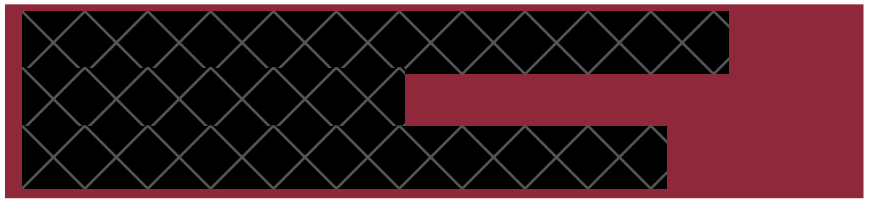
In flight critical care during strategical aeromedical evacuation of SOF casualties

SOF Combat Medical Care Conference – Paris – October 20th, 2022



Conflicts of interest

The assertions are the personal point of view of the author and do not represent the message of the french medical health service or french armed forces.

What are we talking about?

- SOF casualties
  - Severely injured patients
  - Low number (usually 1 to 3)

- Operations
  - Low footprint on the ground
  - No role 3

Precoce StratMEDEVAC

French survival chain

Definition – A combat operation

MEDEVAC = Medical evacuation

AERO-MEDEVAC

STRAT-MEDEVAC : from the theater to the homeland

These operations are decisive for the engagement of the armed forces.

Service de santé des armées

An healthcare operation

The aim is to provide en-route care with a continuum of quality of care

and security for the patients.

Avoid monitoring rupture and load breaks, despite a challenging environment and

despite isolation during several hours

Service de santé des armées

MEDEVAC triple interest

- Medical
  - Transport the patients to the best medical and surgical environment
- Psychological
  - Soldiers keep in mind that they rapidly will benefit from the best level of care
- Operational
  - Avoid the saturation of the medical facilities and allow the ongoing of combat operations

Service de santé des armées

French activity

- Each year : around 800 patients
- Each year : around 50 intensive care patients

Service de santé des armées

Typology of patients

- 2015 – 2017 : 2129 French patients

- Medicine or non-traumatic surgery : 48 %

- Trauma : 48 %
  - Non battle injury = 43%
  - Battle injury = 3%

- Psychiatry 5%

Luft A. et al. Military Medicine 2019

Intensive care patient and MEDEVAC

16 years period

	Trauma patients ($n = 245$)	Medical patients ($n = 207$)	p
Age*	28 [24–33]	35 [28–45]	< 0,001
SAPS-II*	13 [8–40]	11 [8–16]	0,027
Initial GCS < 8**	33 (13%)	19 (9%)	0,202
Vasopressor support**	74 (30%)	29 (14%)	< 0,001
Mechanical ventilation**	119 (49%)	36 (17%)	< 0,001
Emergency surgery**	174 (71%)	14 (7%)	< 0,001

SAPS-II: Simplified Acute Physiology Score-II.

GCS: Glasgow Coma Scale.

* median [1st-3rd quartile range].

** number (%).

Ponsin P et al. Injury 2020

Service de santé des armées

Intensive care patient and MEDEVAC

The most severe patients are those suspectible of in-flight worsening events

Factors associated with in-flight worsening health status.

	In-flight worsening health status (n = 123)	Absence of in-flight worsening health status (n = 329)	p
Age*	31,5 [25,0 ;36,0]	32,7 [25,0 ;38,0]	0,198
SAPS-II*	23,18 [8,0 ;40,0]	16,2 [8,0 ;18,0]	<0,001
Trauma**	71 (58%)	174 (53%)	0,42
Cardiovascular disease**	13 (10%)	56 (17%)	0,121
Initial GCS < 8**	17 (10%)	35 (2%)	0,606
Vasopressor support**	48 (39%)	55 (17%)	< 0,001
Mechanical ventilation**	64 (52%)	91 (28%)	< 0,001
Emergency surgery**	65 (52%)	123 (38%)	0,004
Hemorrhagic shock**	22 (18%)	24 (7%)	0,004

* median [1st-3rd quartile range].
** number (%).

