Forward In-Flight Damage Control Resuscitation

French Special Operations Forces
point of view

Paris SOF
Combat Medical Care
Conference

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MP


CONTEXT

Interest of damage control rescucitation (DCR) :
no longer discussed in TCCC or french « *sauvetage au combat* »

Special Operations are often violent and risky :
-> significant risk of injured operator
→ **need of a robust medical support and evacuation chain**

<u>In French SOF :</u>
far forward medical support is provided by the pair :
physician + nurse
which is included in the SOF TU on field.
They provide DCR directly at the point of injury

- Leibnet et Al. Damage control resuscittaion. Clin Exp Emerg Med. 2020 Mar; 7(1):5-13.
- Cap et Al. Damage Control resuscitation. Mil Med. 2018 Sep1;183(suppl_2):36-43.
- Bogert et Al. Damage Control resuscitation. J Intensice Care Med. 2016 Mar;31(3):177-86
- TCCC Guidelines, Joint Trauma System, 15 décembre 2021.
- Référentiel d'enseignement des gestes du sauvetage au combat, Ecole du Val-de-Grace, 28 janvier 2020

From POI to Surgical Facility

Curent french doctrine is marked by the Sahelian experience and its History :

« Physician go to the wounded »

SAHEL, from 2013/02 to 2014/07 :

157 A-wounded evacuated by forward MEDEVAC

median evacuation time = 145 min [100-251]
median distance = 126 km [90-285] (*78 miles [56-177]*)

Due to distance : A-timeframe is longer than NATO recommandations

• Carfantan et Al.Forward medevac during Serval and Barkhane operations in Sahel : a registry study. Injury. 2017 Jan;(48)1:58-63.

French SOF

Rapidly wounded = 18 min [5-36] from direct action helicopter insertion

83% of wounded = by night

Severity = A 31 %
B 28 %

Initial care on field : 60%

MEDEVAC Evacuation time :
SOF (ARF) = 13,5 min (+/- 11)
Conventional or Allied = 89 min (+/-18)

MEDEVAC Flight time to surgical facility :
SOF (ARF) = 65 min (+/-15)
Conventional or Allied = 115 (+/-21)

* Prof, Col TRAVERS S. French special operation WOI management 2016-2020. (non published data).

MEDEVAC

Maintaining the level of care during transport
→ Providing in-flight DCR

« Ability to move stabilized
but not necessarily stable patients »
…. And even unstable patient

• Johannigman J.Maintaining the continuum of en route care. Crit care Med. 2008 Jul;36(7 Suppl):S377-82.

French SOF are often supported
by conventional forces forward MEDEVAC.

They provide high level support
(new generation helicopter NH90, well trained medical team, day and night flight, unsecured area operating)

<u>And so what ?</u>
No dedicated MEDEVAC unit or helicopter in French SOF

—> any helicopter can be adaptated
in 15 min by a minimum trained team

—> any SOF physician and nurse are trained
to work in a MEDEVAC

The spirit :

Be able to be autonomous to conduct any operation,
even if conventional MEDEVAC is not available

French SOF MEDEVAC concept :

Simple and Efficient

- 1 medical team : 1 SOF physician + 1 SOF nurse (+/- 1 SOF medic)
- 1 medical kit : standardized, weight < 150 kg (330 lb), conditioned to be easily transportable

currently use in Sahel in direct support of French special operations or our local partners

INTERESTING CAPABILITIES

French SOF MEDEVAC is able to provide *en route* care for
any wound
any severity

Maximal capacity : 1 A + 1 B
(+ 1 A or + 1 B if reinforced by 1 medic)

First

Multi-parameter monitoring

Complete what has not been done on ground
(lack of time / unsafe situation)

