NERVE

It skirts the higher bottom of the orbit and gives [4, 6] several branches of which:
- the posterior ethmoidal nerve;
- the infratrochlear nerve supply the root of the nose.
- the anterior ethmoidal nerve or nasal nerve; it passes trough the anterior ethmoidal foramen and go to the nasal cavity; that is divided into two branches [4]:
    - the internal nerve supplies the anterior septal mucosa, the anterior part of the lateral nasal wall;
    - the external nerve [1], at the lower border of he nasal bone and descends under the transverse part of nasalis to supply the nasal teguments under the nasal bone [4] (above under the dependence of the infratrochlear nerve) and point of nose, except the nasal ala and the external nares (under the dependence of infraorbital nerve).

MAXILLARY NERVE OR V2

It leaves the skull via the foramen rotundum, which leads directly into the posterior wall of the pterygopalatine fossa, or it gives its terminal branches:

- meningeal and orbital branches
- zygomatic branches
- superior alveolar nerve; posterior and middle branches
- pterygopalatine and parasympathetic branches
- palatine and pharyngeal branches
- infraorbital nerve continuing the axis of the maxillary nerve

MAXILLARY NERVE

At its arrival with the foramen rotundum, this nerve is presented in the form of a plexus, at the upper part of the pterygopalatine fossa [1, 4], in which it is almost alone.

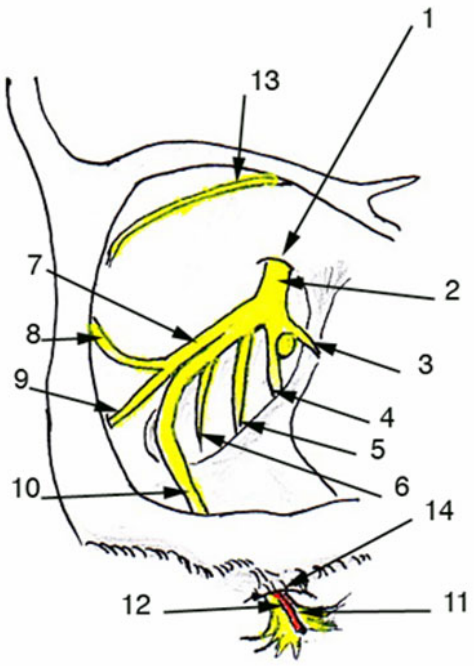
This level, it will give its terminal branches and it will be accessible here for a complete maxillary block.

ZYGOMATICOTEMPORAL NERVE

The zygomaticotemporal nerve is a terminal branch of the zygomatic nerve. It crosses the zygomatic bone and emerges on the anterior part of the temporal zone, above the zygomatic arch where it supply the skin of the temple [1]. It communicates with the facial nerve and the auriculotemporal nerve [1, 4]; and also an anastomosis with the lacrimal nerve.

ZYGOMATICOFACIAL NERVE

Terminal branch of the zygomatic nerve; it crosses the lower and lateral angle of the orbit and emerges on the face by a bone foramen. It supplies the skin on the prominence of the cheek [1,4].



Maxillary nerve in its resulting from the foramen rotundum (floor of the orbit removed) and its way will intramaxillary.
1 Foramen rotundum
2 Maxillary nerve
3 Pharyngeal nerve
4 Palatine Nerves
5 Superior alveolar nerve: posterior
6 Superior alveolar nerve: middle
7 Zygomatic nerve
8 Zygomaticotemporal nerve
9 Zygomaticofacial nerve
10 Infraorbital nerve; in its way will intra infraorbital maxillary
11 Infraorbital nerve issue at the face
12 Infraorbital artery
13 Lacrimal nerve (in lateral orbital wall)
14 Infraorbital foramen.

INFRAORBITAL NERVE

Principal terminal branch of the maxillary nerve, it crosses the maxillary bone to emerges onto the face at the infraorbital foramen. It is presented there in the a largest nervous plexus of which is detached from the groups of nerves with local destiny:

- palpebral branches, going up towards the inferior eyelid than they supply, being anastomosed with the facial nerve and the zygomaticofacial nerve
- nasal branches, for the lateral wall of the nose(alar portion), the movable part of the nasal septum, and join the branches of the external nasal nerve;
- labial superior branches, large and numerous, for the anterior part of the cheek and the superior lip.

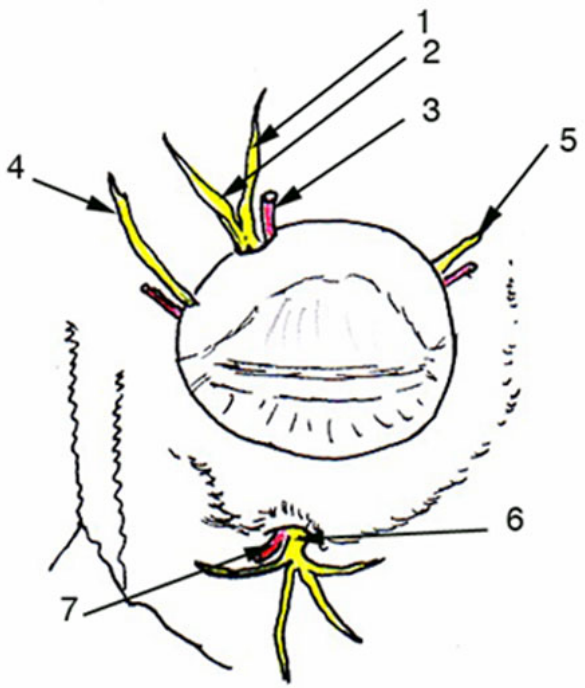
The other branches of the maxillary to endo-oral destiny and are simply evoked.

Alveolar superior nerve, posterior and middle for the superior teeth, being detached from the maxillary at the bottom of the foramen rotundum towards the oral cavity;

Pharyngeal nerve, supply the mucosa of the nasopharynx;

Palatine nerves (greater and lesser) for the posterior roof of the mouth;

Pterygopalatine ganglion and nasopalatine nerve with the sympathetic and parasympathetic branches [6] giving of the nasal and nasopalatine branches [7].



Orbital Nerves.
1- Supraorbital nerve, lateral branches
2 -Supraorbital nerve, medial branches
3- Supraorbital artery
4- Supratrochlear nerve and artery
5- Lacrimal nerve (and artery)
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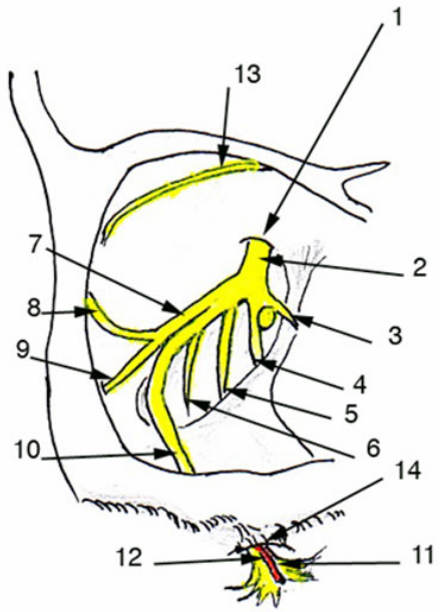
7- infra-orbital artery



Maxillary nerve in its resulting from the foramen rotundum (floor of the orbit removed) and its way will intramaxillary.
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7 Zygomatic nerve
8 Zygomaticotemporal nerve
9 Zygomaticofacial nerve
10 Infraorbital nerve; in its way will intra infraorbital maxillary
11 Infraorbital nerve issue at the face
12 Infraorbital artery
13 Lacrimal nerve (in lateral orbital wall)
14 Infraorbital foramen.

MANDIBULAR NERVE OR V3

The mandibular nerve is the largest trigeminal branch. at emerges of the oval foramen very quickly will give two branches [6], anterior and medial motor branch , the only one of the trigeminal nerve [1] and another continuing the principal axis of the mandibular giving the sensitive terminal branch. It is thus appeared as two trunks [1, 4, 5, 6].

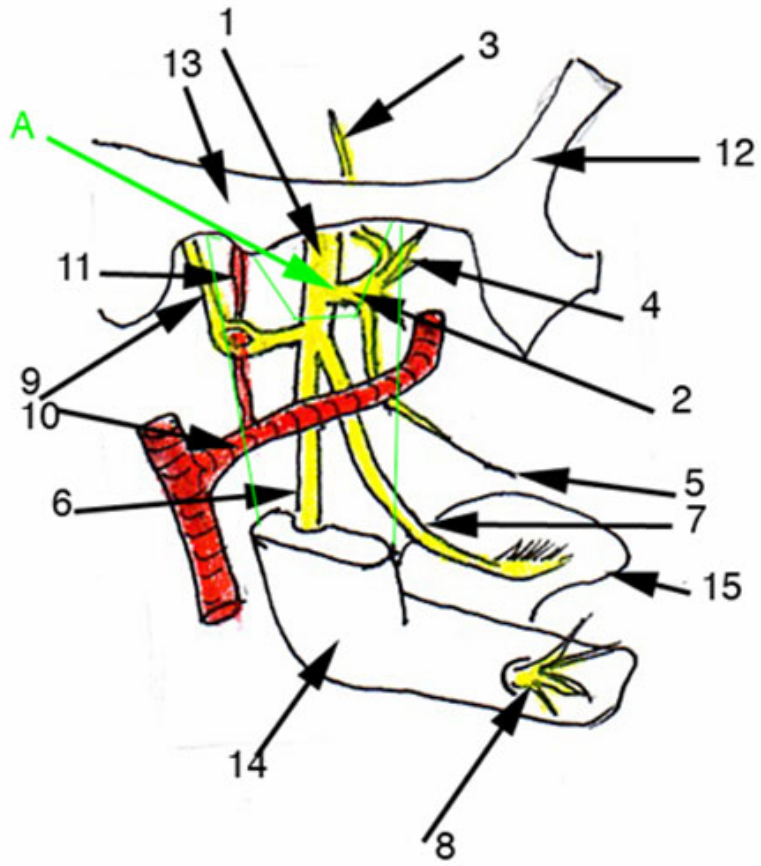
The anterior trunk of mandibular nerve gives

- the buccal nerve
- the motor root for the mastication muscles.

The posterior trunk gives:

- the auriculotemporal nerve
- the lingual nerve
- the inferior alveolar nerve terminal branch of mandibular nerve and which on the level of the mental foramen gives the mental nerve
- the mylohyoid nerve.

We will see the cutaneous branches and the deep branches.



Mandibular nerve.
1 Trunk of the Mandibular nerve at its exit of the oval foramen
2 Motor Branches
3 Nerve of the temporal muscle
4 Pterygoid nerve
5 Buccal nerve
6 Inferior alveolar nerve
7 Lingual nerve
8 Mental nerve
9 Auriculotemporal nerve
10 Maxillary artery
11 Meningeal artery
12 Lateral wall of the orbit
13 Zygomatic arch
14 Mandibular bone
15 Tongue.
In green the removed vertical mandibular bone;
A = puncture point, very high, near the coronoid proces.

BRANCHES WITH CUTANEOUS DESTINY

BUCCAL NERVE

Small medial branch, being detached from the anterior motor trunk. It carries the motor fibres to lateral pterygoid giving the sensitive supply of a small zone of the skin above the superior lip and the buccal mucous membrane.

MENTAL NERVE

The mental nerve is the terminal branch of the inferior alveolar nerve. It enters the face through the mental foramen and which supply the inferior lip, the chin and the incisivo-canin dental group [6, 7].

AURICULOTEMPORAL NERVE

It is detached from the mandibular very high on the level of the temporomandibular joint, and then becomes surface and goes up towards the tragus, posterior with the superficial temporal vessels. It gives superficial branches starting from the tragus for

- the tragus and the entry of the auditory canal, part of the cheek in the pretragus area [8]
- the anterior part of auricle of the ear
- the posterior part of the temple.

It gives anastomosis easily with the facial nerve and zygomatic nerve.

OTHER BRANCHES

- Motor mandibular branches for the muscles of the mastication:
  To masseter, to lateral pterygoid, to temporal [1, 9].
- Lingual nerve
  Connect medial going down along the vertical branch from the mandible and which moves towards the base of the tongue to give the sensitivity for the anterior two-thirds of the tongue, the floor of the mouth and the mandibular lingual gingivae [4, 6, 9].
- Inferior alveolar nerve
  Significant lateral branch which goes down towards the mandible and enter the mandibular canal via the mandibular foramen in its horizontal portion, traversing this one, to end in the mental nerve.
  He gives the inferior dental innervation [1, 6, 9].
- Meningeal branch
- Medial pterygoid nerve

THE SUPERFICIAL CERVICAL PLEXUS

By its superficial branches coming from C2 and C3, it takes part in the sensitive innervation of the face; primarily;

- great auricular nerve; its arises from the second and third cervical rami, is detached from the plexus at the Erb point at the posterior border of the sternocleidomastoid muscle (SCM) and which moves in top towards the ear lobe [1, 6, 9]. Its supply the back of the auricle (except its upper part), the lobule and the concha; but he innerve also the skin of the angle of the mandible (in complement of the mandibular).
- lesser occipital nerve exit of second cervical nerve which gives, amongst other things, the innervation of the upper part of the ear lobe [1, 4], and lateral occipital zone.

Remember, these nerves are very intricate at the face, the anaesthesia for only one nerve is not recommended; a zonal anaesthesia is the best technic.

HEAD & NECK
FACE PARTICULARITY

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For any regional anesthesia of the face, it is necessary to comply with the sedentary rules: realisation in a room dedicated to the anaesthesia, with a usual monitoring: electrocardiogram (ECG), non-invasive blood pressure (PNI), measurement continuous arterial oxygen saturation (SaO 2).

A plate with emergency drugs ready with employment must be present: Pentothal, midazolam. A written procedure is posted, in the event of toxic accidents with the anaesthetic solution, with the action to be taken immediate. It is only with this discipline that the incidents will be rare and the safety realisation. The rules published by the SFAR (French Society or Anaesthesia), concerning the peripheral blocks of the members also apply to the blocks of the face, in particular: consultation of anaesthesia with patient information, the monitoring and the place of realisation of the anaesthesia, premedication and venous way before the act, realisation with gloves and asepsis, injections slow and split [17].

The characteristics of the blocks of the face must be known. First of all vascular richness of the face (the surgeons frequently infiltrate the zone with a adrenalin solution to decrease the bleeding by it, genuine blood sponge, which will pose the risks of vascular breach and injection in a vessel; fast resorption of the anaesthetic solution with obvious toxic risk. The use of needle with short bevel with the advantage of being less aggressive for the vessels with the very slowly progressing.

The superposition of the territories [7] obliges to construct blocks wider than the strict surgical territory, and to rather construct sometimes a block at the origin of the nerve (maxillary, mandibular) than a too restrictive terminal section.

PHARMACOLOGY OF LOCAL ANAESTHETICS AND ADDITIVE DRUG (ADJUVANT)

The pharmacological characteristics on the level of the face are: vascular richness, the toxic risk, generally a sensitive block need only.

The vascular resorption of the anaesthetic solution is defined by the site of administration (the face is very vascularised), proportioning, the addition of a vasoconstrictor or another additive drug, and the pharmacological profile of the product [10]; thus the ropivacaine is interesting by its vasoconstrictives properties. This facial vascular richness as well as the fast resorption on the level of the mucous membranes exposes to the risk to reach the toxic plasmatic concentrations (CMax= toxic plasmatic concentration) in a short time (TMax= time to go at the CMax) [11]. Use recommended of additive drug associated with low volumes and low concentrations, strongly reduced this toxic plasmatic risk.

The additives drugs used are: adrenalin with 1/200.000, without exceeding 1 ml; the block will last longer and the operational bleeding per will be decreased. It is necessary to respect however reserve indication for the final arteries and the orbital cavity [10, 11]. The clonidine is also used with the amount of 0,5 µg. Kg-1 [12] and presents few side effects; it presents effects close to adrenalin except the vasoconstriction and can thus be used largely on the face.

The molecules of anaesthetic solution most largely used are:

- lidocaine 1% or 1.5% for short surgery (emergency, ambulatory)
- bupivacaine 0.25% to avoid for the neurological and cardiac toxic risk
- mepivacaine 1% or 1.5% for surgery of average duration; the characteristic has to diffuse well with the nervous structures, to be not very toxic, and to have a rather fast lifting of block (ambulatory)
- ropivacaine 0.5% and 0.75% for surgery of average duration and long postoperative analgesia; it is less toxic than the bupivacaine. and lends itself very well to the blocks of face (good sensitive block, vasoconstrictive action)
- levobupivacaine intermediate between ropivacaine and bupivacaine, in the course of evaluation.

One can construct dissociative anaesthesia, or differential nervous block [11] on the level of the face, as on the level of the upper limb [13], if several territories are concerned. One can associate two anaesthetic solution (short local anaesthetic and long local anaesthetic) for a fast block of installation; once again it is strongly recommended the use of additive drug in particular the clonidine, which leaves the free surgeon make his infiltrations with adrenalin.

In conclusion for the blocks of the face it is necessary to retain, the use of small volumes of anaesthetic solution especially for a sensitive block, and the systematic use additive drug.

NEUROSTIMULATION

Since more than one ten year, the neurostimulation became impossible to circumvent in the perform of the peripheral nervous blocks [14,15]; the blocks of face them also will find advantage there. Indeed safe for the really superficial blocks and of easy identification, this technique of location can improve the rate of success and decrease the incidents. That is particularly obvious for the deep blocks (block of "fossa'), like the mandibular block and the maxillary block. For the mandibular the existence of a motor branch will allow the search for an easily identifiable muscular answer. For the nerve exclusively sensitive maxillary, one will be able to call upon a sensitive stimulation, very seldom used to date, with research of dysesthesias in the selected territory; accordingly it will be necessary to have a neurostimulator [15] making it possible to lengthen the time of stimulation to 0,3 milliseconds [16], necessary to stimulate sensitive fibres.

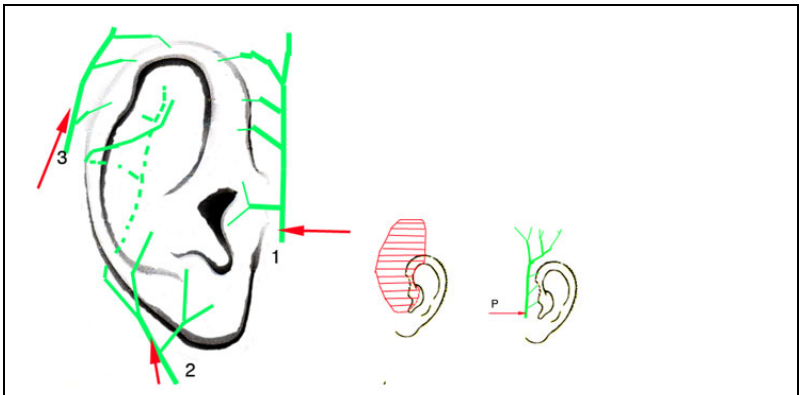
In all the cases the traditional procedure of the neurostimulation must be observed [15]: to know to analyse the answer, to define the Minimal Intensity of Stimulation (IMS), not to inject too much close to the nerve (with too low intensities), to check the disappearance of the answer that it is driving or sensitive as of first millilitre (ml) injected. The advantages of this sensitive neurostimulation, in addition to the assistance with the location, are a better effectiveness, a reduction of the nervous lesions [16], an easier training especially on the level of the face.

ZONAL BLOCKS

BLOCK FOR EXTERNAL EAR

For a complete anaesthesia of the external ear, 3 blocks should be associated: the auriculotemporal nerve block (2 ml), the great auricular nerve block (7 ml) and the lesser occipital nerve block (4 ml).

That will allow all the surgery of this zone that it is aesthetic, repairing (external ear plasties) or carcinologic surgery, frequently bilateral. Only the zone of Ramsay-Hunt [1] escapes these blocks.



External Ear blocks . and auriculotemporal territory; and block.
1 - Auriculotemporal nerve block
2 - Great auricular nerve block
3 - Lesser occipital nerve block
P: puncture.

BLOCK FOR THE NOSE

The nasal teguments are blocked by the association of two bilateral blocks: infraorbital and nasal; all the surgery of surface can be made thus (tumours, rhinophyma) [20].

The simple bone surgery as the reduction of nasal fracture is practicable under block, very interesting in emergency (supratrochlear block, and nasal block) [20].

Finally the rhinoplasties will be able to profit from association general anaesthesia - blocks of the nose (infraorbital and nasal) for an excellent postoperative analgesia.

Nasal nerve block and nose anaesthesia.
Left fig.:
1- Infratrochlear nerve
2- Nasal nerve
3- Infraorbital nerve

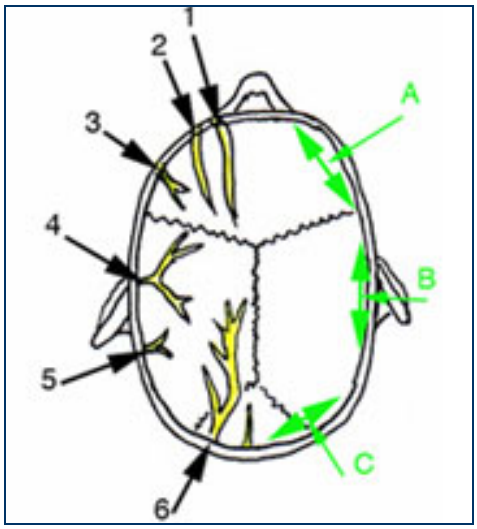
Middle fig. : Nasal nerve territory

Right fig.: block of nasal nerve:
1- first injection;
2 - second injection.
3 - Nasal nerve internal branch
4- Nasal nerve external branch

BLOCK FOR THE SCALP

Within the framework of the care in urgency and wounds of cranium, one can propose a blocking of the innervation of the scalp; either by a semi-circumferential infiltration (2,7), or by three infiltrations blocking the terminal branches:

- in forehead (supraorbital nerve, supra- trochlear nerve with 5 ml);
- in lateral zone temporo-parietal (zygomatic nerve, auriculotemporal nerve with 5 ml),
- and in posterior zone (lesser and great occipital with 4 ml).



HEAD & NECK — OPHTALMIC NERVE BLOCKS

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Nice - France

The blocks of the face remained the poor relations of the peripheral locoregional anaesthesia. Except some pilot centers, the disaffection of these blocks is due to a group of factors: knowledge necessary of the complexes anatomy of facial innervation, the technicality of realisation, the frequency of bilateral blocks, the fear of incidents on a very vascularised zone like the face.

However with the evolution these last years of the locoregional anaesthesia, the creation of practice formative centers, these blocks start to diffuse itself. The contribution of new molecules of anaesthetic less toxic buildings, the neurostimulation which found its place, even on the level of the face, made grow the benefice risks ratio. The rise of the ambulatory practices, to which the blocks of face are adapted perfectly, gave an impulse to these practices, in spite of very interesting at fragile or old patients and in urgency. Finally a good collaboration with the surgical operator will allow a better precision in the indication of these blocks thus reducing the risks of incidents.

PERFORMING

SUPRAORBITAL NERVE BLOCK

At its exit of the supraorbital foramen or channel, the nerve is generally made up in two groups, a medial and lateral [1] accompanied by its artery. It hangs an ascending frontal direction for supply the forehead zone (except the median zone above the root of the nose).

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.

The puncture procedure is very simple.

The operator places himself vis-a-vis the patient. The supraorbital foramen is located with the pulp of the finger (marked with the pen), the point of puncture is done on the level of the orbital edge, classically with the balance of the centered pupil [7]. The needle will seek the bone contact (with less than 10 mm generally) at the edge of the foramen, with a medial direction [18]; to avoid the penetration of the foramen at all costs causes nervous traumatism [6, 7,19].

Movie of supraorbital block

An approach by sensitive neurostimulation is possible: it will then be necessary to seek rythming paraesthesias with the frequency of neurostimulation.

The injection will be very slow (and thus less sensitive) with 2 to 2,5 ml of anaesthetic solution, in a medial direction. After the shrinking of the needle, a discrete massage supports the diffusion of the product.

The territory supply by this block is all teguments, skin to bone (external table). The supraorbital nerve supplies the superior eyelid especially in its central part, and the forehead until the coronal linea.

The supraorbital block remains simple, easy [7], with a very high success and very fast training for this superficial block.

They are many indications for the supraorbital block. In surgery, all acts on the superior eyelid (in association with the supratrochlear nerve) and on the forehead.

In emergency, all multiple skin lesion the forehead zone, and the superior eyelid. The surgery under block can be very fast, with very good postoperative analgesia.

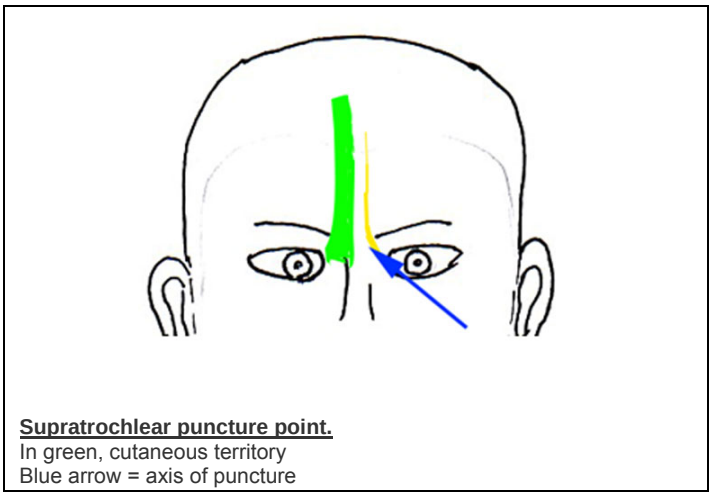
The other indications are especially a postoperative analgesia (out of relay of a general anaesthesia); treatment of certain supraorbital neuralgias.

With the supraorbital block the complications are very rare. The cutaneous puncture and the bone contact are sensitive, a sedation can be necessary. The puncture of the supraorbital artery is exceptional and would mean quasi-nervous puncture. A transitory palpebral ptose can be seen, by diffusion of the product towards the elevator muscle of the eyelid; this transitory paresis can be awkward (especially if bilateral block) for an ambulatory patient. Paraesthesias sequels in the territory of the nerve can be seen, because of an oedema of the nerve, strangled in its foramen, and whose origin is especially traumatic. To reject the foramen injection, origin of complications [1,7].

SUPRATROCHLEAR NERVE BLOCK

The supratrochlear nerve leaves by the identical foramen, and takes a superior and medial direction for supply the forehead above the nose.

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.



Supratrochlear puncture point.
In green, cutaneous territory
Blue arrow = axis of puncture

The puncture procedure is very simple. The operator is vis-a-vis a the patient. The point of puncture is at the junction of two axial lines: superior palpebral linea, horizontal axe and nasal linea, vertical axe; needle will seek the bone contact, with a medial direction [1, 7, 18]; then injection. It will be necessary to be compelled at a surface point of puncture close to the root of the nose to avoid the risk of ponction of the angular vein.

Movie of supratrochlear block

The injection will be very slow with 1 to 1,5 ml of anaesthetic solution, with a medial direction. After the shrinking of the needle, a discrete massage supports the diffusion of the product.

The territory supplies by the supratrochlear block is all teguments, skin to bone, in medial forehead zone with the top of the root of the nose.
The supratrochlear block remains simple, and very easy success.

The indications of this block, in surgery is, acts on the upper eyelid (in association with the supraorbital block); the forehead above the root of the nose. In emergency, the fracture nose (in association with the nasal block).

Few incidents with the supratrochlear block: the cutaneous puncture and the bone contact are sensitive: sedation can be necessary. The only incident is the puncture of the angular vein involving a haematoma obstructing the surgery zone [18].

NASAL OR ANTERIOR ETHMOIDAL NERVE

The nasociliary nerve leaves by the ethmoidal foramen, in the upper and medial wall of the orbit. The intraorbital approach of the nasal block thus joining the constraints of the eyes blocks is thus perished (very dangerous).

After its orbital exit, the nerve gives the infratrochlear nerve, and the anterior ethmoidal nerve that one will improperly call “nasal” with his internal nasal branches very close with the root of the nose, and the external nasal branch.

Nasal nerve block and nose anaesthesia.
Left fig.:
1- Infratrochlear nerve
2- Nasal nerve
3- Infraorbital nerve

Middle fig. : Nasal nerve territory

Right fig.: block of nasal nerve:
1- first injection;
2 - second injection.
3 - Nasal nerve internal branch
4- Nasal nerve external branch

Movie of nasal block

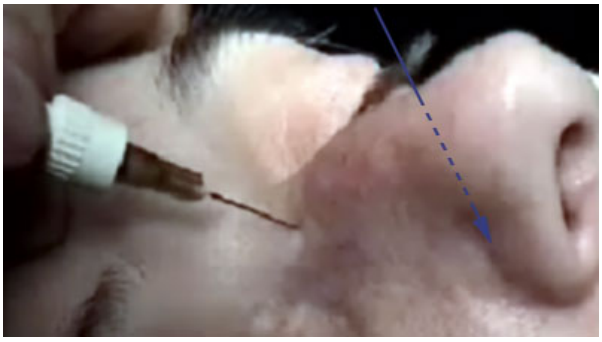
The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.

Two puncture procedures are possible:

INTRAORBITAL TECHNIQUE

it will be voluntarily isolated for several reasons [7, 20]:

- difficult technique, with a rate of obvious failure,
- many incidents and complications are described: palpebral oedemas, transitory diplopias, orbicular paresis and the transitory ptosis, bruises at the point of puncture controlled by a pressure of the interior angle of the eye; retro bulbar haemorrhage after nasal block for dacryocystostomy [7].



However in professionals hands, the quality of the anaesthesia is correct and the complications rare for simple acts [20]. Nevertheless this technique remains very difficult in training.

EXTRAORBITAL TECHNIQUE

It is the good technique; it is essential by its obvious simplicity [18], its harmlessness, and its effectiveness [19], with a maximal ratio benefit risks. The operator is vis-a-vis the patient.

Two injections will be necessary:

- first, with the root of the nose, the level of the interior angle of the eye, an infiltration, with more close to the nasal bone, while pricking close to the edge of the nose with a direction towards the nasal base.
- second, in the axis of nasal alar; of the back of the nose, towards its base and alar joint.

The injection must be particularly slow because very sensitive: 1 ml on the first site and 1,5 ml of anaesthetic solution, on the second site. After the shrinking of the needle a discrete massage supports the diffusion of the product.

The territory supplies by the nasal nerve, is the nasal bone, edge of the nose; supply also the anterior part of the lateral wall and upper parts of the septum; the skin of the external nose to the nasal tip. The root of the nose requires in more the supratrochlear nerve.

The nasal block remains simple, and very easy success, compared to the intraorbital technique.

The indications of the nasal block are in surgery: all acts of tegumental surgery of the nose (in association with the infraorbital and supratrochlear nerves); the rhinoplasty (in association with a general anaesthesia). In emergency: nose fracture, nasal skin traumatism.

Another indication is postoperative analgesia of the nasal surgery under general anaesthesia.

No particular complication with the nasal block, however the cutaneous puncture and the bone contact are very sensitive: sedation is necessary.

INDICATIONS

WITH SURGERY TYPE

TEGUMENTAL SURGERY

The explosion of the indications of the surgery of facial surface made strongly develop the requests for facial blocks. Practically all the teguments are accessible to these techniques. The carcinologic surgery of face (basocellular tumour and spinocellular tumour) with or without local scrap of rebuilding is integrated perfectly in this diagram [7, 18, 19], the more so as it is often practised at subjects at the risks (old patient, or at the patient risk) and more and more, into ambulatory surgery. Plastic surgery and cosmetic like face lipostructure, localised repair of scars, face lifting and especially, upper and lower blepharoplasty, surgery of the lips, the chin, and the "separated" ears. In emergency the wounds of the face also profit from these techniques [7]: indeed the interest of small volume of local anaesthetic, not deforming the banks of the wound, will facilitate repair [7]. The anaesthesia for the scalp is included in the same category that it is in emergency, or to ensure a good postoperative analgesia in neurosurgery. Thus the face and the upper eyelids will be accessible with supraorbital block and supratrochlear block; the cheek and the lips with an infraorbital block or maxillary block; for the nose one will need bilateral infraorbital and nasal blocks; finally for the chin and the inferior lips a mental block is enough. However for broad acts covering several territories it is to better extend nervous blocking; thus for a lipostructure of the face interesting the maxillary territory and the mandibular territory in their totality. It is advised to make maxillary and mandibular blocks at their origin, if one chooses a regional anaesthesia.

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In this indication the alone regional anaesthesia is exceptionally used [7]. Nevertheless simple gestures as the mandibular osteotomy can be carried out under blocks [21]. Generally these techniques accompany a traditional general anaesthesia to carry out an operational analgesia and especially great quality postoperative analgesia. Practically all the facial bone surgery can be performed with complementary block of the trigeminal branches; it is then preferable to perform these blocks at a waked up patient, especially if one chooses a neurostimulation.

NASAL SURGERY

The rhinoplasty, associating blocks of face and general anaesthesia optimizes comfort, and the hemodynamics effects and gets a great quality postoperative analgesia.

WITH THE OPERATIONAL CIRCUMSTANCES AND PATIENT

It is an indication of choice at the subjects at the risks:

- old patient, within the framework of the oncologic surgery of face, rather frequent surgery [7];
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- an allergy to a local anaesthetic,
- an infection on the level of the site of injection,
- coagulation disorders.

The counter-indications due to the patient are especially:

- the refusal of the patient after information made with the consultation of anaesthesia,
- a not controlled neurological pathology,
- a cardiac pathology, disorders of cardiac conduction to be discussed.

The reserves due to the operator must be taken into account. The variable level of difficulty of these blocks is solved only by one anatomical knowledge and a hands-on training preliminary [7, 27]. A few blocks are of easy and durable acquisition: supraorbital, infraorbital, mental, nasal, ear block, very safe from serious complications. On the other hand the blocks carried out in the "plexus" beginning, like the maxillary nerve and the mandibular nerve, are more delicate, with a rate of less raised success, even for accustomed, and with risks of complications raised in the literature. Only the neurostimulation although not evaluated, seems in this case to facilitate the access to these blocks.

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POSTOPERATIVE ANALGESIA

The tegumental surgery can be controlled in postoperative analgesia plan by prolonged facial blocks. A local anaesthetic of long duration, with an additive drug, allows a very good quality of postoperative analgesia (EVA < III), during at least ten hours. In certain cases, a postoperative analgesic block could be performed after the end of surgery.

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Some rare indications of prolonged analgesia by perineural catheter are described [28, 29, 30]; primarily within the framework of a major carcinologic surgery (postoperative analgesia) or of a complementary treatment to an algic pathology rebel with the traditional treatments, like an in eradicable orofacial cancer [28]. They will get a good quality and stable analgesia.

The sites of realisation are the nerves located in a fossa: maxillary nerve in rotundum foramen (suprazygomatic way) or by infrazygomatic way [30]; mandibular nerve near the oval foramen. The technique of realisation of these catheters is same with that of the simple block except that the perform is optimized by the use of motor stimulation for the mandibular nerve. The catheters will be introduced only one centimetre beyond the nozzle and will be fixed with a wire (the head being very mobile). Currently the choice rather goes worms of the discontinuous injections with a local anaesthetic to low concentration (ropivacaine 0,2%). On a short series as a double blind study (8 patients) a team showed that the postoperative analgesics consumption over 4 postoperative days was very low in the catheter group, and very significant compared to the group without regional anaesthesia [30].

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For a long time the nerves of the face and especially the trigeminal nerve, were targeted for the treatment of the pains on the level of the face [1, 31].

Some indications with diagnostic and therapeutic aiming exist on the level of the face.

All the neuralgias of the maxillary nerve (superior alveolar nerve), and the mandibular nerve (inferior alveolar nerve), can be relieved by blocks. Nervous alcoholisations can use the same procedures as those, which are employed for the anaesthetic blocks. Rare but effective indications exist like the treatment with mandibular block, of a trismus associated a hypoxic encephalopathy [32].

COMPLICATIONS

VASCULAR COMPLICATION

The facial vascular richness is the essential cause of the major risk, which is the vascular breach [7, 18, 21] with on the pharmacological plan an intense and fast resorption of the anaesthetic solution and the possibility of an intravascular injection. All the nerves are accompanied by an artery (supra and infraorbital) or close to a significant arterial axis (mandibular nerve and maxillary artery); only the maxillary nerve with the foramen rotundum is above the vessels.

In order to have a time of rise of the plasmatic concentrations in the local anaesthetic, longest possible it is necessary: to inject most slowly possible, to use small volumes and to associate an additive drug, standard clonidine.

NEUROLOGICAL COMPLICATION

The only notorious accidents are the extension of the anaesthesia to the motor nerves: facial paralysis, ptose of superior eyelid; all these incidents are regressive spontaneously.

The specific accident is the risk of paraesthesias due to the wound of one nerve at the exit of its foramen with oedema and suffering: the injection in the foramen is to be rejected formally.

ARTICULAR COMPLICATION

A characteristic: the intramuscular injection in the pterygoid muscles can involve a blocking of the temporomandibular articulation with limited oral opening and trismus [33].

TOXIC COMPLICATION

They are due either to the vascular passage, or with a fast resorption of the anaesthetic solution. They do not present characteristics and are superposable with those of the other peripheral blocks (arm or leg).

CONCLUSION

The regional anaesthesia of the face is accessible by two types of blocks; deep blocks supplies a large territory, specialised perform and not easy realisation; and the superficial blocks of very easy access and simple to realise, but with more reduced territories where they could be associated.

HEAD & NECK MAXILLARY NERVE BLOCKS

A Pulcini, M.D. & J.-P. Guerin, M.D.
Nice - France

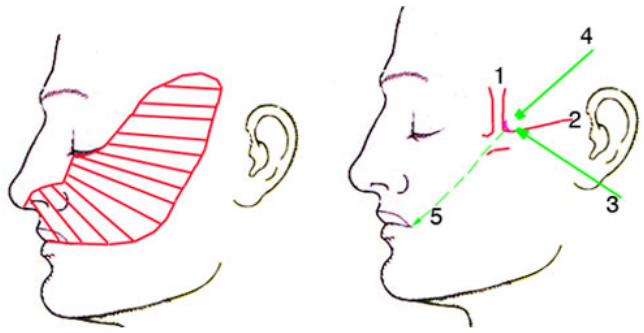
The blocks of the face remained the poor relations of the peripheral locoregional anaesthesia. Except some pilot centers, the disaffection of these blocks is due to a group of factors: knowledge necessary of the complexes anatomy of facial innervation, the technicality of realisation, the frequency of bilateral blocks, the fear of incidents on a very vascularised zone like the face.

However with the evolution these last years of the locoregional anaesthesia, the creation of practice formative centers, these blocks start to diffuse itself. The contribution of new molecules of anaesthetic less toxic buildings, the neurostimulation which found its place, even on the level of the face, made grow the benefice risks ratio. The rise of the ambulatory practices, to which the blocks of face are adapted perfectly, gave an impulse to these practices, in spite of very interesting at fragile or old patients and in urgency. Finally a good collaboration with the surgical operator will allow a better precision in the indication of these blocks thus reducing the risks of incidents.

PERFORMING

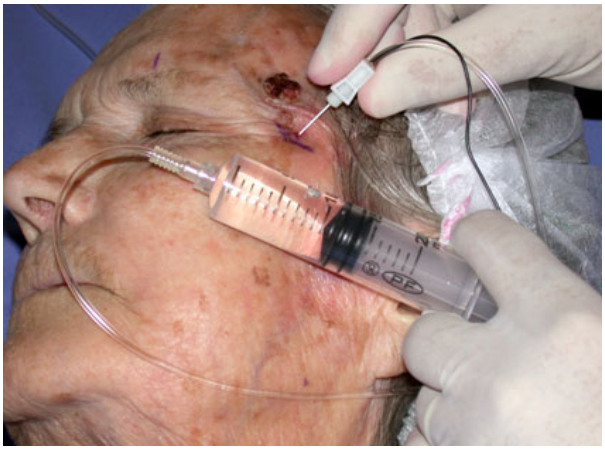
MAXILLARY NERVE BLOCK

The maxillary nerve is accessible to the level from the foramen rotundum. This level the blocking of the terminal maxillary branches gives total maxillary block. The material for performing this block is standard neurostimulation needle, with court bevel of 50 mm (24G) connected to a syringe luer lock; a nervestimulator allowing to lengthen the time of the duration of stimulation starting from 0,3 milliseconds (ms).



Maxillary nerve: territory and procedure of puncture
1- orbital line;
2- zygomatic line;
3- first axis transversal;
4 - second axis media and caudal
5- axis towards lips.

A cutaneous pen marker.For this approach, the patient will have the turned head on the side opposed to the puncture; the operator will be side of the puncture. Two techniques are possible.



Movie of maxillary block

TRADITIONAL PROCEDURE

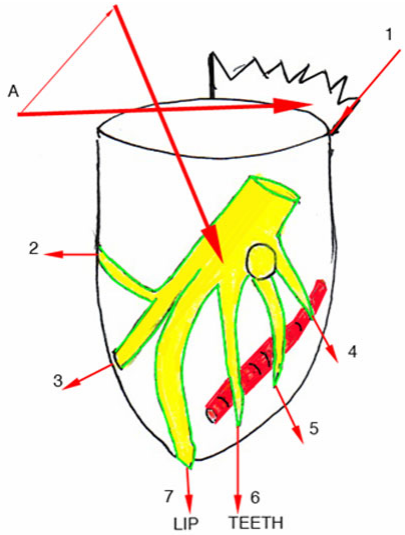
The point of puncture is done with the junction of two lines: a vertical line, the lateral bone orbital wall and a horizontal line, the zygomatic arch [6]. It is in this bone angle that the needle [7] will be introduced. The first direction is perpendicularly at the skin until the bone contact (approximately 10 to 15 mm), on this level, one finds the temporal muscle; the second direction move the needle, according to a caudal and medial axis by aiming at labial commeasure on the same side. In this space, the penetration is very easy, it is necessary to advance of 20 mm to obtain a total penetration of the needle from approximately 30 to 35 mm in total; one injects on this level.