Ponsin P et al. Injury 2020

Service de santé des armées

What is necessary?

- A same langage
- Classification of patients
- Medical informations
- Logisitical organization
- Command and control medical and aeronautic

- Aircraft
- Medical teams
- Material and medical devices

Service de santé des armées

STRAT MEDEVAC classification

PMR
STANAG 3204

- **PRIORITY**
  - P1 : Urgent < 12h
  - P2 : Priority < 24 H
  - P3 : Routine < 72 H

Notice to move
=
Delay from the order
to the take-Off

- **DEPENDENCY**
  - D1 : High : MV (require intensive support)
  - D2 : Medium : IV lines, O_2, drainages, deterioration possible
  - D3 : Low : no deterioration expected
  - D4 : Minimal : help for moving

Command and control

Service de santé des armées

MEDEVAC teams

- **Crews of the French armed forces**
- **Medical doctors and nurses**
- **Anesthesiologist**

On duty 24h 7/7

Aeronautic, Medical Competences and non technical skills

Teamworking

Service de santé des armées

Material

- Preconditionned material
- Boxes loaded and easy to plug on board in a few minutes (<1 hour)

- MEDEVAC : a way for reconditionning the medical operational units (blood)

Service de santé des armées

Medical devices

Service de santé des armées

Aircrafts

Confortable
High distance
Rapid flight

High quality of airport runway

Air superiority is required

Individual or bi-individiual MEDEVAC

Elongation : 7400 km

Delay Alert – Take off = hours

50 flights each year

On key-word

ANTICIPATION

Need to anticipate the problem related to the pathology

(refer to PMR and **to DoC to Doc call before the mission**)