New bleeding and hemostasis check … and all MARCH / ABCD

Tranexamic acid, antibioprophylaxis, calcium etc…

• Xray et Al. The Diamond of Death : Hypocalcemia in trauma and rescucitation. Am J Emerg Med. 2021 Mar;41:104-9
• CRASH-2 collaborators. Effects of Tranexamic Acid on Death, Vascular Occlusive Events, and Blood Transfusion in Trauma Patients with Significant Haemorrhage (CRASH-2): a Randomised, Placebo-Controlled Trial. Lancet 2010 Jul3;376(9734):23-32
• CRASH-3 collaborators. Effects of Tranexamic Acid on Death, Disability, Vascular Occlusive Events and Other Morbidities in Patients with Acute Traumatic Brain Injury (CRASH-3): a Randomised, Placebo-Controlled Trial. Lancet 2019 Nov 9;394(10210):1713-23
• Gerhardt RT, Matthews JM, Sullivan SG. The effect of systemic antibiotic prophylaxis and wound irrigation on penetrating com- bat wounds in a return-to-duty population. *Prehosp Emerg Care.* 2009;13(4):500–504.
• Murray CK, et al. Prevention and management of infections asso- ciated with combat-related extremity injuries. *J Trauma.* 2008;64 (3 Suppl):S239–251.

Blood = 1st line fluid for hemorragic shock

Its use during aeromedical evacuation is documented, safe and effective.

We have :

- 2 units O low titer WBD or 2 units O- PRBC
  in a « Golden hour Box » (1)
  with blood warming capacity (2)

- 3 units of FLYP (3)