PROCEDURE WITH SENSITIVE NEUROSTIMULATION

The puncture point is the same, the procedure also the same. A nervestimulator is necessary; with selected the duration of stimulation is 0.3 milliseconds.

The participation of the patient is essential and information will have been made during the anaesthesia consultation. It will be necessary to seek a response of the rytming dysesthesias by the frequency of nervestimulator, in the selected territory or in the middle of the surgical act.

To the level of the pterygopalatine fossa, to the exit of the foramen rotundum, the maxillary nerve gives its terminal branches in a divergent nervous bouquet; the needle will position on one of its branches to dirige the injection and to thus seek the answer adapted to this nervous root.



Maxillary nerve approach in the Pterygopalatine fossa , by sensitive stimulation; possible answers.
A: First direction of the needle (perpendicular) which will butt against the sphenoidal wing
B: Second orientation of the needle : caudal and medial.

Sphenoidal ala -
2 and 3 - Cutaneous answer type zygomatic zone: too much lateral -
4 and 5 - Intra-oral answer (pharyngeal and palatine), too medial
6 - Answer superior teeth: good answer
7 - Answer to upper lip and ala of the nose: good answer.

For a complete block, one needs a central answer, or superior alveolar nerve (dysesthesias on the teeth), or infraorbital nerve (dysesthesias on the upper lip). With the injection the dysesthesias stop immediately.

One will inject 0,1 ml.Kg-1 on average very slowly, of anaesthetic solution.

The territory supplies by the maxillary block, when the block is complete is:

- in surface, lower eyelid, ala of the nose, cheek, upper lip, cutaneous zygomatic and temporal zone;
- in deep, superior teeth, palatine zone, maxillary bone.

The success is higher than 80% for a complete block with a traditional technique; thus in a series of 58 blocks [21] one notes a success of 84% (for a maxillary surgery).

The technique with neurostimulation allows a higher success rate (> 95% in our personal experiment). Nevertheless a defect in a territory can be corrected by troncular peripheral block, branches of the maxillary nerve (infra-orbital, zygomatic, palatine).

Many indications for the maxillary block, in surgery: acts on the lower eyelid, the nose (with the nasal nerve), the cheek, the zygomatic area, the lower lip; superior dental surgery and acts on the palatine zone; and also the maxillary bone surgery, in complement of a general anaesthesia or used alone [22, 23].

In emergency, for the maxillary bone surgery and the wounds of the face (inferior eyelid, upper lip).

The other indications gather those for postoperative analgesia; especially of bone maxillary surgery, but also the surgery of the tumours of the face. An indication, which starts to emerge, is the treatment of the pain of the maxillary zone, pain rebellious with other analgesics. One can then construct either a long duration block, or a perineural catheter with discontinuous injections of 0.2% ropivacaïne (see further). A maxillary block know-zygomatic guided by scanner was described in the treatment of the trigeminal neuralgias [23].

This block is paradoxically not painful: sedation can be necessary however, except in the neurostimulation.

Except the failure few serious complications are described: on the same series [21] of 58 blocks, one notes 8 complications, regressive cephalgias, facial paralysis, a limitation of opening of mouth and a haematoma. Stimulation is certainly a reducing element of the potential complications, but which remains to be validated (in our experiment on 20 blocks in sensitive stimulation, not particular complication).

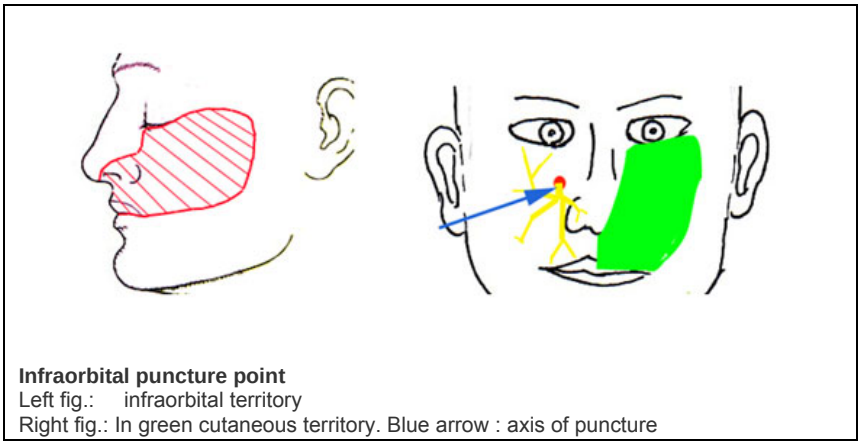
Other techniques are described; an initially infrazygomatic approach [6, 7, 25], but it is of more difficult realisation, exposing to the vascular risk of breach and other rarer but more serious complications [7].

In the event of incomplete block, an additional block is completely realisable on the level

- infraorbital;
- zygomatic; cutaneous connection with maxillary nerve, divided into zygomaticotemporal nerve and zygomaticofacial nerve [9, 18]: this last can be infiltrated by an injection under cutaneous compared to the union of the two bone axes, vertical (lateral orbital) and horizontal (zygomatic arch) by 1,5 ml of anaesthetic solution [18].

INFRAORBITAL NERVE BLOCK

The infraorbital nerve leaves by the infraorbital foramen located at 4 -7 mm below the infra-orbital bone edge [18], before its exit, it gives the anterior superior alveolar nerve. It is appeared as a large nervous plexus [18] accompanied by its artery, and gives here its terminal branches.



Infraorbital puncture point
Left fig.: infraorbital territory
Right fig.: In green cutaneous territory. Blue arrow : axis of puncture

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.

The infraorbital block is performed frequently.The infraorbital foramen is located with the finger (marked with the pen), the point of puncture is done on the level of the lateral edge of the infraorbital foramen, while trying not to wound the nervous branches, classically with the balance of the centered pupil [7].

The needle will seek the bone contact (with less than 10 mm generally) at the edge of the foramen, with a cephalic and medial direction. It is necessary to avoid the penetration of the foramen at all costs, causes nervous traumatism [19]: by palpating permanently the foramen [6].

The axis of the infraorbital foramen look towards the ala of the nose, also it is better to prick with a needle directed towards the root of the nose. Another approach can be done with introduction of the needle to the level of the nasal ala and with cephalic and lateral direction [6, 7, 18]. A sensitive neurostimulation is possible: with dysesthesias on the level of the upper lip or nose ala will then be sought.

The injection will be very slow with 2,5 to 3 ml of anaesthetic solution, in a medial direction (or lateral in the other approach). After the shrinking of the needle a discrete massage supports the diffusion of the product.

The territory supplies by the infraorbital nerve is, teguments to the bone: the lower eyelid, the cheek, the upper lip, and the ala of the nose.

The infraorbital block is a block with a very high success quasi 100% for some [18]; is an easily accessible superficial block for everybody, very much used by accustomed. Stimulation remains on this level only anecdotic.

The main indications in surgery are: all acts on the lower eyelid, the upper lip, the cheek, the nose (with the nasal nerve and the supratrochlear nerve). In emergency, multiple wounds of the face in the maxillary tegumental zone.

The other indications are dominated by postoperative analgesia, or for certain infraorbital neuralgia.

The cutaneous puncture and the bone contact are sensitive: sedation can be necessary.

The puncture of the infraorbital artery is exceptional and would mean quasi-nervous puncture. To reject the injection in the foramen source of complications [6,7,18]. They are especially sequels paraesthesias due to an oedema of the nerve strangled in its foramen directly related to a traumatic cause [7]. It was noted a transitory paralysis of the extrinsic muscles of the ocular sphere by orbital passage of the anaesthetic solution [1].

There is two other infraorbital approach [6,7]:

- endo-oral, forsaken because difficult and more sensitive with risks of dysesthesias with injection in the infraorbital foramen.
- infranasal way close to the ala of the nose, in the nasolabial furrow; but the block is incomplete and aims only the nasal and labial branches [6].

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TEGUMENTAL SURGERY

The explosion of the indications of the surgery of facial surface made strongly develop the requests for facial blocks. Practically all the teguments are accessible to these techniques. The carcinologic surgery of face (basocellular tumour and spinocellular tumour) with or without local scrap of rebuilding is integrated perfectly in this diagram [7, 18, 19], the more so as it is often practised at subjects at the risks (old patient, or at the patient risk) and more and more, into ambulatory surgery. Plastic surgery and cosmetic like face lipostructure, localised repair of scars, face lifting and especially, upper and lower blepharoplasty, surgery of the lips, the chin, and the "separated" ears. In emergency the wounds of the face also profit from these techniques [7]: indeed the interest of small volume of local anaesthetic, not deforming the banks of the wound, will facilitate repair [7]. The anaesthesia for the scalp is included in the same category that it is in emergency, or to ensure a good postoperative analgesia in neurosurgery.Thus the face and the upper eyelids will be accessible with supraorbital block and supratrochlear block; the cheek and the lips with an infraorbital block or maxillary block; for the nose one will need bilateral infraorbital and nasal blocks; finally for the chin and the inferior lips a mental block is enough. However for broad acts covering several territories it is to better extend nervous blocking; thus for a lipostructure of the face interesting the maxillary territory and the mandibular territory in their totality. It is advised to make maxillary and mandibular blocks at their origin, if one chooses a regional anaesthesia.

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HEAD & NECK
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A Pulcini, M.D. & J.-P. Guerin, M.D.
Nice - France

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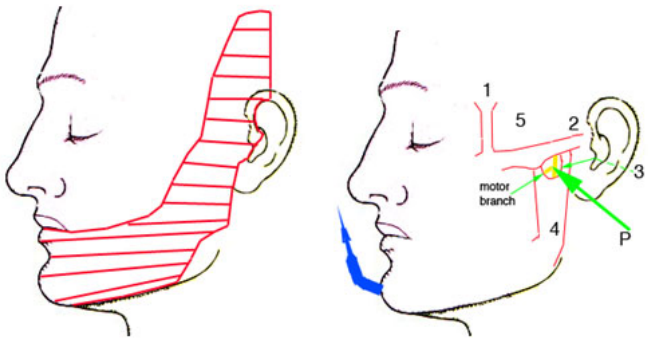
PERFORMING

MANDIBULAR NERVE BLOCK

The mandibular nerve is accessible to the level from the oval foramen. To this level it gives two trunks; anterior to motor destination and posterior sensitive. An access on this level gives a complete mandibular block.

The material for performing this block is standard neurostimulation needle, with court bevel of 50 mm (24G) connected to a syringe luer lock; a nervestimulator with motor stimulation, the duration of stimulation starting from 0,1 milliseconds (ms). A cutaneous pen marker.

Two approach for the mandibular block, traditional procedure and neurostimulation procedure.



Mandibular nerve; cutaneous territory and procedure of puncture with stimulation.
1- lateral bone orbit
2- zygomatic arch
3- tragus :15 mm ahead between mandibular condyle and coronoid, space crossed by the motor branches.
4- Vertical mandible.
P = puncture by direct access
In blue: motor answer elevation of mandible

TRADITIONAL PROCEDURE

The point of puncture is done in a semi-circumferential zone with upper limit by the zygomatic arch and between coronoid apophysis and condyl process.

The needle is directed perpendicular to the skin and will butt against the pterygoid apophysis (7, 21) towards 20 to 30 mm of deep; then this one will again be directed in top and to come behind under the oval foramen around 30-40 mm of deep where the injection will be performed. This block is relatively easy, but there is a notable rate of failure (7); thus in a series of 49 blocks, one notes 4 failures (21). In addition the presence of the maxillary artery and the penetration with the blind technique expose to the risk of vascular complications (7, 21).

PROCEDURE WITH MOTOR NEUROSTIMULATION

The point of puncture is the same, the similar procedure for the first sequence. A neurostimulator is necessary; with the duration of stimulation are 0.1 milliseconds. Information will have been made during the anaesthesia consultation. The technique is simplified, indeed:

- It is necessary to prick highest possible in the semi-circumferential space traced with the pen, between coronoid and mandibular collar behind zygomatic arch in top. (a trick: right in front of the tragus, this space admits the pulp of the finger of the operator, to trace a half-circle around the pulp of the finger). It is necessary to remain in top of this space, to avoid the risk of arterial puncture, and rather ahead towards the coronoid, with the research of the motor trunk.
- One advances guided by a motor answer which is the rytming rise of the mandible with the neurostimulation frequency; one will determine the Minimal Intensity of Stimulation (IMS) which is the best response for the smallest intensity, and one will inject slowly with the research of the immediate disappearance of the movements as of the first milliliter.

For a complete mandibular block it is the best technique, with an easier nervous location, and can be surest, although currently there are not series published. In our experiment (publication in progress) on 100 blocks performed with stimulation, we practically noted not safe failure, 5 complements on the mental nerve; no serious complication except two diffusions with the facial nerve spontaneously resolutive.

The injection will be very slow with 0,10 to 0,15 ml.Kg-1 on average, of anaesthetic solution.

The mandibular territory supplies, when performed complete block;

- in surface, the lower lip, the mandibular skin zone and lateral temporal zone (excluded the zone of the angle of the mandible, under the dependence of the superficial cervical plexus), the chin, the auricle of the ear in its anterior zone;
- in deep, lower teeth, anterior two-thirds of the tongue, the mandibular bone.

The rate of success remains for the accustomed centers, higher than 80% for a complete block and a traditional technique: in the series referred to above one notes 91% of success [21].

The stimulation technique allows a higher success rate (> 95%) and simplifies the approach.

Nevertheless a defect in a territory can be corrected by troncular distal block on the branches of the mandibular nerve (auriculotemporal, mental, alveolar inferior).

Many indications for the mandibular block in surgery. Alls acts on the lower lip, the mandibular skin zone and temporal skin zone, the chin; mandibular bone surgery. And inferior dental surgery. In emergency, fracture of the mandible, wound of the tongue, superficial wounds in a mandibular territory.

The other indications are analgesia:

- is postoperative, of bone surgery, tegumental surgery (cutaneous tumours) or lingual;
- is in the rebellious pains with other analgesics.

A perineural mandibular catheter, according to the same procedure of installation, can be used with discontinuous injections of ropivacaïne 0,2% (see further).

This block is not very painful: sedation can be necessary however.

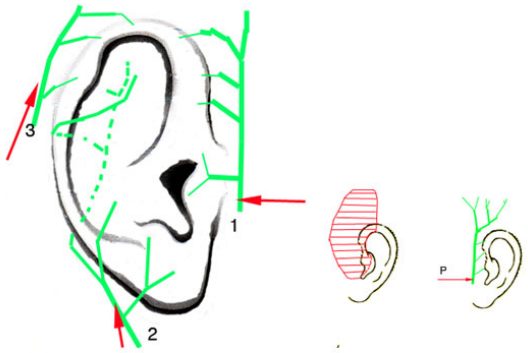
Except the failure few complications are published [7]: thus in a series one notes, of the difficulties of opening of mouth, the regressive facial paralysis, of nauseas, a cephalgias, a haematoma, representing nevertheless 9 complications out of 49 blocks [21].

The neurostimulation seems to reduce the risk of potential complications.

AURICULOTEMPORAL NERVE BLOCK

The auriculotemporal nerve terminal branch of mandibular nerve passes in front of the ear to distribute itself to the temporal zone.

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.



External Ear blocks . and auriculotemporal territory; and block.
1 - Auriculotemporal nerve block
2 - Great auricular nerve block
3 - Lesser occipital nerve block
P: puncture.

The point of puncture is done in front of the tragus to 15 mm, the needle penetrates to 10 mm in medial of this point, in moves towards the tragus, the injection is made right in front of this one.

The injection must be very slow by means of 1 to 2 ml of anaesthetic solution, with a lateral direction. After the shrinking of the needle a discrete massage supports the diffusion of the product.

The territory supplies by the auriculotemporal block is, the auricle of ear, anterior zone, the external auditory canal and the temporal skin zone on the top of the ear lobe [6].

This block is very easy, with a big success, simple, without major risk.

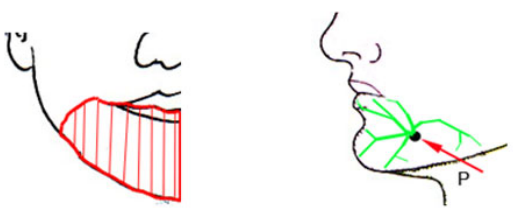
The indications of the auriculotemporal block are in surgery: acts on the auricle of the ear, in association with the great auricular nerve (see further); tegumental surgery of the temporal zone. In emergency: all multiple wounds of the scalp, in the temporal zone.

Finally in complement of a mandibular block which would not be complete on the temporal territory: indeed after a mandibular block, the auriculotemporal nerve is blocked only in 22% of the cases [26] and can be easily blocked by local way.

The vascular puncture of the superficial temporal vessels is possible; they are however deeper than the nerve and the use of needle with bevel short tiny room the risk of vascular penetration with the proviso of progressing slowly.

MENTAL NERVE BLOCK

The mental nerve leaves by the mental foramen near the labial commeasure and the first premolar [7]; its artery accompanies it. It takes an upper and medial direction for supply the chin, the lower lip, gencive, the teeth (incisors and the canine).



Mental block.
Cutaneous territory
P = Axis of puncture, near the mental foramen

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.

Movie of mental nerve block

The point of puncture is done at the edge lateral to 10 mm of the mental foramen [27], located with the finger and marked with the pen.

The needle will seek the bone contact, with a medial direction, towards the foramen [19]; then one will inject. To reject an injection in the mental foramen.

The injection is very slow with 2 to 3 ml of anaesthetic solution, and a medial direction. After the shrinking of the needle a discrete massage supports the diffusion of the product.

The territory supplies by the mental nerve is, inferior lip, chin, gencivies, teeth (incisors and canine).

The mental block is a very easy block, with very good success.

The indications of the mental block are in surgery all acts on the lower lip, the teeth, gencivies, and the chin [18]. In emergency: facial wounds in labial zone, medial mandibular zone and mental zone: a bilateral block is then necessary.
In odontology: acts on the incisors and the canine.

The cutaneous puncture and the bone contact are sensitive: sedation can be necessary.

The puncture in the mental foramen risk involving nervous lesions with paraesthesias [7]; a risk of haematoma is related to an uninsured technique [6].

INFERIOR ALVEOLAR NERVE BLOCK

Although this nerve is not "facial", it can be useful in the event of incomplete mandibular block or of alternative to the mental block [26].

The inferior alveolar nerve is a terminal branch of the mandibular nerve, it progresses in a bone mandibular tunnel all the length of the horizontal branch, to finish with the mental foramen where it gives the mental nerve.

The material for performing this block is an intradermal needle (26 G 5/8, 16 mm) connected to a syringe luer lock by an extension cable; or a needle with court bevel of 25 mm (24 G), standard neurostimulation needle. A cutaneous pen marker.

Only one puncture procedure will be retained, that endo-oral, will be said to the Spix spine [7]. The needle is directed towards the medial face the vertical mandibular branch, in contact with the Spix spine, before the canal bone penetration of the nerve;

The injection is very slow with 2 to 3 ml of anaesthetic solution.

The territory of inferior alveolar nerve is an inferior tooth; sometimes the lingual nerve is reached [26].

The indications for the inferior alveolar block are a dental surgery or also for rescue a defective mandibular block.

This block is very easy and frequently performed by odontologists.

A possible lesion of the lingual nerve with dysesthesias of the lingual edge and loss of the taste [7, 26] are noted; a lesion of the facial nerve (resolutive paralysis) is also noted.

More rarely [7]: a superior laryngeal block, vascular lesion, an injection will intra muscular (pterygoid) involving a blocking temporomandibular articulation.

INDICATIONS

WITH SURGERY TYPE

TEGUMENTAL SURGERY

The explosion of the indications of the surgery of facial surface made strongly develop the requests for facial blocks. Practically all the teguments are accessible to these techniques. The carcinologic surgery of face (basocellular tumour and spinocellular tumour) with or without local scrap of rebuilding is integrated perfectly in this diagram [7, 18, 19], the more so as it is often practised at subjects at the risks (old patient, or at the patient risk) and more and more, into ambulatory surgery. Plastic surgery and cosmetic like face lipostructure, localised repair of scars, face lifting and especially, upper and lower blepharoplasty, surgery of the lips, the chin, and the "separated" ears. In emergency the wounds of the face also profit from these techniques [7]: indeed the interest of small volume of local anaesthetic, not deforming the banks of the wound, will facilitate repair [7]. The anaesthesia for the scalp is included in the same category that it is in emergency, or to ensure a good postoperative analgesia in neurosurgery. Thus the face and the upper eyelids will be accessible with supraorbital block and supratrochlear block; the cheek and the lips with an infraorbital block or maxillary block; for the nose one will need bilateral infraorbital and nasal blocks; finally for the chin and the inferior lips a mental block is enough. However for broad acts covering several territories it is to better extend nervous blocking; thus for a lipostructure of the face interesting the maxillary territory and the mandibular territory in their totality. It is advised to make maxillary and mandibular blocks at their origin, if one chooses a regional anaesthesia.

MAXILLOFACIAL SURGERY

In this indication the alone regional anaesthesia is exceptionally used [7]. Nevertheless simple gestures as the mandibular osteotomy can be carried out under blocks [21]. Generally these techniques accompany a traditional general anaesthesia to carry out an operational analgesia and especially great quality postoperative analgesia. Practically all the facial bone surgery can be performed with complementary block of the trigeminal branches; it is then preferable to perform these blocks at a waked up patient, especially if one chooses a neurostimulation.

NASAL SURGERY

The rhinoplasty, associating blocks of face and general anaesthesia optimizes comfort, and the hemodynamics effects and gets a great quality postoperative analgesia.

WITH THE OPERATIONAL CIRCUMSTANCES AND PATIENT

It is an indication of choice at the subjects at the risks:

- old patient, within the framework of the oncologic surgery of face, rather frequent surgery [7];
- insufficient respiratory, cardiac or renal.

Interesting indication also in emergency, at the patient not with jeun, with an often surface surgery.

Within the framework of ambulatory surgery the these blocks have a dominating place, allowing, acts in full safety with a remarkable residual analgesia facilitating the return with the social life in the day surgery.

CONTRAINDICATIONS

The general counter-indications are those of any regional anaesthesia, in particular [27]:

- an allergy to a local anaesthetic,
- an infection on the level of the site of injection,
- coagulation disorders.

The counter-indications due to the patient are especially:

- the refusal of the patient after information made with the consultation of anaesthesia,
- a not controlled neurological pathology,
- a cardiac pathology, disorders of cardiac conduction to be discussed.

The reserves due to the operator must be taken into account. The variable level of difficulty of these blocks is solved only by one anatomical knowledge and a hands-on training preliminary [7, 27]. A few blocks are of easy and durable acquisition: supraorbital, infraorbital, mental, nasal, ear block, very safe from serious complications. On the other hand the blocks carried out in the "plexus" beginning, like the maxillary nerve and the mandibular nerve, are more delicate, with a rate of less raised success, even for accustomed, and with risks of complications raised in the literature. Only the neurostimulation although not evaluated, seems in this case to facilitate the access to these blocks.

BLOCKS FOR ANALGESIA

POSTOPERATIVE ANALGESIA

The tegumental surgery can be controlled in postoperative analgesia plan by prolonged facial blocks. A local anaesthetic of long duration, with an additive drug, allows a very good quality of postoperative analgesia (EVA < III), during at least ten hours. In certain cases, a postoperative analgesic block could be performed after the end of surgery.

CATHETERS

Some rare indications of prolonged analgesia by perineural catheter are described [28, 29, 30]; primarily within the framework of a major carcinologic surgery (postoperative analgesia) or of a complementary treatment to an algic pathology rebel with the traditional treatments, like an in eradicable orofacial cancer [28]. They will get a good quality and stable analgesia.

The sites of realisation are the nerves located in a fossa: maxillary nerve in rotundum foramen (suprazygomatic way) or by infrazygomatic way [30]; mandibular nerve near the oval foramen. The technique of realisation of these catheters is same with that of the simple block except that the perform is optimized by the use of motor stimulation for the mandibular nerve. The catheters will be introduced only one centimetre beyond the nozzle and will be fixed with a wire (the head being very mobile). Currently the choice rather goes worms of the discontinuous injections with a local anaesthetic to low concentration (ropivacaine 0,2%). On a short series as a double blind study (8 patients) a team showed that the postoperative analgesics consumption over 4 postoperative days was very low in the catheter group, and very significant compared to the group without regional anaesthesia [30].

MEDICAL INDICATION

For a long time the nerves of the face and especially the trigeminal nerve, were targeted for the treatment of the pains on the level of the face [1, 31].

Some indications with diagnostic and therapeutic aiming exist on the level of the face.

All the neuralgias of the maxillary nerve (superior alveolar nerve), and the mandibular nerve (inferior alveolar nerve), can be relieved by blocks. Nervous alcoholisations can use the same procedures as those, which are employed for the anaesthetic blocks. Rare but effective indications exist like the treatment with mandibular block, of a trismus associated a hypoxic encephalopathy [32].

COMPLICATIONS

VASCULAR COMPLICATION

The facial vascular richness is the essential cause of the major risk, which is the vascular breach [7, 18, 21] with on the pharmacological plan an intense and fast resorption of the anaesthetic solution and the possibility of an intravascular injection. All the nerves are accompanied by an artery (supra and infraorbital) or close to a significant arterial axis (mandibular nerve and maxillary artery); only the maxillary nerve with the foramen rotundum is above the vessels.

In order to have a time of rise of the plasmatic concentrations in the local anaesthetic, longest possible it is necessary: to inject most slowly possible, to use small volumes and to associate an additive drug, standard clonidine.

NEUROLOGICAL COMPLICATION

The only notorious accidents are the extension of the anaesthesia to the motor nerves: facial paralysis, ptose of superior eyelid; all these incidents are regressive spontaneously.

The specific accident is the risk of paraesthesias due to the wound of one nerve at the exit of its foramen with oedema and suffering: the injection in the foramen is to be rejected formally.

ARTICULAR COMPLICATION

A characteristic: the intramuscular injection in the pterygoid muscles can involve a blocking of the temporomandibular articulation with limited oral opening and trismus [33].

TOXIC COMPLICATION

They are due either to the vascular passage, or with a fast resorption of the anaesthetic solution. They do not present characteristics and are superposable with those of the other peripheral blocks (arm or leg).

CONCLUSION

The regional anaesthesia of the face is accessible by two types of blocks; deep blocks supplies a large territory, specialised perform and not easy realisation; and the superficial blocks of very easy access and simple to realise, but with more reduced territories where they could be associated.

HEAD & NECK — CERVICAL NERVE BLOCKS

A Pulcini, M.D. & J.-P. Guerin, M.D.
Nice - France

The blocks of the face remained the poor relations of the peripheral locoregional anaesthesia. Except some pilot centers, the disaffection of these blocks is due to a group of factors: knowledge necessary of the complexes anatomy of facial innervation, the technicality of realisation, the frequency of bilateral blocks, the fear of incidents on a very vascularised zone like the face.

However with the evolution these last years of the locoregional anaesthesia, the creation of practice formative centers, these blocks start to diffuse itself. The contribution of new molecules of anaesthetic less toxic buildings, the neurostimulation which found its place, even on the level of the face, made grow the benefice risks ratio. The rise of the ambulatory practices, to which the blocks of face are adapted perfectly, gave an impulse to these practices, in spite of very interesting at fragile or old patients and in urgency. Finally a good collaboration with the surgical operator will allow a better precision in the indication of these blocks thus reducing the risks of incidents.

PERFORMING

GREAT AURICULAR NERVE BLOCK

The great auricular nerve is a terminal branch of the superficial cervical plexus; it moves towards the ear lobe according to an axis passing by the posterior edge of SCM (Erb point) and mastoid.

The material for performing this block is standard neurostimulation needle, with court bevel of 50 mm (24G) connected to a syringe luer lock. A cutaneous pen marker.

For the puncture the patient must be positioned with the head turned towards the side opposed to the block [18]. The first reference mark is the mastoid (to mark it with the pen); the second reference mark, the lateral edge of SCM on the cricoid level. The block will be done on the line joining together these 2 points. The puncture point is done to 10 mm of the point of SCM; the needle passes in infradermic and moves towards the mastoid, the injection is done throughout way.

Great auricular nerve block.
Cutaneous territory
M: mastoid
scm : sternocleidomastoid muscle
P: puncture

The injection is very slow with 7 ml of anaesthetic solution, while advancing towards the mastoid. After the shrinking of the needle a discrete massage supports the diffusion of the product.

The territory supplies by the great auricular nerve is external ear, in its inferior and posterior zone (half inferior external ear), as well as a small cutaneous territory of the angle of the mandible.

This block is very easy, simple and with many success.

The indications are in surgery: all acts on the external ear, repairing surgery with local scrap.

In emergency: wounds of the external ear.

No incident is noted, except, if the puncture is too deep, a diffusion on the facial nerve is possible, with a transitory paresis.

LESSER OCCIPITAL NERVE BLOCK

The lesser occipital nerve is a terminal branch of the superficial cervical plexus on the C2 level; it leaves behind SCM and moves towards postero-superior zone of the ear lobe.

The material for performing this block is a needle with court bevel of 50 mm (24 G), standard neurostimulation needle connected to a syringe luer lock by an extension cable. A cutaneous pen marker.

The puncture point is behind the ear lobe at middle height at the level of the occipital zone. The needle will inject the anaesthetic according to a quarter of arc of circle to finish the injection at the top of the ear lobe.

A "trick" can facilitate the block: the needle will be slightly curved and will be able in a way, to inject the anaesthetic solution behind the ear lobe, parallel to this one.

The injection will be particularly slow here, to make it less sensitive. One needs 4 ml of anaesthetic solution. After the shrinking of the needle a discrete massage supports the diffusion of the product.

Movie of lesser occipital nerve block

The territory supplies by the lesser occipital nerve is, ear lobe in postero-superior zone ("9 hours to 12 hours") where the nerve branches supply the sensitivity of the lobe [27].

The lesser occipital block is very easy, simple with big efficacy.

The indications of this block is in surgery all acts on the ear lobe. In emergency: wounds of the scalp in occipital zone.

Only disadvantage with this block, the injection, which is sensitive; the slowness of the injection will decrease the pain.

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THORAX & ABDOMEN

TABLE OF CONTENTS

- Epidural anaesthesia in Cardio-thoracic surgery
- Ilioinguinal-Iliohypogastric block
- Peri-umbilical & Rectus sheath block
- Pudendal block

THORAX & ABDOMEN

EPIDURAL ANAESTHESIA IN CARDIO-THORACIC SURGERY

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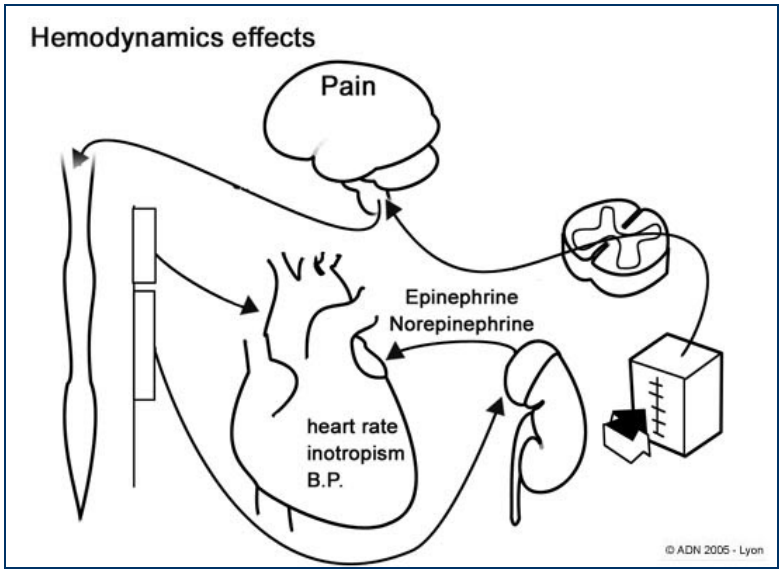
Rene Martin, M.D., Ph. D.
Sherbrooke - Quebec – Canada

THE PHYSIOLOGICS EFFECTS OF THORACIC EPIDURAL ANESTHESIA

HAEMODYNAMIC EFFECTS

Hemodynamics effects of spinal and epidural blocks are the same. They are in relation with the block levels and are as follow:

- T10 - L5 : blood pooling into the lower limbs due to an arteriolar vasodilatation and to an increase in venous capacity. Preload and cardiac output are reduced. A compensatory reflex produces a vasoconstriction of the upper part of the body and an increase in heart rate in order to maintain an adequate blood pressure.
- T5 - T8 : blockade of the sympathetic nervous system with a vagal dominance (bradycardia and hypotension).
- T5 - L5 : cathecholamines secretion reduction and blood pooling into the gastro-intestinal system.
- T2 - T5 : cardiac output decrease without myocardial contractility and telediastolic volume changes of the left ventricle.



EFFECTS ON CORONARY ARTERY CIRCULATION

In the animal [10] thoracic epidural anesthesia after coronary artery clamping reduces myocardial infarction size and the incidence of ventricular arrythmia.

Thoracic epidural anesthesia (TEA) [11] produces a vasodilatation of stenotic epicardial arteries and inhibits post-stenotic vasoconstriction responsible either for a coronary artery blood flow diversion towards the myocardial ischemic territory or for a coronary artery steal syndrome.

TEA produces a temporary sympathectomy. This results in a reduction of myocardial ischemic signs, which is a consequence of a better O^2 supply / O^2 consumption relationship. TEA affects 2 of the 5 factors responsible for myocardial ischemia.

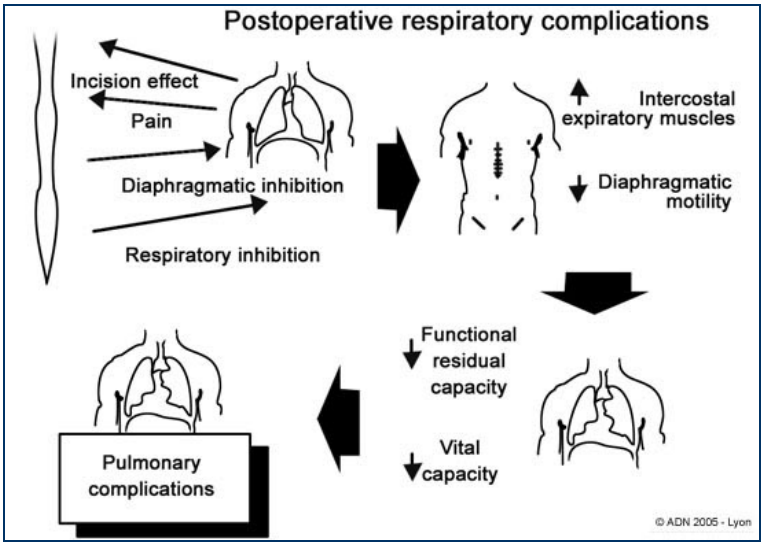
Pathophysiology	Medical treatment	TEA effect
Non occlusive thrombus	Anticoagulants and antiplatelets agents	No
Dynamic occlusions	Coronary vasodilatation	Yes
Progressive dynamic occlusion	Mechanical treatment	No
O^2 supply /O^2 consumption mismatch	b - blockers	Yes
Inflammation and/or infection	?	No

RESPIRATORY EFFECTS

TEA improves the pulmonary dynamic after thoracotomy, thoracic trauma and upper abdomen trauma. Two mechanisms are involved.

Direct action on vital capacity secondary to an action on the diaphragm and on the respiratory muscles.

Indirect action on the vital capacity through the analgesia produced, which permits a better spontaneous ventilation. Analgesia without sedation helps for a more rapid mobilization and for an active rehabilitation.



STRESS RESPONSE

TEA with local anesthetics or opioids inhibits the neuro-endrocrine response to surgery. The most important effect is observed with local anesthetics injected during and after surgery.

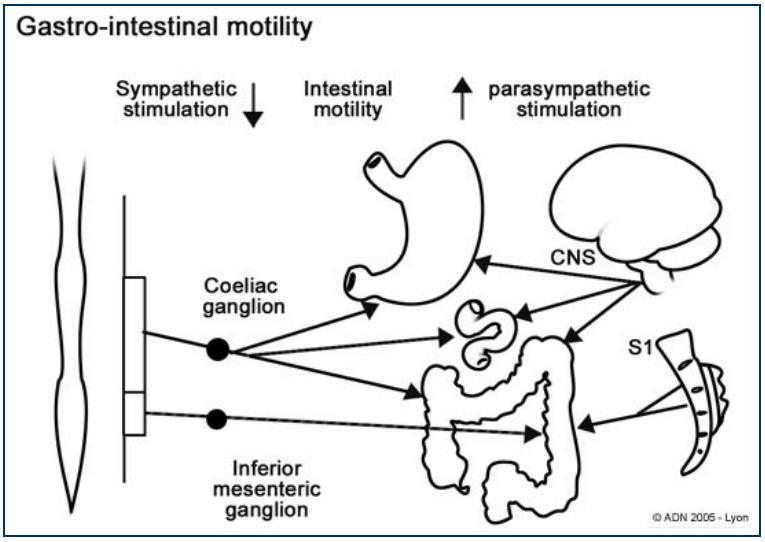
Opioids and local anesthetics produce different effects due to their differents sites of action.

Opioids produce analgesia through modulation of nociceptive pathways whereas local anesthetic block both the nociceptive and the non-nociceptive pathways.

GASTRO-INTESTINAL MOBILITY

Digestive transit is faster to recover when the block level is over T12. Many mechanisms can explain why thoracic epidural anesthesia can favor a more rapid digestive transit recovery :

- Blockade of nociceptive afferents influx and of sympathetic lumbar and thoracic afferents.
- Non-antogonism of parasympathetic efferents influx.
- Increase of G-I blood circulation.
- Systemic Absorption of local anesthetics.
- Reduction of postoperative opioids consumption.



ANAESTHETIC SOLUTIONS

Epidural blockade is actually the best technique for control of postoperative pain.

OPIOIDS

The more they are soluble in lipids, the more their onset time is short and faster is their peak effect. The more soluble in lipids opioids are rapidly absorbed into the blood. This is the reason why they have to be infused continuously.

- Morphine : epidural injection of morphine produces better results than IV and IM injections. Late respiratory depression (0.09 to 0.2 %), sedation, pruritis (25% to 80%), nausea (28% to 60%) vomiting and urinary retention may occur with its use.
- Liposoluble drugs (fentanyl, sufentanil) : they are responsible for early respiratory depression. They have to be delivered at the spinal level involved with the pain for maximal effect. The blood levels of fentanyl infused continuously into the epidural space vary between 2-4 ng/ml.

LOCAL ANAESTHETICS (LA)

They are used at low concentrations in order to produce a sensory block (A delta and C fibers) without a motor block (big myelinated fibers). After thoracic and upper abdominal surgery, the combinaison of LA, opioids, NSAID and analgesics is mandatory for optimal results.

- Bupivacaine : 2.5 mg/ml concentrations (0.25%) do not present any advantage over 1.25 mg/ml concentrations (0.125%) in regard to opioids consumption.
- Ropivacaine : produces sensory blocks similar to Bupivacaine at equipotent concentrations, but the motor block is slow to appear, less important and fades out rapidly. Its toxicity is less than that of Bupivacaine. It is usually used at a 2 mg/ml concentration (0.2%) in epidural analgesia.

COMBINED ANALGESIA

The mixture of a local anesthetic and of a liposoluble opioid produce better results than the individual drugs used solely. Their infusion into the thoracic epidural space allows a reduction in the use of both drugs.

NEW AGENTS

Midazolam combines with GABA receptors and ketamine with NMDA receptors.

Clonidine combines with a2 adrenergic receptors, inhibiting the release of substance P. Combined with Bupivacaine and fentanyl at a concentration of 1-2 mg/kg, it potentiates analgesia without major side effects.

CLINICAL USE

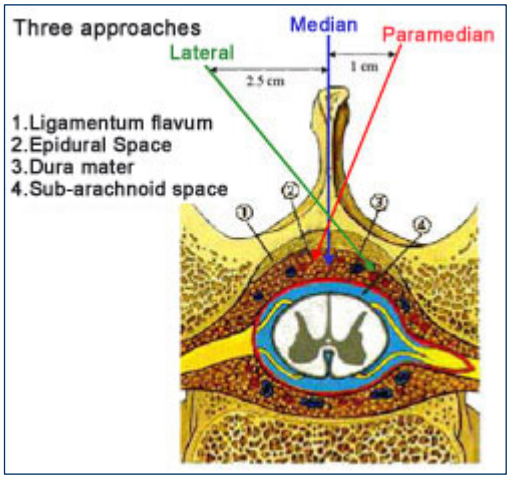
CLINICAL INDICATIONS FOR THORACIC EPIDURAL ANALGESIA

- Respiratory problems;
- Cardiac problems;
- Myocadial ischemia ; neuro-vascular problems;
- History of a difficult postoperative period in the past;
- Sleep apnea syndrome is a contraindication to the use of opioids into the epidural space.

SPECIAL TECHNICAL ASPECTS OF TEA

There are at least 3 majors differences between the thoracic and the lumbar spine :

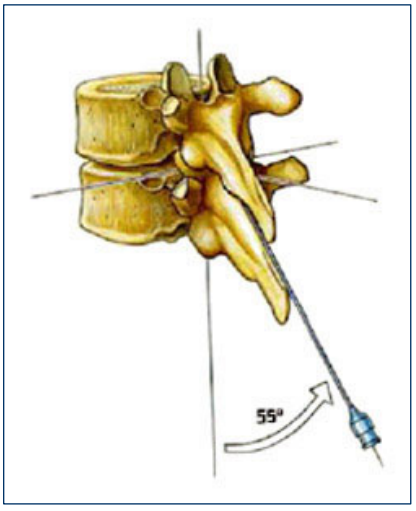
- the thoracic spinous processes are oblique;
- a mechanical lesion of the medulla is possible;
- ligamentun flavum is thinner in the thoracic spine (loss of resistance is more difficult to perceive).