Need to know your material and devices

Need to know the specific constraints

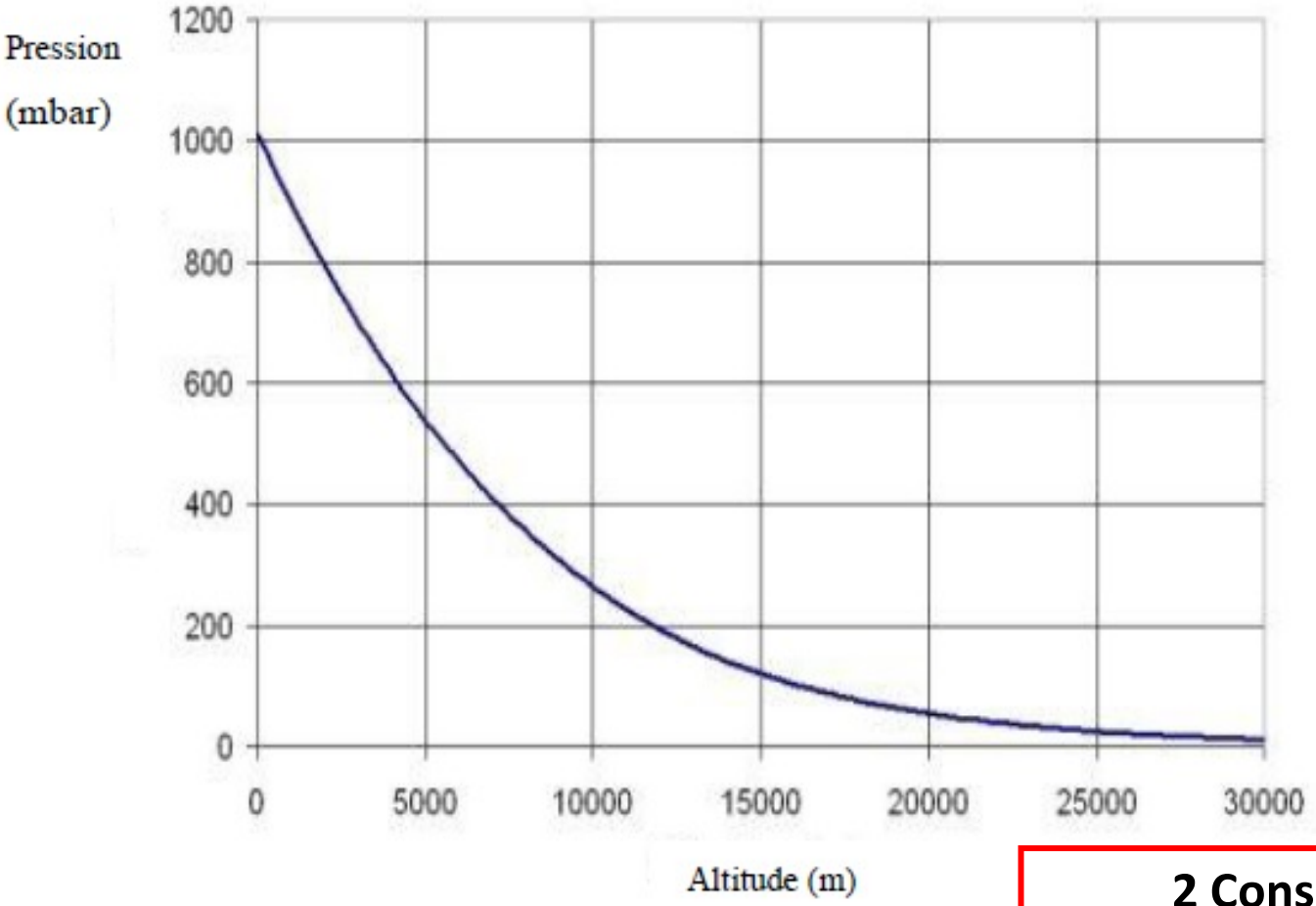
due to the aircraft environment

Service de santé des armées

What are the specific constraints ?

- Related to altitude
  - Dysbarism : expansion of enclosed gas
  - Hypobaric hypoxemia
- Related to the flight
  - G-forces
  - Sickness
- Related to the cabin ambiance
  - Noise
  - Vibration
- Isolation