1

2

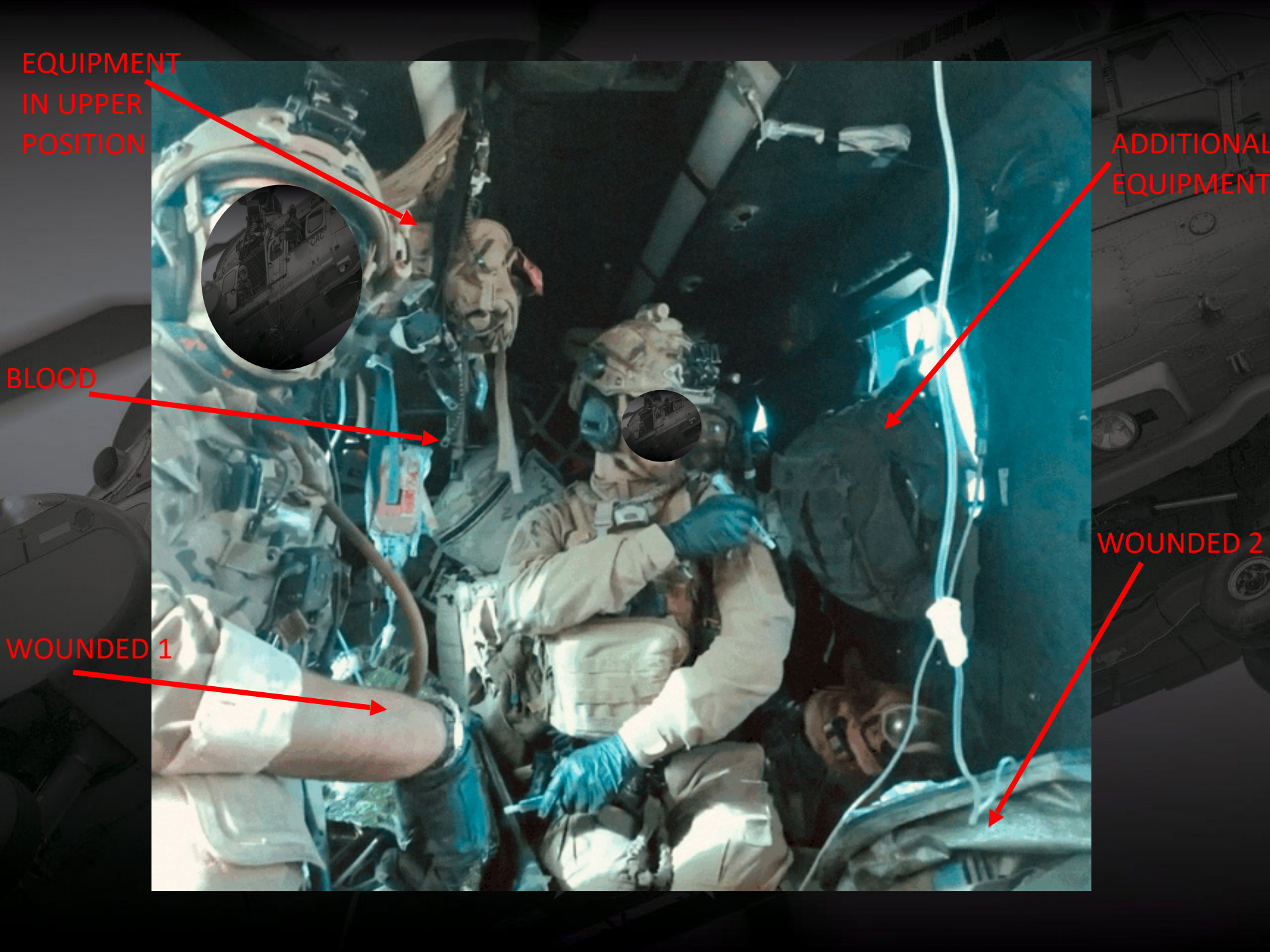
3

• Shackelford et Al. Association of Prehospital Blood Product Transfusion During Medical Evacuation of Combat Casualties in Afghanistan With Acute and 30-Day Survival. JALA. 2017 Oct24;318(16):1581-91

• Chen et Al. Prehospital blood transfusion during aeromedical evacuation of trauma patients in israel : the IDF CSAR Experience. Mil Med. 2017 Mar;182(S1)

• Nguyen et Al. Use of French lyophilized plasma transfusion in severe trauma patients is associated with an early plasma transfusion and early transfusion ratio improvement. J Trauma acute care surg. 2018 May;84(5):780-5

• Wallen et Al. Blood product resuscittaion mitigates the effects of aeromedical evacuation after polytrauma. J Trauma Acute Care Surg. 2022 Jan 1;92(1):12-20


EQUIPMENT IN UPPER POSITION
ADDITIONAL EQUIPMENT
BLOOD
WOUNDED 2
WOUNDED 1

Sonography

We are equiped with Vscan or U-lite.

<u>According to studys :</u>

not a game changer
but a useful tool in this environnement !

Noise = no auscultation possible
Vibrations = disturbing clinical examination

High specificity but poor sensitivity

- Especially useful for thoracic injuries
- Help to choose the most suitable surgical facility for the injuries.

• Madill et Al. In-flight thoracic ultrasound detection of pneumothorax in combat. J Emerg Med. 2010 Aug;39(2):194-7
• Griffiths et Al. Helicopter emergency medical services use of thoracic point of care ultrasound for pneumothorax: a systematic review and meta-analysis. Scand J Trauma resusc Emerg Med. 2021 Nov 20;29(1):163.
• Press et Al. Prospective evaluation of prehospital trauma ultrasound during aeromedical transport. J Emerg Med. 2014 dec;47(6):638-45
• Quick et Al. In-flight ultrasound identification of pneumothorax. Emerd Radiol. 2016 feb;23(1):3-7
• Jorgensen et Al. Does prehospital ultrasound improve treatment of the trauma patient? A systematic review. Eur J Emerg Med.2010 Oct;17(5):249-53
• Yates et Al.Aeromedical ultrasound : the evaluation of point of care ultrasound during helicopter Transport.Air Med J. 2017 May-Jun;36(3):110-5

Rapid Sequence Intubation and Positive Pressure Ventilation

Possible and safe in-flight
even if the environnement complicate the procedure

Physician are frequently associated with higher rate of success.

Major limitation is not technical, but medical :
-> Only when needed because of side effect on shocked patient

• Mackay et Al. Prehospital rapid sequence induction by emergency physicians: is it safe? Emerg Med J. 2011 Jan;18(1):20-4
• Thompson et Al. Risk of Harm Associated With Using Rapid Sequence Induction Intubation and Positive Pressure Ventilation in Patients With Hemorrhagic Shock. J Spec Oper Med. 2020 fall;20(3):97-102
• Hudson et Al. Airway and ventilation management strategies for hemorrhagic shock. To tube, or not to tube, that is the question! J Trauma Acute care Surg. 2018 Jun;84(6S Suppl1):S77-S82.
• McHenry et Al. feasibility of Prehospital rapid Sequence Intubation in the Cabin of an AW169 Hekicopter. Air Med J.2020 Nov-Dec;39(6):469-72.
• Fouche et Al. Flight Versus Ground Out-of-hospital Rapid Sequence Intubation Success: a Systematic Review and Meta-analysis. Prehosp Emerg care. 2018 Sep-Oct;22(5):578-87

Anesthesy and Antalgy

RSI : ketamin + succinylcholine

Anesthesia protocoles :

several protocols using iterative bolus or seryngue pump :

midazolam, sufentanil, GHB acid

Be aware of induced hypotension !