There are 3 approaches for thoracic epidural space localization, but the majority of anesthesiologists use the median approach.

- median approach;
- paramedian approach;
- lateral approach.

The difference among the 3 approaches resides in the insertion sites of the needle in regard to the inter-spinous processes.



MORPHOLOGICAL LANDMARKS

- C7 - protuberant cervical process
- T3 - origin of the spine of the scapula
- T7 - tip of the scapula
- L1 - tip of the 12th rib.

TECHNICAL DIFFICULTY

The difficulty to realize a thoracic epidural block is linked to the obliquity of the thoracic spinous processes.

Easy	Difficult
C7-T3	T3-T7
T9-L4	

LEVEL OF CATHETER INSERTION IN REGARD TO THE SITE OF THE SURGERY

Site of surgery	Dermatomes implicated	Suggested puncture level
Shoulder	C4-T2	T1-T2
Arm	C5-T2	T1-T2
Cardiac surgery	T1-T8	T3-T4
Thorax	T2-T10	T6-T7
Abdomen supra-umbilicus	T6-T10	T8-T9
Abdomen infra-umbilicus	T9-L1	T11-T2

MONITORING

- Of the analgesia with a simple scale (verbal or numerical).
- Of the respiratory rate.
- Of the sedation level (especially for a patient who snores).
- Of the motor block.
- Of the sensory level of analgesia (with temperature).

GUIDELINES FOR CATHETER

- The epidural catheter should he covered with a semi-permeable membrane at its exit point, and this point should be inspected every day for signs of local inflammation with or without signs of systemic infection. The catheter should be removed when there are signs of local inflammation.
- Antibacterial filters should be used; they don't need to be changed when the catheter was inserted in a sterile surrounding.
- The medication injected into the epidural catheter should be sterile and perfusion bags should be changed every 12 to 24 h.
- There is no rule concerning the life of an epidural catheter, but after 3 to 4 days, we should be vigilant.

CONCLUSION

We should always consider thoracic epidural analgesia in a cost / benefit ratio.

A careful management is mandatory.

One should be familiar with lumbar epidural anesthesia before moving to thoracic epidural anesthesia. The use of thoracic epidural analgesia implicates a special ward set up.

THORAX & ABDOMEN — ILIOINGUINAL-ILIOHYPOGASTRIC BLOCK - SINGLE SHOT

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Jean Paul Mission, MD
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Clermont-Ferrand (France)

The ilioinginal-iliohypogastric block is usually used for analgesia in children, associated with general or perimedullar anaesthesia. This block is a challenge to general and spinal anaesthesia in adult. Ilioinguinal-iliohypogastric block combined with genitofemoral block and spermatic cord block can provide good anaesthesia and rapid analgesia. In addition, it is used for hernia repair in adults as a sole anaesthesic as a challenge to local field block.

ANATOMY

The iliohypogastric nerve is formed by fibres from L1, with some contribution from T12. The nerve runs obliquely across the quadratus lumborum muscle behind the kidney. Close to the iliac crest the nerve pierces the transversus abdominis muscle. Its lateral branch pierces the muscle of the lateral abdominal wall to supply the skin over the lateral gluteal region. The anterior branch runs forwards and down wards between transversus abdominis and internal oblique to supply the skin above the pubis.

The ilioinguinal nerve is formed in common with the iliohypogastric nerve. The nerve lies on the quadratus lumborum muscle and the iliacus until it perforates the body wall near the anterior iliac crest. It lies between the internal and external oblique to pass through the superficial inguinal ring. It distributes sensory fibres to superomedial thigh, root of the penis and upper part of the scrotum in the male, or mons pubis and labium majus in the female.

The genitofemoral nerve is formed from L1-L2 and passes through the psoas to emerge on its anterior surface. It runs down wards on the psoas and divides into genital and femoral branches. The genital branch enters the inguinal canal through the deep inguinal ring to supply the cremaster muscle and a small area of overlying skin. The femoral branch passes behind the inguinal ligament to enter the femoral sheath and supply the skin over the femoral triangle.

MATERIAL

- A skin marker
- A 24–gauge short bevel (45°) needle Plexufix® type
- A 30 ml or 50 ml syringe filled up with the chosen local anaesthetic agent

LOCAL ANAESTHETIC SOLUTIONS

For the anaesthetic ilioinguinal-iliohypogastric block, 30 ml for each side are necessary.

For the analgesic ilioinguinal-iliohypogastric block, 15 ml for each side are necessary.

Ropivacaine 0,5 % appears to be the local anaesthetic of choice. This concentration can provide up to a 12-hour period of post-operative analgesia [1, 2]. Adding one microg/kg clonidine to 0.5% ropivacaine provide a 18 to 24 hour postoperative analgesia [3].

Bupivacaine 0.5% also for anaesthesia or a mixture of short-acting and long acting drugs.

For analgesia a concentration of 0.25 Bupivacaine or Ropivacaine 0.2% might be sufficient.

INDICATIONS

Anaesthetic indication is the inguinal hernia repair.

Analgesic indications in combination with light general anaesthesia or spinal anaesthesia include inguinal hernia repair and pelvic surgery with Pfannenstiel incision (caesarean section, hysterectomy, myomectomy, Burch), orchidopexia

CONTRAINDICATIONS

- Patient refusal.
- Local anaesthetic allergy.
- Severe coagulation disorders.
- Local infection.

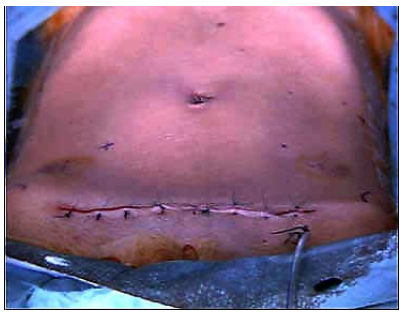
TECHNIQUE

Three punctures point are necessary to perform ilioinguinal-iliohypogastric block:

1/ A line between the anterior superior iliac spine and the umbilicus, injection site is located at intersection between the third lateral and the third medial,
2/ A line between the anterior superior iliac spine and the pubic spine, injection site is located at intersection between the third lateral and the third medial,
3/ Pubic spine.

A 24–gauge short bevel needle is inserted in a 45° angle to the skin, in caudal direction. So, the bevel is parallel to the different plan and allows a good resistance to identify the aponeurosis. After passing through the skin and subcutaneous tissue, the needle meets the firm resistance of the external oblique sheath. The needle is pushed to penetrate this sheath with a definite snap and then pushed deeper to penetrate the internal oblique sheath. Two snap are needed for the two first point and only one for the third. After the usual security tests, 5 ml of local anaesthetic solution are injected after each snap and in subcutaneous at the pubic spine, Thirty ml of local anaesthetic solution are necessary for each side [4]. In men sometimes, it is necessary to complete the block with spermatic cord infiltration.

Analgesic Ilioinguinal-iliohypogastric block is much simpler. The single injection point is located at intersection between the third lateral and the third medial of a line between the anterior superior iliac spine and the umbilicus [5,6]. A 24–gauge short bevel needle is inserted in a 45° angle to the skin, in caudal and medial direction. After passing through the skin and subcutaneous tissue, the needle meets the firm resistance of the external oblique sheath. The needle is then pushed to penetrate this sheath with a definite snap and 15 ml of local anaesthetic solution are injected to each side.



COMPLICATIONS

Potential complications are intra vascular-injection and penetration of the peritoneum. These complications are rare, as long as good material is used and security test are always performed. Femoral nerve anaesthesia by diffusion is possible and can compromise day case surgery.

The main disadvantage of this block is whole or partial fall. Complement anaesthesia is sometimes needed as hernia orifice and spermatic cord infiltration.

CONCLUSION

This block gives a good rapport benefit/risk and represents an elective anaesthesia and analgesia technique for day case surgery.

THORAX & ABDOMEN

PERI-UMBILICAL & RECTUS SHEATH BLOCK - SINGLE SHOT

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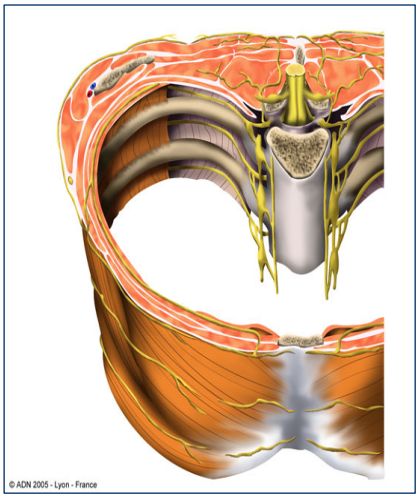
ANATOMY

The rectus muscles extend from the xiphoid and 5-7th costal cartilages to the pubic crest. These muscles are enclosed in the rectus sheath, which is formed by the aponeurosis of the external and internal oblique and transverse muscles. Along their whole length, the rectus muscles are separated into four segments by three fibrous intersections .



These intersections are attached to the anterior, but not to the posterior, surface of the rectus sheat. This allows the superior and inferior epigastric vessels to pass along the posterior surface without encountering a barrier.The lower thoracic nerves (T7-T12) innervate the anterior abdominal wall, the oblique and transverse muscles .

After they have passed through the rectus sheath, these nerves innervate both rectus muscles. T10 innervates the dermatome around the umbilicus and T12 the skin just above the ilioinguinal ligament.

EQUIPMENT

- Surgical skin marker
- A 24-gauge short bevel (45°) needle Plexufix® type
- A 30 or 50 ml seringe filled with the chosen local anaesthetic.

ANAESTHETICS

FOR THE PARA-UMBILICAL BLOCK

10 to 15 ml for each side are sufficient.

FOR THE RECTUS SHEATH BLOCK

5 to 7 ml are required for each point giving a total volume of 40 ml.

Ropivacaine 0,5 % appears to be the local anaesthetic of choice. This concentration can provide up to a 12-hour period of post-operative analgesia [1]. Adding one microg/kg clonidine to 0.5% ropivacaine provide a 18 to 24 hour postoperative analgesia [2].

INDICATIONS

FOR THE PARA-UMBILICAL BLOCK

In combination with light general anaesthesia, indications for pre-operative para-umbilical block include umbilical hernia repair [3] and some forms of diagnostic gynaecological laparoscopy, like microlaparoscopy [4, 5, 6].

Indications for post-operative par-umbilical block include umbilical hernia surgery and certain gynaecological laparoscopic operations (oophorectomy, salpingectomy, myomectomy). In these cases, an endobag can be used for the extraction of removed pieces through the umbilical incision, which can be extended for this purpose.

FOR THE RECTUS SHEATH BLOCK

Pre-operative rectus sheath block, in combination with light general anaesthesia can be given in epigastric hernia repair [7]. In the case of midline laparotomy, post-operative anaesthetic block of the rectus sheath can also be given [8].

CONTRAINDICATIONS

- Patient refusal.
- Local anaesthetic allergy.
- Severe coagulation disorders.
- Local infection.

PERFORMANCE

THE PARA-UMBILICAL BLOCK

The para-umbilical block consists of the blockade the 10th thoracic nerve which innervates the rectus muscle, after it has pass through the rectus sheath.

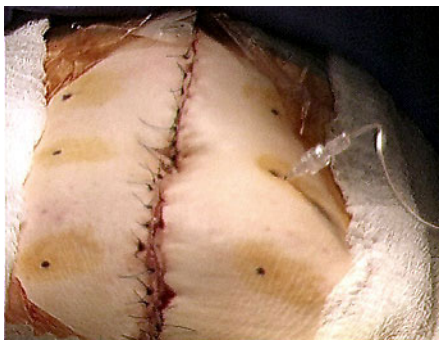
Each injection site is located at a point 3-5 cm above the umbilicus, at the lateral border of the rectus sheath .

A 24-gauge short bevel needle is inserted in a 45° angle to the skin, in umbilicus direction . So, the bevel is parallel to the different plan and allows a good resistance to identify the aponeurosis.

After passing through the skin and subcutaneous tissue, the needle meets the firm resistance of the anterior rectus sheath. The needle is pushed to penetrate this sheath with a definite snap. After the usual security tests, 10 to 15 ml of 0,5% ropivacaine mixed with 0,5 microg/kg of clonidine, are injected at each side.

THE RECTUS SHEATH BLOCK

Rectus sheath block consists of the blockade of the lower thoracic nerves. Injections are usually given to 3 or 4 sites on each side, depending on the location and size of surgical incision. Each injection site is located at a point 3-5 cm above the level of the linea alba at the lateral border of the rectus sheath. Those sites are spaced at a height of 5 cm one from the other .



A 24-gauge short bevel needle is inserted in a 45° angle to the skin, in linea alba direction .

After passing through the skin and subcutaneous tissue, the needle meets the firm resistance of the anterior rectus sheath. The needle is pushed to penetrate this sheath with a definite snap. After the usual security tests, 5 to 7 ml of 0,5% ropivacaine, mixted with clonidine, are injected at each site. Thirty to forty ml of 0,5% ropivacaine associated to 1 microg/kg of clonidine are usually necessary.

COMPLICATIONS

Potential complications are intra vascular-injection and penetration of the peritoneum. These complications are rare, as long as good material is used and security test are always performed.

THORAX & ABDOMEN

PUDENDAL BLOCK - CONTINUOUS

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First described at the beginning of the XXth century, the pudendal nerve block allows in theory analgesia and/or anaesthesia of the perineal area.

This block was usually used and performed by surgeons or obstetricians. It was gradually left essentially by lack of efficiency. Nerve stimulator enables anaesthesiologist to updated this block. Nerve stimulator use improves nerve localisation, rate success and is a good way for teaching this block.

ANATOMY

The pudendal nerve arises from S2, S3, and S4 roots. In the pelvis it runs on piriformis and then passes laterally through the greater sciatic foramen to enter the gluteal region.

Here it lies inferior to piriformis as does the sciatic nerve, the inferior gluteal neurovascular bundle and the nerve to quadratus femoris.
The pudendal nerve curls around the spine of the ischium lying superficial to the sacrospinous ligament and then passes into the lessor sciatic notch to enter the ischioanal fossa.

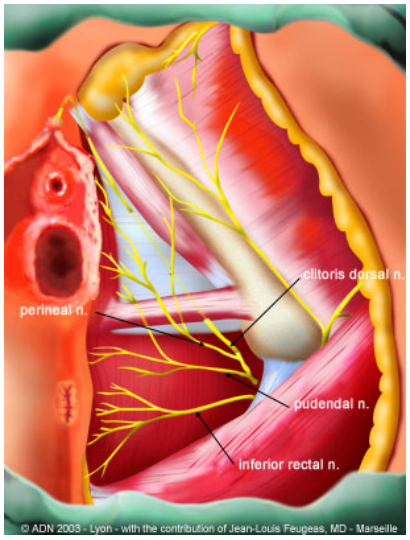
This nerve then divides into the inferior rectal, the perineal and the dorsal nerve of the penis (clitoris).

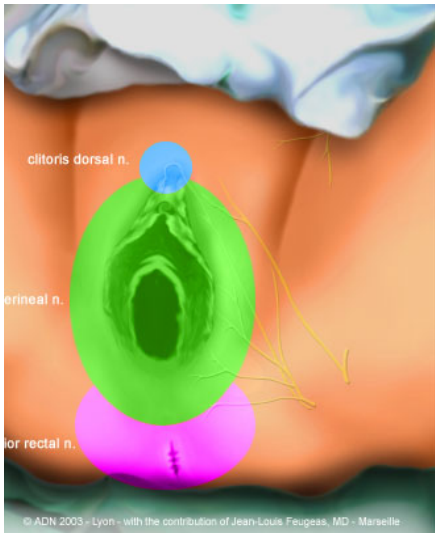
The inferior rectal nerve supplies the external anal sphincter, puborectal muscle and perianal skin.

The perineal nerve supplies ischiocavernosus, bulbospongiosus, superficial and deep transverse perinei, sphincter urethra and skin over the posterior two-thirds of the scrotum (labium majorum) and the mucous membrane of the urethra (labia minoria).

The dorsal nerve of the clitoris (penis) supplies most of the skin of the clitoris (penis) a patch of skin on the dorsum of the clitoris (penis) is innervated by the ilioinguinal nerve.

The cutaneous area innervated by the pudendal nerve is saddle-shaped or isosceles triangle-shaped.





EQUIPMENT

- Surgical skin marker
- A short bevel isolated needle (100 mm)
- A 20 ml or 30 ml syringe filled up with the chosen local anaesthetic agent

ANAESTHETICS

For the pudendal block, 10 to 15 ml for each side are sufficient.

Ropivacaine 0,5 % appears to be the local anaesthetic of choice. This concentration can provide up to a 12 hours period of post-operative analgesia [1].

Adding one microg/kg clonidine to 0.5% ropivacaine provide an 18 to 24 hours postoperative analgesia [2].

INDICATIONS

GYNAECOLOGIC SURGERY :

Bartholin duct cysts [3], vulvar biopsy, skene duct cyst, episiotomy scar refection and in general all perineo-vulvar surgery compatible with pudendal innervation area.

PROCTOLOGIC SURGERY :

haemorrhoid, anal fissure, rectal static surgery by perineal way and shincteral repair.

OBSTETRIC :

Vacuum or forceps birth and vaginal or perineal pain when epidural analgesia is contraindicated or not desired [4].

Chronic pain : perineo-vulvar chronic pain diagnostic and/or therapeutic.

CONTRAINDICATIONS

- Patient refusal.
- Local anaesthetic allergy.
- Severe coagulation disorders.
- Local infection.

PERFORMING

Puncture movie

The pudendal block is performed with the patient in lithotomy position under sedation or light general anaesthesia to limit lack of cosiness.

The approach is transperineal and the puncture point's landmark is medial to the ischial tuberosity.

After cutaneous local anaesthesia, the short bevel isolated needle (100 mm) connected to the nerve stimulator is introduced at this point. The direction is perpendicular to the skin in a horizontal and sagittal plan. Superficial perineal sheath penetration is sometime perceptible with a typical snap.

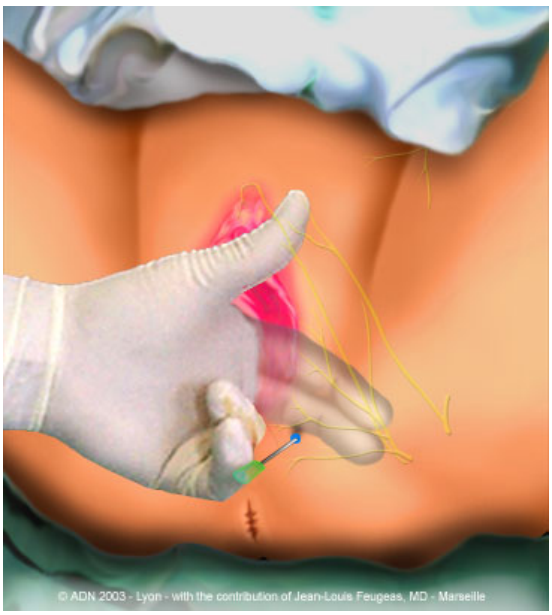
Best motor responses at the lowest intensity possible (0.5-1 mA for 0.1 ms) are: vulva constrictor muscle contraction and/or bulbocavernous muscle contraction and/or anal sphincter contraction.

The pudendal nerve is not always divided in three branches at this point so you can have three responses in the same time.

It is also possible to slightly move the needle up or down to have the best stimulation.

10 to 15 ml of ropivacaine 0,5 % with clonidine 0,5 mcg/kg could be injected to each side.

Local anaesthetics with epinephrine are not required because pudendal artery is a terminal one. Perineal analgesia is then obtain for several hours.



COMPLICATIONS

Potential complications could be local anaesthetic systemic toxicity, ischio-rectal haematoma, infection or deep abscess, foetal trauma or direct local anaesthetic injection [5, 6]. These complications are rare, as long as good material is used and security test are always performed.

PRELIMINARY STUDY

MATERIALS & METHODS

We realised an open prospective study after informed consent. Uni- or bilateral pudendal block was performed in 17 patients 18 to 24 years old for perineal gynaecologic surgery. Indications were : Bartholin duct cysts, vulvar biopsy, skene duct cyst, vulvar abscess, papillomas resection, hemivulvectomy, vulvar plasty and TVT refection. Pudendal block was performed under light general anaesthesia with sevoflurane and laryngeal mask. In lithotomy position, the short bevel isolated needle (100 mm) connected to the nerve stimulator was introduced medial to the ischial tuberosity. Best motor responses at the lowest intensity possible (0.5-1 mA for 0.1 ms) were researched: vulva constrictor muscle contraction and/or bulbocavernous muscle contraction and/or anal sphincter contraction. Ten to 15 ml of local anaesthetic was injected uni or bilaterally as required for surgery. Depth, intensity and the kind of motor responses were noted. Results are scribed as means ± SD [extreme]. NSAID-acetaminophen association was systematically used as postoperative analgesia. Pain was evaluated on VAS hourly during 6 hours.

RESULTS

Motor responses were inferior rectal nerve in 9 cases (53 %), inferior rectal nerve and perineal in 6 cases (35 %) and inferior rectal nerve, perineal nerve and dorsal nerve of the clitoris in 2 cases (12 %). Mean nerve stimulation depth was 44,5 ±9,8 mm [25-60]. Mean nerve stimulation intensity was 0,6±0,1 mA [0,52-0,7]. Pain score was equal or less than 10/100 during 6 postoperative hours. No rescue analgesic was necessary.

DISCUSSION

Nerve stimulation use optimises pudendal block realisation. Apprenticeship and practice are very easy. This block is perfectly integrated in the multimodal analgesia concept, allowing less morphine consumption and best postoperative rehabilitation.

UPPER LIMB TABLE OF CONTENTS

- Choice of a technique
- Brachial plexus anatomy
- Interscalen block
- Supraclavicular blocks
- Infraclavicular blocks
- Axillary block

UPPER LIMB CHOICE OF A REGIONAL ANAESTHESIA TECHNIQUE

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To choose between the numerous different approaches to the plexus brachial for a specific intervention needs to previously answer several questions. Patient's medical history and inherent risks of the technique must be taken into account at the same level that the anatomic extension of the block.

To minimize the risks of clinical failure, it is necessary to remember that there is no superposition between dermatomes (cutaneous innervation) myotomes (muscular sensory innervation) and sclerotomes (osseous innervation). An extension of the anesthesia wider than theorycally needed is often a guaranty for clinical success.

To establish the best choice in a determined surgery, we have to deal with only very few comparative studies. Furthermore for the same surgery, more than one technique of blocking the brachial plexus can offer an effective block. More criteria than success or block failure must to be appreciated. Possible complications or common side effects must absolutely be taken into account in the choice of the technique. The necessity of (prolonged) postoperative analgesia, of (immediate) physiotherapy (active or passive) should also be considered.

To really have a choice, every anesthetist, must to master at least 2 different techniques to block the plexus brachial.There are very numerous approaches of the plexus brachial, but there are only very few comparative studies in a precise surgical indication, or about clinical extension of anesthesia. In most of cases, we are obliged to establish our choices on the analysis of not comparative studies.

The study of Lanz [1] is one of the rare to describe systematically the extension of the various techniques of blocking the plexus brachial. It is necessary however to remind it the methodology to clarify the limits of it. The technique of location was not standardized (paresthesia or neurostimulation), in all cases 50 mL of 0,5 % bupivacaine were injected, and blocks were estimated only until the twentieth minute. However, this study remains a basis for a valid reflection.

ANATOMICAL PROBLEMS

In term of anatomy, one will differentiate approaches above or under the clavicle. If all the blocks performed above the clavicle are anatomically interscalene approaches, only the Winnie's approach targetting C6 have the privilege of this naming. Infraclavicular, axillary, mid-humeral and distal truncal blocks are sub-clavicular approaches [2].

The brachial plexus is formed from anterior rami of the fifth, sixth, seventh and eighth cervical and first thoracic nerves. It frequently received contribution of the forth cervical (prefixed plexus) and/or second thoracic nerves (post-fixed plexus). Roots anastomose among them to form three trunks then cords, where from will arise the peripheral branches (nerves).

It is very important to understand that interscalene blocks realize almost a metameric blockade, while infra-clavicular approaches only offer trunks or peripheral nerve blockade.

This difference must be considered when choosing an approach and in understanding neurostimutation. The brachial plexus adopts the shape of an egg timer, the most shrunk portion being situated behind the clavicle. Some authors show that a metallic wire cannot be passed through this shrunk part, and that local anesthetic solutions are not free to cross from one part to the other part of the brachial plexus.

Although the supraclavicular part of the brachial plexus is in theory surrounded by a continuous sheath, the diffusion of an anesthetic solution injected at this level is more cephalic than caudal, easily reaching the roots of the phrenic nerve (C2-C4). To the opposite, caudal extension to the lowest roots (C8-D1) is unpredictable.

Only cords and branches can be blocked at the infraclavicular level. Moreover, some terminal nerves leave very early the sheath of the brachial plexus, so that during an axillary approach, they are not always concerned by the distribution of the local anesthetic solution.Furthermore, the intercostobrachial nerve, assuring the sensitive innervation of the high part of the hollow axillary is a branch of the 2-nd intercostal nerve. It is never blocked during an axillary approach and rarely via a supraclavicular approach.

DIFFERENT APPROACHES

INTERSCALENE BLOCK

Theoretical extension of the Winnie's interscalene block is clarified in the study of Lanz [1], which shows that the highest roots of the plexus brachial are most constantly blocked. Usually, an interscalene block allows to perform shoulder and arm surgery. Block extension is more cephalic [4], than caudal [5], so that cephalic it allows the carotid surgery. To the opposite posterior extension is sometimes insufficient, as well as the block of the ulnar nerve, explaining in part failures at the level of the osseous surgery of the elbow.

The paresis of the phrenic nerve is constant [6]. Trying to force the solution to migrate caudally by a firm compression above the puncture site does not protect from this cephalic extension of the block towards the higher cervical roots C2-C4 [5]. The interscalene block, even performed by experimented anesthetist carries the risk of pneumothorax [7]. For these reasons, COPD is the major contraindication [8]. As an emergency setting, thoracic trauma is also a contraindication because of the risk of acute respiratory failure.

The frequency of the recurrent nerve blockade (5 -17 %), mainly in the right side, has to justify its indication in patients with high risk of inhalation or vomiting [9,10]. The high frequency of Horner's syndrome (estimated at 70 %) [11,12] is an argument to prefer another approach if possible in case of associated head trauma because of the difficulty of neurological monitoring. Because of the needle direction, epidural [13,14,15,16,17], subdural [18] or even intrathecal injections are possible [19,20]. There is at least one case report of delayed (more than one hour) total spinal blockade after a unique bolus injection. This risk do exists with all the supra-clavicular approaches [21], its frequency is estimated close to 0,6 % with the Kulenkampff approach. Consequences are related with the injected volume, and with the quality of patient monitoring and initial recussitation [21,22]. These potential complications must be taken into account before performing a supraclavicular technique in patients with unstable hemodynamic state.

SUPRACLAVICULAR BLOCKS

The different supraclavicular approaches are not equal with regard to block extension and side effects [23-29]. On this figure and this table are illustrated their theoretical extensions. Usually they provide homogeneous blocks, without gross defect. Their main risks are phrenic nerve paresis and pneumothorax, which is increased at thin patients, especially in right side, because the upper part of the right lung is reaching the supraclavicular fossa.

Recently described approaches of Dalens [25], Dupré [26] and Brown [28] allowed to reduce this risk, which is however anatomically always present. Furthermore epidural extension or vascular puncture are side effects of these approaches [21,33].

INFRA-CLAVICULAR BLOCKS

Infraclavicular routes are probably underused, despite a predictable and homogeneous extension. The incidence of pneumothorax is very low whatever the technique. Winnie's, Raj's or Sims' approaches [30,31,32], offer comparable blocks to the lower supraclavicular routes. Crossing the major pectoral muscle is perhaps the psychological limit for a widespread diffusion of these techniques. However, they are recommended for implementation of long-term catheter.

AXILLARY APPROACH

The axillary route is theoretically simple to perform, with no serious side effect, but there is a permanent debate about its efficacy and about the best technique to choose. A large literature compares the relative advantages of each technique, paresthesia vs. transarterial vs. sheath crossing vs. neurostimulation (unique(only) or multiple) vs. a catheter technique [34-45].What ever the technique, no study reports a 100 % success rate [1]. Multistimulation with selective blockade of each nerve largely improves clinical results, but some failures are still possible. The very low incidence of complications is a major argument in choosing this approach. However accidents exist and must be known to be avoided [46-47]. Access axillary is particularly used for a catheter technique [48,49,50].

MID-HUMERAL APPROACH

Dupré's block at the mid-humeral level [51] aims to track down then to block individually each nerve in the upper third of the arm. The advantages of the multistimulation technique have already been evoked by Baranowski [37] at the axillary level, but the risk of the multiple paresthesia seemed to him excessive. Clinical results are very encouraging [52] and complications (known or published) very rare. Time will give to this still young but already widely diffused technique, its real place in the armentorium of useful techniques.

DISTAL BLOCKS

There is no classical description of blocking the hand by distal blocks, as for ankle blocks. These techniques are however widely used, with very high rates of success. Moreover several selective catheters can be used for anesthesia and early postoperative physiotherapy.

CHOOSING THE BEST APPROACHES ACCORDING TO ANATOMY

Interscalene blocks are recommended for shoulder, clavicle and arm anesthesia and analgesia. Periclavicular blocks (supra or infra) are suitable for anesthesia of the arm, the elbow and the forearm (radial nerve). Axillary approaches are indicated for forearm and the hand anesthesia and the analgesia. Targetting radial and musculocutaneous nerves in this case improve success rate. However, all these theoretical guidelines are often face with reality, and we need to make our choice on different basis than simple statistical extension of each approach. Furthermore, this analysis of the extension of the anesthesia reflects only cutaneous metameric blockade. It is urge to take into account also muscular and osseous innervations, as we know that dermatomes, moytomes and sclerotomes are not strictly superimposed. This allows to easily explain some "amazing" failures.

Seven questions must be answered before blocking the upper limb:
1. Which territories are concerned by the planed surgery?
2. Must a tourniquet be used and at which level will it be positioned?
3. Can the shoulder and/or the elbow be moved ?
4. Is a catheter technique indicated?
5. Is there any contraindication to the scheduled approach?
6. Is there any interest to associate 2 (or more) techniques?
7. Is it a day-case surgery?

1. WHICH TERRITORIES ARE CONCERNED BY THE PLANNED SURGERY?

BLOCKING THE SHOULDER

A complete anesthesia of the shoulder would require an extensive block from C2 to D8, as well as the 11-th and 12-th cranial nerves [11]. In clinical practice, it is rarely needed to anaesthetize the entire shoulder. Winnie's interscalene block, is usually indicated for surgical anesthesia and analgesia of the shoulder and the upper part of the humeral bone. Numerous publications illustrate its efficiency in the surgery for total shoulder arthroplasty, acromioplasty, capsuloraphy, and clavicular surgery [24,53,54,55]. Jochum et al. reported in these patients, very high rates of efficacy, with surgical anesthesia in 95 % of cases of and 100 % of postoperative analgesia in this indication [56]. In cases of shoulder arthroscopic surgery, there is a risk of a defect of anesthesia in the posterior border of the axilla. The ambiguity of the innervation of this region (cutaneous twig of the nerve axillary, nerve intercostobrachial, connects of the nerve, or the intercostal nerve) often requires a complement to local anesthetic in the site of arthroscop insertion. Classically, interscalene approach neglects the lower roots of the brachial plexus, missing the ulnar nerve. Increasing the injected volume does not resolve this problem.

Supraclavicular approaches allowing catheter placement can be indicated for shoulder analgesia [57]. However, anesthesia extension is sometimes insufficient in providing effective anesthesia. Clinical experience shows that Dupré's [26] approach is useful for shoulder anesthesia and analgesia. The parascalene approach of Dalens [25], or its transposition to adults by Brown [28] seems little indicated in this situation.

BLOCKING THE ARM

There is no specific study regarding how to block the arm; however it is possible to suggest [1] that supra clavicular approaches are indicated for arm surgery. Dupré's, Dalens', Brown's and Moorthy's approaches are certainly indicated [25,26,27,28]. The Winnie interscalene block is not indicated because it often neglected the medial cutaneous nerve [1]. The need and the effective blockade of the intercostobrachial and the medial cutaneous of the arm of the arm must be checked before incision. In arm surgery, it is important to know the incision site, which in some cases can be distant of the traumatism site. For example, a fracture of the upper third of the humerus can require a surgical access at the level of the shoulder, while a fracture of the lower third can justify an access at the level of the elbow. An interscalene approach is indicated in the first case, while a supraclavicular one should be a better choice in the other case.

Anesthesia complements, such as a specific block of the ulnar nerve, are sometimes required. Axillary or mid-humeral approaches are not indicated in this case .

BLOCKING THE ELBOW

Elbow surgery is known to be the privilege of supravlavicular. In traumatic injuries, when the shoulder or the arm are difficult to mobilize, one must choose approaches with the lower risk of pneumothorax such as Dupré's, Dalens' or Brown's one [25,26,28]. However recent publications question this dogma [58]. In a retrospective study on 330 interventions on the elbow, Schroeder et al. reported that axillary block is effective in 89 % of cases, while the known supraclavicular or even interscalene blocks were statistically ($p = 0,0025$) less successful (respectively, 78 and 75 % of efficiency). The mid-humeral approach is reported effective in case of non-traumatic elbow surgery, on the condition of blocking the terminal branches of the nerve axillary by an infiltration in the lower edge of the deltoid muscle [11].

Besides, Urmey [60] reported on a short series of 18 patients where AXIS (association of an interscalene and an axillary block) offers 100 % success block in elbow surgery.

BLOCKING THE FOREARM, THE WRIST OR THE HAND

Five nerves median, radial, ulnar, musculocutaneous and medial cutaneous nerves of the arm, must be blocked to obtain surgical anesthesia. The most frequent failures are reported in the territories of musculocutaneous and radial nerves, frequently involved in surgical repairs of Coles' fractures. Then, it is necessary to privilege approaches or techniques insuring a high frequency of anesthesia in these territories. The interscalene approach have no indication in these anatomical regions, especially since surgery involves the territory of the ulnar nerve. Supra-clavicular approaches are is variously appreciated in these indications. Fleck et al. [61] reported the Moorthy's paravascular approach more effective than axillary approaches in hand or forearm surgery.

Infra-clavicular blocks are effective in these indications, but few studies exist to confirm this impression.Axillary approaches is a never-ending debate for the surgery of this segment of member. Several techniques are useful, and in every techniques several variants exist. For example, Cockings et al. [38] reported that the transarterial technique is nearly 100 % effective, while in the same conditions, Hickey et al. [40] reported 40 to 47 % failure in the territory of the musculocutaneous nerve and from 11 to 35 % failure in the territory of the radial nerve. Stan et al. [47] in a study on 1000 patients find 11,2 % of failure by this transarterial technique. Servin et al. [62] reported that via the axillary approach, single shot without neurostimulation, the rate of failure is significantly higher (defined as the need for general anesthetic 30 minutes after the realization of the block) in the Coles' fractures (35 %) than in the other traumatic injuries of the upper limb (10,6 %, $p < 0,001$). However, the study of Choquet et al. (blocking specifically all the nerves) [63] in the same context indicate a very low incidence of failure and suggest that reflex sympathetic dystrophic syndromes are less frequent after regional anesthesia. Lavoie et al. [42] in a limited study, show that blocking specifically the nerve the most concerned by the intervention, as well as the musculocutaneous nerve is more effective than blocking only one single nerve. This study does not show that blocking all the major nerves improve clinical results. On the opposite, Bouaziz et al. reported that blocking all the nerves via the mid-humeral approach [51] give better results that those reported by Lavoie et al. [52].

2. IS A TOURNIQUET NEEDED AND AT WHICH LEVEL WILL IT BE POSITIONED?

The tourniquet must always be positioned below the superior level of the block. If a mid-humeral block is chosen, it will be necessary to place the tourniquet just above the elbow. If this is impossible, then it will be necessary " to go back up", to a higher level. When the tourniquet is used for more than 20 minutes, one will appreciate the effective anesthesia in the medial territory of the arm.

3. ARE THE SHOULDER OR THE ELBOW IT IS MOBILIZABLE?

Axillary and mid-humeral routes require shoulder (and sometimes elbow) mobilisation. If this is not possible it will be necessary to give up these lower approaches and to go back up at least to infra-clavicular level. Clinical experience shows that the AXIS (AXillary-InterScalene) technique [60] allows partially to overpass these limits. Performing first an interscalene block often offers sufficient analgesia for a careful and gentle mobilization of a traumatized upper limb for the axillary route. This double injection technique improves the success rate of plexic blocks in elbow surgery.

4. IS A CATHETER INDICATED?

Long-duration surgery [64,65], postoperative analgesia [66,67], early physiotherapy [68] and the management of vascular pathologies [69] are indications for catheterization of the brachial plexus. If all approaches can be used, however, via the interscalene route, the catheter is sometime difficult to place and to keep. Supraclavicular approaches (Kulenkampff, Winnie and Brown) are not good choices for catheter insertion. Usually, a catheter is easily inserted via approaches described by of Dupré, Pham-Dang et al. [70], or using infra clavicular [71] or axillary routes. It have been reported that interscalene block lead to constant diaphragmatic paresis; however using a catheter for long duration analgesia is possible as this effect is very discreet during continuous infusion [72]

5. IS THERE ANY CONTRAINDICATION FOR THE SCHEDULED APPROACH?

Complications are possible with all approaches of the brachial plexus. Their frequencies or their gravity are sometimes a major contraindication in certain situations. These contraindications are mainly addressed against the supraclavicular routes. The constancy of the diaphragmatic paresis limits the indications in case of COPD. Acute respiratory failure, whatever the cause, obvious or potential (chest trauma, peumothorax, pleural effusion), is a contraindication to the interscalene approach. Head trauma can be a contraindication because of a possible Horner's syndrome, making clinical monitoring difficult. A full stomach, mainly during a right interscalene block is another contra-indication because of the extension of the block to the recurrent nerve [11]. The high incidence vaso-vagal attack of the Bezold-Jarish's syndrome [73] , must always be kept in mind during shoulder surgery. Hypovolemic patients or patients either treated by ß blockers or CEIs need particular attention for this.

The blood coagulation abnormalities only authorize the axillary approach (and mid-humeral perhaps), because of the ease of compression. However, even by this way, extensive nasty bruises are reported.

6. IS THERE ANY INTEREST TO ASSOCIATE TWO (OR MORE) TECHNIQUES?

Only the study of Urmey et al. [60] shows any interest of the AXIS technique in elbow surgery. Clinical experience shows that proximal blocks realized with short-duration mixtures for surgery, combined with more distal selective blocks (elbow or wrist) with long-acting anesthetic mixtures for postoperative analgesia are of great interest in clinical practice.

7. IS IT A DAY-CASE PROGRAM?

In this setting several points must be considered. The incidence of complications, sometimes of late revelation, such as pneumothorax, but also recurrent nerve blockade pleads against interscalene blocks. Axillary or mid-humeral approaches, when possible are the best choice.

Although some side effects are reported, in ambulatory surgery 93 % of the patients, according to Cooper et al. would choose again the same technique of anesthesia [74]. The mid-humeral approach, challenging today the classical axillary approach can be performed as a two separate blocks: anesthesia for all territories and postoperative analgesia on selected ones. So, it is possible in hand palmar surgery to block the radial and musculocutaneous nerves only with the lidocaine for short duration blockade, and to block median and ulnar nerves with the ropivacaine for postoperative analgesia. Also, when they are possible, more distal troncular blocks with long-lasting mixtures offer perfect postoperative analgesia. Only the study of Bouaziz et al. [75], at mid-humeral level is today available.

To choose the best approach to block the brachial plexus necessitate to answer several questions; this is sometimes difficult. Considering first the different levels of sensitive innervation, dermatomes, myotomes and sclerotomes is very important to minimize the rate of failure. Keeping in mind all the possible side effects of each approach is also an argument of the choice. At least, at the same level than a specific approach, the total account of anesthetics (in milligrams), the quality of the injected solution, et the overall cares to the patient are factors determining the success or the failure of a regional anesthesia. Tetzlaff [75] have reported that the majority of patients who refuse regional anesthesia, have a personal or relative history of regional anesthesia failure.

ANATOMY BRACHIAL PLEXUS

Elisabeth Gaertner , MD
Strasbourg - France

BRACHIAL PLEXUS

The brachial plexus consists of anterior rami of the cervical nerves from C5 to T1.

These anterior rami pass through their respective intervetebral foramina and converge laterally and caudally to form the trunks of the brachial plexus.

C5 and C6 unite to become the superior trunk, C7 forms the middle trunk and C8 and T1 converge to form the inferior trunk.