Altitude - Pressure



2 Consequences

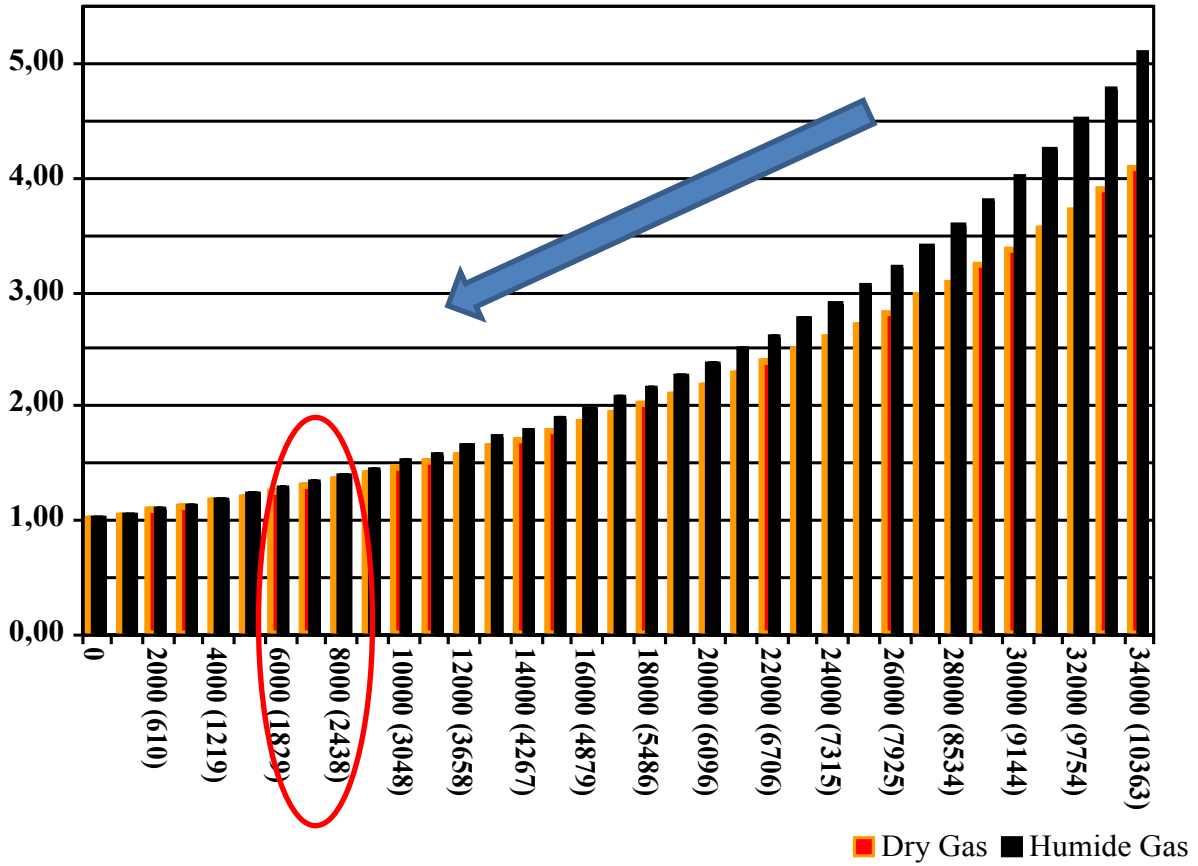
Dysbarism

Hypobaric hypoxemia

Service de santé des armées

Cabine Pressurization

Gas expansion



Altitude

1 Ft=0,3 m

1 m = 3,28 Ft

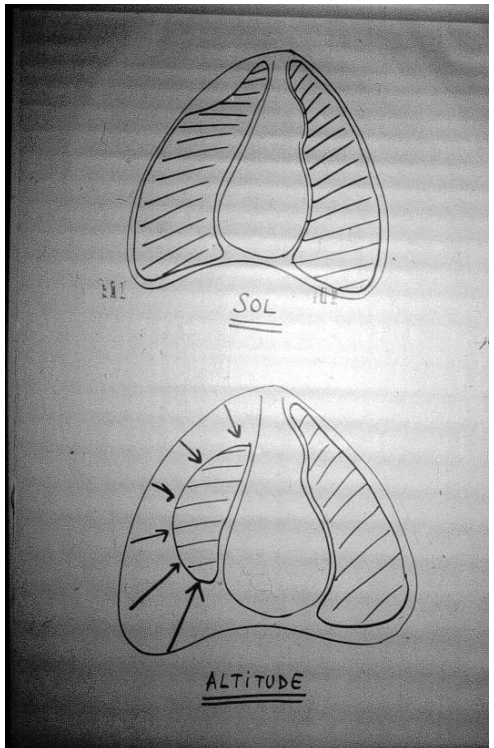
Cabine Altitude → Volume x 1,2

Altitude - Dysbarism and pneumothorax

Boyle's law

$P.V = k$

Gas volume varies inversely to pressure



Chest tube drainage BEFORE the flight

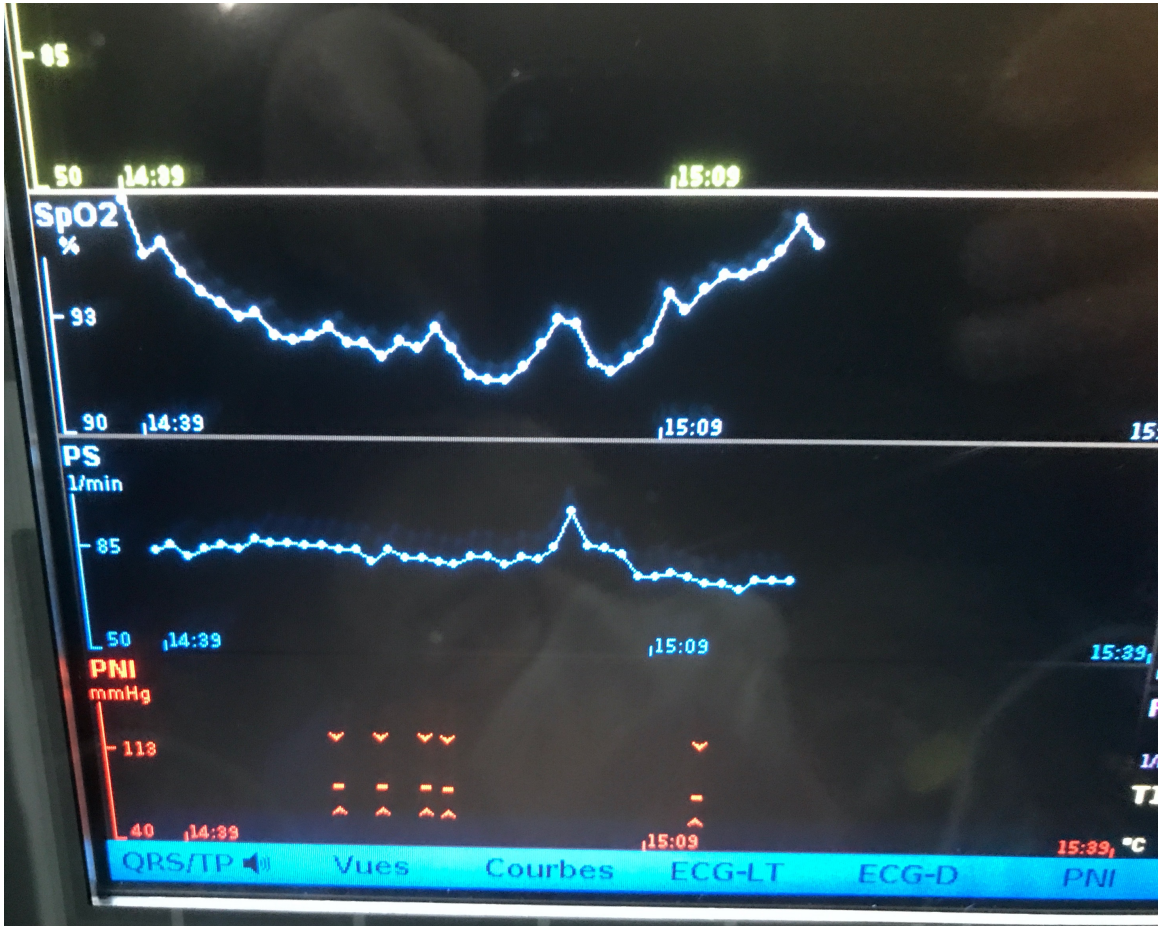
Risk = gas tamponade

Service de santé des armées

Altitude - Hypobaric hypoxemia

Dalton’s law and Henry’s law

Low pressure -> low $PalvO_2$ -> hypoxemia



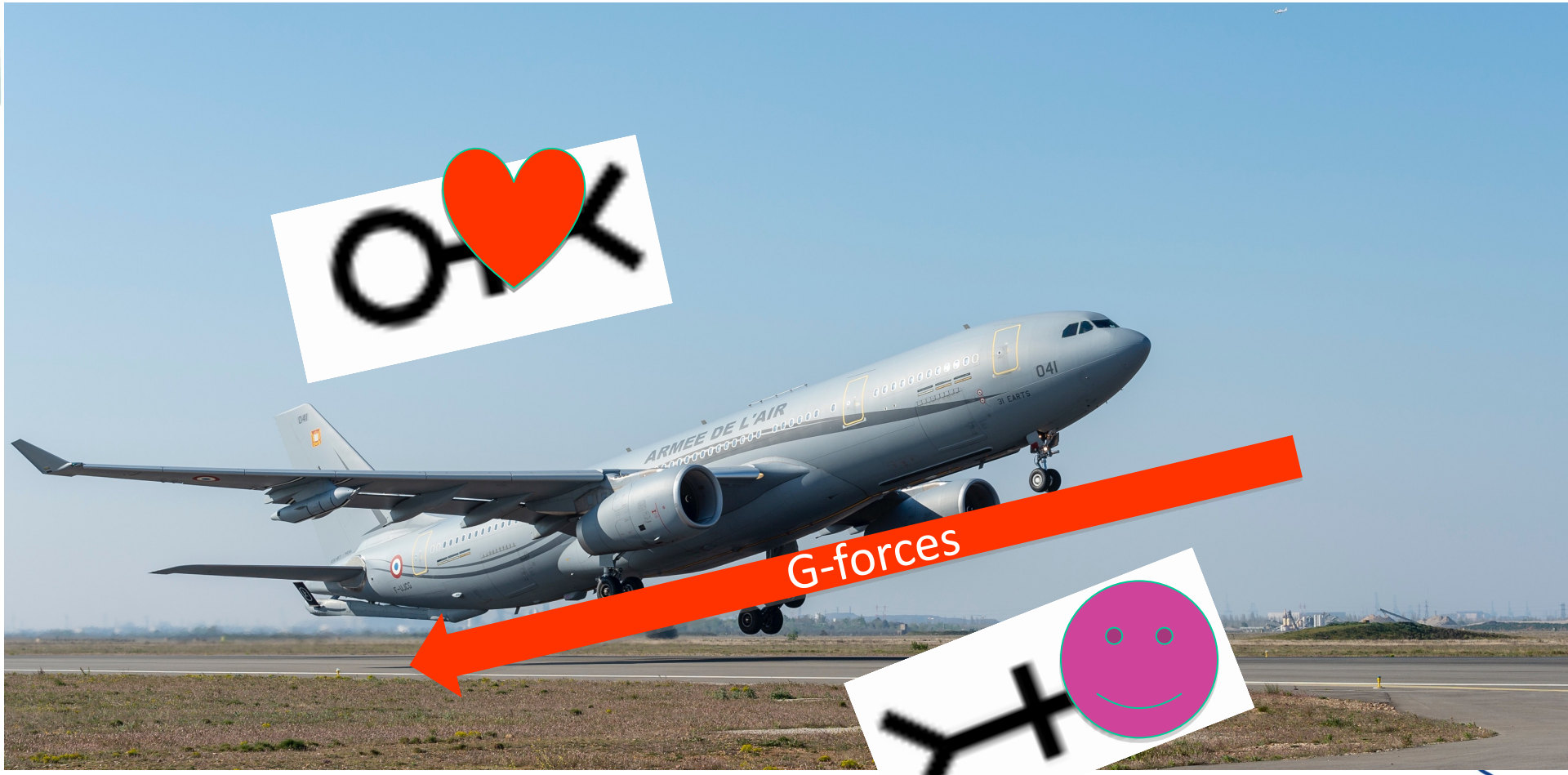
Service de santé des armées