- Référentiel d'enseignement des gestes du sauvetage au combat, Ecole du Val-de-Grace, 28 janvier 2020
- Pollack et Al. The Use of Ketamine for Air Medical Rapid Sequence Intubation Was Not Associated With a Decrease in Hypotension or Cardiopulmonary Arrest. Air Med J. 2020.
- Hiestand et Al. Rocuronium versus succinylcholine in air medical rapid-sequnce intubation. Prehosp Emerg Care. 2011 Oct-Dec;15(4):457-63

Vasoactive medications

We use norepinephrine in management of :

- hypotensive hemorhagic shock
- severe trauma brain injury

Standard or miniaturised electric syringes :

In emergency we use epinephrine bolus (0,05mg)

• Gauss et Al. Association of Early Norepinephrine Administration With 24-Hour Mortality Among Patients With Blunt trauma and Hemorrhagic Shock. JAMA Netw Open. 2022;5(10):e2234258

• Spahn et Al. The European guideline on management of major bleeding and coagulopathy following trauma : fifht edition. Crit Care. 2019 Mar27;23(1):98.

LIMITATIONS AND CONSTRAINTS

- No additional power source (currently) : 3 hours autonomy
  (Conventionnal MEDEVAC is equipped)

- Mainly night operations = limited light source

- Tactical flight : unpredictables movements during procedures
  low flight level : no gaz expansion

- **Side doors open** (for gunner) : wind and low temperature

- **Noise ++++ :** communication / don’t hear alarms

HYPOTHERMIA

IT KILLS —> Part of lethal diamond

Currently :

passive warming : blanket and wrap

active warming : chemical thorso pad and fluid warmer

<u>According to studies :</u>

not completly satisafying -> **need to improve !**

• Schauer et Al. hypothermia in the combat trauma population. Prehosp Emerg care. 2022 Sep 19;1-7

• Ficher et Al. An analysis of the incidence of hypothermia in casualties presenting to emergency departments in Iraq and Afghanistan. Am J Emerg Med. 2020 Nov;38(11):2343-6

• Haverkamp et Al. The prehospital management of hypothermia - An up-to-date overview. Injury. 2018 Feb;49(2):149-64.

• Ting J. The rewarming benefit of anterior torso heat pad application in mildly hypothermic conscious adult trauma patients remains inconclusive. Scand J Trauma resusc Emerg Med. 2012 Mar 4;20:17.

NOISE :
complicates all communications

Communication with the injuried : by voice or written on slate

- to reassure (part of analgesia)
- to gather important information

Communication within the medical team : **b**y voice, radio, or on slate

- Close each communication loop : make sure your teammate has received the information
- Say what you do and do what your say
- pay attention to the procedure's safety !

Communication with helicopter crew :

- Can we use light ? Can we close doors ?
- Can we flight quiet ? How much play-time ?
- Can we speed up ???

Inaudible alarms :

- check your devices frequently !


Information received
INFU-SURG
500 ml
Ethox
Information on slate


PROJECTS
AND SPECIAL
PROCEDURES

LONG-RANGE MEDEVAC

Long-range Helicopter MEDEVAC :

Air Force « Caracal » helicopters are equipped for in-flight refueling

- Advantage : more flight time and distance
- Inconvenient : high altitude for refueling
  - low temperature
  - hypoxy
  - gaz expansion
- Need to develop :
  - light auxilliary power source
  - more efficient warming procedures

Fixed wing forward MEDEVAC

- Advantage and limitation are close to long range helicopter MEDEVAC
- Planes are pressurised and warmed
- Need an appropriate Landing Zone

CASEVAC

MEDEVAC Evacuation time :

SOF (ARF) : 13,5 min (+/- 11)
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MEDEVAC Flight time to surgical facility :

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In SOF mindset, nothing is forbidden :
If the faster way to the surgeon is CASEVAC : you have to think about it.