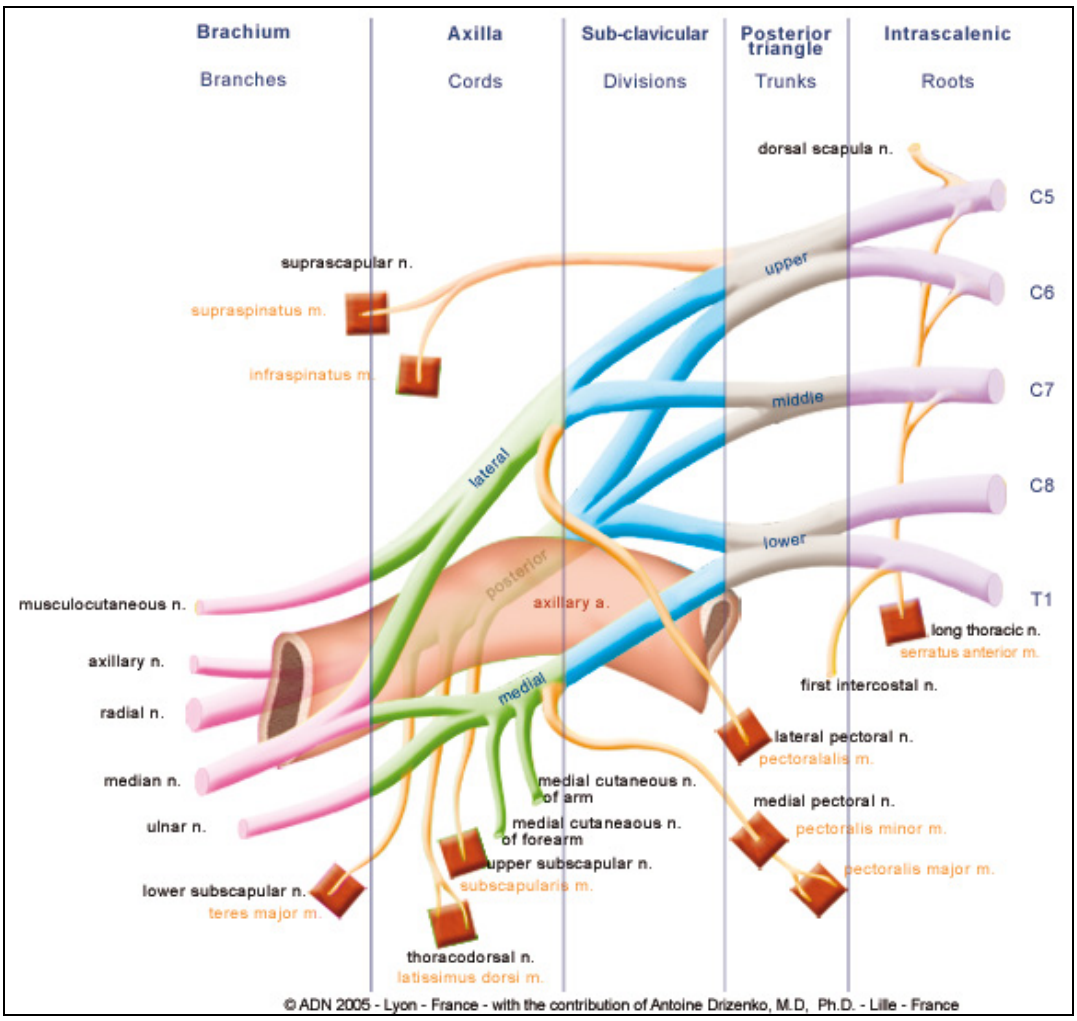
The brachial plexus runs between middle and anterior scalene muscles.

- The phrenic nerve passes between these muscles and then runs ventrally to the anterior scalene muscle, in its fascia, to direct ventrally and medially. A diaphragmatic twitch during interscalene block performed with a nerve stimulator indicates placement of the needle anterior to the plexus.
- The laryngeal recurrent nerve, more medial, is also close to the plexus, mainly on the right side. It can be blocked by diffusion of local anaesthetic.
- Medially to the anterior scalene muscle runs the cervical sympathetic chain. Medially and dorsally lies the vertebral artery and central nervous structures, exposing to a risk of injection into vertebral artery or epidural or intrathecal anaesthesia
- Caudally, the plexus overhangs the pleura and the subclavian vessel.

COLLATERALS OF THE BRACHIAL PLEXUS

- The dorsal scapular nerve arises from the C5 root and passes through the middle scalene muscle to supply the rhomboideus and levator scapulae muscles
- The long thoracic nerve supplying the serratus anterior arises from the C5,6, and 7 roots and also pierces the middle scalene as it passes posterior to the plexus
- The suprascapular nerve participates to the shoulder sensory innervation and provides innervation of the infra and supraspinatus muscles

The spinal accessory nerve (XI) runs posterior to the brachial plexus over the middle and posterior scalene muscles. With a nerve stimulator, a contraction of the trapezius indicates placement of the needle posterior to the plexus.


Brachium
Branches
Axilla
Cords
Sub-clavicular
Divisions
Posterior triangle
Trunks
Intrascalenic
Roots
dorsal scapula n.
C5
suprascapular n.
supraspinatus m.
upper
C6
infraspinatus m.
middle
C7
lateral
C8
lower
posterior
T1
musculocutaneous n.
axillary a.
long thoracic n.
serratus anterior m.
axillary n.
first intercostal n.
medial
radial n.
lateral pectoral n.
pectoralalis m.
median n.
medial cutaneous n. of arm
medial pectoral n.
ulnar n.
medial cutaneaous n. of forearm
pectoralis minor m.
upper subscapular n.
pectoralis major m.
subscapularis m.
lower subscapular n.
teres major m.
thoracodorsal n.
latissimus dorsi m.
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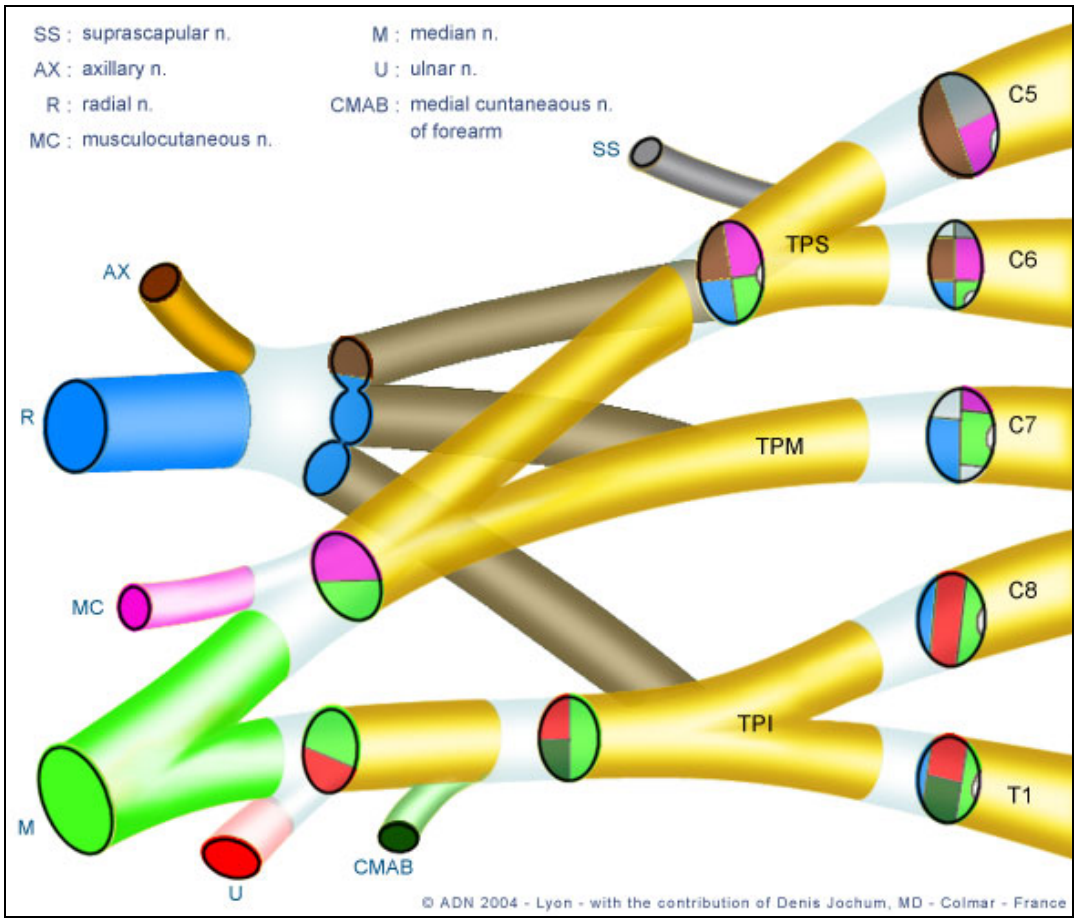
SS : suprascapular n.
AX : axillary n.
R : radial n.
MC : musculocutaneous n.
M : median n.
U : ulnar n.
CMAB : medial cuntaneaous n. of forearm
SS
C5
TPS
C6
AX
R
TPM
C7
MC
C8
TPI
M
T1
CMAB
U
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UPPER LIMB INTERSCALEN BLOCK - SINGLE SHOT

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Interscalene nerve block provides per and postoperative analgesia, prolonged or not by a catheter.

Discribed in 1971 by Winnie [1], this technique has been modified by the use of a nerve stimulator and insulated needles.

ANATOMY

The brachial plexus consists of anterior rami of the cervical nerves from C5 to T1. These anterior rami pass through their respective intervetebral foramina and converge laterally and caudally to form the trunks of the brachial plexus. C5 and C6 unite to become the superior trunk, C 7 forms the middle trunk and C8 and T1 converge to form the inferior trunk. To perform an interscalene block, the puncture is performed in the interscalene groove, between anterior and middle scalene muscles (scalenus anterior and medius). This block concerns the trunks of the plexus [2]

The brachial plexus runs between middle and anterior scalene muscles.

- The phrenic nerve passes between these muscles and then runs ventrally to the anterior scalene muscle, in its fascia, to direct ventrally and medially. A diaphragmatic twitch during interscalene block performed with a nerve stimulator indicates placement of the needle anterior to the plexus.
- The laryngeal recurrent nerve, more medial, is also close to the plexus, mainly on the right side. It can be blocked by diffusion of local anaesthetic.
- Medially to the anterior scalene muscle runs the cervical sympathetic chain. Medially and dorsally lies the vertebral artery and central nervous structures, exposing to a risk of injection into vertebral artery or epidural or intrathecal anaesthesia
- Caudally, the plexus overhangs the pleura and the subclavian vessels

Collaterals of the brachial plexus

- the dorsal scapular nerve arises from the C5 root and passes through the middle scalene muscle to supply the rhomboideus and levator scapulae muscles
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- the suprascapular nerve participates to the shoulder sensory innervation and provides innervation of the infra and supraspinatus muscles

The spinal accessory nerve (XI) runs posterior to the brachial plexus over the middle and posterior scalene muscles. With a nerve stimulator, a contraction of the trapezius indicates placement of the needle posterior to the plexus.

EQUIPMENT

SINGLE SHOT BLOCK

- A nerve stimulator is essential
- 25 mm insulated needle
- gauze and disinfectant solution
- sterile gloves
- syringues with anesthetic local solution

BLOCK WITH A CATHETER

- catheter set
- antibacterian filter

ANAESTHETICS

LOCAL ANAESTHETICS (LA)

The choice of LA depends on necessity to obtain a good motor blockade, desired duration of the block and particularities of the patient (bupivacaine and AV conduction abnormalities , ambulatory surgery…).

Local anaesthetic volumes : 0.5mL.kg-1 (40 ml max.) provides a good peroperative anaesthesia. A smaller volume is insufficient [3].

Choice of local anaesthetics : Lidocaine or mepivacaine are used for short duration operations, bupivacaïne ropivacaïne or levobupivacaine for the long duration surgery or when a prolonged postoperative analgesia is necessary.

OUR PROTOCOLS

Short duration surgery : lidocaïne 1.5% with epinephrine 1/400000 or mepivacaine 1.5%

Long duration surgery or necessity of postoperative analgesia: ropivacaïne 0.75%

For the catheters, three types of local anaesthetics administration are proposed :

- Bolus of bupivacaine 0.25% or ropivacaine 0.2% 20 ml/8h
- Continuous injection of ropivacaine 0.2 % 7 to 10 ml/h
- PCIA of ropivacaïne 0.2% 5 ml/h;, bolus 5 ml, lock-out time 45 minutes

ADDITIVES

Clonidine (0.5 to 1µg/kg) prolongs block duration (3-4 hours).

The benefit of opioids addition is discussed : prolongs duration of the block but non negligible side effects (nausea, vomiting, pruritus…), onset time reduced [4].

Alcalinization of the solution allows to reduce onset time of the block [5].

Epinephrine prolongs duration of the block by reducing the diffusion of the local anaesthetics. It prolongs duration but not as much as clonidine [6].

INDICATIONS

Interscalene nerve block allows anaesthesia and postoperative analgesia of shoulder surgery [7] and clavicle surgery. Local anaesthetics and catheter insertion depend on surgery indications. This technique is well accepted and tolerated by the patient [8-9]. Arthroscopic shoulder surgery is easy to perform with an interscalene block only even in ambulatory practice.[10]. Patient's comfort and installation are important to ensure.

Interscalene block can be realised alone or combined with sedation or general anaesthesia, depending on patient wishes.

Indications of interscalene catheter [11] :

- Rotator cuff repair
- Recidivant luxations
- Total shoulder arthroplasty
- Acromioplasties
- Artyhrolyses
- Carcinologic surgery of the shoulder
- Physiotherapy of the shoulder

Ropivacaine (less toxic than bupivacaïne) is used for continuous, discontinuous or PCIA administration, avoiding side effects of opioids. If bolus are used alone, clonidine is added, (0.5 to 1µg.kg.-1) to prolong injections intervals. PCIA allows to reduce local anaesthetic consumption compared with continuous administration, improves analgesia with a high patient's satisfaction and accelerates postoperative rehabilitation [12-13-14].

CONTRAINDICATIONS

As interscalene block leads to phrenic paresis, some contraindications are highlighted:

- Contra lateral phrenic palsy
- Contra lateral pneumothorax
- Contra lateral pneumectomy
- Any patient in incapacity to endure a decrease of 25 % of his vital capacity (VC) is contraindicated to the interscalene block. A vital capacity < 1 l is an absolute contraindication [15].

Sensory defects in the block territory is a contraindication. A complete neurological exam is performed and noted in the patient's observation before performance the block. (i.e. a radial palsy due to an humeral fracture is not a contraindication). If a doubt persists, electromyogram should be performed before interscalene block.

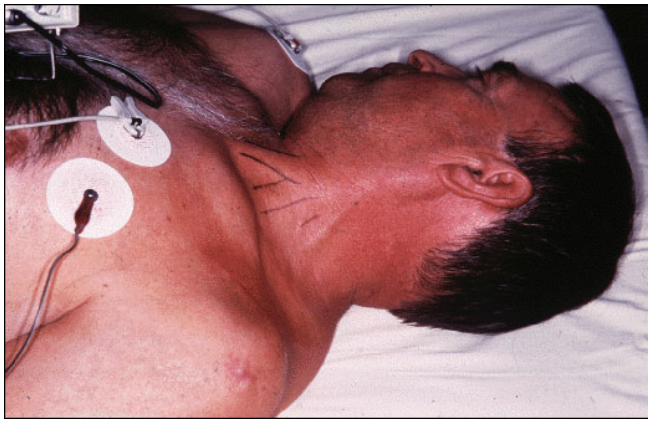
Bilateral surgery of the shoulder cannot be performed under interscalene block, due to the large necessary volume of local anaesthetics and to the bilateral phrenic palsy.

The other contraindications are not specific of the interscalene block : coagulopathy, infection at site of injection, personality disorder not consistent with awake sedation.

PERFORMING

POSITION

The patient lies supine, head slightly [16] turned away from the side to be blocked (no more than 20°). The arm is along the body, slightly flexed. The patient is awake, so he can warn in case of pain during injection.



ANATOMICAL LANDMARKS

Clavicular or posterior head of the sternocleidomastoid muscle, easily palpated if the patient lifts the head against a resistance

Behind this muscle the physician can palp the interscalene groove between anterior and middle interscalene muscles. The interscalene groove is better appreciated by asking the patient to sniff.

PUNCTURE POINT

The puncture point lies at the junction of the interscalene groove and a line drawn horizontally passing through the cricoid cartilage. This line defines C6. The anterior tubercule of C 6 can be palpated but this technique is both useless and painful. [17] Sometimes the lateral head of the sternocleidomastoid muscle is difficult to palpate. Brown et al advise to perform the puncture 3 cm behind the more prominent part of the sternocleidomastoid muscle [18].

PUNCTURE

After drawing landmarks, skin is disinfected and the puncture is performed with a 25 mm insulated needle, connected to a nerve stimulator.

The needle is inserted to the skin, then the nerve stimulator is twitched to 2 mA. The needle is inserted into the interscalene groove at the level of the cricoid cartilage and advanced into the groove with a caudal (30°), medial and slightly posterior direction (direction of the contra lateral elbow). The motor responses are looked for. They are of C6 type. Failure to obtain motor response to nerve stimulation should prompt withdrawal of the needle and reinsertion in 5% to 10% angle anterior or posterior to the initial plane.

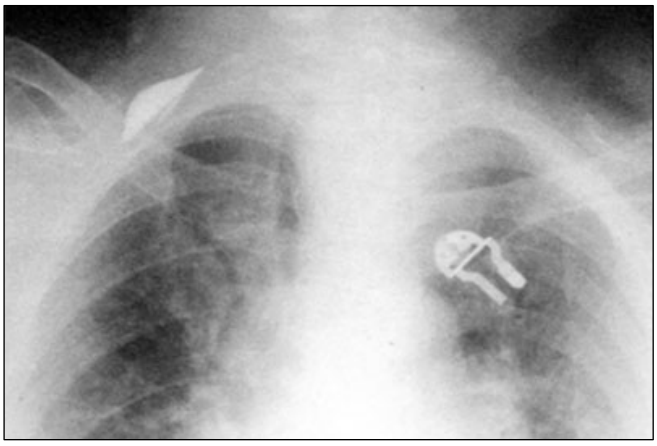
- A deltoïd muscle contraction corresponds to the stimulation of fibers destinated to the axillary nerve.
- An anterior muscles of the arm contraction corresponds to the stimulation of fibers destinated tothe musculocutaneous nerve.
- A triceps muscle contraction corresponds to the stimulation of fibers intending the radial nerve.

INJECTION

The twitches of shoulder, arm or forearm are typically elicited at a depth of 1 to 2 cm. When twitches are obtained at a current of 0.3 to 0.5 mA, local anaesthetic solution is injected in 3 to 5 ml boluses, pausing to aspirate between each bolus. The motor response has to disappear after the first ml injection. Compression by the fingers of the operator is not judged useful anymore [19]. Successful block is indicated by a rapid installed incapacity for the patient to abduct and lift the arm. The change in sensory and temperature perception over the shoulder area and an immediate loss of proprioception is also a good sign. Sensation of pins and needles in the two first fingers is also rapid. (money sign). Surgery can generally begin 20 to 30 mn after the block performance.

INSERTION OF A CATHETER

Stimulation and motor responses are the same as in the single shot block.



The puncture point is the same as for single shot puncture, but needle direction becomes more tangential to the interscalene groove (directed to the middle of the clavicle for easier catheter insertion.[20] The anaesthetic solution is injected through the catheter and then the catheter is inserted (5 to 7 cm). The catheter is fixed with steristrips and connected to an antibacterial filter.

Before using the catheter an RX control is performed injecting 3 - 5 ml of contrast product to verify its position (not intravascular, epidural…). The image to obtain is a spindle, laterally, and caudally oriented, crossing the clavicle.

The block has to be evaluated by the anaesthesiologist 10 mn after the puncture (sensory and motor blocks).

It is used alone or combined with sedation or general anaesthesia [21].

COMPLICATIONS

The most common complications of the interscalene block occur when adjacent non-brachial plexus nerves are blocked. The true complications of interscalene block are intravascular injection cervical or total central block and nerve injury.

RESPIRATORY COMPLICATIONS : THEY ARE THE MOST COMMON

- Ipsilateral hemidiaphragm paresis is more a side effect than a real complication. It appears in 100% of interscalene blocks, leading to a 30 % reduction in vital capacity. As long as the patient is seated and warned of the physical effects to avoid his frightening, this is not a true complication.
- Recurrent laryngeal nerve block, responsible for hoarseness and swallowing disorders (5-25% of cases. It is important though, after an interscalene block, to encourage the patient to drink in order to detect swallowing disorders.
- Pneumothorax can occur, rarely if short needles are used (<30mm).

LOCAL ANAESTHETIC TOXICITY, DEPENDING ON THE DOSE OF LOCAL ANAESTHETICS

Injection of local anaesthetics in the Vertebral artery or even in the small cervical vessels can lead to neuro and cardio toxicity during the first mL injection.

NEUROLOGICAL COMPLICATION

- Horner's syndrome is often associated (18-20% of cases), due to the proximity of the sympathetic cervical chain. In a cranial trauma patient, this syndrome that occurs after interscalene block may be a problem of differential diagnosis.
- Pourfour-Dupetit's syndrome (exophtalmia, mydriasis and impossibility to close the ipsilateral eye) is rare., due to a irritation of the cervical sympathetic chain.
- Epidural injection is suspected if sensory defect of the contra lateral upper limb occurs. To avoid this complication, the needle for an interscalenic block has to be correctly oriented: never perpendicular to the vertebral column, but medially, caudally and slightly dorsally
- Rachianaesthesia is possible but avoided by the same precautions described.

Neuropathy is the consequence of an intraneural injection or a direct trauma of the nerve by the needle. The nerve damage can be due to a surgical trauma (stretching of the brachial plexus during shoulder arthroscopy or shoulder arthroplasty.

HAEMODYNAMIC COMPLICATIONS

We can note a high incidence of vasovagal episodes associated with the use of interscalene block for shoulder surgery in the sitting position. The episode consists of sudden hypotension and/or bradycardia, frequently associated with symptoms of light-headedness or nausea and sometimes (rarely) asystolic cardiac arrest requiring resuscitation. These symptoms are due to an activation of the Bezold-Jarisch reflex. It has to be known by the anaesthesiologists so that progression from prodromal symptoms to cardiovascular collapse may be avoided. [22]

HAEMATOMA AND INFECTION

They are rare but can prolong hospitalisation.

TIPS

SOME MUSCULAR RESPONSE INDICATE AN INCORRECT POSITION OF THE NEEDLE

- Diaphragm contraction (hiccups) due to a phrenic nerve stimulation: The needle is too anterior
- Infra and supraspinatus muscle contraction (posterior part of the shoulder) due to a suprascapular nerve contraction. The needle is too posterior
- Trapezius contraction (scapula elevation), due to a stimulation of a spinal nerve stimulation. The needle is too posterior.

TO IMPROVE THE SUCCESS RATE OF THE INTERSCALENE BLOCK

Jochum et al demonstrated that the optimal range of stimulating intensity has to be between 0.3 and 0.5 mA.

NERVE STIMULATION BRINGS DIFFERENT ADVANTAGES

Allows an objective analysis of the distance between needle and nerve and thus permits to avoid the difficulty to obtain by the patient the localisation of paresthesia and avoids pain and trauma sequels due to a paresthesia technique.

Fanelli and al described a multistimulation technique, with at least 2 stimulations to perform an interscalene block, enabling to reduce the LA dose [23].

COMPLEMENTAL BLOCKS

After testing the block, one may have to complete the interscalene block, depending on the surgical needs:

- If surgery extends medially to the deltopectoral groove, it is necessary to complete anaesthesia by a supercifial cervical plexus block which is performed by a subcutaneous injection of lidocaine or mepivacaine (6 to 10 mL without epinephrine), behind the posterior head of the sternocleidomastoid muscle.

In case of failure of complete block in the axillary territory, this nerve can be stimulated 4 cm below the lateral border of the acromion and blocked with 5 mL LA.

Subcutaneous LA infiltrations in the deltopectoral groove and on the posterior side of the shoulder could be necessary to block the borders of the cutaneous territories depending on the first thoracic roots.

To provide a perfectly complete anaesthesia of the shoulder , it may be necessary to extend the block on the thoracic territories (T1-T4) by performance a paravertebral block at these levels. Anyway if necessary, our team preferes to combine interscalene block with general anaesthesia (risk of pneumothorax of the paravertebral blocks.

CONCLUSION

Interscalene block is a safe technique under the condition that one knows the risks and respects the performance precautions:

- Correct needle direction
- Minimal stimulation < 0.5 mA
- Slow injection
- Repeated aspiration test during injection
- Muscular response disappearing after the first injected mL
- Stop injection in case of pain
- Catheter RX control before use

UPPER LIMB

SUPRACLAVICULAR BLOCKS
SINGLE SHOT & CONTINUOUS

Andrea Casati, MD
Parma – Italy

ANATOMY

The roots that form the brachial plexus emerge from cervical vertebra in a frontal plane. Roots from C5 to T1 join in the interscalene groove between anterior and middle scalene muscles to form 3 trunks (superior, middle and inferior) which run caudally and laterally to pass between the clavicle and the first rib in an anteroposterior plane.

Dupré [1] and Dalens [2] techniques reach the brachial plexus far away from the pleura, the great vessels of the neck and the vertebra.

Brown's technique called 'plumb bob' reaches the plexus on the upper border of the clavicle at the lateral border of the sternocleidomastoid muscle. Needle insertion is strictly in an anteroposterior plan to avoid the top of the lung and the subclavian artery.

The intersternocleidomastoid technique [4] goal is also to lower the risk of pneumothorax and it uses simple landmarks. Due to the increased risk of pneumothorax and subclavian artery puncture, Kulenkampff [5] and Winnie-Collins [6] classical techniques are seldom used today. More recent published techniques major objective was to lower those risks.

NERVE BLOCK DISTRIBUTION

It is at the supraclavicular level that there is the greatest chance to block the brachial plexus with only one injection.

Nerve's blocks territories are those supplied by the following nerves:

- axillary (inconsistent block)
- musculocutaneous
- median
- radial
- ulnar

The success of this block depends mostly on which trunk is stimulated (superior, middle or inferior). Stimulation of the middle trunk is associated with a more consistent complete block of the three trunks. An injection at the superior trunk level sometimes spares the inferior trunk, leaving C8-T1 territories unblocked (ulnar and medial cutaneous nerves of the arm and forearm) [7, 8]

DIFFUSION OF THE LOCAL ANAESTHETIC SOLUTION

The anesthetic solution usually reaches middle and lower interscalene space.

INDICATIONS

SINGLE BLOCK

A single injection may be used for proximal upper arm surgery from the superior third of humerus to the elbow.

However, for elbow surgery, infracoracoid techniques of infraclavicular blocks might be more suitable, because these blocks are extrathoracic.

For shoulder surgery, interscalene block is more suitable.

For surgery distal to the elbow, axillary or humeral block are less invasive.

CONTINUOUS BLOCK

Continuous block via indwelling catheter is used for postoperative analgesia of elbow surgery and allows early mobilization (e.g. arthrolysis).

WITH SUPPLEMENTARY BLOCKS

Ulnar, medial cutaneous nerves of arm and forearm (C8-T1) blocks might be necessary if the surgery is outside the territories of supraclavicular nerves block.

CONTRAINDICATIONS

LOCAL

History of ipsilateral:
- carotid surgery,
- lymph node surgery,
- radiotherapy.

GENERAL

As a phrenic block occurs in 28 to 80 % of cases and as a pneumothorax is a rare but a known complication, patients with respiratory disease are not good candidates for supraclavicular blocks, even with expert physicians.

Other contraindications are:
- controlateral phrenic nerve palsy,
- coagulation defect,
- ambulatory surgery.

SETTING

POSITIONING OF THE PATIENT

The patient lies supine , the arm along his body, the head slightly rotated on the opposite side.

POSITIONING OF THE PHYSICIAN

The physician is placed at the head of the patient, on the side to be blocked.

SUPRACLAVICULAR BLOCK OF DUPRÉ & DANEL

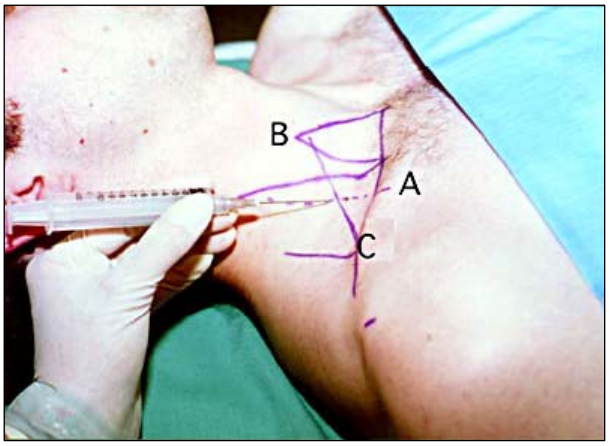
This technique relies only on skin landmarks; the needle reaches the plexus on a tangential plane which facilitates catheter insertion for continuous block.

EQUIPMENT

- Single injection: a 25 mm insulated short beveled or pencil pointed needle.
- Continuous block: a 30 to 50 mm catheter kit.

LANDMARKS [9]

- external jugular vein;
- medial aspect of trapezius insertion on the clavicle (move finger on superior border of the clavicle from it medial to lateral aspect to find it);
- top of Sedillot's triangle which is limited by the clavicle and the two heads of the sternocleidomastoid muscle.



LOCATION

To facilitate the location of the sternocleidomastoid muscle, the patient is asked to slightly lift his head from the table.

PUNCTURE SITE

Two lines are drawn on the patient: the first one is from the top of Sedillot's triangle to the medial insertion of the trapezius muscle on the clavicle and the second one is delineated over the external jugular vein. The puncture site is at the intersection of those two lines.

PUNCTURE

The needle is introduced at the intersection of the two latter lines, sparing the external jugular vein. It is caudad and laterally directed, followin g an axis which follows the ear lobe. As the superficial fascia is pierced, nerve stimulation is set at 1.5 mA with a 0.1 msec duration.

The usual response is a triceps contraction or a contraction of posterior muscles of the forearm. Biceps contraction is also a good response, corresponding to a lateral positioning of the needle. If the motor response is a contraction of the flexor carpi ulnaris, the needle is too medial and should be moved more laterally; there is a risk of pneumothorax when the needle is on the medial cord.

DEPTH

Maximum 1 to 2.5 cm.

SINGLE INJECTION

When the nerve is stimulated at lowest current and after a negative aspiration test, 25 to 30 ml of the local anesthetic solution is injected.

CONTINUOUS BLOCK

The catheter should not be advanced more than 2 cm.

Injection could be realized through the catheter after a negative aspiration test; 25 to 30 ml of the local anesthetic solution are injected.

ALTERNATIVE TECHNIQUES

PARASCALENE TECHNIQUE OF DALENS

The goal of this technique is to reach the brachial plexus in the perivenous sheath at the level of the omohyoid muscle, in an anteroposterior plane. It was first described for pediatric use, but it is suitable to adults.

EQUIPMENT

Single injection: 50 mm insulated short beveled or pencil pointed needle.

POSITIONING OF THE PATIENT

A pillow is placed under patient’s shoulders in order to extend the cervical spine and to facilitate the puncture; as the head is pulled back, brachial plexus is more superficial.

LANDMARKS

- middle of the clavicle;
- transverse process of C6 (Chassaignac’s tubercle); identify the cricoid cartilage and move the fingers laterally until the tubercle is palpated in the interscalene groove, near the apex of the sternocleidomastoid muscle. A line is delineated from the middle of clavicle to the C6 tubercle.

PUNCTURE SITE

It is located at the junction of the upper 2/3 and the lower 1/3 of this line.

PUNCTURE

The puncture is anteroposterior, perpendicular to the horizontal plane.

SINGLE INJECTION

After nerve location and negative aspiration test, inject 30 ml of the local anesthetic solution. Continuous block is not suggested with this approach because the needle direction is perpendicular to the brachial plexus.

DEPTH

It is between 7 and 30 mm.

BROWN'S SUPRACLAVICULAR BLOCK TECHNIQUE

In order to lower the risk of pneumothorax associated with the classical Kulenkampff technique, Brown proposed an anteroposterior needle insertion.

EQUIPMENT

Single injection: insulated 50 mm needle, short or pencil point bevel.

LANDMARKS.

- the clavicle
- the sternocleidomastoid muscle

LOCATION

The lateral border of the sternocleidomastoid muscle is easier to locate at its insertion site on the clavicle, especially if the patient lift his head from the table.

WARNING

If the patient is tall and thin, the risk of pneumothorax is higher.

PUNCTURE SITE

The puncture site is 1 cm above the clavicle, on the lateral border of the sternocleidomastoid muscle.

PUNCTURE

The needle is introduced in the parasagittal plane, perpendicular to the table, in an anteroposterior direction (8.8 and 8.9).

First, the needle should not penetrate deeper than 3 to 4.5 cm. If the brachial plexus is not encountered at this depth, the needle is reintroduced in a more cephalad angulation and if there is no success with the cephalad angulation, it could be with precaution reintroduced caudad.

As for the other approaches, the desired motor responses are those of radial and musculocutaneous nerves stimulation. Ulnar nerve stimulation means that the needle direction is too medial and the needle should be more laterally reoriented.

SINGLE INJECTION

After location of the nerves and a negative aspiration test, inject 30 ml of the local anesthetic solution. As with the previous technique, the needle is perpendicular and does not allow catheter insertion for continuous plexus block.

INTERSTERNOCLEIDOMASTOID TECHNIQUE

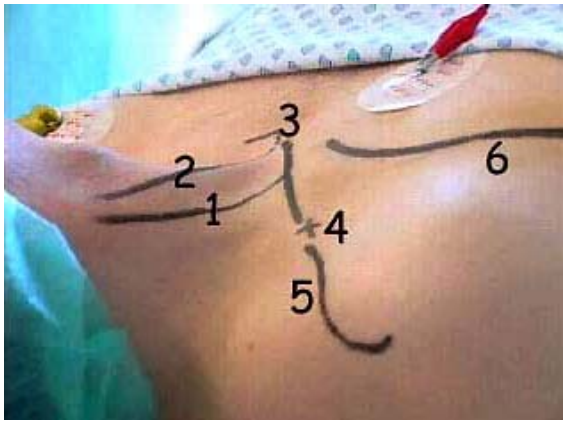
This technique uses easy landmarks: the clavicle and the two heads of the sternocleidomastoid muscle.

EQUIPMENT

- Single injection: insulated 50 mm short beveled or pencil pointed needle;
- Continuous block: a 50 mm catheter kit.

LANDMARKS

- The middle of the clavicle;
- sternal and clavicular heads of the sternocleidomastoid muscle which forms the Sedillot's triangle with the clavicle.



1. Chef claviculaire du M. sternocléidomastoïdien
2. Chef sternal du M. sternocléidomastoïdien
3. Fourchette sternale
4. Middle of clavicle
5. Clavicle
6. Rebord externe du grill costal

LOCATION

The patient is asked to lift his head from the table and to rotate it on the opposite side of the block: this move helps to the palpation of the muscle.

PUNCTURE SITE

It is located in the Sedillot's triangle, 3 cm above the sternal notch on the lateral border of the sternal head of the sternocleidomastoid muscle.

PUNCTURE

The needle is introduced at a 45° angle to the table in a lateral and caudad direction, towards a point approximately situated 1 cm above the middle of the clavicle. The brachial plexus is usually located at a depth of 5 to 7 cm. If the plexus is not encountered at this depth, the needle is reintroduced slightly more medial towards the middle of the clavicle; The middle of the clavicle should not be exceeded.

Muscle movements in the radial and musculocutaneous nerves territories are the good motor responses most often observed. Contraction of the flexor carpi ulnaris means that the needle is too medial and the needle should be moved laterally. At the beginning of the needle insertion, phrenic nerve stimulation is usual. Diaphragmatic movements should stop at 1 mA and it allows a deeper progression of the needle. If not, needle should be reintroduced more laterally in order to spare the phrenic nerve.

SINGLE INJECTION

After adequate nerve stimulation and a negative aspiration test, inject 30 ml of the local anesthetic solution.

CONTINUOUS BLOCK

Catheter insertion is easier with this technique because the needle insertion is parallel to the plexus.

NERVE STIMULATIONS DURING SUPRACLAVICULAR BLOCKS

WANTED RESPONSES

- biceps contraction (related to the musculocutaneous nerve stimulation) : lateral cord;
- triceps contraction (related to the radial nerve stimulation) : posterior cord.

Those two types of stimulation are better than an axillary muscle nerve response which means a stimulation of the superior trunk often observed in the interscalene block.

UNWANTED RESPONSES

- deltoid muscle contraction (related to axillary nerve stimulation): superior trunk;
- diaphragmatic contraction which is related to phrenic nerve stimulation and indicates a medial positioning of the needle;
- ulnar nerve stimulation also indicates a medial positioning of the needle which should be reinserted laterally;
- infra and supraspinatus muscle stimulation is related to suprascapular nerve stimulation which is outside the brachial plexus sheath and outside the interscalene groove. The needle is posterior and should be moved anteriorly;
- pectoral muscle contraction (rare) indicates that the needle is anterior.

POSTOPERATIVE CONTINUOUS BLOCK

- Induction: 25 to 30 ml of local anesthetic solution.
- Catheter:
  - on demand injections: ○10 ml of 0.2 % ropivacaine or 0.25 % bupivacaine 3 to 4 times daily;
  - bolus rescue: 10 ml.
  - Continuous infusion: 10 ml/h.
  - Perineural PCA : 4 ml/hr infusion plus rescue bolus of 5 ml /30 min.

BLOCKS OF SUPPLEMENT

Even after a good nerve stimulation muscular response of the lateral and posterior cord, a C8-T1 territory block deficit is possible (medial cord).Ulnar, medial cutaneous nerves of arm and forearm blocks are sometimes necessary to supplement the block. An incomplete supraclavicular block usually gives a pain relief which permits to move the arm in a position to complete the block at the elbow or at the midhumeral level.

SPECIFIC COMPLICATIONS

IMMEDIATE

- phrenic nerve block with diaphragmatic ipsilateral parlysis. This is less frequent than with the interscalene approach (76%);
- pneumothorax (may be delayed);
- intravascular injection.

SIDE EFFECTS

- recurrent laryngeal nerve block;
- Claude-Bernard-Horner syndrome.

CRITERIA FOR SELECTION OF A SUPRACLAVICULAR TECHNIQUE

	Kullenkampf	Winnie's paravascular	Dupré & Danel	Dalens	Brown	Pham-Dang ISCM
Puncture	Paresthesia	Easy	Easy if good landmarks (jugular vein)	Easy	Easy	Slightly painful
Risks	Pneumothorax +++	Hématoma ++	Failure if difficult landmarks	No specifics	Pneumothorax +	Hématoma(internal jugular vein puncture with a too deep insertion)
Catheter	0	+	+++	0	0	+++
Indications	Not indicated	Not indicated	Elbow surgery, good landmaks	children	Non expert physicians	Short necks Difficult landmarks Long term continuous block

CONCLUSION

The parascalene approach of Dalens has been used for a long time in pediatric anesthesia with few complications.

Landmarks of Dupré & Danel technique are sometimes difficult due to anatomical variations. This block is usually easy to perform with regular practice and the occurrence of pneumothorax is very rare. A continuous block is well adapted to this approach.

The intersternocleidomastoid approach landmarks are very easy for the non expert physician and a continuous block is well adapted to this approach.

Brown's technique favours middle primary trunk location at the first trial compared to the more tangential techniques, even for the non expert physician. Pneumothorax risk is higher.

The indications of a supraclavicular block should consider a cost/benefit ratio in regard to the infraclavicular, axillary and midhumeral techniques.

UPPER LIMB

INFRACLAVICULAR BLOCKS
SINGLE SHOT & CONTINUOUS

X. Paqueron, M.D.
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ANATOMY

The brachial plexus is composed of roots, trunks, cords and terminal nerves. Anterior primary rami of C5-T1 form the roots of this plexus. The roots of the brachial plexus lie between scalenus anterior and medius.

Deep to the scalenus anterior muscle C5 and C6 merge together to form the upper trunk, C7 forms the middle trunk and C8 and T1 merge together to form the lower trunk. These trunks are located close to the subclavian artery, where they usually lie at its lateral side. Then, the upper, middle and lower trunks scatter as they become more distal.

Posterior to the clavicle, the trunks divide into anterior and posterior divisions. The posterior divisions join all together to form the posterior cord of the brachial plexus. The anterior divisions of the upper and middle trunks join together to form the lateral cord. The anterior division of the lower trunk forms the medial cord. A close relationship exists between the subclavian artery and the cords: the lateral cord is lateral, whereas the medial cord is medial, and the posterior cord is posterior to the artery.

WHICH NERVES ARE INVOLVED ?

- Axillary nerve
- Musculo-cutaneous nerve
- Median nerve
- Ulnar nerve
- Radial nerve
- Median antebrachial and brachial cutaneous nerves

The techniques explained here derive from the one described first by Raj, then modified by Sims.

INDICATIONS

The infraclavicular block provides anesthesia of the upper arm, from the shoulder to the hand. It is suitable for surgical procedures of the distal arm, elbow, forearm and wrist.

This block is also useful for postoperative analgesia when a catheter has been inserted.

MATERIALS REQUIRED

- A peripheral nerve stimulator
- A 50 mm insulated short-beveled needle (or 100 mm) connected to the peripheral nerve stimulator
- A cutaneous electrode
- 10 ml syringes
- One 2 ml syringe
- A 25 Gauge subcutaneous needle

LOCAL ANESTHETIC SOLUTIONS

SHORT PROCEDURE AND AMBULATORY SURGERY

- Mepivacaine 1-2 %
- Ropivacaine 0.5 % to 0.75% (if long duration of postoperative analgesia is wished)

LONG SURGICAL PROCEDURE

- Ropivacaine 0.5 % to 0.75%

VOLUME TO INJECT

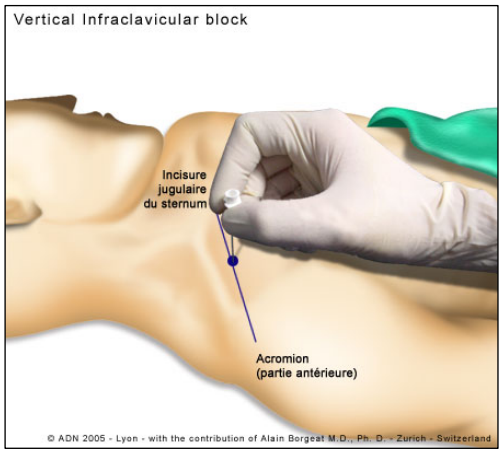
- Single injection technique: 30 - 40 ml
- Multiple injections technique: 20 – 25 ml

TECHNIQUES FOR PERFORMING THE INFRACLAVICULAR BLOCK

Three main approaches are used for performing this block.