Altitude - Hypobaric hypoxemia

- Little consequences for the well being person (crew member = asthenia)
- Little consequences = Patient under mechanical ventilation
- Anticipation is required for the patients with respiratory dysfunction who is not under mechanical ventilation

Flight - G - forces

Take-off



Constraints due to cabin ambiance

- Noise
  - Alarm
  - Physical examination

- Vibration
  - Risk of material projection
  - Premature dysfunction of the medical devices

Isolation = Anticipation
Is this patients OK to flight?

- Haemorrhagick shock, splenectomy

- Tachycardia
- Haemoglobin is going down, lactate is going up
- NORepinephrin is going up

- 8 hours-flight to go

Isolation = Anticipation
Is this patients OK to flight?

- Surgical hemostasis must be achieved
- Airway must be secured
- Gas tamponnade must be prevented

Ergonomy

Boarding plan

Secure patient and devices

Prefer
Access to the head

Access to chest tube drainage

Access to dressing

Service de santé des armées

During the flight

Less is more

- Ongoing DCR
  - catecholamine, transfusion,…
- Intensive care
  - Sedation, ventilation, preventing nurses (eschar…)
  - Intracranial pressure monitoring
  - Analgesia (locoregional…)

Service de santé des armées

Conclusion – Take-home message

Anticipation

The success is achieved before take-off

Causes of avoidable mortality must have been fixed before the flight

Service de santé des armées