1. The Vertical Infraclavicular Block [1]
2. The coracoid block [2,3]
3. The modified Raj technique [4]

Each approach has his own advantages and disadvantages : With the VIB approach, the risk of pneumothorax and phrenic nerve block may be more frequent than with the other techniques [5,6].



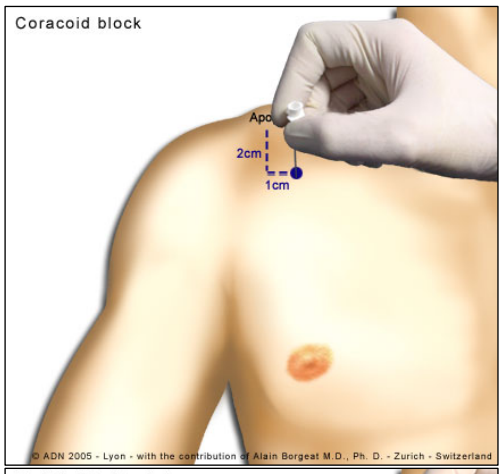
TECHNIQUE OF CORACOID BLOCK

POSITION OF THE PATIENT

The patient lies supine, with his head slightly rotated toward the opposite side to the puncture site, the upper arm along the body in a neutral position (or with the palm of the hand supine). The anesthesiologist stands laterally or at the patient's head.

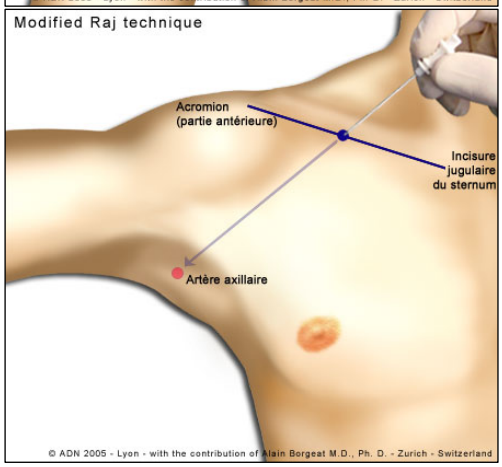
CUTANEOUS LANDMARKS

The clavicle and the coracoid process are drawn on the skin. The puncture site is drawn 2 cm caudad and 1 cm medial to the coracoid process. Thus, the puncture site is usually located in the deltopectoral groove.



HOW TO PROCEED

After the skin had been anesthetized with a subcutaneous injection of 1 % lidocaine without epinephrine, the insulated stimulating needle is inserted at the puncture site. Then, the peripheral nerve stimulator is activated and set up at an Intensity of 1.5 mA and a frequency of 1 Hz. The needle is slowly driven in, perpendicular to the skin. While progressing carefully with the insulated needle, one search for an evoked motor response.



SINGLE INJECTION TECHNIQUE

If the evoked motor response is a stimulation of the musculo-cutaneous nerve (elbow flexion), the needle tip is too superficial and too medial. Therefore, the needle has to be redirected more medially. A musculo-cutaneous evoked motor response does not necessary represent a wrong motor response, but if the total volume of local anesthetics solution is injected on this motor response, the likelihood of block failure is high.

In case of single stimulation, a median nerve or a radial nerve evoked motor response is more reliable : flexion and pronation of the wrist and second and third fingers for the median nerve, wrist and finger extension for the radial nerve

Once an evoked motor response is obtained, the intensity of stimulation is progressively, lowered and the local anesthetics solution is injected only when the intensity is equal or below 0.5 mA. After a careful aspiration, one ml of solution is injected and the evoked motor response has to disappear immediately. Then, the remaining of the solution is slowly administered and aspiration tests are performed every 5 injected ml.

MULTIPLE STIMULATION TECHNIQUE

At least two evoked motor responses have to be elicited: one from the posterior cord (i. e. radial nerve) and one from the lateral cord (i. e. median nerve). The musculo-cutaneous evoked motor response is one possible correct response to be searched for, in association with a radial and median nerve motor response.

Once an evoked motor response is obtained, the intensity of stimulation is progressively lowered and the local anesthetics solution is injected only when the intensity is equal or below 0.5 mA. After a careful aspiration, one ml of local anesthetic solution is injected and the evoked motor response has to disappear immediately. Then, the remaining of the solution is slowly administered and aspiration tests are performed every 5 injected ml. The insulated needle is withdrawn of 3 – 4 cm and the stimulation intensity is increased again up to 1.5 mA before searching for a second evoked motor response.

5 to 10 mL of local anesthetic are injected on each response.

CATHETER INSERTION

A catheter insertion requires an insulated needle connected to a peripheral nerve stimulator. Needle progression must be very careful to avoid a perforation of the axillary artery.

Once a median, radialor ulnar evoked motor response has been obtained, and the stimulation intensity has been lowered (approx. 0.5 mA), the catheter is slowly introduced into the perineural sheath 3 to 5 cm deep. The catheter is then secured to the skin, before being covered with a sterile dressing.

In case of catheter insertion, it is interesting to search for an evoked motor response corresponding to the peripheral sensory distribution of the surgical field.

POSSIBLE COMPLEMENTARY BLOCKS

Surgery requiring a tourniquet: The medial cutaneous nerve of the arm and the intercostobrachial nerves must be anesthetized by a sub-cutaneous infiltration of 5 ml of local anesthetics perpendicular to the axillary artery in the axilla crease.

In case on an incomplete block, the un-anesthetized nerves might be blocked in the axilla or at the midhumeral level.

TRICKS

To avoid the stimulation through the sheath, when the stimulation intensity is low, progress make the needle carefully progress until the stimulation disappear. When stimulations reappear during needle withdrawal, the tip of the needle is correctly located for the local anesthetics injection.

In order to not move the needle tip, the hand that hold the needle has to lie on the patient’s chest.

UPPER LIMB AXILLARY BLOCK - SINGLE, DOUBLE OR MULTIPLE INJECTIONS AND CONTINUOUS BLOCKS

Z.J. Koscielniak-Nielsen, MD
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Axillary approach is used commonly for anaesthetizing the distal upper limb. Lack of serious complications and good analgesia makes this block particularly suitable for ambulatory procedures of longer duration, which require a tourniquet. This is especially important nowadays, when most of hand surgery is done on a day-case basis.

ANATOMY

In the apex of the axilla, the three plexus cords (lateral, medial and posterior) form the main terminal nerves of the upper extremity (axillary, musculocutaneous, median, ulnar and radial).

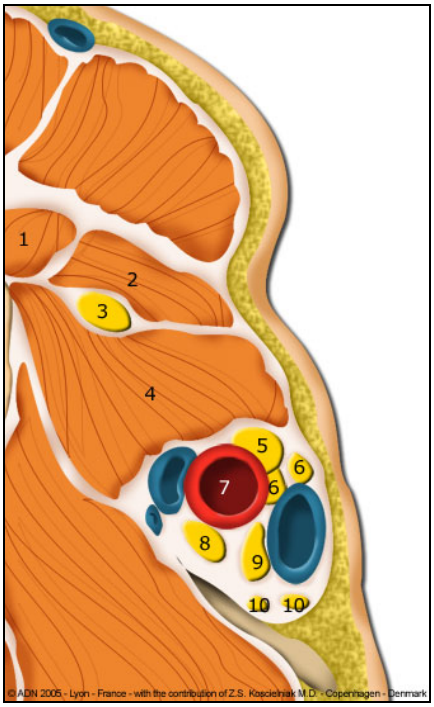
However, only the last three nerves accompany the blood vessels on the way down through the axilla where the blocks are performed.

The axillary and the musculocutaneous nerves leave the neurovascular sheath (NVS) at the level of the coracoid process.

The medial antebrachial- and brachial cutaneous nerves run subcutaneously parallel to the axillary vessels, although the medial antebrachial cutaneous often follows the median nerve within the NVS.

In the axilla, the median and musculocutaneous nerves lie superior to the artery, while the ulnar and radial nerves lie inferior to it. The depths at which the nerves are found vary individually, but the median nerve is more superficial than the musculocutaneous and the ulnar nerve is more superficial than the radial.

Occasionally, the radial and/or the musculocutaneous nerves are found behind the artery.



1. caput longum of biceps m.
2. caput breve of biceps m.
3. musculocutaneous n.
4. coracobrachialis m.
5. median n.
6. medial cutaneous n. of forearm & arm
7. brachialis a
8. radial n.
9. ulnar n.
10. muscular rr.

AREA OF ANAESTHESIA

Upper arm excluding lateral parts (axillary nerve), elbow, forearm, wrist and hand.

INDICATIONS

Hand, wrist or forearm surgery of longer duration in a bloodless field.

LANDMARKS

- Pulse of the axillary artery
- Coracobrachialis muscle
- Pectoralis major muscle
- Biceps muscle
- Triceps muscle

MATERIAL

- Sterile gloves, marking pen and ECG electrode (neutral)
- 27-27 gauge needle and 5 ml syringe for skin infiltration
- 3.5-5 cm long atraumatic, insulated stimulating needle
- 10-20 mL syringes containing the chosen local anaesthetic
- Peripheral nerve stimulator

ANAESTHETIC AGENTS

Depends on length of surgery, “switch over” time between the patients, duration of patient’s stay in the hospital, intensity of postoperative pain and individual preferences of an attending anaesthesiologist. For the single shot blocks, short and medium acting local anaesthetics (prilocaine, lidocaine or mepivacaine) in concentrations 1.5 to 2% with adrenaline will provide deep sensory and motor block of rapid onset (10-20 min) and sufficient duration (3-4 h) for most acute and subacute procedures (wound debridement, closed fracture repositions, ligament-, tendon-, nerve sutures, finger amputations etc). For the elective procedures requiring more time (artrodeses, arthroplasties, osteosyntheses, extensive palmar fasciectomies, etc.) ropivacaine 0.5-0.75% or bupivacaine 0.375-0.5% with or without adrenaline will provide analgesia of slower onset (20-40 min), but lasting 8-12 hours or more. For specialized hand surgery, which may last several hours, f.ex. multiple joint replacements or re-implantations of severed parts of extremity a continuous ropivacaine 0.2% infusion via an indwelling catheter is probably the best technique.

OUR PRACTICE AT RIGSHOSPITAL, COPENHAGEN, DK.

- All patients: 3-5 ml of 0.5-1% mepivacaine for skin infiltration
- Ambulatory patients: 0.5 ml/kg b.w. (min. 30 ml, max. 50 ml) of the mixture of equal volumes of 2% mepivacaine with adr. and 0.75%ropivacaine (onset 10-20 min, duration 5-6 hours).
- Hospitalized patients: 0.5 ml/kg b.w. (min. 30 ml, max. 50 ml) of the mixture of equal volumes of 0.5% bupivacaine with adr. and 0.75% ropivacaine (onset 20-30 min, duration 8-12 hours).

BLOCK TECHNIQUES

COMMON FEATURES

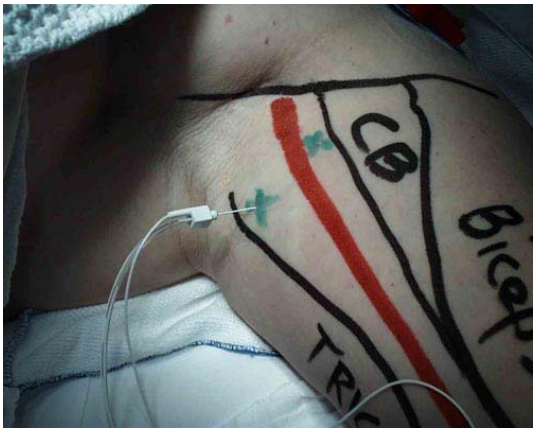
The patient is supine. Arm to be operated is abducted to ca. 900. Elbow is flexed and the forearm rests comfortably on a pillow. An ECG electrode is placed on patient’s shoulder and connected to the neutral lead (anode) of the nerve stimula¬tor. After scrubbing the axilla the arterial pulse is palpated at the level of the major pectoral muscle and the subcutaneous tissue overlying the artery is infiltrated with 3-5 ml of LA to block the intercostobrachial and the medial cutaneous nerves of the arm. A stimulator frequency is set to 2 Hz, stimulus duration to 0.1 ms and the electrical connections with the needle and the neutral electrode are checked.

SINGLE INJECTION

(useful in children, not reliable in adults – Klaastad et al. 2002)

Depending on the surgical site (palmar and medial or dorsal and lateral aspects of the hand/forearm) the stimulating needle is inserted respectively above and superficial to the arterial pulse towards the median nerve, or below and deep to it - towards the radial nerve. As soon as the superficial fascia is penetrated with a characteristic “click” the current amplitude is slowly increased until the desired twitch (wrist and fingers’ flexion or extension) is obtained. This helps to avoid painful electrical paraesthesie when the elastic fascia suddenly “gives in” and the needle enters the NVS before amplitude reduction (Koscielniak-Nielsen et al., 2002). The needle is slowly advanced towards the stimulated nerve while reducing the amplitude to 0.3-0.5 mA. The entire LA volume is then injected at one site, while continuously aspirating the needle to reduce the risk of accidental intravenous injection.

DOUBLE INJECTION

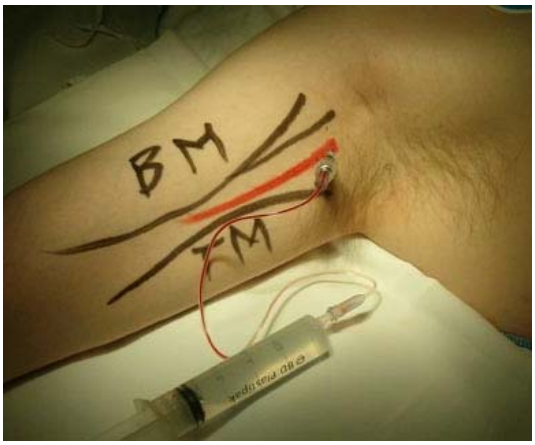


(better than single injection, but less effective than multiple injection)

The stimulating needle is first inserted above the artery, below the coracobrachialis muscle. After penetrating the fascia the amplitude is increased until stimulation synchronous wrist flexion/pronation and flexion of the first three fingers are obtained (median nerve stimulation). The needle is slowly advanced towards this nerve while reducing the amplitude to 0.3-0.5 mA. Half of LA volume is then intermittently injected. The needle is withdrawn and inserted below the artery and above the triceps muscle. The fascia is again penetrated and the amplitude slowly increased. The first response is usually either arm extension (muscular branches to the triceps) or thumb adduction and flexion of the last two fingers (ulnar nerve). They should be ignored and the needle is advanced deeper, often slightly upwards, behind the artery until wrist and finger extension are obtained (radial nerve). After amplitude reduction the remaining half of LA volume is slowly injected.

Another, popular double injection technique, which does not require a nerve stimulator is the trans-arterial, where the axillary artery is transfixed by a thin sharp needle. Half of the LA volume is injected behind the posterior wall anaesthetizing the radial nerve and half is injected superficial to the anterior wall anaesthetizing the median and the ulnar nerves. This technique however has a relatively high risk of complications (Stan TC et al. 1995).

MULTIPLE INJECTIONS - 4 OR 3



(our preferred technique)

This technique has faster onset and higher effectiveness than either single or double injections (Handoll HH & Koscielniak-Nielsen ZJ. Cochrane Database Syst Rev. 2006 Jan 25).

Puncture sites are identical to the double injection technique. After electrolocation of the median nerve 1/4th of the LA volume is injected and the needle withdrawn subcutaneously and re-directed obliquely upwards into the coracobrachialis muscle. After obtaining stimulation synchronous biceps flexion the amplitude is reduced to 0.3-0.5 mA and another 1/4th of LA is injected. The needle is then removed and inserted below the artery.

The first stimulated nerve is usually the ulnar, where 1/4th of the LA is deposited and the needle is advanced deeper until the radial nerve is found (see double inj.). However, two studies by Sia et al. 2001, suggested that two separate injections below the artery do not improve success rates and one injection is sufficient. It should be made close to the radial nerve and contain half of the LA volume.

▷Video of this technique ▷

SEDATION

Multiple nerve stimulation techniques may be associated with a significant patient's discomfort (Koscielniak-Nielsen et al. 2002, 2004). This discomfort is effectively reduced by intravenous sedation (Fanelli et al. 1999, Kinirons et al. 2000). The titrated sedation not only improves patient's acceptance of the block, but also helps him or her to relax the arm muscles. This aids the anaesthesiologist to identify the twitches correctly and control the needle advancement more precisely.

RESCUE ELBOW BLOCKS

Except for the two cutaneous forearm nerves: the lateral, which is derived from the musculocutaneous nerve and is blocked by the "blind" subcutaneous injection over the brachioradialis muscle and the medial, which branches are blocked by a similar injection over the medial aspects of the elbow, the remaining three nerves (median, radial and ulnar) contain motor fibers to the forearm and hand muscles and are easily electrolocated. Because of the smaller nerve diameter these blocks are faster in onset than either axillary or midhumeral, but are seldom used as the primary techniques because of the lack of tourniquet analgesia. Most anaesthesiologists use them to supplement the insufficient higher blocks. A typical stimulating needle is 25-35 mm long, 25 gauge and the LA volume for each nerve is 5 mL.

MEDIAN NERVE

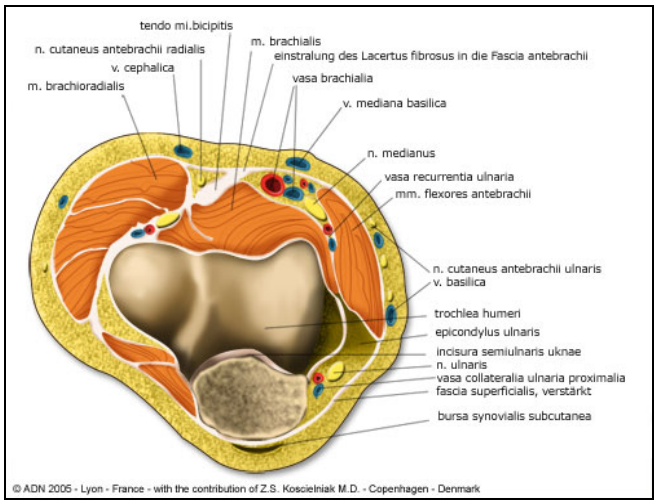
Is located under the superficial fascia, medial to the basilic vein and the brachial artery, which in most patients is easily palpated medial to the biceps tendon. Its stimulation produces forearm pronation and flexion of the first three fingers.

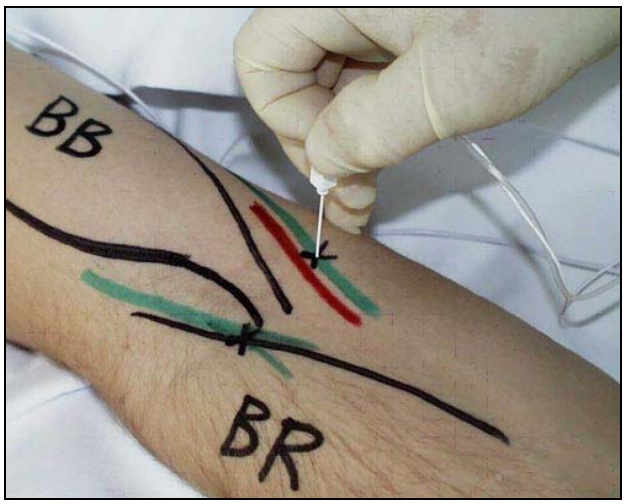
RADIAL NERVE

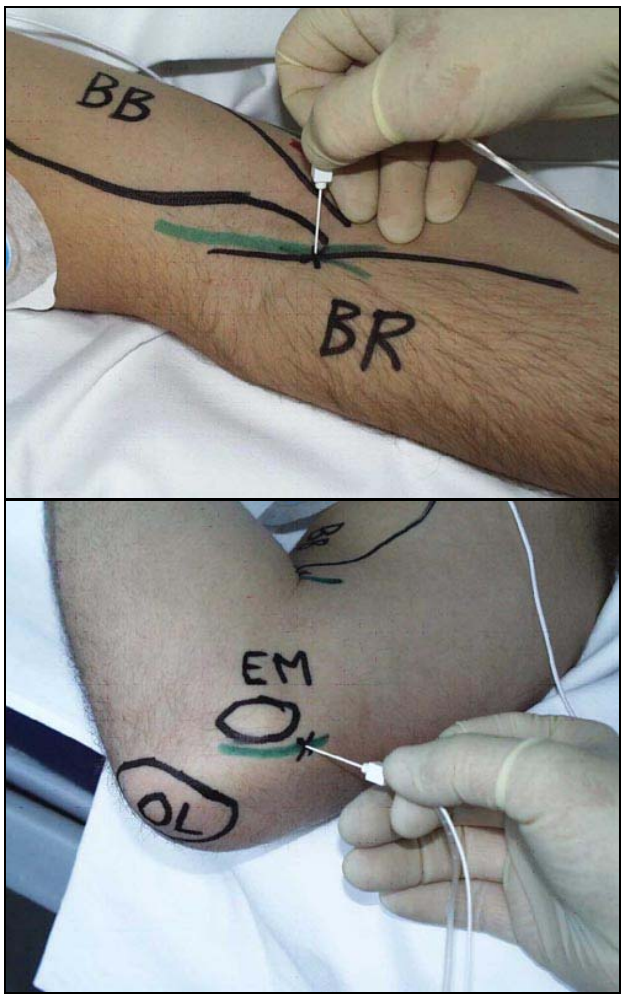
Is usually divided into a deep (mixed) and a superficial (sensory) branch - n. cut. antebrachii posterior. The superficial branch runs lateral to the biceps tendon, while the deep branch is located between the lateral epicondyle and the belly of the brachioradialis muscle. The needle is inserted just lateral to the biceps tendon towards the lateral epicondyle. Nerve stimulation results in wrist and fingers extension.

ULNAR NERVE

Runs very superficially in its own groove (sulcus n. ulnaris) between the medial epicondyle and the olecranon. Its stimulation results in ulnar wrist flexion, flexion of the 4th and 5th fingers and the thumb adduction. LA injections should be made just proximal to the the groove to reduce the risks of neuritis.







CONTINUOUS AXILLARY INFUSIONS

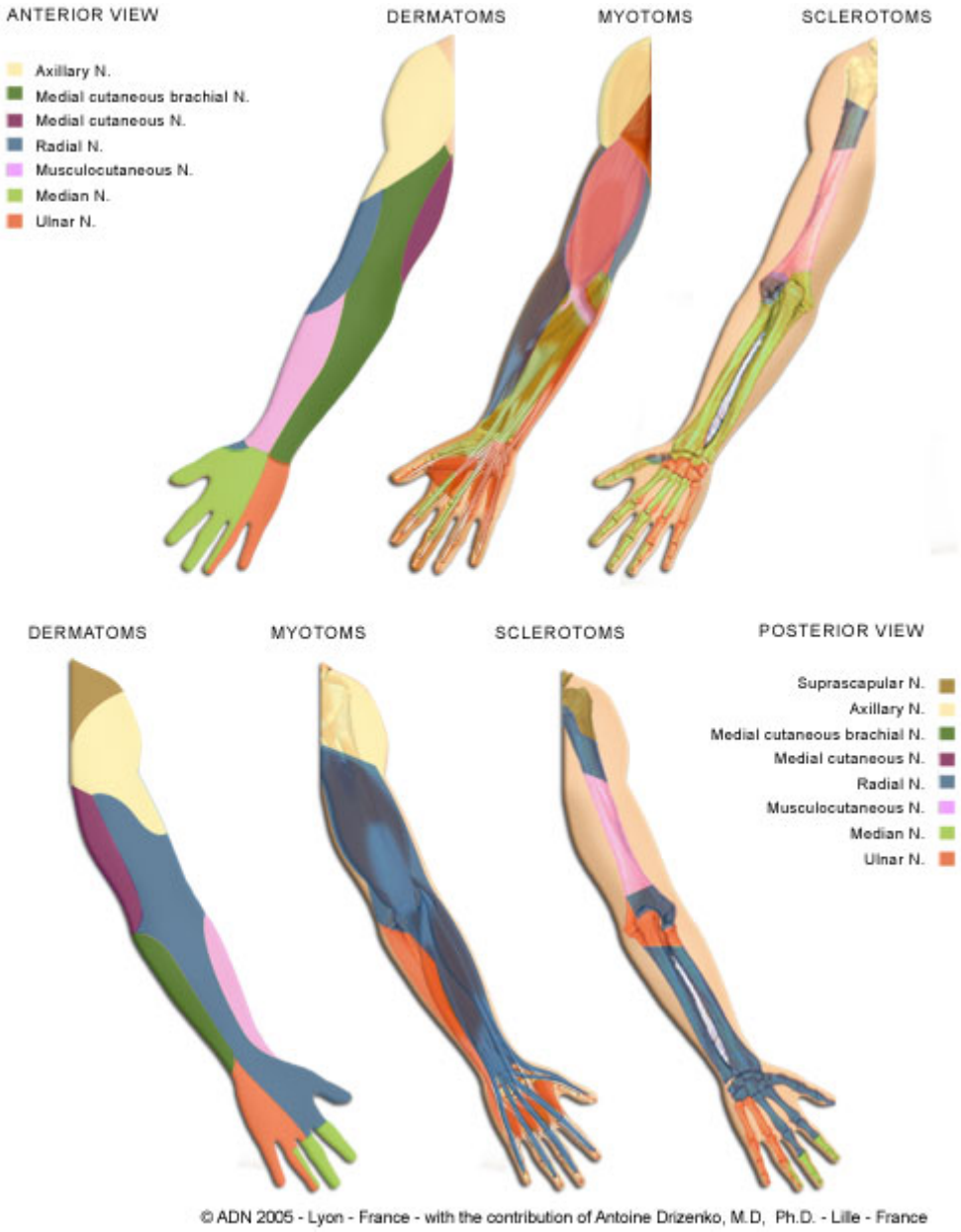
INDICATIONS

- Control of acute post-operative pain
- Management of chronic pain syndromes
- Treatment of vascular diseases f.ex. Raynaud's

BLOCK ASSESSMENTS

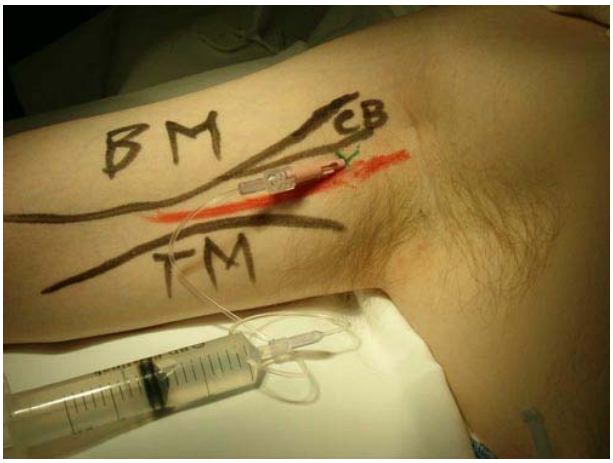
The first sign of a successful block is the weakness of the upper arm muscles, which can be tested immediately after needle withdrawal by asking the patient to place the hand on the abdomen. Loss of coordination implicates that the mantle fascicles of the musculocutaneous and the radial nerves, which supply biceps and triceps are being blocked. Often patients also report early loss of position sense in the blocked extremity.
The spread of analgesia should be systematically tested every 5 or 10 min after block insertion in the middle of sensory areas of the seven terminal nerves.

A painful pinch with a plastic clamp is probably the most effective and leaves no puncture marks, which may increase the risk of infection. Patient is declared ready for surgery when anaesthesia or analgesia is present in 5 sensory areas distal to the elbow. Muscle relaxation is usually tested at the same time. Twenty to thirty minutes after block insertion the unblocked nerves should be supplemented distal to the initial block site, f.ex. at the elbow and the sensory testing continues until the analgesia is complete.



CATHETER INSERTION

Essentially similar to the single injection technique, but with a stricter demands on sterility (sterile drapings, face mask and surgical gown). The armpit is shaved and disinfected. After subcutaneous LA infiltration the specific muscle twitch from the nerve most involved in surgery is elicited by a stimulating introducer cannula (see single injection technique). The intensity of the stimulating current is progressively reduced to < 0.5 mA, while adjusting cannula's position. A catheter is inserted under sterile conditions 5-8 cm cephalad into the NVS either blindly (normal catheter) or while maintaining the electrical stimulation (stimulating catheter).



Using the later, a non-conducting solution f. ex. 5% dextrose is recommended by Tsui et al. 2004 to dilate the NVS and facilitate the catheter insertion, because contrary to normal saline and LA solutions, which are ionized it does not

dissipate the stimulation currents. The catheter is either sutured to the skin or tunneled. This helps to maintain the catheter in place because the nerves lie superficially and the arm sweat makes maintenance of an occlusive dressing difficult.

MAINTENANCE

Diluted solutions of the long acting local anaesthetics are most often used f.ex. 0.125% bupivacaine or 0.2% ropivacaine. Ropivacaine is preferable because of the sparing effect on the motor neurons and the lower cardiotoxicity. Either electronic or elastomeric pumps may be used. The former are more expensive but allow repeated adjustments, have alarms and data storage systems. They are mostly used in the hospitals. The later are cheaper, simpler and disposable, but lack versatility and accuracy. They are preferred for home infusions. Different modes of LA administration may be employed: a continuous basal infusion, repeated boluses and a combination of both, in which bolus administration is patient controlled. The first is limited by the size of pump's reservoir f.ex. 250 ml reservoir with 10 ml/h will only last a day. Repeated boluses from disposable pumps were associated in the past with LA overdose. The last technique offers the advantage of adjusting the level of analgesia to the individual needs and puts the patient "in charge" of pain control, which has an important psychological aspect. A typical infusion regimen for a 0.2% ropivacaine is a basal rate of f.ex. 0.1 ml/kg b.w. per hour (min. 5 ml, max. 10 ml) and a 5 ml PC bolus with a lock-out time of 30 min. Such regimen may be maintained for 2-3 days for the treatment of acute post-operative pain and as long as necessary in the chronic conditions.

COMPLICATIONS

ACUTE

- Vascular puncture – frequent, but usually detected by a repeated needle aspiration. However, venous puncture may be undetected if aspiration collapses the venous lumen.
- Intravascular LA injection – intravenous injection manifests itself as lighheadness and or tachycardia (ropivacaine or epinephrine containing solutions). Intraarterial injection produces hand paresthesia during injection accompanied by sudden paleness, which may last a couple of minutes. Intravascular injection of a large LA dose may lead to loss of consciousness, seizures and cardiac arrest. Slow injection with repeated needle aspiration is mandatory.
- Haematoma – may occur after arterial puncture, especially with a large bore blunt needles and in elderly patients. If the artery is punctured a firm steady pressure should be applied over the puncture site for 5-10 min.
- LA overdose – in contrast to the accidental intravascular injection, which becomes symptomatic during or immediately after the injection the symptoms of LA overdose appear 5-10 min later. The typical clinical picture is: lightheadness, dizziness, tunnel vision, circumoral paresthesie, brady- or tachycardia, anxiousness eventually progressing to loss of consciousness and seizures. Oxygen should be immediately applied, a sedative/hypnotic administered in refracted doses and the airway supported if necessary.

SUBACUTE & CHRONIC

- Nerve injury – may be caused by a needle, intraneural injection, a tourniquet or a combination of these. Most needle injuries are manifested by painful paraesthesie or twitches and are localized to particular nerve f.ex. median. Intraneural injections are characterized by pain, extremity withdrawal and resistance to injection. Ischemic damage by a tourniquet is diffuse, affects several nerves and is usually accompanied by the soreness of the upper arm. Symptoms of nerve damage (sensory loss and persistent paraesthesie) usually appear within a day or two after recovery from the block. Most nerve injuries are neuropraxias (functional damage), which carry a good prognosis and heal within few weeks. However, all patients presenting the symptoms should be followed closely and scheduled for neurophysiological assessment.

PRACTICAL TIPS

- Arterial pulse palpation may be difficult and imprecise in obese patients. The ultrasound probe may be used to visualize the arterial pulsations. Alternatively, the first obtained twitch response helps with the needle location. Elbow flexion indicates that the needle is outside the NVS and inside the coracobrachialis muscle (musculocutaneous nerve). The needle should be redirected downwards and more superficially. Elbow, wrist and hand extension (radial nerve) indicates that the needle is below the artery. Most difficult is the differentiation between the median and the ulnar nerves, which both result in wrist/finger flexion. If this flexion is accompanied by forearm pronation the needle is above the artery and the stimulated nerve is the median. Another way to differentiate between these two nerves is by palpation of the flexor tendons at the wrist. Median nerve stimulation produces movements of the palmaris longus and the flexor carpi radialis tendons, which lie in the middle of the wrist while the ulnar nerve stimulation produces movement of the flexor carpi ulnaris tendon, which lies medially. Lower current amplitudes facilitate this detection.
- A trans-arterial fixation should be made as high up in the axilla as possible and the needle should traverse the artery at the oblique angle. This, on one hand, reduces the risk of too deep (intramuscular) injection behind the

artery and on the other hand improves the LA spread to the plexus cords and increases chances of anaesthetizing the musculocutaneous nerve.

- Electrolocation of the multiple nerves is time consuming and first LA injection in the vicinity of the median nerve may partially block the ulnar nerve. Therefore, if one chooses to use the 4-injection technique, the search for the nerves should be limited in time to a maximum of 10 min. (our arbitrary value) to minimize the risk of nerve damage.
- Axillary nerve is blocked in only half of the patients having axillary block. For elbow surgery an infraclavicular approach is a better choice. For minor procedures in the elbow area f.ex. anterior transposition of the ulnar nerve and additional analgesia for the upper part of the incision can be provided by a subcutaneous LA injection on the posterior aspects of the upper arm.
- Most of hand surgery is being done on the volar aspects of the hand, f.ex. palmar fasciectomies, nerve or tendon repairs etc. These can be theoretically performed in partial blocks (without the radial and/or musculocutaneous nerves). Alternatively, thumb surgery can be done without blocking the ulnar nerve. However, patients are often alarmed by the un-anaesthetized parts of the hand and demand heavy sedation making control over anaesthesia more difficult. Surgeons can also unexpectedly extend the operation site encroaching upon the unblocked nerves. Hence, it is advisable to make sure that forearm, wrist and hand are completely anaesthetized before the start of surgery.
- Do not inject LA when the stimulating current's amplitude is < 0.2 mA and when there is a high resistance to injection. The needle tip may lie intraneurally. Reposition the needle.

CONCLUSIONS

- Triple injection after electrolocation of median, musculocutaneous and radial nerves provides the best success rate and the fastest onset of analgesia. A double injection technique is the next best and may be used without a nerve stimulator.
- For continuous blocks a catheter should be placed close to the main nerve innervating the surgical site: median nerve - for surgery of medial and volar surfaces and radial nerve for surgery of lateral and dorsal surfaces. For a very extensive surgery or major trauma/amputation it may be preferable to use higher approach. An optimal perineural infusion technique is the basal rate + PC boluses and the most common LA agent is ropivacaine 0.2%

An accidental intravascular injection is the commonest complication of axillary block but may be prevented by repeated aspiration and slow injection. Pain, paresthesie, extremity withdrawal and/or high resistance to injection may indicate an intraneural needle placement and prompt immediate repositioning.

LOWER LIMB TABLE OF CONTENTS

- Lumbar plexus block
- Iliofascial block
- Obturator block
- Sciatic blocks
  - Sciatic blocks - parasacral nerve approach
  - Sciatic blocks - posterior popliteal approach
- Ankle blocks

LOWER LIMB LUMBAR PLEXUS BLOCK - POSTERIOR APPROACH *SINGLE SHOT & CONTINUOUS*

Philippe Macaire, M.D.
Soyaux - France

Winnie, Hanna, Dekrey, Parkinson and Chayen have all described different technics or suggested modifications with regard to the posterior approach of the lumbar plexus block . With the advent of new material, the posterior approach can now be used to insert catheters.

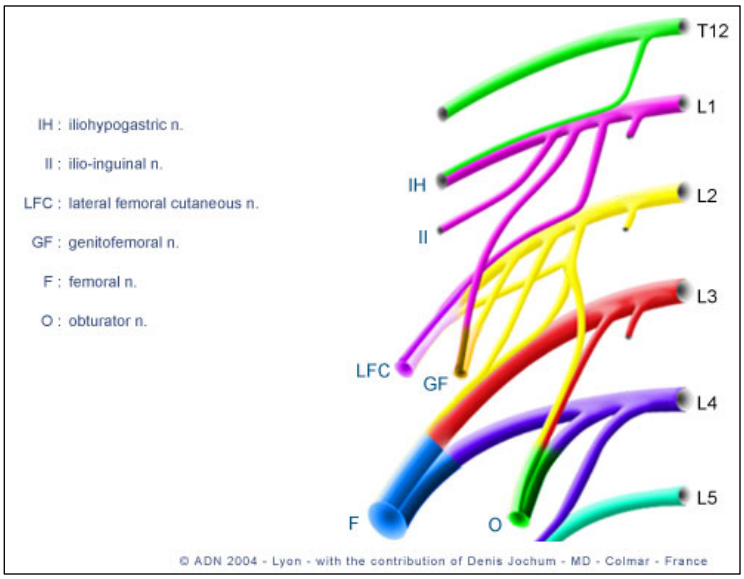
Contrary to its anterior counterparts (iliofascial or "three-in-one" blocks), the posterior approach enables the clinician to block reliably all major nerves (femoral, obturator and lateral cutaneous) originating from the lumbar plexus.

ANATOMY

The lumbar plexus is formed by the ventral rami of the first three lumbar nerves and the greater part of the fourth that unite to form the following nerves:

- Iliohypogastric nerve,
- Ilio-inguinal nerve,
- Genitofemoral nerve,
- Lateral femoral cutaneous nerve,
- Femoral nerve,
- Obturator nerve.

Two major anastomosis involving the lumbar plexus, one with a branch of the last thoracic nerve and another between the fourth and fifth lumbar nerves give birth respectively to the infracostal nerve and the lumbosacral trunk. The latter contributes to the sacral plexus.

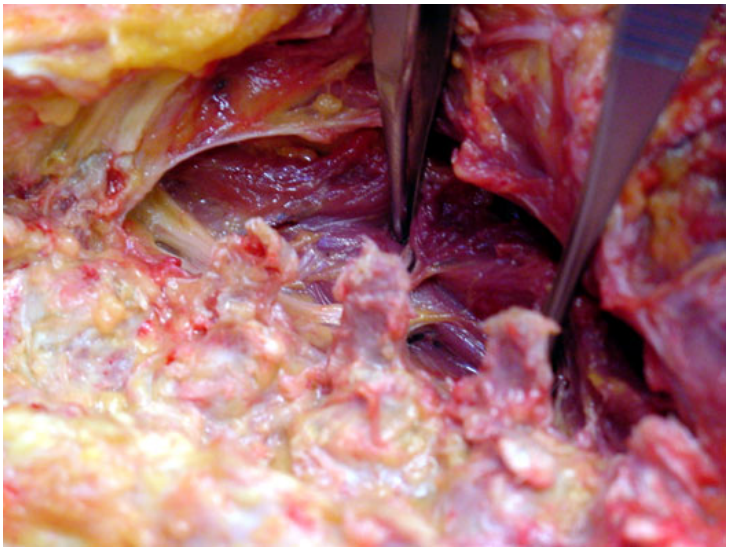


PLEXUS LOCATION

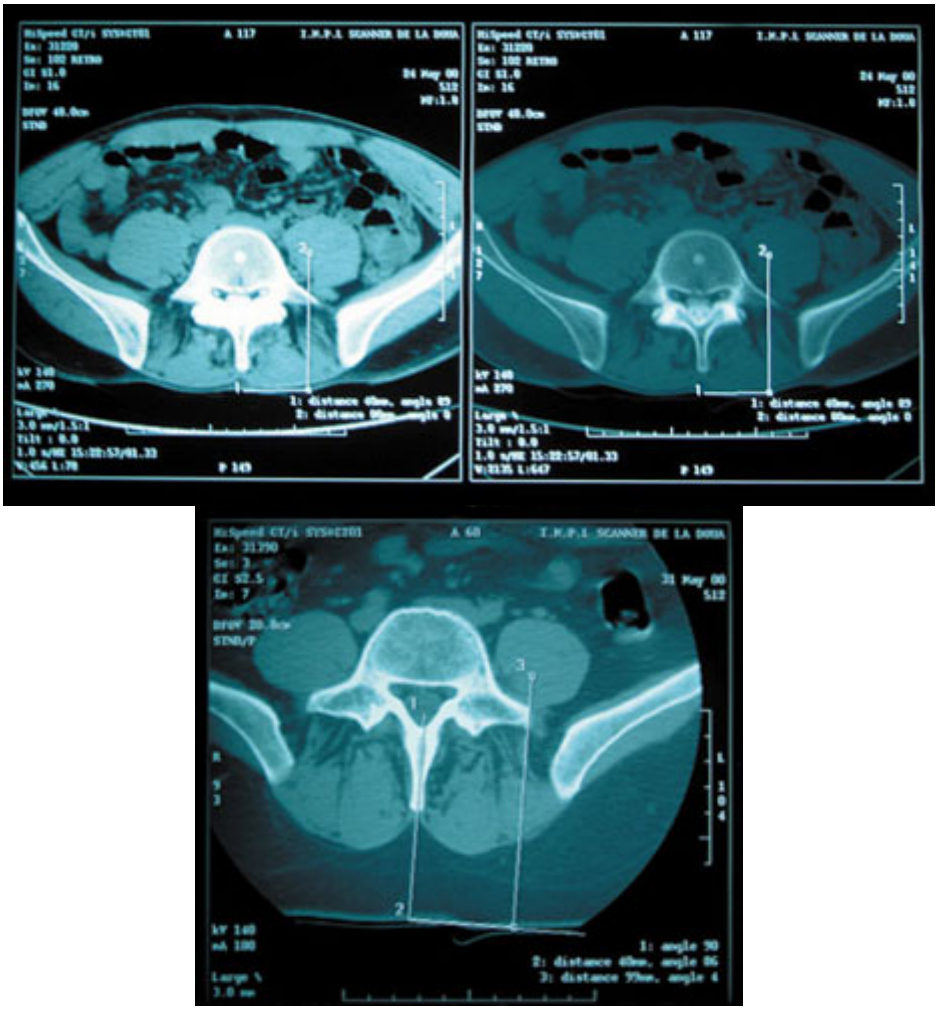
The lumbar plexus is located in a virtual space inside the Psoas major muscle.

This space is limited medially by Psoas major insertions on the bodies of the vertebrae and their transverse processes and by the lumbar spine itself.

The aponevrosis surrounding the plexus inside the Psoas major constitutes the anterior, posterior and lateral limits of this space.



FROM SKIN TO PLEXUS



The depth at which the plexus is located varies.

To reach it, the needle goes through skin, subcuatneous fat, Erector spinae, Quadratus lumborum, and Psoas major muscles.

During its progression, the needle may come into contact with the transverse process of L4, providing an excellent landmark.

BLOCKED NERVES	
Upper thigh	Lower limb
Ilio-inguinal nerve	Femoral nerve
Iliohypogastric nerve	Lateral femoral cutaneous nerve
Genitofemoral nerve	Obturator nerve

FREQUENCY OF ANESTHESIA IN THE THREE MAJOR NERVES' TERRITORIES		
	Piffaut, 1996 (single injection)	Rickwaert, 2000 (catheter)
Femoral nerve	100%	97.5%
Obturator nerve	100%	88%
Lateral femoral cutaneous nerve	96%	92%

EQUIPMENT

- Flexible ruler (cm).

SINGLE INJECTION

- 100- or 120-mm, 22- or 24-gauge needle (short bevel).

CATHETER INSERTION

Neurostimulation set including. Equipment allowing catheter insertion through a 100- or 110-mm graduated (cm) needle (blunt tip) designed for neurostimulation is recommended.

INDICATIONS

ALONE:

- It can be used for hip or knee surgery

Single injection

The lumbar plexus block has been recommended for:

- Repair of hip fractures [6]. It may then be necessary to proceed with subcutaneous infiltration toward the top of the surgical incision to ensure anesthesia of branches arising from lower thoracic nerves.
- Early analgesia following hip arthroplasty [7-8].

Catheter insertion

- Recommended for perioperative analgesia during and following major hip or knee surgery.

COMBINED WITH A SCIATIC NERVE BLOCK:

The lumbar plexus block can be used for most surgeries involving the lower limb

CONTRAINDICATIONS

- Vertebromeningeal infections.
- Lumbar vertebral trauma.
- Associated trauma or disorders making lateral positioning impossible (Femoral neck fracture is no contraindication to the lateral position).
- Coagulation abnormalities,
- In patients exhibiting severe lumbar scoliosis, the landmarks may be modified.

PERFORMING

SEDATION

Although recommended, sedatives administration should allow for uninterrupted communication with the patient.

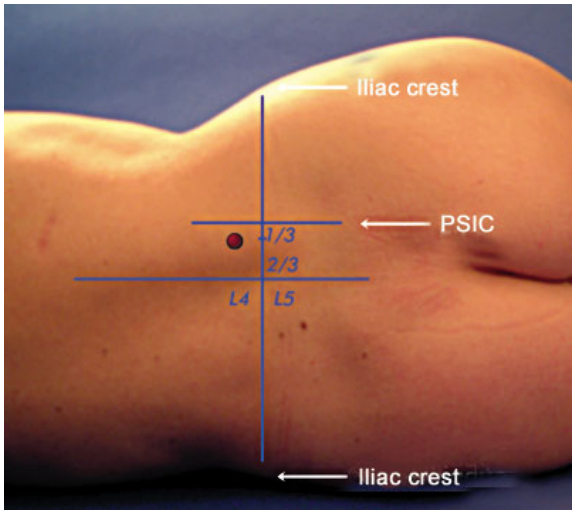
POSITION

The patient lays on the side opposite to the block (thigh flexion: 30°; knee flexion: 90°) while the physician stands behind. An assistant facing the patient with hands on the upper thorax and thigh will help maintain correct position and identify thigh movements during neurostimulation.

LANDMARKS

It is advisable to trace the following landmarks:

- An horizontal line joining the top of the iliac crests at the L4-L5 level.
- A line joining the spinous processes of L3, L4 and L5.
- A line parallel to the line joining the spinous processes and passing over the posterior superior iliac spine.
- A line starting at the spinous process of L4 and reaching perpendicularly the line passing by the posterior superior iliac spine

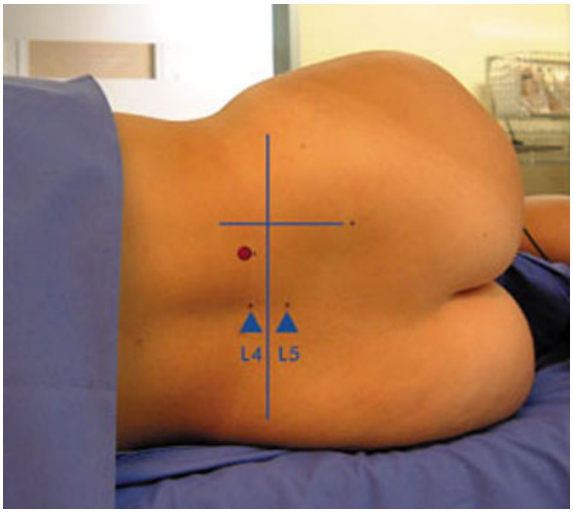


PUNCTURE SITE

The puncture site is located at the union of the lateral 1/3 and medial 2/3 of the line joining the spinous process of L4 to the line passing through the posterior superior iliac spine (approximately 40 mm lateral the spinous process of L4).

This site differs from the classic one located at the junction of the line passing through the posterior superior iliac spine and the line joining the top of the iliac crests.

Anatomical studies suggest that the location of the classic site is in fact too lateral. See the scanners above where we can see the puncture site and the anatomical cut.



PUNCTURE

Puncture on anatomy animation

Given the depth of the lumbar plexus, it is important to proceed with the block in a methodical fashion in order to ensure success and avoid complications.

Following surgical skin asepsis, the needle is introduced perpendicularly to the skin. Stimulation intensity is adjusted between 1 and 2 ma for a 0.1-ms period of stimulation.

The needle is inserted slowly through the muscles until it reaches the transverse process of L4. This contact is expected and provides a real safeguard. Anatomical studies [10] have shown that the distance between the posterior edge of the costal process and the lumbar plexus is 15-20 mm [11]. The insertion depth of the needle is then noted.

After adding 20 mm to the depth indicator, the needle is withdrawn and reoriented with a 5° angle in cephalic or caudal direction, thus avoiding the transverse process.

The needle is inserted more deeply (without exceeding the additional 20 mm) until the required stimulation of the femoral nerve (ascension of the patella) can be observed.

The intensity of the stimulation is then gradually reduced until the motor response disappears (0.5 ma). An aspiration test is then carried out to avoid vascular or spinal injection.

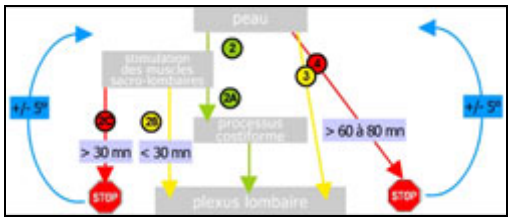
For a single injection, a volume of 20-30 ml of anesthetic solution is required. Injection must be slow and divided.

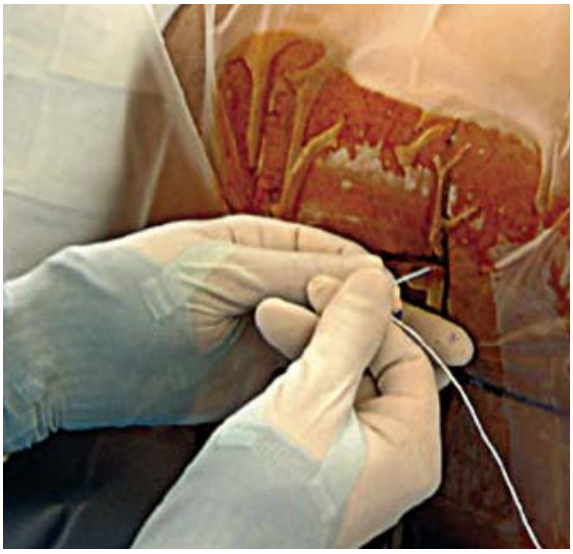
If a catheter is inserted, it should not protrude more than 5 cm beyond the tip of the needle

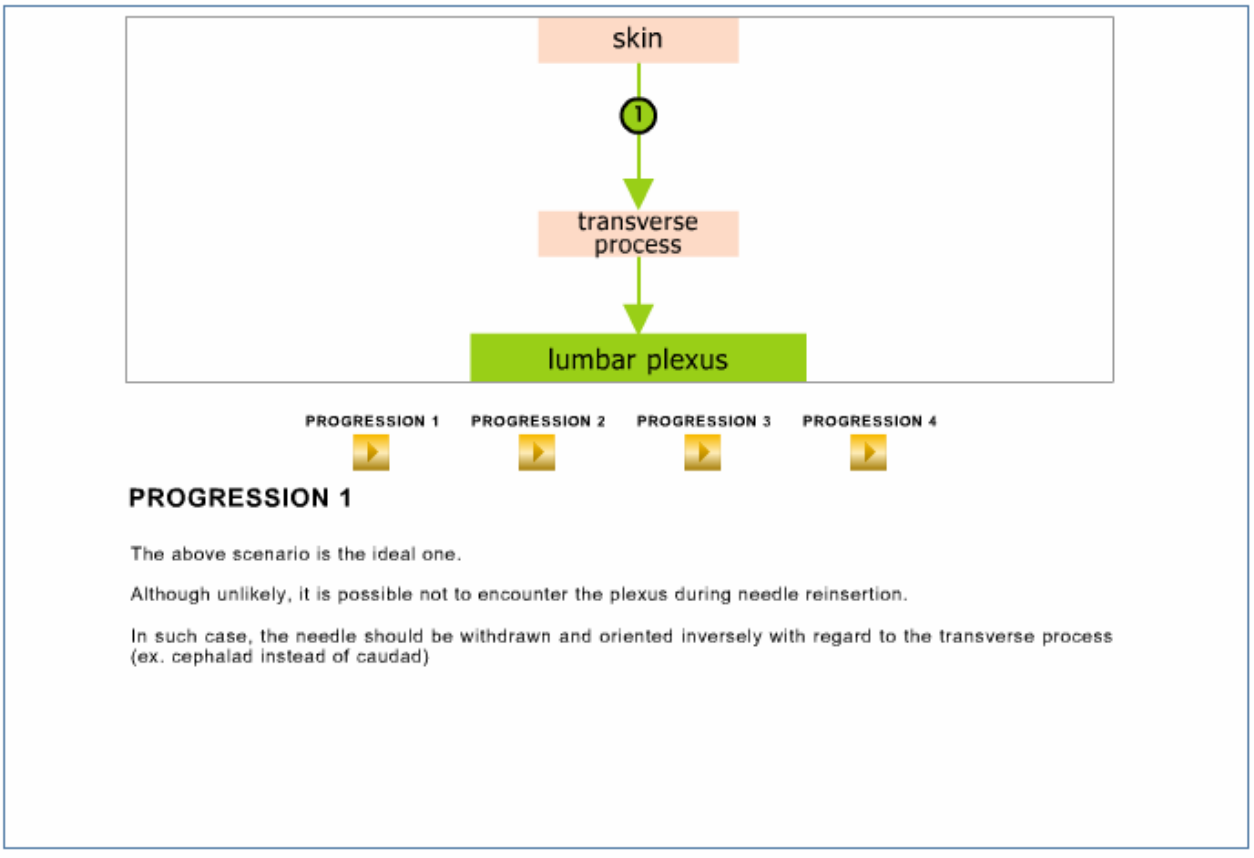
PUNCTURE'S PROCEDURE

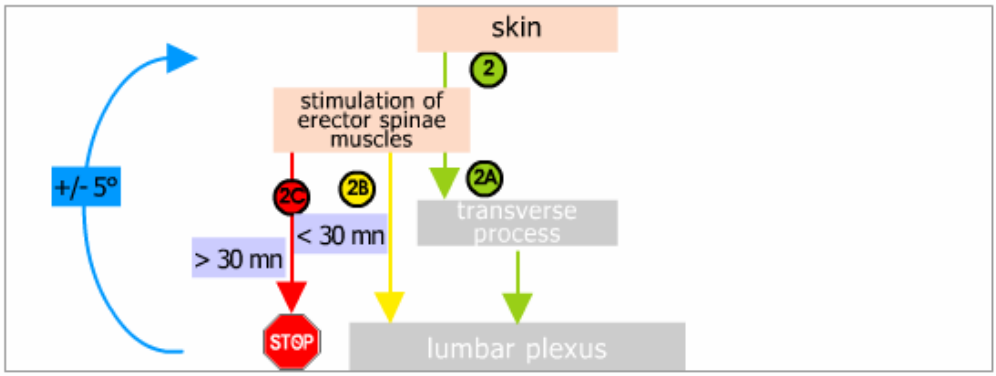
Please have a look on the procedure diagram movie to understand the differents cases of progression.

Procedure diagram animation









PROGRESSION 1 PROGRESSION 2 PROGRESSION 3 PROGRESSION 4

PROGRESSION 2

Needle insertion causes contractions in the Erector spinae muscle.

The needle is inserted further until contractions fade and disappear.

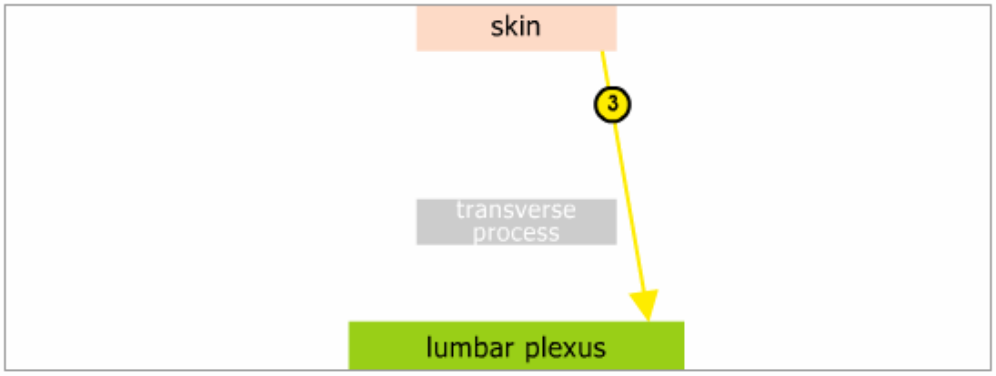
Then:

- 2a: The needle meets the transverse process (back to progression 1).

- 2b: The needle comes directly into contact with the plexus (back to progression 3)

- 2c: neither the transverse process nor the plexus are encountered (back to progression 4).

It is mandatory to verify the cutaneous landmarks following several unsuccessful attempts.

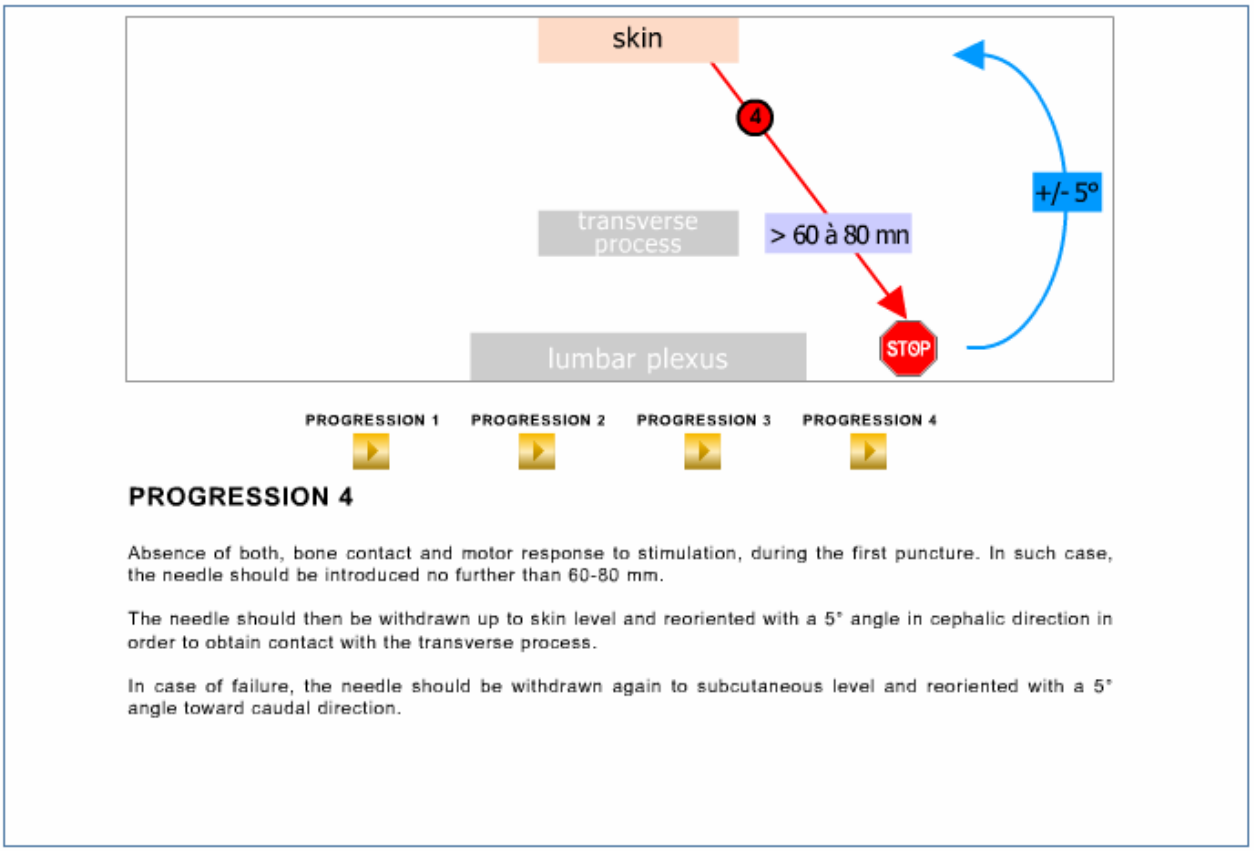


PROGRESSION 1 PROGRESSION 2 PROGRESSION 3 PROGRESSION 4

PROGRESSION 3

The needle encounters the plexus without ever touching the transverse process.

It is then adequate to proceed with the aspiration and injection.



STIMULATION

SUITABLE RESPONSES

- **Stimulation of Erector spinae or Quadratus lumborum muscles:**
  This is a usual response to initial needle insertion. Poorly defined contractions are observed around the puncture site. Progression must continue.
- **Stimulation of the femoral nerve:**
  Contraction of the Quadriceps femoris muscle is noted. This is the ideal and sought-after response

Stimulation of the femoral nerve movie

UNSUITABLE RESPONSES

- **Stimulation of the obturator nerve:** Contraction of the adductors, felt by palpation of the internal portion of the thigh, reveals that the needle is located too medially. The needle is withdrawn and reoriented laterally with a 5° angle.
- **Stimulation causing thigh adduction and patella ascension**. It may correspond to a stimulation of nerve near the spinal canal. This reveals that the needle is located too medially. The needle should then be withdrawn and reoriented with a 5° angle laterally.
- **Thigh flexion on the pelvis** is caused by stimulation of a motor branch to the Psoas major. Needle reorientation with a 5° angle toward cephalic or caudal direction should allow for stimulation of the femoral nerve at approximately the same depth.
- **Sciatic nerve stimulation** may happens if the puncture site is either too caudal or too medial (stimulation of the lumbosacral trunk). The needle must be reoriented with a 5° angle in both, cephalic and lateral direction

TEST DOSE

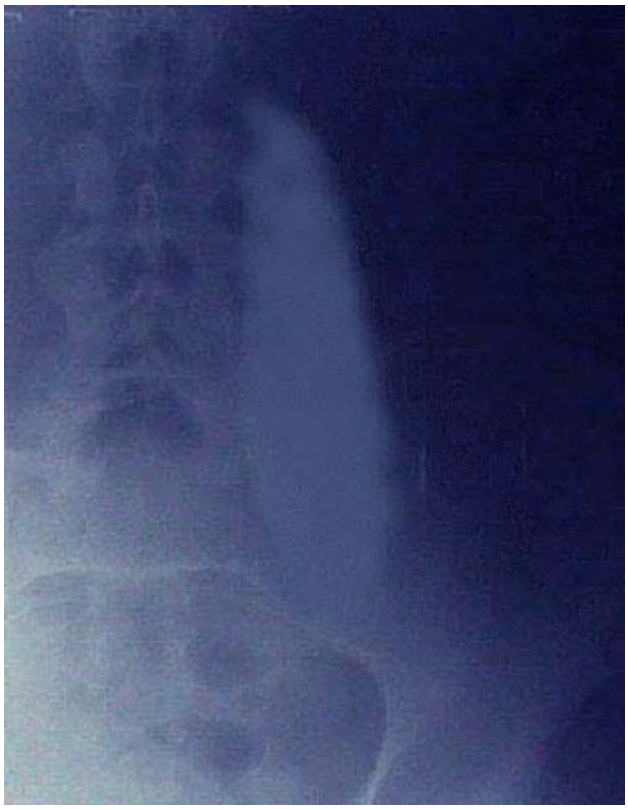
The administration of a test dose (3 ml of 2% lidocaine with epinephrine) is strongly recommended to avoid vascular or spinal injection.

CATHETER PLACEMENT

Although not mandatory, radiological visualization of the catheter can be performed. This will ensure that the catheter is in proper position while observing the diffusion space.

There are three types of diffusion images:

bundle-shaped, which parallels the Psoas major location



a plaque, of more blurred
and larger appearance,
representing the space between
the Psoas major and Quadratus lumborum muscles

vertical paravertebral opacity from L2 to L5.

Spread's animation

The radiological study can also detect faulty placements associated with epidural diffusionor aberrant routes (epidural, intraperitoneal, intraspinal, up or lateral outside the plexus).

CLINICAL EVALUATION OF THE BLOCK

The obturator nerve is responsible for 40% of the adduction strength of the thigh. In case of complete plexus block, the patient will exhibit paralysis of the adduction of the blocked limb. Only a motor evaluation allows for proper assessment of the obturator nerve function since its cutaneous distribution exhibits extreme variability.

PROTOCOLS

ANESTHESIA

- 20-30 ml of anesthetic solution.

POSTOPERATIVE ANALGESIA

- **Repeated injections:**
  20 ml of anesthetic solution (0.2% ropivacaine or 0.25% bupivacaine with epinephrine), two to three times daily.
- **Continuous infusion:**
  0.2% ropivacaine or 0.125% bupivacaine: 10 ml per hour.
- **Patient-controlled infusion:**
  0.2% ropivacaine or 0.125% bupivacaine: 5 ml per hour and boluses of 5 ml/30 min.
- **Surveillance:**
  Look for epidural diffusion (bilateral block).
  Regular hemodynamic monitoring due to possible epidural spread.
  Request presence of nursing staff when the patient gets up: risk of falling due to motor blockade.

COMPLICATIONS

- **Venous puncture:**
  The lumbar vein may be punctured. The needle is then located too medially and must be reoriented with a 5° angle laterally.
- **Ureter puncture:**
  Needle tip is too deep.
- **Kidney puncture [11]:**
  The needle is inserted too deep and too cephalic. Avoid puncture at the L3 level, particularly on the right side.
- **Peritoneal puncture:**
  Needle tip is too deep.
- **Spinal or epidural puncture:**
  The puncture site or the direction of the needle are too medial. Always aspirate before injecting slowly small quantities of anesthetic solution.
- **Epidural extension of anesthesia [1]:**
  In this case, whether the catheter is located in the paravertebral space or in the Psoas compartment, the anesthetic solution reaches the epidural space. Analgesia is effective. The catheter can be left in place but it should then be treated as an epidural.
- **Intravascular injection:**
  Intravascular injection can be prevented with a proper test dose and divided injections.
- **Secondary risks:**
  Psoas major hematoma causing nerve compression .
  This block is contraindicated in case of hemostatis disorder, anticoagulant or antithrombotic treatment

CONCLUSION

Whether it is used for surgery or postoperative analgesia, the posterior approach for the lumbar plexus block can provide complete blockade of all major nerves. This technic is useful during or after knee or hip surgery. To be reliable and safe, it should be performed in a methodical way.

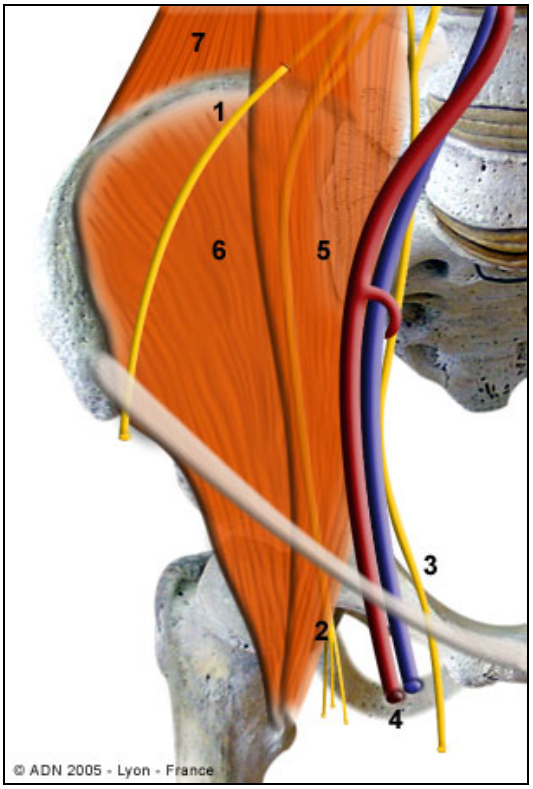
LOWER LIMB — ILIOFASCIAL BLOCK *SINGLE SHOT & CONTINUOUS*

Bernard Dalens , MD
Clermont-Ferrand – France

ANATOMY

The nerves involved in this block procedure are:

- The lateral cutaneous nerve of the thigh
- The femoral nerve
- And the obturator nerve



1. Cutaneous femoral nerve
2. Femoral nerve
3. Obturator nerve
4. Femoral artery
5. Psoas muscle
6. Iliac muscle
7. Lumbar quadrate muscle

EQUIPMENT

MAIN

- short, short-bevel and non-insulated needle (21-23G, 25 to 50 mm long)
- the interposition of a flexible and transparent extension line between the needle and the syringe is mandatory ("immobile" needle)

ALTERNATIVELY

short IV cannula (19-20G) with obturator or Tuohy-like needle for catheter insertion at the inner surface of the fascia iliaca (allowing iterative reinjections or continuous infusion for long-lasting pain relief

ANAESTHETICS

LOCAL ANAESTHETICS

- Bupivacaine up to 2 mg/kg
- Lidocaine up to 5-7 mg/kg
- Mépivacaine up to 5-7 mg/kg
- Ropivacaine up to 2.5 mg/kg

ADDITIVES

- Adrenaline (commercial solutions containing adrenaline)
- Clonidine (1-2 µg/kg)

BOLUS DOSE

- 1 ml/kg (up to 35ml)

REPEAT DOSES

- 0.5 ml/kg (up to 20ml) of 1% lignocaine or mepivacaine
- no more than 4 doses per 24 hours

CONTINUOUS INFUSION

- 0.75 to 1.5 ml per year of age (up to 10 ml/h)
- plain solution of either 0.1-0.125% bupivacaine or 0.2% ropivacaine

PERFORMANCE

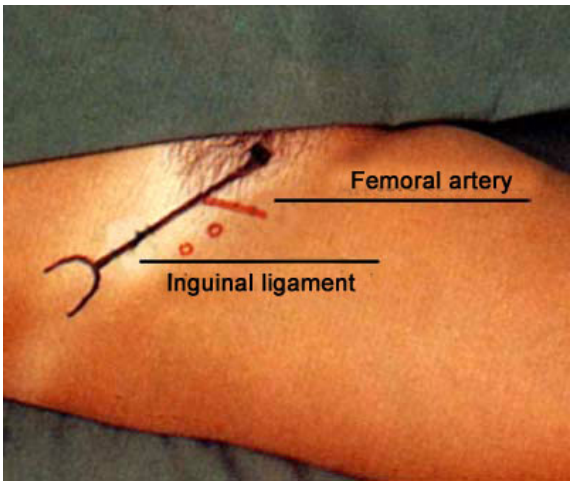
PATIENT'S POSITION

Dorsal recumbent position with the relevant lower extremity slightly abducted and externally rotated (if possible). In fact, any position allowing access to upper ventral part of the limb is suitable.

PUNCTURE SITE

The key landmark is the inguinal ligament which extends from the pubic tubercle to the anterior superior iliac spine.

The puncture site lies at 0.5-1 cm below the union of the lateral with the two medial thirds of the inguinal lateral, lateral to and at distance from the femoral artery.



TECHNIQUE

Insert the needle at right angles to the skin until two clearly identifiable losses of resistance are felt, respectively at the crossing of the fascia lata then the fascia iliaca

Single shot technique: inject the local anaesthetic through the lumen of the needle according the usual safety rules, then massage the swelling produced in order to favour the upward spread of the local anaesthetic

Continuous infusion or iterative injection technique: when the tip of the needle is below the fascia iliaca, remove the obturator and introduce the catheter through the lumen in order to insert 2-3 cm of catheter at the inner aspect of the fascia iliaca. Set the connecting device and interpose an antibacterial filter before carefully dressing and fixing the catheter on the skin.

TIPS

Ropivacaine has no legal recommendation for use in children less than 12 years of age.

LOWER LIMB — OBTURATOR BLOCK *SINGLE SHOT*

Olivier Choquet , MD
Marseille – France

Selective blockade of the obturator nerve is not as common as other major peripheral nerve blocks (e.g., sciatic or femoral nerves).

When femoral nerve block combined with sciatic nerve block is used for lower limb surgery, combined sedation or general anesthesia are frequently reported in 13–37% of patients scheduled for knee arthroscopy [1-4], and in 42% of patients for open knee surgery [5].

Femoral nerve block is effective for femoral nerve blockade, sometimes effective for lateral femoral cutaneous nerve blockade and not effective at all for obturator nerve blockade [6-9]. The concept of three-in-one block is now defunct and it is necessary to separately block individual nerves to consistently provide complete anesthesia for procedures on the knee joint or involving the medial aspect of the thigh [10-13].

In half of the cases, the cutaneous contribution of the obturator nerve is missing or overlapped by the femoral, posterior cutaneous, or sciatic nerve; in half of the cases, hypoesthesia is either in the medial part of the knee or in the inner part of the popliteal fossa. For the vast majority of patients, the femoral nerve supplies the medial cutaneous aspect of the thigh. The cutaneous distribution of the obturator nerve must not been assessed on the medial aspect of the thigh and the only way to effectively evaluate obturator nerve function is to assess the adductor strength [10-13].

Some practitioners are reluctant to perform an ONB using the classical pubic approach described by Labat [14] witch is reputed to be difficult. Moore said that the block could be missed, even in the most expert hands [15]. The success rate is now between 89 and 100 % with the aid of the nerve stimulator [11,16]. With the pubic approach, 90% of patients reported moderate to severe discomfort and patient satisfaction is low [17]. This could be due, in part, to the puncture site at the mons pubis close to the genitals and because of painful bone contact for a great number of patients.

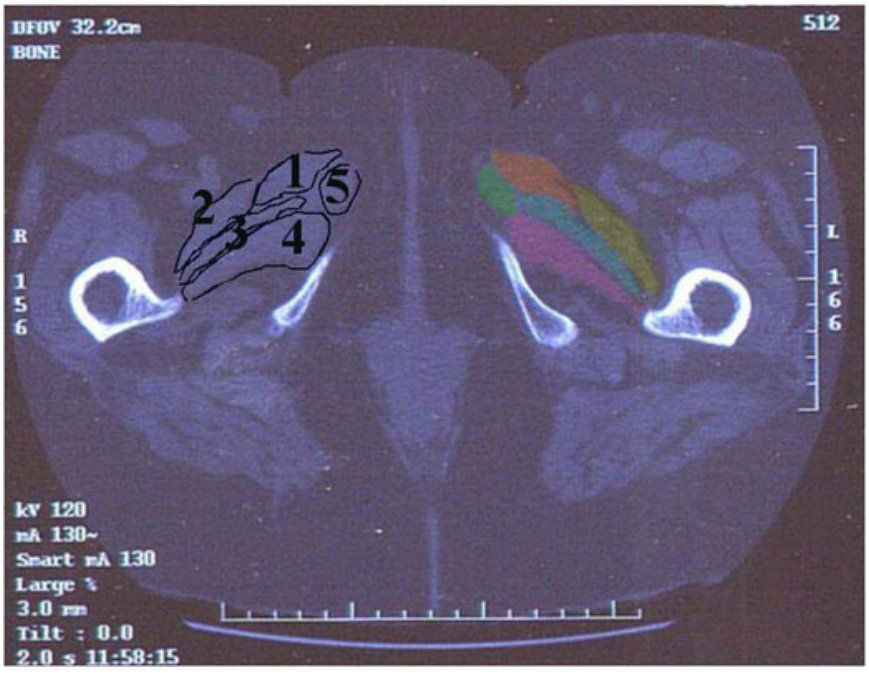
An inguinal approach for ONB offers various advantages. In clinical experience, this technique is easy, successful, less painful and more comfortable than the pubic approach [18].The inguinal approach is more acceptable to the patient because palpation and penetration of the mons pubis is avoided. Delineating the groove between the vascular bundle and adductor muscles, drawing only in the inner part of the thigh and introducing the needle at the level of the inguinal crease probably improve patient acceptance.

ANATOMY

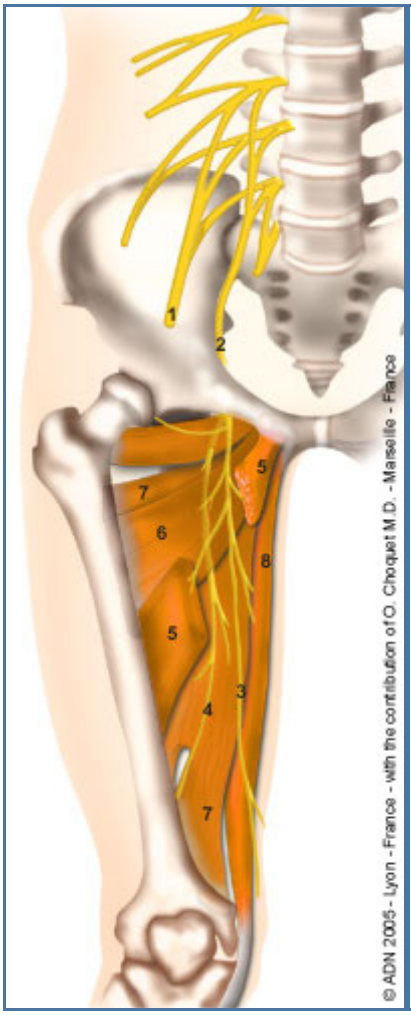
The medial (adductor) compartment of the thigh consists of the adductor longus, brevis, magnus, and the gracilis muscles, mainly innervated by the obturator nerve.

The obturator nerve, which originates from the ventral rami of L2, L3, L4, is the most anterior and medial branch of the lumbar plexus. It emerges from posterior and medial border of the psoas muscle, piercing the iliaca fascia between L5 and S1. It runs on the lateral side of the pelvis over the obturator muscle. It crosses the obturator foramen with the obturator vessels and gives two divisions, anterior and posterior, for the medial side of the thigh.

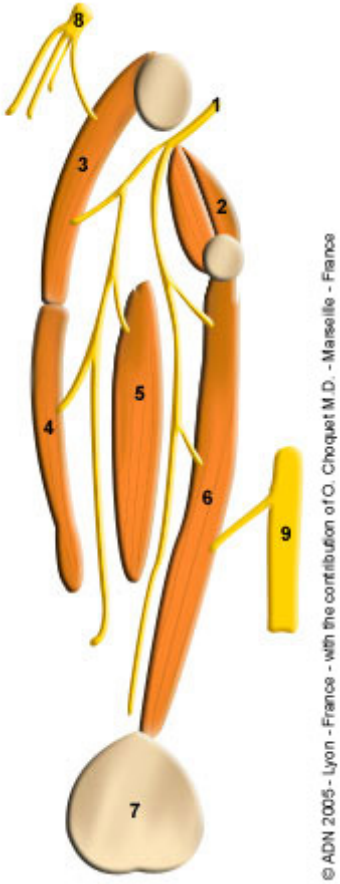
The posterior branch runs over adductor magnus and behind the adductor brevis, and contributes to the articular capsule of the knee.



The anterior branch runs in front of the adductor brevis muscle and behind the adductor longus, and contributes to the cutaneous posterior and / or medial aspect of the knee.



1. Femoral nerve
2. Obturator nerve
3. Anterior branch of the obturator nerve
4. Posterior branch of the obturator nerve
5. Adductor longus muscle
6. Adductor brevis muscle
7. Adductor magnus muscle
8. Gracilis muscle



1. Obturator nerve
2. Obturator internus muscle
3. Pectineous
4. Adductor longus muscle
5. Adductor brevis muscle
6. Adductor magnus muscle
7. Medial condyle
8. Femoral nerve
9. Sciatic nerve

INDICATIONS

Obturator nerve block at the pubic level combined with spinal or general anesthesia is indicated in transurethral resection (TUR) of tumors located on the lateral and inferolateral bladder. Direct electrical stimulation of the obturator nerve by the surgical resectoscope by way of contractions of the thigh adductor musculature and sudden movements of the leg pose a potential for bladder wall perforation, bleeding, incomplete resection, and/or dissemination of the tumor.

The block is also used for the diagnosis and treatment of adductor muscle spasticity and in chronic pain conditions (hip pain, pelvic tumor). For these indications, the inguinal obturator block has not been evaluated.

Obturator nerve block improves the quality of anesthesia during knee surgery under peripheral nerve block [19,20] and postoperative analgesia after total knee arthroplasty [21,22].

INGUINAL OBTURATOR BLOCK

Anterior and posterior branches of the obturator nerve are selectively blocked at the inguinal level.

SEDATION

All patients do not require sedation if only an inguinal ONB is performed. Patients who are anxious or who demonstrate needle phobia, trauma patients in whom multi-nerve stimulation may be particularly painful should clearly benefit from sedation.

POSITIONING OF THE PATIENT

The patient is placed supine and legs slightly abducted as for a femoral block.

EQUIPMENT

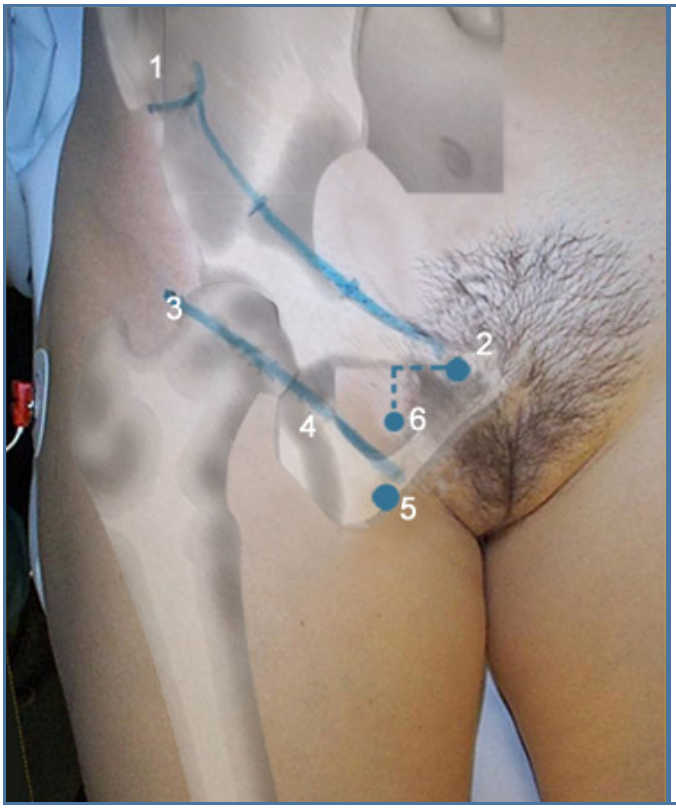
- a nerve stimulator;
- a 50 mm short bevel needle at the inguinal fold, 70 mm at the pubis or in overweight patients;
- a 10 ml syringe of local anesthetic.

CUTANEOUS LANDMARKS AND PUNCTURE SITE

The patient is first asked to flex his/her hip and a line marked the inguinal crease.

The adductor longus tendon is identified as the most superficial palpable tendon in the medial part of the thigh.

A mark on the skin is made in the inguinal crease at the midpoint of the line drawn between the inner border of the adductor longus tendon and the femoral arterial pulse. This point corresponds to the center of an easily palpable groove between the vascular bundle and the adductor longus muscle.



1. Superior anterior iliac spine
2. Pubic tubercle
3. Inguinal crease
4. Femoral pulse
5. Insertion point of the needle in the inguinal approach
6. Insertion point of needle in the pubic approach

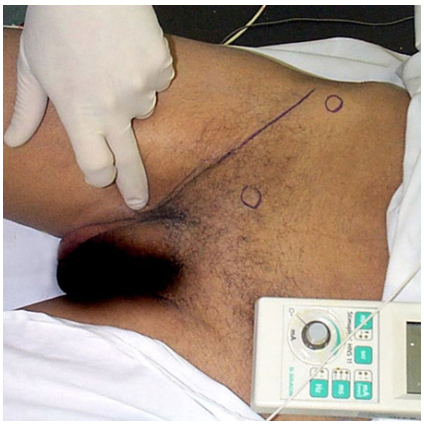
PUNCTURE

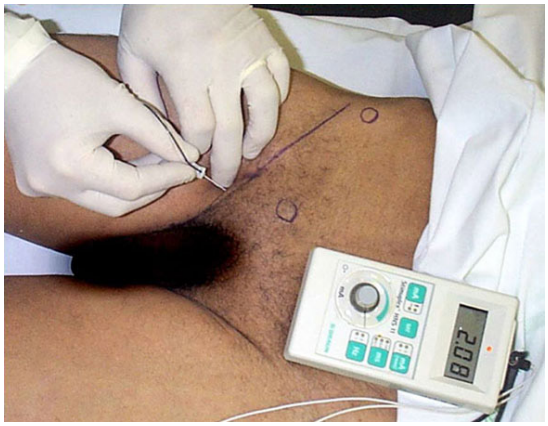
The stimulation is begun using a current of 2 mA for 0.1 ms at 1 Hz. The needle is inserted in a 30° cephalad direction until contractions of the gracilis and/or adductor longus muscle is elicited.

The adductor longus twitch (anterior branch) is observed at the anterior part of the inner thigh. Weak contraction of the gracilis, which frequently accompanies the former, forms a narrow muscular band down to the medial part of the knee. The current is gradually decreased until the muscle twitch stopped between 0.2 and 0.7 mA. At that time, 5 mL (0.07 ml.kg-1) of LA is injected (anterior branch of the obturator nerve).

The needle is inserted deeper and in a 5° lateral direction until contractions of the adductor magnus muscle are elicited.

The strongest adductor magnus (posterior branch) twitch appears at the posterior part of the inner thigh and produces a noticeable hip adduction. In the same manner, 5 mL (0.07 ml.kg-1) of LA is injected (posterior branch of the obturator nerve).





TIPS

The needle direction from its point of entry is mainly perpendicular to the plane of the anterior and posterior branches which spread out and diverge downward on leaving the obturator canal. Thus, needle access to the branches is highly likely at the first attempt.

When the nerve is not located after some attempts, the current charge may be increased, then the insertion point is moved 1 cm more laterally, then 1 cm more medially if necessary.

A 50-mm needle seems adequate for the majority of subjects except for those who are overweight.

One may easily differentiate one branch from the other, even when they are still on the same plane.

A bone contact in the inguinal approach indicates that the needle is too deep and touches the ischiopubic ramus.

The main limitation is failure to reach obturator branches contributing to hip joint innervation which arises frequently prior to entry of the nerve into the thigh.

The total dose must be taken into consideration in the case of combined blocks.

CLASSICAL PUBIC APPROACH

The patient is placed supine and legs slightly abducted and externally rotated.

The pubic tubercle (pubic spine) and the inguinal ligament are palpated and a line is drawn between the tubercle and the anterior-superior iliac spine.

Stimulation is begun using a current of 2 mA for 0.1 ms at 1 Hz.

The needle is inserted posteriorly and 20° laterally, 2 cm caudal and 2 cm lateral to the pubic tubercle.

Intentional bone contact and sliding off the inferior border of the superior pubic ramus is not necessary with the aid of the nerve stimulator.

The current is gradually decreased until the muscle twitch stopped between 0.2 and 0.7 mA. At that time, 10 mL of LA is injected for an adult patient. A volume of 0.3 ml.kg-1 is suggested for children.

BLOCK ASSESSMENT

One may be unable to demonstrate cutaneous loss of sensation following ONB.

The only way to effectively evaluate obturator nerve function is to assess the adductor strength asking the patient to squeeze his (her) knees.

With a complete combined femoral, sciatic and obturator nerve block, the patient only adduct the contralateral leg toward the midline.

Diffusion de la solution radio-opaque immédiatement après l'injection.

1. aiguille et diffusion du bloc obturateur inguinal
2. aiguille du bloc fémoral

COMPLICATIONS AND CONTRAINDICATIONS

No complications directly related to an obturator block have been reported in the literature. Some specific complications are likely with the traditional approach [23-26]. The needle may pass above the pubic ramus penetrating the pelvic cavity, particularly when identifying the pubic spine is difficult. Care must be taken not to advance the needle too far and to damage surrounding structures (e.g., bladder, rectum, spermatic cord). This approach is performed in a highly vascularized region (obturator vessels, circumflex arteries and veins). Intravascular injection and hematoma may occur. The vascular connections between the obturator and external iliac systems behind the pubic ramus (i.e., corona mortis) can be life-threatening in case of injury [27].

The puncture at a distance from the pelvis and large vessels in the inguinal approach minimize the risk of complications and allows compression in the event of a hematoma.

These blocks should be avoided in cases of entrapment neuropathy or compression [28].

CONCLUSION

Inguinal obturator nerve block is easy, efficacious and safe [29]. An ONB is mandatory for adequate anesthesia when surgery involves the medial thigh or the knee.

ANATOMY SACRAL PLEXUS

Frederic Lacroix , MD
Marseille – France

SACRAL PLEXUS

It is formed by the union of the lumbosacral trunk with the first three sacral nerves.

The lumbosacral trunk consists in the anastomosis of the last two lumbar nerves with the anterior branch of the first sacral nerve.

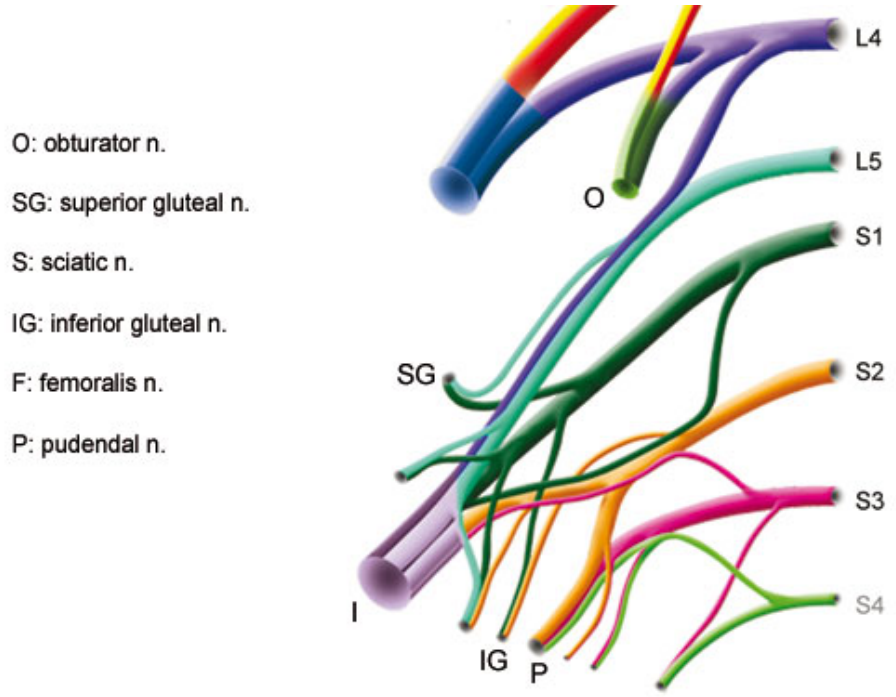
This structure then receives the anterior branches of the second and third sacral nerves, forming the sacral plexus.

The sacral plexus is shaped as a triangle pointing toward the sciatic notch, with its base spanning across the anterior sacral foraminae. It rests on the piriformis muscle's anterior aspect and is covered by the pelvic fascia that separates it from the hypogastric vessels and pelvic viscera.

Seven nerves stem from the sacral plexus: six collateral branches and one terminal branch, the sciatic nerve.

Collateral branches of the sacral plexus

Name	Source	Muscular innervation
N. to obturator internus	Lumbosacral trunk and S1	Obturator internus
Superior gluteal n.	Lumbosacral trunk and S1	Gluteus medius Gluteus minimus Tensor fasciae latae
N. to piriformis muscle	S2	Piriformis
N. to biceps femoris superior	Anterior portion of plexus	Biceps femoris superior
N. to biceps femoris inferior and quadratus femoris	Anterior portion of plexus	Biceps femoris inferior Quadratus femoris Branch to coxofemoral articulation
Posterior femoralcutaneous nerve (lesser sciatic n.)	Lumbosacral trunk, S1, S2	Inferior gluteal n. to gluteus maximus muscle Sensory branch to buttock, thigh, popliteal fossa, and lateral aspect of knee



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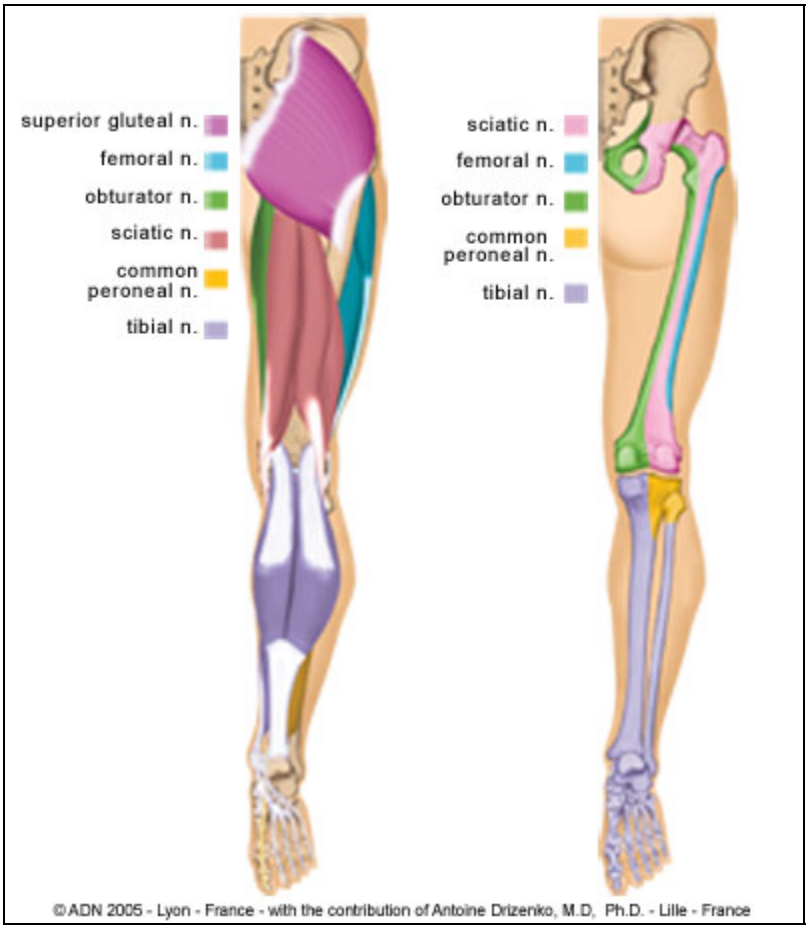
SCIATIC NERVE

It originates from contributions of all nerves composing the sacral plexus. It leaves the pelvis through the ischiatic notch and follows an almost straight course along the posteromedial aspect of the femur. In the popliteal fossa, the sciatic nerve divides into its two terminal branches, the tibial and common peroneal nerves.

TERMINAL BRANCHES OF THE SCIATIC NERVE

The sciatic nerve usually divides into its two terminal branches at the apex of the popliteal fossa.

This division may arise as proximally as the anterior aspect of the piriformis muscle as the sciatic nerve exits the pelvis. In the popliteal fossa, the two terminal branches become more superficial. They rest in a matrix of fatty connective tissue and are isolated from the vascular compartment by a fascia.



TIBIAL NERVE

It is larger than the common peroneal nerve. The tibial nerve innervates the posterior (flexor) muscles of the calf and the flexor muscles of the plantar area of the foot. It follows the same orientation as the sciatic nerve along the posterior aspect of the tibia where it gives off motor branches to the calf muscles and a sensory branch to the knee joint. A sural branch emerges after exiting the popliteal fossa.This branch follows the same path as the external saphenous vein behind the external malleola of the ankle. The sural nerve innervates the skin lateral to the ankle and foot. The tibial nerve ends its course in the plantar ara of the foot after following the posterior aspect of the medial malleola of the ankle. It supplies motor innervation to the intrinsic muscles of the foot and sensitivity to the plantar surface of the foot.

COMMON PERONEAL NERVE

It exits the popliteal fossa laterally, crossing the peroneal neck before splitting into its two terminal branches: the superficial nerve that provides sensitivity to the dorsum of the foot, and the deep peroneal nerve which supplies motricity to the anterior (extensor) muscles of the leg. A small cutaneous area between the first and second digits is innervated by the deep peroneal nerve.

LOWER LIMB SCIATIC BLOCKS - PARASACRAL NERVE APPROACH - SINGLE SHOT & CONTINUOUS

Elisabeth Gaertner, M.D.
Strasbourg - France

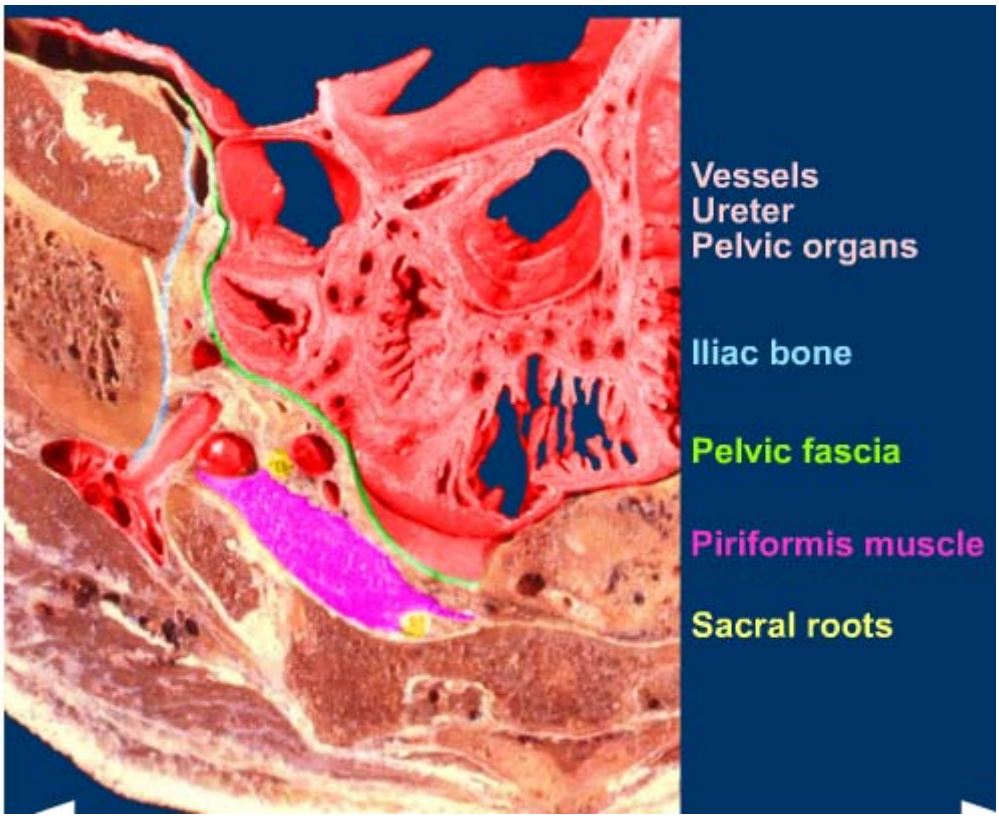
Sciatic nerve block is classically used in combination with a femoral nerve block for the lower limb surgery. Mansour has described a Para sacral approach to the sciatic nerve in 1993 [1]

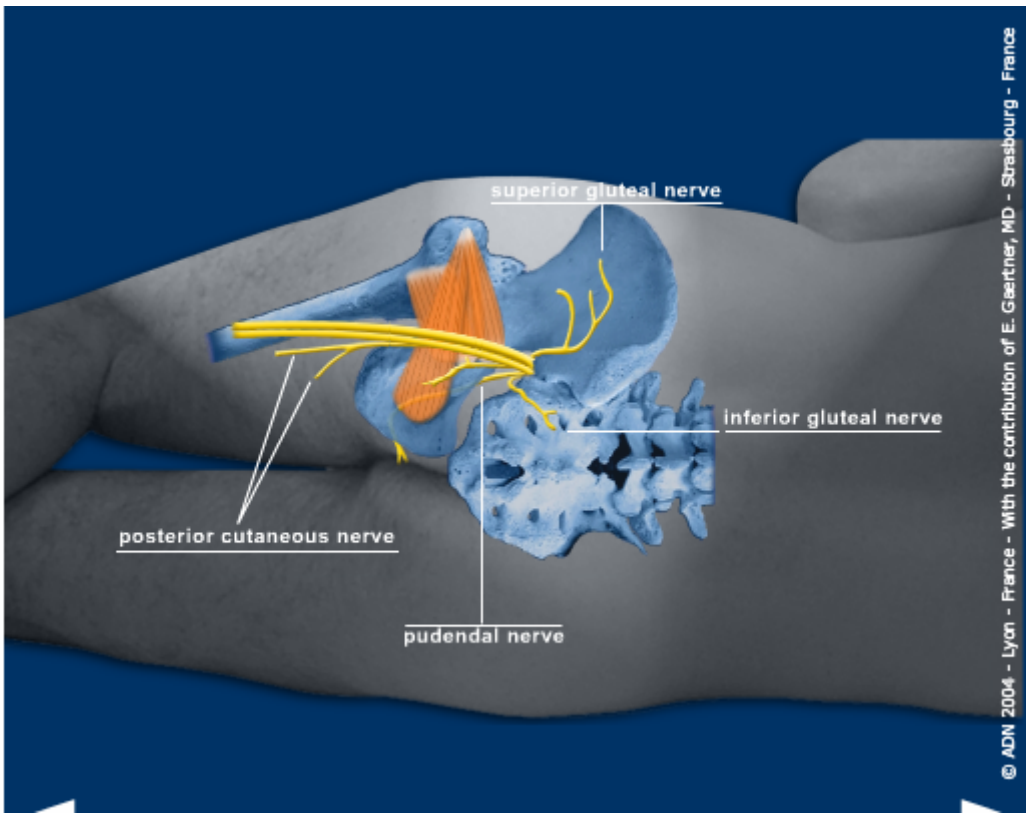
This block, rather than a sciatic nerve block, is a real sacral plexus block. This approach aims to inject local anaesthetic solutions in a fascial area including the sacral plexus branches before they form the sciatic nerve, above the piriformis muscle.

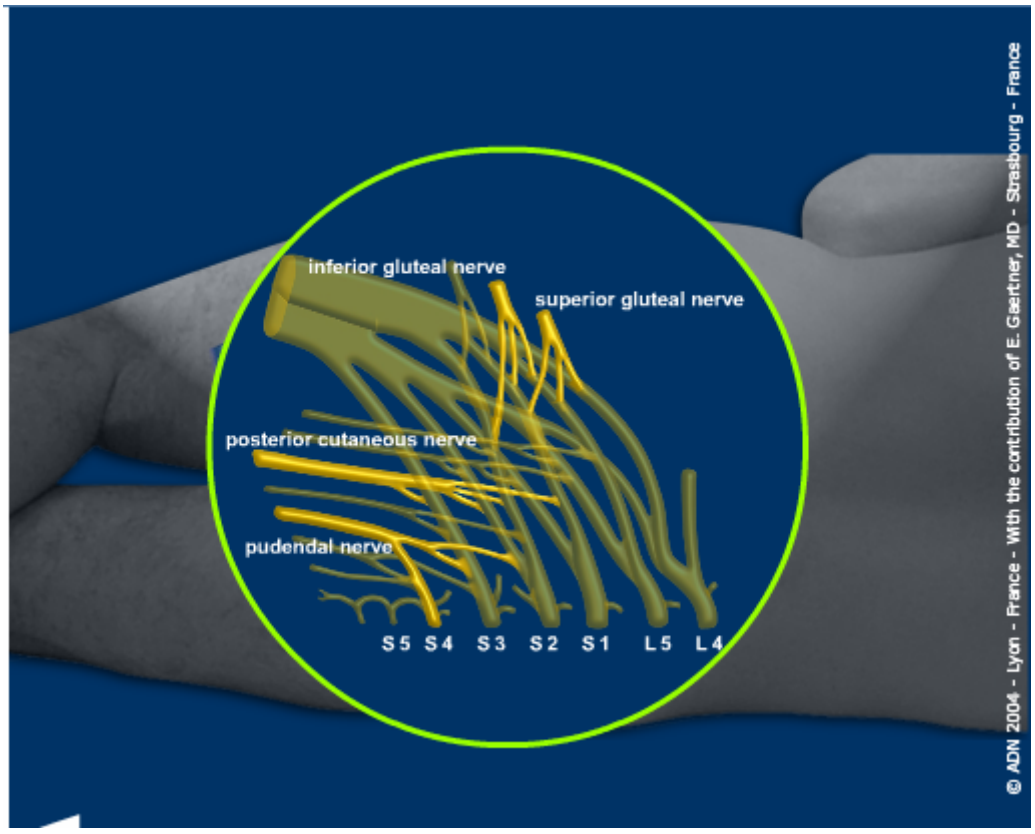
While Mansour already has mentionned the possible insertion of catheters through this way, Morris described two case reports for lower limb surgery in 1997[2].

ANATOMY

The sacral plexus is formed by the lumbosacral trunk and the ventral rami of the first, second, third and fourth sacral nerves and from and L5. The nerves forming the sacral plexus converge towards the greater sciatic notch and unite to form a large band located on the posterior wall of the pelvic cavity, in front of the piriformis muscle. In 10% of patients, the sciatic nerve is separated in greater sciatic foramen by all or part of the piriformis. The sciatic nerve is accompanied by the Posterior Femoral Cutaneous Nerve (PFCN) and the inferior gluteal artery and its special branche to the nerve. The nerve enters thigh beneath the lower border of the maximus gluteal muscle. It descends near the middle of the thigh, lying on the adductor magnue muscle and being crossed obliquely by the long head of the biceps femoris. The nerve usually separates in upper aspect of the popliteal area.







Anatomic report animation

In front of the sacral plexus are the hypo gastric vessels, the ureter and the sigmoid colon. The gluteal vessels follow the same course as the sacral nerves [3], in an anterior plane. The sacral plexus lies dorsally on the piriformis and ventrally on the fascia of this muscle. This fascia contributes to form the pelvic aponevrosis or fascia. This one, fibrous and resistant, is fixed medially on the anterior sacral foramina, where the sacral nerves emerge.

Through this fascia, the sacral plexus lies near the rectum. Laterally, the sacral plexus lies close to the greater sciatic foramen doubled by the obturator internus muscle.

The sacral plexus runs in a fascia plane limited by the pelvic fascia ventrally, the piriformis dorsally and medially and laterally by the obturator internus muscle.

Near the sacral plexus runs the hypogastric vessels and particularly the superior gluteal artery that passes between the lumbosacral trunk and the first sacral nerve. The inferior gluteal vessels run between the second and the third sacral nerves. The other important arteries are the lateral superior and inferior sacral arteries, the ischiatic arteries and the pudendal artery.

- Ventral collateral branches of the sacral plexus are the nerve to the obturator internus muscle, the haemorrhoidal nerve, the pudendal nerve and the pelvic organs nerves. All these nerves form the pudendal plexus, formed by the ventral branch of S4, anastomosed with the S2 and S3 branches of the sacral plexus. They supply to the pelvic and perineal organs.
- Dorsal collateral branches are the inferior and superior gluteal nerves, the nerves to the piriformis, gemelli and quadratus femoris muscles.
- One terminal branch is the sciatic nerve.

The sacral plexus supplies to the skin of the medial part of the glutea and the posterior face of the thigh. It supplies also to the hip joint and to the proximal muscles of the thigh.

More caudally, the sensitive territory of the sacral plexus is the one of the sciatic nerve.

The extension of the LA volume : in the parasacral area, limited dorsally by the central aponevrosis of the piriformis muscle, laterally by the obturator internis muscle, and medially by the pelvic aponevrosis.

Video of scanner

EQUIPMENT

- 100 mm insulated needle is used to perform a single shot block
- Several kits for catheter insertion exist on the market. We usually use to place Contiplex D 110 ™, Bbraun, Melsungen, Germany. The needle is at least 90mm long. The ideal set includes an insulated needle with a short bevel, a canula to insert the catheter, an electrical wire connection and an antibacterial filter. In some kits catheter passes through the needle, without canula (ie: Tuohy needle).
  The Morris et al team use Tuohy insulated needles. [2].

Two syringes with local anaesthetics are prepared: 3 mL of lidocain 1% for local anaesthesia of the skin and 20 mL ropivacain 0,75%.

POSITION OF THE PATIENT

The parasacral block is preferably performed preoperatively, on an awake patient. A light sedation with 1 or 2 mg of midazolam is recommended to avoid an unpleasant puncture.

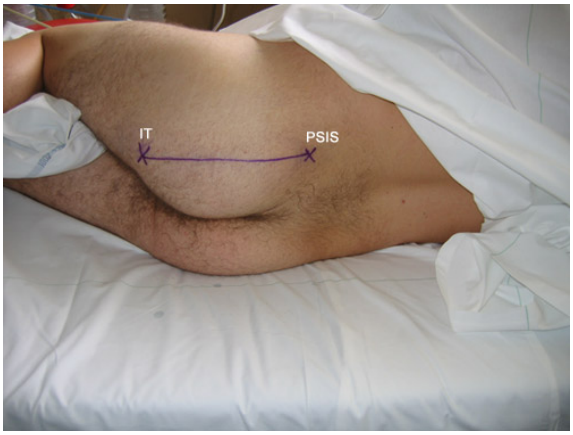
He is positioned as for any sciatic nerve block by the posterior approach : in the Sim's position; the side to be blocked is uppermost. The dependant limb should be straightened at the knee and hip, and the limb to be blocked should be flexed at both hip and knee.

SURFACE LANDMARKS

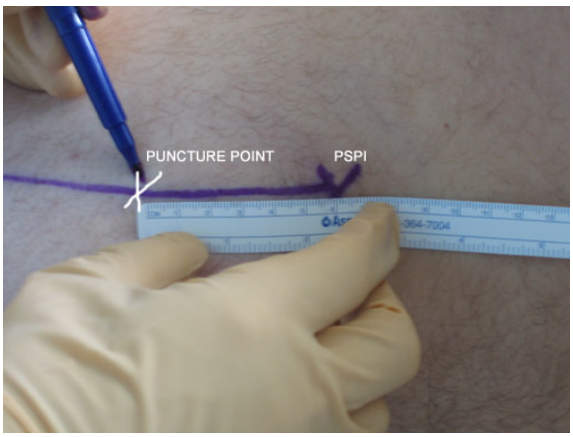
A line is drawn between the posterior superior iliac spine (PSIS) and the lowest point of the ischial tuberosity (IT), both points may generally be felt and seen.

Surface landmark animation

The puncture point lies three fingers breadth (6 to 8 cm) inferior to the PSIS on this line. This point is just below the posterior inferior iliac spine, which cannot be felt. The motor response is generally found at 6 to 8 cm deap.



PUNCTURE



The needle is connected to a nerve stimulator.

For a single shot, the needle is directed perpendicular to the skin, to all planes, strictly horizontal. It is important not to direct the needle medially.

To introduce a catheter, the puncture point is the same; the needle is directed 10° more caudally to facilitate the catheter insertion.

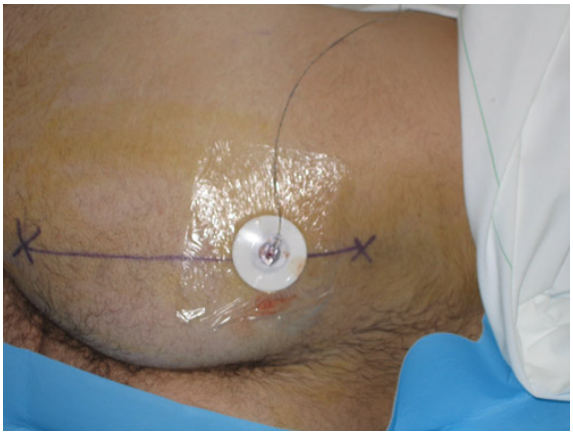
Puncture animation

MOTOR RESPONSES

As soon as the skin is crossed, the nerve stimulator is switched at 2 mA intensity, in order to elicit motor responses: a positive response of plantar flexion of the foot or toes (tibial division of the sciatic nerve) or dorsiflexion/eversion of the foot or toes (peroneal division of the sciatic nerve) is sought. The type of motor response to find is indifferent [4]. The intensity is then reduced in order to preserve this motor response around 0.5mA. The mean depth of eliciting the response is 7 cm. The local anaesthetic solution can then be injected with the usual precautions of regional anaesthesia: motor response disappearance with the first mL injection, repeated negative blood aspiration tests, fractioned and slow injection, verbal contact with the patient. A volume of 15 to 20 mL local anaesthetics is sufficient. With this approach a multistimulation is not essential due to the fascia space where lies the sacral plexus lies [4].

Usually the 3 branches of the sciatic nerve (tibial, common peroneal and posterior cutaneous nerve of the thigh) emerge above the piriformis muscle. The catheter is then inserted (8 to 10 cm from the skin, at most 2cm from the extremity of the needle). It is not useful to insert the catheter further: this avoids misplacement and pushing the catheter below the piriformis. Indeed if the catheter is pushed too far along the sciatic nerve, the posterior cutaneous nerve of the thigh may escape the block. This nerve leaves the sciatic trunk above the piriformis.

It is preferable to tunnellise the catheter below the skin for 4 to 5 cm in order to move it away from a septic area. The catheter is then fixed and an antibacterial filter is connected.



TIPS

The correct motor responses are, as discussed above, an extension or flexion of the foot or toes.

A proximal response localised only to the hip or thigh cannot be accepted: it can be a sign of muscular contraction of the piriformis (too caudal and superficial puncture), of the obturator internus muscle (too lateral puncture). An obturator nerve stimulation (adduction of the thigh) is due to an excessively deep and medial puncture. This nerve runs in front of the parasacral plexus, in the same fascia plane.

A gluteal muscle contraction means a puncture too superficial.

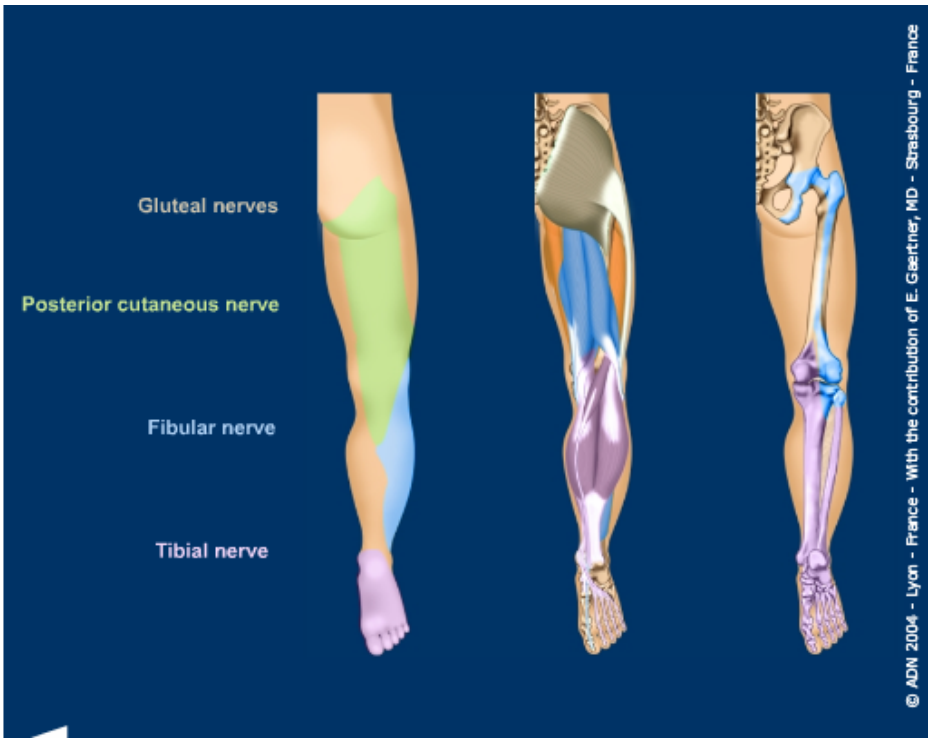
In case of bony contact (sacral or iliac bone, near the sacroiliac joint, at the top of the greater sciatic notch), the needle has to be re-oriented more caudally and laterally on the line drawn. This bony contact is a good depth marker: the nerve is approached on the top of the greater sciatic foramen, where the sciatic nerve leaves the pelvis. The needle tip should be no more than 20 mm deeper than the surface of the bone if encountered.

EXTENSION OF THE PARASACRAL BLOCK

A motor and sensory test of the block is essential. The advantage of this block is the fact that with only one stimulation we can anaesthetize the three main branches of the sciatic nerve to perform a surgical anesthesia: tibial, common peroneal and posterior cutaneous nerve of the thigh [5]. Not only the origin of the sciatic nerve is to be found with this block, but the superior and inferior gluteal branches and the nerve to the quadratus femoris are also blocked.

Anatomical data can explain that an extension to the obturator nerve is common (93% in the Morris's study, n=30) [6]. With a "three in one" block, the obturator block is often incomplete. Jochum demonstrated the unreliability of the parasacral sciatic nerve block to achieve conduction block of the obturator nerve. The parasacral approach does not result in a concurrent obturator nerve block.[7]

Extension animation



An extension to the pudendal plexus branches is also possible, essentially to the pudendal nerve. In the Morris's study, 80% of the patients had an unilateral anaesthesia of the perinea.

The proximity of the pelvic splanchnic nerves, the position of the terminal branches of the sympathetic trunks and the inferior hypogastric plexus can explain hypothetical urinary retention. Morris didn't find any case of difficult voiding and no patient required postoperative catheterization

The Cuvillon's study demonstrated that Winnie's single injection and parasacral block were performed faster than Winnie's double injection. However, Winnie's single injection produced a higher number of incomplete blocks compared with the other groups. The parasacral and Winnie's double-injection methods produced similar success rates for sensory and motor block of the different components of the sciatic nerve. Time to perform the block was faster in the parasacral group than in the Winnie's double-injection group (2.0 vs. 5.5 min), whereas onset time was faster in the Winnie's double injection group (15 vs. 25 min). Overall, the total block times (time to perform block onset time) were similar between the parasacral and Winnie's double-injection groups.

ANESTHETICS

For the moment, few studies mention the parasacral approach. For the first injection or single shot, 20 to 30 mL local anaesthetics are used. The local anesthetics used are lidocain or mepivacain fort short surgery, ropivacaïne levobupivacain for longer or painful surgery. The concentrations and volumes depend on the combination or not with a lumbar plexus block or a saphenous block. The two case reports of Morris concern an ankle arthrodesis and a leg amputation. The initial dose was 30 mL lidocain 1% with 1/200000 epinephrin, then postoperatively a bolus of bupivacain 0,375% with epinephrin and a continuous infusion of bupivacain 0,1% 8mL/h. Cuvillon used only 20mL in his study.

The protocols in our hospital (orthopaedic and traumatology unit, Hautepierre Hospital, Strasbourg, France): 20 mL ropivacain 0.75% then patient controlled administration of ropivacain 0,2% 5mL/kg/h, bolus 5mL, lock-out time 45 minutes.

COMMON INDICATIONS

SURGERY

Common indications for use of parasacral sciatic nerve block for surgery include knee, leg and foot surgery, or as a supplement to femoral nerve block

PAIN MANAGEMENT

Postoperative pain management after knee, leg or foot surgery.

The facility of insertion of a catheter in the space formed by the pelvic fascia medially, piriformis muscle dorsally, obturator internus laterally allows a good prolonged analgesia in the surgery of the lower limb.

This continuous parasacral sciatic block is reserved to the proximal surgery, where the posterior cutaneous nerve of the thigh is concerned:

- carcinologic surgery of the lower limb
- thigh or leg amputation
- popliteal fossea surgery (tumors, cysts…)
- total knee arthroplasty

Other indications are prolonged ankle, leg or foot surgery with a thigh tourniquet (serious trauma or microsurgery): in these indications the catheter technique is not only beneficial for the pain but by the prolonged sympathetic block as well.

CONTRA INDICATIONS

These are the same as the other peripheral blocks: infection at the puncture point, coagulation disorders and neurological defects in the territories of the block

A sacral sore is of course a contra-indication, a non cooperative patient is another. For a trauma patient it can be impossible to endure the puncture position

No complication of the parasacral plexus block has been published yet, in spite of the very proximity of the sacral plexus to the pelvic vessels and organs. A misplacement of a parasacral catheter without complication was discribed: the catheter was in the presacral area, and wxas only too deep introduced. A withdrawing of 2 cm was sufficient to have an efficient catheter [8].

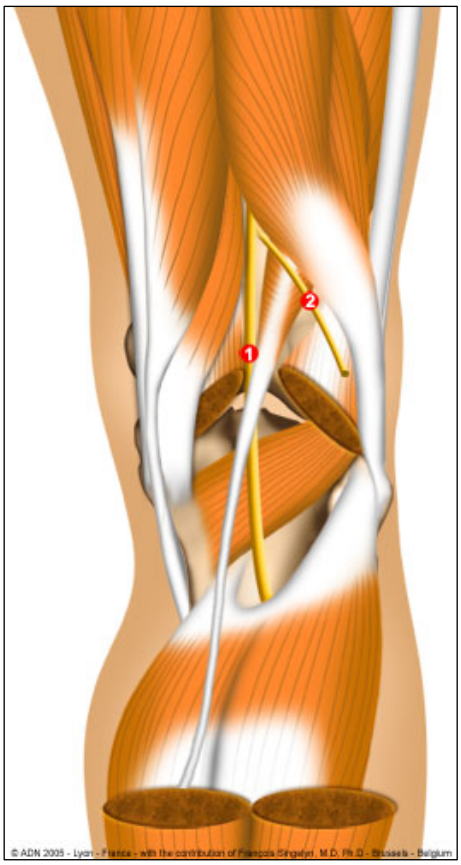
The extent of the pudendal plexus is sometimes worrying for the patient who has to be informed.

The parasacral approach is a very good block for anesthesia of the lower limb, in combination with a lumbar plexus block. Its success rate is excellent, even for the beginning regional anesthetists. The satisfaction index of the patient is very good. The pain during the puncture is less than with a posterior approach of the sciatic nerve (because of crossing muscular layers with the Labat's approach). The extension of the block is better than those of other approaches: the extension to the obturator nerve can be beneficial. It is a real plexic block, which can provide an excellent block of all the branches of the sciatic nerve with one stimulation. In combination with a lumbar plexus block, it can anesthetize the whole of the lower limb, including the posterior face of the knee. Insertion of the catheter is easy because of the fascia space. This block is reserved to the cases where a more distal sciatic nerve block is not enough.

LOWER LIMB SCIATIC BLOCK - POSTERIOR POPLITEAL APPROACH *SINGLE SHOT & CONTINUOUS*

François Singelyn, M.D., Ph. D
Brussels – Belgium

ANATOMY



The sciatic nerve is formed by the union of the first three sacral spinal nerves and the 4th and 5th lumbar nerves.

It is the largest of the four major nerves supplying the leg. It actually consists of two nerves contained within a common connective tissue sheath: the tibial (medial) and the common peroneal (lateral) nerves. It leaves the pelvis through the greater sciatic foramen.

It runs toward the posterior aspect of the thigh between the greater trochanter of the femur and the ischial tuberosity, down to the popliteal fossa. At 60 + 30 mm above the popliteal skin crease [1], it divides into its terminal branches :

1. The **tibial nerve** supplies the heel and the sole of the foot.
2. The **common peroneal nerve** innervates the lateral aspect of the leg and the dorsum of the foot.

INDICATIONS

USED ALONE

Single dose technique

- Surgery limited to the area innervated by the tibial and/or common peroneal nerve: broken toe, foot wound (particularly interesting in diabetic patient),...

Continuous technique

- Postoperative analgesia after major foot (hallux valgus, metatarsal osteotomy, broken calcaneus,…) or ankle (broken malleolus,…) surgery.

COMBINED WITH A FEMORAL OR A SAPHENOUS NERVE BLOCK

Any surgery below the knee.

CONTRAINDICATIONS

Previous popliteal surgery (vascular graft,…), popliteal tumor, local infection, preexisting sciatic neuropathy.

Relative contraindication is the morbidly obese patient for technical reason (locating needle too short!).

MATERIAL

A peripheral nerve stimulator.

Single dose technique: a 100 mm, 22 or 24 gauge, short bevelled or pencil point, sheathed, conducting needle.

Continuous technique: a kit for “plexus” catheter placement with a 80- 100 mm introducing needle (e.g. Contiplex, BBraun, Melsungen, Germany)

MONITORING

As for any regional anesthetic technique, an IV line must be in place. Monitoring includes ECG, non invasive blood pressure and pulse oximetry. All resuscitation drugs and all equipment required for handling possible complications (face mask, ambu bag, oxygen supply,...) should be available.

LOCAL ANESTHETIC ADMINISTRATION

SINGLE DOSE TECHNIQUE

The choice of the local anesthetic solution depends on the expected duration of anesthesia and analgesia:
< 3-4 hrs: 1.5% lidocaine with epinephrine 1/200000.
< 5-6 hrs: 1% mepivacaine with epinephrine 1/200000.
> 6 hrs: 0.5% bupivacaine, levobupivacaine or ropivacaine with epinephrine 1/200000.

Adding 0.5 µg/kg of clonidine significantly prolongs the duration of both anesthesia and analgesia, particularly when a short- (e.g. lidocaine) or medium- (e.g. mepivacaine) acting local anesthetic is used.[2]

The volume of local anesthetic to be administered is 20-25 mL.

CONTINUOUS TECHNIQUE :

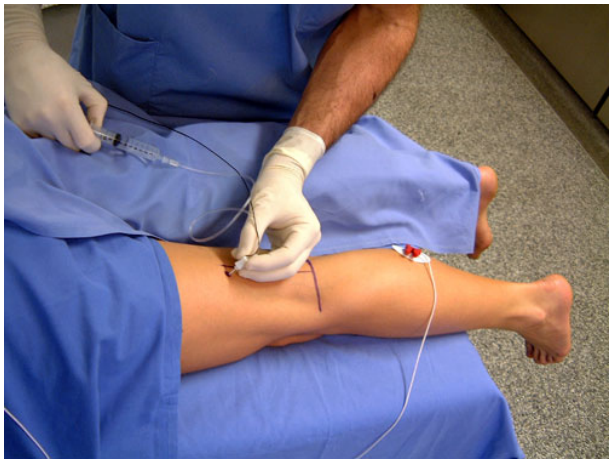
- *Initial bolus dose* :
1% mepivacaine or 0.5% bupivacaine, levobupivacaine or ropivacaine with epinephrine 1/200000.
The volume of local anesthetic to be administered is 20-25 mL.

- *Continuous infusion* :
A low basal infusion rate (e.g. 5 mL/hour) associated with PCA boluses (e.g. 2.5 mL - lockout of 30 min) [3] of 0.125% plain bupivacaine or levobupivacaine, or 0.2% plain ropivacaine.

BLOCK PROCEDURE

POSITION

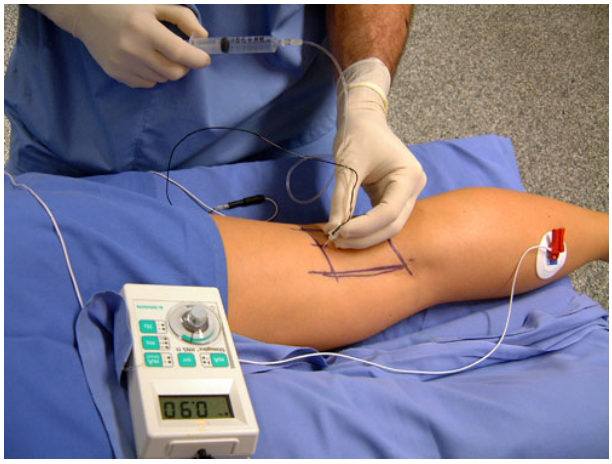
The patient lies in the prone position. She/He is asked to lift the leg from the table so that muscular borders of the popliteal fossa become easily palpable.



SITE OF PUNCTURE

On the midline, between the muscular borders of the popliteal fossa (biceps femoris laterally, semitendinosus and semimembranosus medially), at least 10 cm above the skin crease.[4]

Such high site of puncture would allow to locate the sciatic nerve above its division into terminal branches in most patients.[1]



PROCEDURE

SINGLE DOSE TECHNIQUE:

Connected to the peripheral nerve stimulator (starting output: 1.5 mA, pulse duration: 100 µsec), the needle is introduced at an angle of 45° to the skin and advanced in a cephalad direction until foot twitches are obtained. Its position is then optimised and judged adequate when output less than 0.5 mA still elicits a slight motor response.

After a negative aspiration test for blood, the local anesthetic is then injected.

The mean depth of localization is 4-6 cm.

CONTINUOUS TECHNIQUE

As for the single dose technique, the needle is advanced in an anterior and cephalad direction until foot twitches are obtained. Once its position is judged adequate, the catheter is threaded no more than 2- 3 cm beyond the needle or introducer tip, and secured in place. After a negative aspiration test for blood, the local anesthetic is then injected.

ALTERNATIVE BLOCK PROCEDURES

RORIE ET AL.[5]

The triangular popliteal fossa is outlined and longitudinally bisected. The site of puncture is located 1 cm laterally to the bisectrix and 7 cm above the popliteal skin crease. Block procedure is then similar.

DELBOS ET AL.[6-7]

The apex of the popliteal fossa (determined by the crossing point of the biceps femoris laterally and the semitendinosus and semimembranosus muscles medially) is assessed by palpation. The site of puncture is located 0.5 cm below the apex. Block procedure is then similar.

VLOKA ET AL.[8]

The biceps femoris and semitendinosus and semimembranosus tendons are outlined. On both lines, a mark is drawn 7 cm above the popliteal skin crease. The site of puncture is located at the midpoint of a line joining both marks.

Connected to the peripheral nerve stimulator (starting output: 1.5 mA, pulse duration: 100 µsec), the needle is introduced perpendicularly to the skin and advanced until foot twitches are obtained. Once its position is judged adequate and after a negative aspiration test for blood, 10 mL of local anesthetic is injected. The needle is then redirected to locate the other sciatic nerve component on which 10 other mL of local anesthetic is injected.

ADEQUATE MOTOR RESPONSES

COMMON PERONEAL NERVE

- Toes extension (Deep peroneal nerve)
- Foot eversion (Superficial peroneal nerve)

TIBIAL NERVE

- Plantar flexion of the toes (Tibial nerve)
- Foot inversion (Peroneal and tibial nerves)

INADEQUATE RESPONSES

- A bone contacts indicates a too deep needle puncture.
- A popliteal arterial or venous puncture indicates a too medial and too deep needle puncture.

SPECIFIC COMPLICATIONS

SINGLE DOSE TECHNIQUE

Vascular puncture (in our experience: 0.06%) or transient nerve palsy (in our experience, no case in more than 2000 patients).

CONTINUOUS TECHNIQUE

Except for some catheter problems (kinked, prematurely dislodged,…), no complication is described.

SPECIFIC POSTOPERATIVE FOLLOW-UP

After any sciatic nerve block (particularly when a long lasting local anesthetic has been used or during continuous technique), check carefully for:

- Bearing points (e.g. talus,…) on bed
- Compression points under plaster
- Compartment syndrome, particularly after a tibial fracture, tibial osteotomy,…
- Risk of fall when standing up (assistance, crushes,…)

CONCLUSION

Posterior popliteal sciatic nerve block is an easy to perform and reliable technique. The required prone position is the only drawback in some patients (morbidly obese, old, trauma,…).

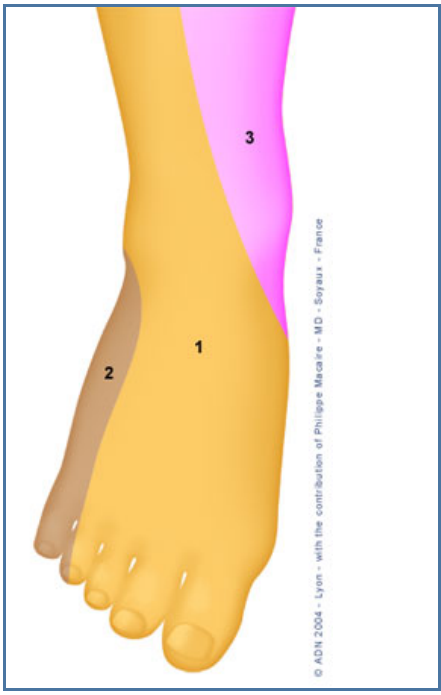
LOWER LIMB ANKLE BLOCKS - SINGLE SHOT & CONTINUOUS

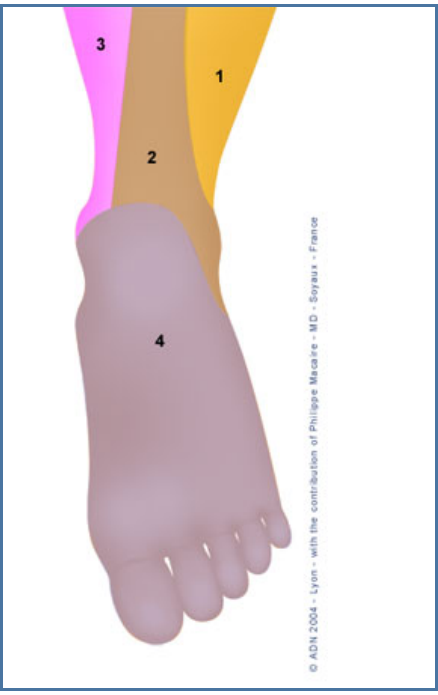
Philippe Macaire, MD
Soyaux - France

The ankle and the foot are innervated by five nerves. One, the Saphenous nerve, is a branch of the femoral nerve, whereas the remaining four, the tibial, sural, deep peroneal and superficial peroneal, are branches of the sciatic nerve.

To obtain a good sensory and motor block of the ankle and foot, it is necessary to block several nerves; the number depends on the surgical requirement. The blocks require slow injection of the local anesthetic solution minimize the pain [1, 2, 3].

ANATOMY





1. Saphenous nerve
2. Sural nerve
3. Femoral nerve
4. Tibial nerve

FEMORAL INNERVATION OF THE ANKLE AND FOOT

SAPHENOUS NERVE

The Saphenous nerve is a terminal branch of the femoral nerve. The Saphenous nerve runs superficially with the great Saphenous vein where it divides into terminal branches. The Saphenous nerves provides sensory innervation to the medial aspect of the ankle and the foot above the territory innervated by the sural nerve.

SCIATIC INNERVATION OF THE ANKLE AND THE FOOT

COMMON PERONEAL NERVE

Before entering the longus muscle, the common peroneal nerve divides into the deep and superficial peroneal nerves.

The Deep Peroneal Nerve
The deep peroneal nerve runs down at the anterior aspect of the leg and medial to the tibial artery. At the level of the amaleola, it runs deep to the extensor retinaculum and superficial to the tibia. It is bounded medially by the tendon of the extensor hallusis longus and laterally by the anterior tibial artery. The deep peroneal nerve provides sensory innervation to the tarsal and metatarsal joint as well as the first interdigital space.

The Superficial Peroneal Nerve
The superficial peroneal nerve travels distally with the peroneous brevis muscle, becoming superficial above the lateral malleoli where it divides in terminal branches that run on the dorsal aspect of the foot. The superficial peroneal nerve provides sensory innervation to the dorsum of the foot and toes.

TIBIAL NERVE

The tibial nerve divides into the posterior tibial nerve and the sural nerve.

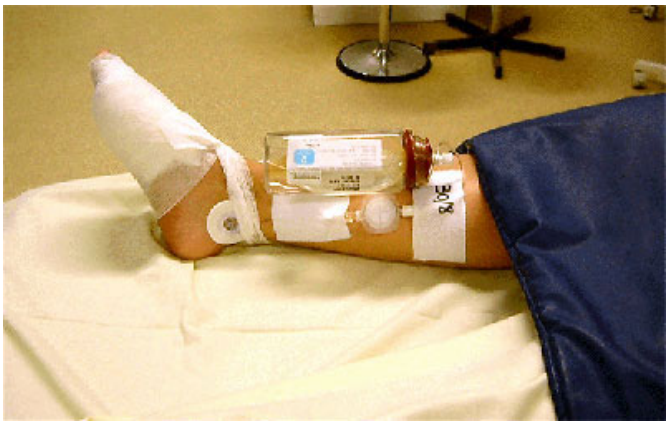
The Posterior Tibial Nerve
The posterior tibial nerve runs deep and posterior to the posterior tibial vein and artery between the Achilles tendon and medial malleolus before its division into the calcaneal and plantar nerves. It is in a plane superficial to the tibia and deep to the flexor retinaculum. The tibial nerve provides motor and sensory innervation to the heel and medial side of the foot below the territory innervated by the Saphenous nerve and above the sural nerve.

The Sural Nerve
The sural nerve runs superficially with the small Saphenous vein and lies subcutaneously behind the lateral malleolus and between the malleolus and Achilles tendon. The sural nerveprovides sensory innervation to the lateral aspect of the foot above the territory innervated by the calcaneal nerve, another branch of the posterior tibial nerve, and below the territory innervated by the lateral cutaneous nerve, a branch of the common peroneal nerve.

EQUIPMENT

SINGLE SHOT

25-g 1.5-inch (65mm) needle, except for the posterior tibial block with a nerve stimulator for which a 25 mm insulated needle is indicated.



CONTINUOUS

Only on the tibial nerve to provide an analgesia of the osteotomies :Cathéter set of 50 mm.

For ambulatory surgery and continuous regional analgesia at home, we are using elastomeric pumps delivering a rate of 5 ml per hour (Exemple BAXTER LV5).

ANAESTHETICS

Various local anesthetics solutions can be used including:

- bupivacaine 0.25%
- ropivacaine 0.5%
- levobupivacaïne

For continuous infusion, a rate of 5 ml per hour of ropivacaine 0.2% is usually appropriate.

POSTERIOR TIBIAL NERVE BLOCK

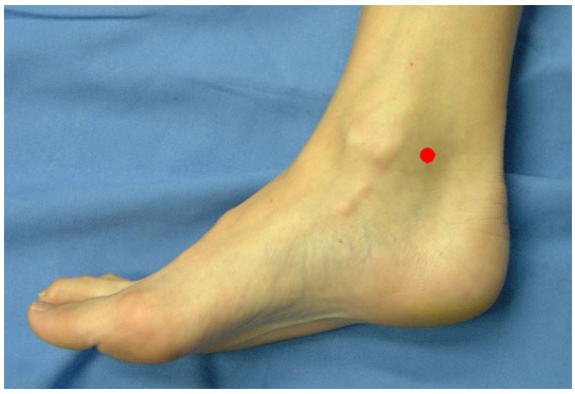
When the surgical requirement includes a posterior tibial nerve block, it is important to start with this block. The posterior tibial nerve is the biggest of the nerves in the ankle and therefore requires the longest onset time.

PATIENT'S POSITION

The leg is extended in a slight internal rotation with the foot at 45°.

PUNCTURE SITE

It is located on the line drawn between the internal malleous and the Achilles tendon, immediately medial to the posterior tibial artery.

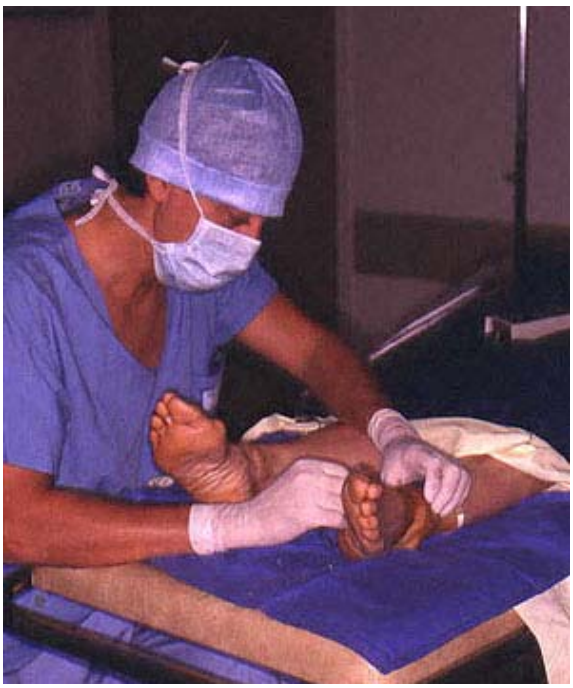


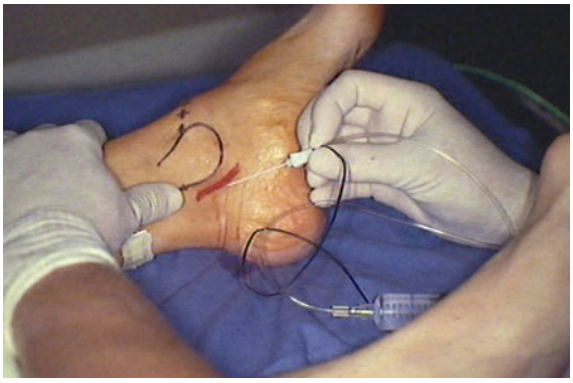
PUNCTURE

Because the posterior tibial nerve is sensory and motor, the block must be performed after identification of the nerve using a 24-g 2.5-cm insulated needle connected to a nerve stimulator set up to deliver 1.5 mA. The stimulation of the tibial nerve produces a plantar flexion of the foot and/or toes.

The intensity of the sensory block can be evaluated in the plantar area of the foot. A continuous block of the posterior tibial nerve can also be performed when required. In this case, the nerve is identified using a contiplex introducing needle and catheter connected to a nerve stimulator set up to deliver 1.5 mA.

The site of the introduction of the needle is 5 cm above the internal malleolus behind the Achilles tendon; the contiplex introducing needle is introduced between the Achilles tendon, and the tibial artery as far as possible without losing the motor response. The introducing needle is then removed and 6-8 cc of ropivacaine 0.5% are injected before the 20-g catheter is introduced usually 1 or 2 cm. The catheter is secured in place with sterystrip, before a tecaderm is applied. The catheter is infused at a rate of 5 ml/hr.

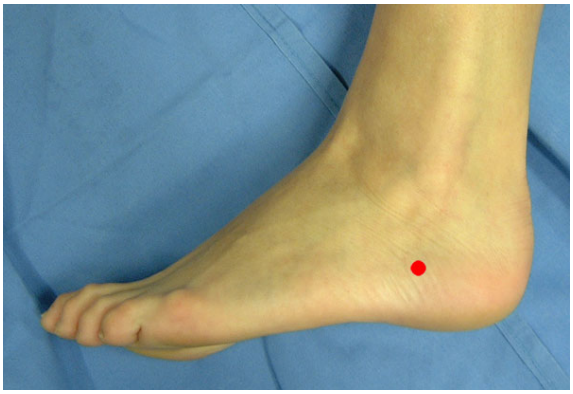




SURAL NERVE BLOCK

PATIENT'S POSITION

The leg is rotated 45° laterally.

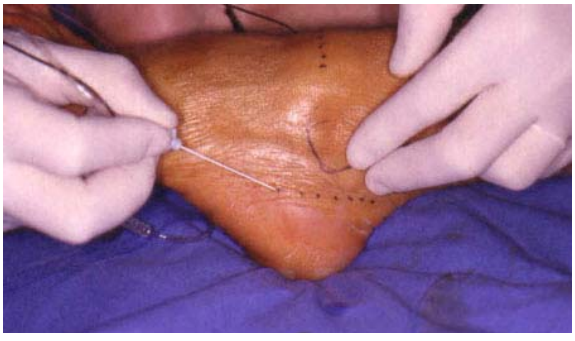


PUNCTURE SITE

It is located at the midpoint between the lower border of the medial malleolus and the Achilles tendon.

PUNCTURE

After introduction of the needle 3-5 mm, 4-6 ml of ropivacaine 0.5% is injected subcutaneously.



INDICATIONS

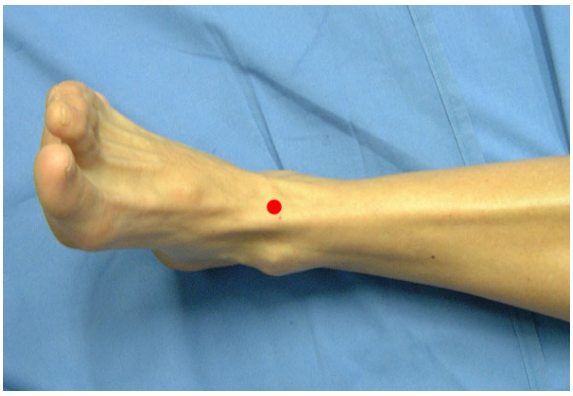
Foot and ankle surgery. However, the duration of the block is in many cases too short compared to the required postoperative analgesia. To satisfy the postoperative analgesia requirement, catheter of the tibial nerve has been used.

DEEP & SUPERFICIAL PERONEAL & SAPHENOUS NERVE BLOCKS

PATIENT'S POSITION

The leg is kept in neutral position.

PUNCTURE SITE



The deep and superficial, peroneal and saphenous nerves can be blocked by using the same site.

- First, a line is drawn between the two malleoli on the dorsal aspect of the foot .
- Second, the patient is asked to do an opposed extension of the foot to identify the extensor hallusis longus.
- Third, the patient is asked to do an opposed extension of the big toe to identify the extensor digitorum tendon of the big toe.

The needle is introduced between the two tendons at the level of the inter-malleoli line.

TO BLOCK THE DEEP PERONEAL NERVE

The needle is introduced perpendicularly to the skin until bone contact . At that point the needle is moved slightly and after negative aspiration 4-6 ml of ropivacaine 0.5% is injected slowly. Next, the needle is repositioned at the level of the skin.

TO BLOCK THE SUPERFICIAL PERONEAL NERVE

4-6 ml of ropivacaine 0.5% is injected subcutaneously and medially up to the medial malleolus. Next, the needle is repositioned at the level of the skin.

TO BLOCK THE SAPHENOUS NERVE

4 ml of ropivacaine 0.5% is injected subcutaneously and laterally up to the lateral malleolus.

The block of the superficial peroneal and saphenous nerves resembles a ring between the malleoli.

TIPS

- The tourniquet is placed just above the malleoli
- To know the cuntaneous nerve supply is very important to test the block.

AXIAL BLOCKS LUMBAR EPIDURAL ANESTHESIA

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Lumbar epidural anesthesia (LEA) is one of the most widely used forms of central neuraxis blockade. For surgical anesthesia, LEA may be used either as the sole technique or in combination with general anesthesia. Although the combined spinal epidural technique is gaining popularity, lumbar epidural analgesia is still the first choice for pain relief during labor and delivery in many centers. In acute and chronic pain treatment, lumbar epidural analgesia is used both as a diagnostic and therapeutic tool.

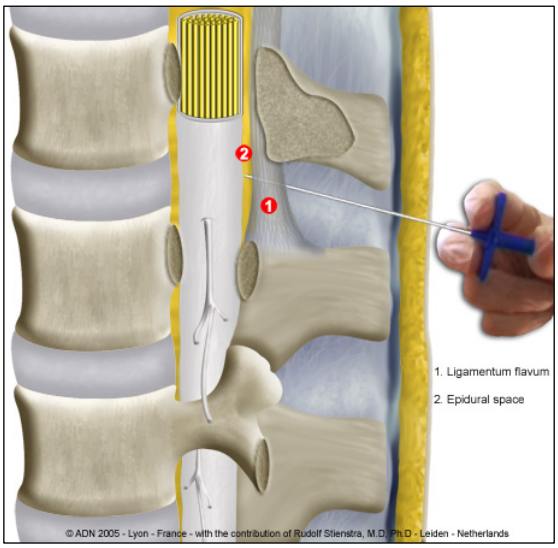
LOSS OF RESISTANCE

For LEA, the loss of resistance technique (LOR) as described by Dogliotti (1) is the golden standard for identifying the epidural space.

The technique is based on the anatomical principle that the advancing needle is passing through the ligamentum flavum before entering the epidural space.

After the epidural needle has been introduced through the skin, the needle stylet is removed and a syringe is attached to the needle.

The ligamentum flavum is a very dense tissue, offering a high resistance to injection, whereas the epidural space offers a very low to absent resistance to injection. When the advancing needle tip crosses from the ligamentum flavum into the epidural space, the sudden loss of resistance to injection confirms the correct needle position.



LOR being the key to identifying the epidural space, it is not surprising that Dogliotti used saline rather than air in his syringe. Unlike air, saline or any other fluid is non-compressible, and consequently a high pressure can be placed on the syringe when the needle tip is entering the ligamentum flavum. Upon entering the epidural space, the sudden loss of resistance is therefore usually very clear and unambiguous. When using a compressible medium such as air, the pressure that can be built up is not as high as when using a non-compressible medium, and consequently the LOR when using air is not as clear.

This elementary fact notwithstanding, LOR using air has gained popularity as well for a variety of reasons. The most important reason is historical; until the seventies, syringes were made from glass and non-disposable. A well-known drawback of these syringes is that when filled with a fluid, the plunger of the syringe may stick to the glass wall, falsely indicating a high resistance to injection when in fact there is none (the “sticky syringe”). In order to avoid this, a completely “dry” technique with air as the medium was developed and for a while, generations of anesthesiologists were trained using air rather than a fluid for LOR. However, with the advent of the disposable, plastic syringe the raison d'être for this modification has vanished.

There is a natural tendency for people to resist change, and one who has performed LOR with air successfully for a long time is not likely to change his habits. Advocates of air have put several arguments forward to justify the practice of not using a fluid; the most frequently cited reasons are that the prior injection of saline into the epidural space may dilute the local anesthetic and slow the onset of anesthesia. While this may be true when injecting a significant volume of saline, this argument ignores the fact that with proper technique, the amount of fluid used to identify the epidural space can easily be limited to less than 1 mL and the perceived problem is thus non-existent.

By contrast, several studies have demonstrated the disadvantages of air as compared to a fluid for LOR, including a higher incidence of inadvertent dural puncture and patchy anesthesia; a recent study confirming the superiority of a fluid and including a review of the available literature is recommended for the interested reader (2).

In summary, when identifying the epidural space, using a fluid for LOR is the logical choice. There are no evidence-based arguments supporting the use of air. While people experienced in performing LOR with air should make their own decision whether or not they want to change their habit or continue a practice they feel comfortable with, the teaching of the LOR technique to residents should be based on the proven superiority of fluid.

MEDIAN OR PARAMEDIAN APPROACH

The median approach to the lumbar epidural space is the most widely used. If the midline can be identified properly, the path of the needle is straightforward, requiring little three-dimensional insight. The ligamentum flavum is thickest in the midline, adding to the tactile feedback obtained from the needle tip.

In certain patients however, the midline route may be difficult or even impossible to achieve due to anatomical variations. Inability to properly flex the spine or malformations of the bony structures in the midline may narrow or obstruct the route to the epidural space to the point where lumbar puncture may be impossible. By avoiding the midline, the paramedian approach offers a better alternative in those patients.

The paramedian approach has some additional advantages: Probably due to the steeper angle of entry, epidural catheter insertion is easier and associated with a lower incidence of paresthesia (3-5); in a cadaver study comparing epidural catheter insertion via the midline and paramedian route, the latter was associated with fewer technical problems, absence of dural tenting and a predictable cephalad direction of the catheter (6).

The point of paramedian needle insertion is approximately 1.5 cm lateral and 1.5 cm caudal to the point of the median needle insertion, with the needle angled in an upward and medial direction.

1. *Median approach*
2. *Paramedian approach*

Disadvantages of the paramedian approach are that it calls for more three-dimensional insight and is more painful than the midline approach.

INDICATIONS & DOSE

LEA is indicated for lower abdominal and lower limb surgery. The third lumbar (L3/L4) and the second lumbar interspace (L2/L3) are the most frequently used. The fourth lumbar interspace is a possibility, but extension of sensory block may be too low at this level. The first lumbar interspace is more comparable to thoracic epidural anesthesia because of the columna extending to the second lumbar vertebra. For the indications mentioned above, this interspace is therefore not recommended.

If LEA is used as a sole technique, sensory block has to be dense and high concentrations of local anesthetic should be used (levobupivacaine 0.75 %, ropivacaine 1 %, lidocaine 2 %). When using lidocaine, the addition of epinephrine 5 micrograms/mL is necessary in order to minimize absorption and to obtain motor block.

Dose varies inversely with age. For the mentioned local anesthetics, volumes of 15 – 20 mL are recommended, to be reduced to 12 – 15 mL in the elderly.

If LEA is combined with general anesthesia, lower concentrations can be used (levobupivacaine 0.5 %, ropivacaine 0.75 %).

SITTING OR LATERAL DECUBITUS POSITION

The advantage of the lateral decubitus position is that it is more comfortable to the patient and there is a lower tendency to vasovagal collapse. However in the sitting position, anatomical landmarks are more easily identified, especially in case of anatomic malformations such as scoliosis and in cases of (morbid) obesity. In addition, a paramedian approach is more easily accomplished with the patient in the sitting position.

SEDATION

Many patients find lumbar puncture threatening, and for that reason most anesthesiologists prefer to administer sedation unless there is a contra-indication. When performing lumbar puncture with the patient in the sitting position, there is a greater tendency for vasovagal collapse, especially in young, male patients. Adequate sedation greatly reduces the incidence of vasovagal collapse.

MONITORING

Establishing prior intravenous access and non-invasive monitoring are a conditiones sine qua non when performing lumbar puncture. Standard monitoring consists of an electrocardiographic trace, peripheral oxygen saturation and non-invasive blood pressure. Mandatory emergency equipment readily available includes a means to ventilate and administer oxygen, laryngoscope and an endotracheal tube. Mandatory drugs readily available include drugs for a rapid sequence induction such as thiopental and suxamethonium, drugs to treat convulsions such as thiopental or midazolam, and drugs to treat bradycardia and or vasovagal collapse such as atropine and ephedrine.

VASOVAGAL COLLAPSE

Preliminary symptoms heralding the imminence of a vasovagal collapse are anxiety and/or confusion, and sweating. One of the most prominent signs of vasovagal collapse is bradycardia, followed by loss of consciousness and often convulsions.

Treatment consists of placing the patient in Trendelenburg position to promote venous return, and the administration of intravenous drugs and fluid.

Bradycardia is a symptom, not the cause of vasovagal collapse; collapse ensues as the result of massive loss of sympathetic tone, resulting in arterial and venous vasodilatation. The resultant decrease in cardiac output and sharp decrease in arterial blood pressure are the cause of cerebral hypoperfusion and loss of consciousness. For this reason, atropine is not the drug of first choice in the treatment of vasovagal collapse. Indicated is a drug that promotes vasoconstriction and increases cardiac output, such as ephedrine. The combination of the Trendelenburg position and intravenous administration of 5-10 mg ephedrine is usually sufficient to restore blood pressure and heart rate.

AXIAL BLOCKS EPIDURAL ANESTHESIA

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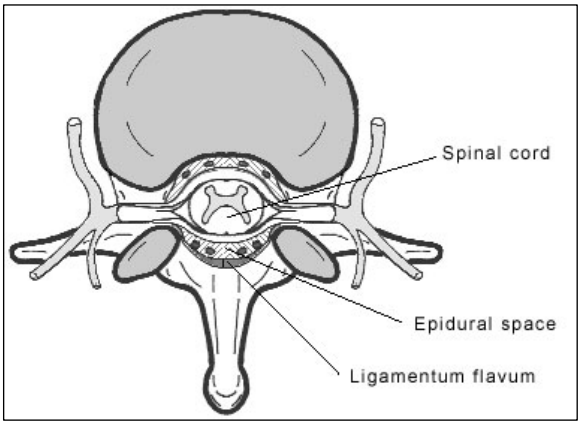
Epidural anaesthesia/analgesia is a central neuraxial block technique commonly used in obstetrics for pain relief during both labour and caesarean section.

ANATOMY

The epidural space is a potential space located between the dura mater and the ligamentum flavum.

Both anterior and posterior nerve roots go across it covered by a dural portion, join in the intervertebral foramen and form the radicular nerves.

The epidural space also contains venous plexuses and fatty tissue.



INDICATIONS

ALONE

Epidural analgesia is the gold standard regional anaesthesia technique during labour as it provides rapid and efficient pain relief, of greater efficacy than with intravenous or intramuscular opioids. Using larger doses, epidural anaesthesia can be used for scheduled caesarean delivery but its slow onset as well as its limited efficacy (even when associated with a lipophilic opioid, nearly 20% of patients feel visceral pain during surgery) have led to its almost complete replacement by spinal anaesthesia. By contrast, in emergency caesarean delivery when an epidural catheter has already been used for labour pain relief, augmentation of anaesthesia with a large bolus dose of local anaesthetic is associated with very rapid and powerful anaesthesia.

Epidural analgesia/anaesthesia is also specifically indicated in certain medical or obstetrical situations such as pregnancy-induced hypertension, breech delivery, multiple pregnancy, uncoordinated uterine action as well as several foetal or maternal medical complications.

COMBINED SPINAL EPIDURAL ANALGESIA (CSE)

This combined technique can also be used for both labour pain relief and caesarean delivery.

During labour, CSE has been used in two different settings. Early in labour, it can lead to 60 to 180 minutes of excellent analgesia, with almost no motor block, thus limiting the need for epidurally administered local anaesthetics injected thereafter. This leads to a well-demonstrated benefit on motor block and obstetric outcome.

It can also be used as a rescue analgesic technique notably when the patient presents with severe pain and is admitted to the maternity unit late in labour. The spinal component of CSE produces almost immediate and profound analgesia. Even if the cervix is fully dilated (and delivery is expected to occur soon), an epidural catheter should be threaded because the need for additional analgesia or anaesthesia cannot be predicted.

Most anesthesiologists are using singls shot spinal anaesthesia as the routine technique of anaesthesia for caesarean section. Combined spinal epdural anesthesia may however be useful in patients with a poor hemodynamic reserve (in whom induction of anaesthesia is performed slowly using a small initial intrathecal dose followed by incremental epidural boluses). This technique can also be used in patients in whom the duration of surgery is difficult ot predict (previous abdominal surgery and subsequent adhesions).

SPECIFIC CONTRAINDICATIONS

- Coagulopathy and anticoagulation therapy. Indeed insertion of a needle or catheter into the epidural space may cause traumatic bleeding that can lead to spinal cord compression.
- Skin infection at the injection site, which may lead to infectious complications (meningitis, epidural abscess).
- Increased intracranial pressure . Accidental dural puncture may lead to brainstem herniation.
- Hypovolemia which may lead to circulatory collapse.
- Patient refusal .

EQUIPMENT

FOR SINGLE SHOT

- A single shot epidural analgesia is not appropriate for obstetrical pain management.

FOR CONTINUOUS ANALGESIA

- Antiseptic solution to prepare the patient's back.
- The physician should wear sterile gloves, a cap and a new face mask. Using a gown is necessary when the catheter is used for several days.
- A sterile area.
- The usual equipment to perform local anaesthesia.
- A skin marking pencil for landmarks.
- A Tuohy needle, which is typically 16-18G, 8 cm long with markings at 1 cm intervals, and has a blunt bevel with a 15-30 degree curve at the tip. The needle is centred by a removable stylet, and has wings providing a better control.
- A 10-ml low resistance syringe (plastic ones have replaced traditional glass syringe).
- A multi-hole catheter (prefer distal multiorifice catheter).
- A connector adapted to the catheter diameter.
- A Luer-Lock antibacterial filter.
- The equipment should be disposable and is usually supplied in a sterile packed kit. All equipment and drugs used should be sterile.

SET-UP

The patient is prepared as usual for regional anaesthesia .

SEDATION

No sedation is performed before the procedure in the obstetric patient to avoid placental transfer of sedative drugs which may result in a low Apgar score at birth.

POSITIONING

ANESTHESIOLOGIST

The anaesthesiologist stands behind the patient. The position of his hands is characteristic of the epidural procedure. The right hand holds the syringe with the thumb on the plunger. The left hand grips the wings of the needle, while its dorsum rests against the patient's back.

PATIENT

To perform the block, the patient can be either in the sitting or lateral recumbent position, and need to adopt a curled up position, in order to open the spaces between spinous processes which will make the identification of the intervertebral spaces easier. Help is sometimes appreciable to position the patient adequately.

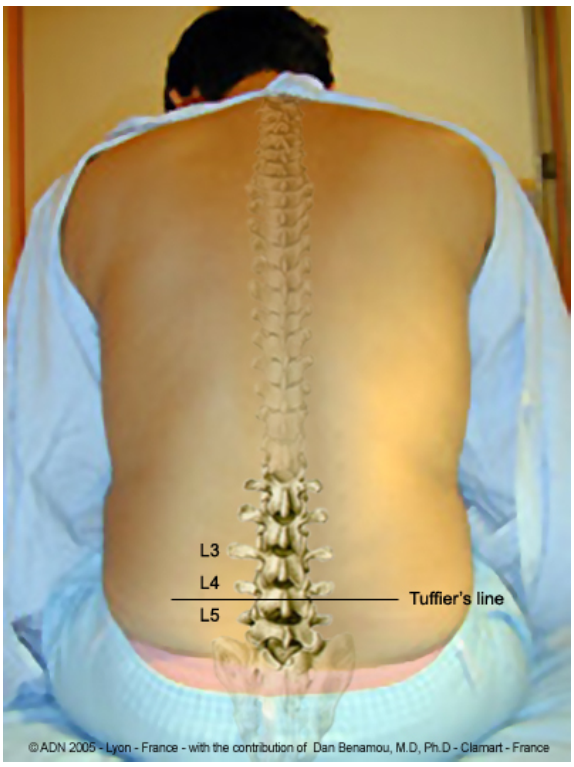
TECHNIQUE OF THE BLOCK

We report below the loss of resistance technique with saline, using a medial approach, which is the most common technique. Loss of resistance to air is a technique which should be abandoned.

CUTANEOUS LANDMARKS

Epidural anaesthesia in obstetrics is performed at the L3-L4 or L4-L5 interspaces which can be theoretically identified using the Tuffier's line. This virtual landmark joins the superior part of both iliac crests and crosses the vertebral axis at the L4 spinous process or L4-L5 interspinous space.

However several studies have shown that the Tuffier's line is not a reliable landmark and puncture should be done in an easily defined interspinous space as caudad as possible.



PROCEDURE OF PUNCTURE / CATHETER INSERTION

After sterile preparation and local infiltration (using a short and small gauge needle), the epidural needle is inserted through the skin at the midpoint between the two chosen spinous processes and advanced in a slightly cephalic direction through the supraspinous ligament and the interspinous ligament. The stylet is removed and a low resistance syringe filled with saline is fixed to the needle.

The operator's hands position is described above. The left hand stabilizes the needle and prevents it from advancing too far or too fast.

Constant pressure is exerted on the plunger while advancing the needle through the interspinous ligament and into the ligamentum flavum. Once the needle enters the ligamentum flavum, a sensation of increased resistance is felt. The needle is then advanced carefully until its tip exits the ligamentum flavum, which creates a loss of resistance and makes the saline easily injected into the epidural space. Special attention will be paid to the depth where the epidural space is reached, using the marks on the needle. In young adults of normal body size and weight the depth of the epidural space is generally between 4 and 5 cm. This distance can increase significantly in obese patients.

The epidural catheter is then inserted into the epidural space through the needle. The catheter should be threaded in order to leave approximately 4- 5 cm into the epidural space.

DOSE OF LA

During labour, many anaesthetic solutions are currently used but data strongly suggest that an amide local anaesthetic (racemic bupivacaine, ropivacaine or L-bupivacaine) used at low concentration (≤ 0.1%) combined with a lipophilic opioid (fentanyl or sufentanil) is the right choice.

The following protocol is suggested, using for instance ropivacaine 0.1% + sufentanil 0.5 µg/mL or bupivacaine 0.08% + sufentanil 0.5 µg/mL.

After injection of a test dose, an initial bolus of 10-20 mL will be administered followed by a continuous infusion from 10 to 15 mL/h. This flow rate needs to be adjusted to the analgesic level. The patient's height only partially correlates with the needed volume of solution.

A PCEA administration is also advisable.

For Caesarean delivery, a mixture of a highly concentrated local anaesthetic (0.5 or 0.75%) with a lipophilic opioid (fentanyl 50 µg or sufentanil 5-10 µg) is injected using 5 ml increments up to a sensory level at T4 (usually 15-25 ml are necessary to read this goal). Morphine (2-3 mg) can be added to prolong postoperative analgesia.

BLOCK ASSESSMENT

The sensory block should be frequently checked by testing the cutaneous area to cold. A T10 level is currently expected for labour analgesia, whereas a T4 level is needed for caesarean section anaesthesia. The sensory level should be tested and both upper and lower level should be identified. Using pinprick or cold sensation, a complete (anaesthesia) or incomplete sensory block (analgesia) can be identified while loss of sensory discrimination of light touch only identifies a deep level of anaesthesia. The sensations in the blocked area should be repeatedly compared with sensory testing in the unanaesthetized area to facilitate discrimination by the patient. Studies have failed to clearly demonstrate that sensory testing should be done in the caudad-cephalad direction or inverse.

Motor block is assessed using the Bromage's score or any other derived scoring system.

RESCUE BLOCK

In case of inadequate analgesia, boluses or catheter mobilisation can be proposed. An additional bolus dose is required when a symmetrical sensory block of inadequate depth is demonstrated. A 1 cm withdrawal of the catheter followed by positioning the patient and administering a top up is used if sensory block is not uniform on both sides. Sometimes, a new catheter insertion is needed if previous actions have failed. The decision should be done rapidly to avoid having a patient remaining painful for a long period of labour.

SPECIFIC COMPLICATIONS

- **Hypotension** is common when epidural anaesthesia is used both in labour and for caesarean section. Nausea is a frequent presenting symptom of hypotension. Hypotension should be avoided or treated immediately to prevent foetal distress due to uteroplacental circulatory insufficiency.
- **High epidural block extension** due to an excessively large dose of local anaesthetic in the epidural space. It associates hypotension, sensory loss and difficulty breathing. In the most severe cases it may require induction of general anaesthesia and should be managed as an emergency (securing of the airway and treatment of hypotension).
- **Local anaesthetic toxicity** can occur early after injection when the catheter is advanced into one of the many epidural veins. Aspirating prior to injecting local anaesthetic is therefore essential. Toxicity can also be delayed (20-40 min) if the total dose used is too large.
- **Total spinal anaesthesia** occurring when the epidural needle or catheter is advanced into the subarachnoid space. Then the local anaesthetic is injected directly into the cerebrospinal fluid. The action of local anaesthetic on the brainstem associates hypotension, apnoea, unconsciousness and mydriasis. The use of a test dose and slow injection should prevent this complication.
- **Accidental dural puncture** . Post-dural puncture headache results from loss of cerebrospinal fluid through the epidural needle and cerebrospinal fluid hypotension. This headache is typically severe, frontal and exacerbated by movement or sitting upright. It is often associated with photophobia, vertigo, nausea and vomiting. In the first instance, it can be treated by analgesics, caffeine, bed rest and rehydratation. An epidural blood patch may be necessary.
- **Epidural haematoma** . Puncture of the numerous veins filling the epidural space may lead to the development of a haematoma which can compress the spinal cord especially in patients with coagulopathy or those receiving anticoagulants.
- **Infection** . It is best prevented by a strict asepsis during the insertion procedure and during the following management period.
- **Block failure** explained by a catheter malposition (false loss of resistance during the procedure) or by anatomic variation of the epidural space.

CONCLUSION

Epidural analgesia is an effective and commonly used technique in obstetrics with few specific complications and side effects.