Ground medical team can :

- embark in a non-medicalized helicopter
- provide DCR with their own medical kits

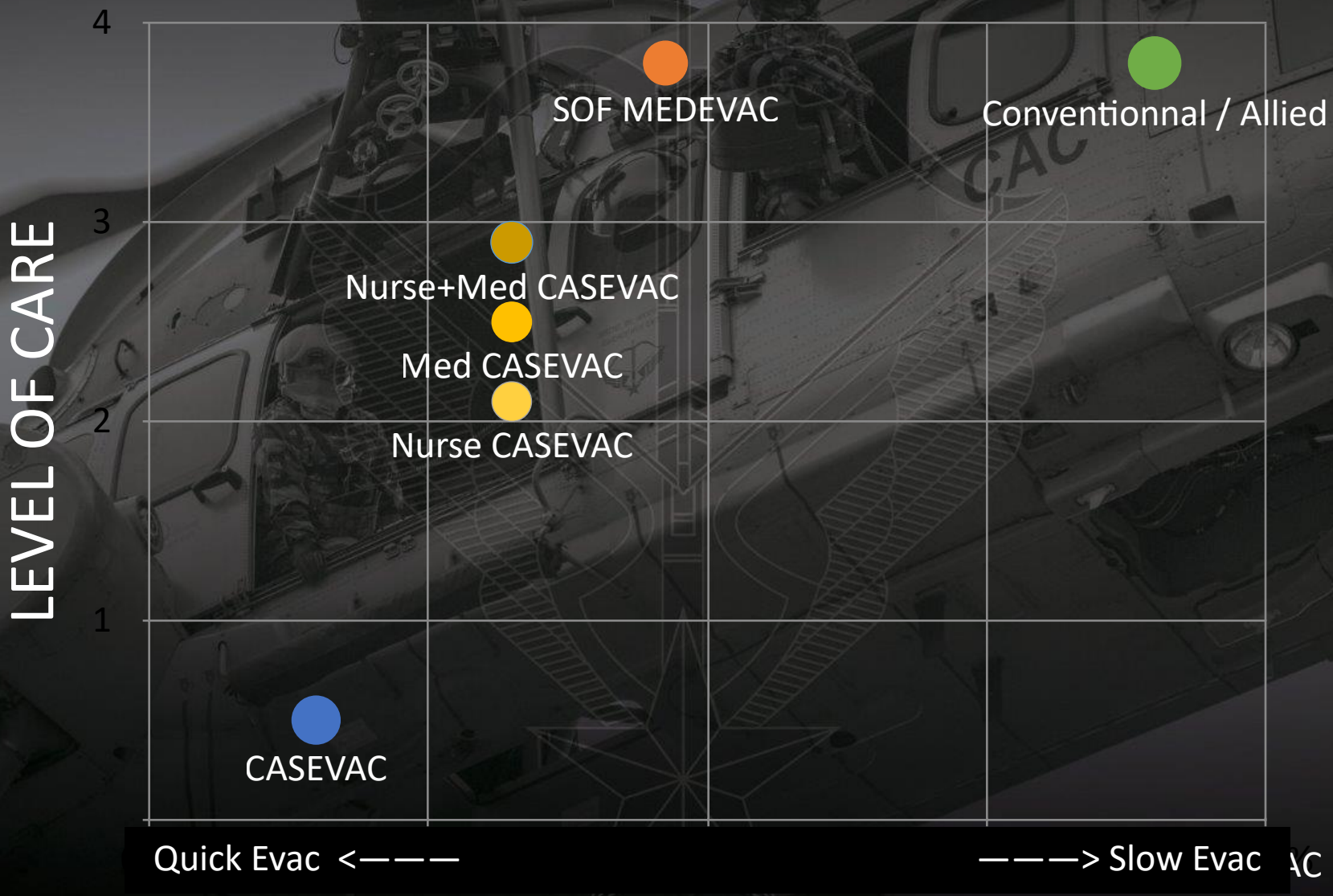
Inconvenients :

- lower level for ground medical support
- Must be planed and coordinated by JMED PECC and J3RW

* Prof, Col TRAVERS S. French special operation WOI management 2016-2020. (non published data).

• Kotwal et Al. A review of sacualties transported to R2 medical treatment facilities in afghanistan. *Mil Med*.2018 Mar1;183(suppl_1):134–45.

BALANCE : Evacuation Time *vs* Level of Care



Light helicopter « Gazelle »

can take 1 lying patient and 1 caregiver

—> no procedure possible in flight

Attack helicopter « Tiger »

can take sitting conscient patient.

very demanding condition = short flight
to get out a danger zone

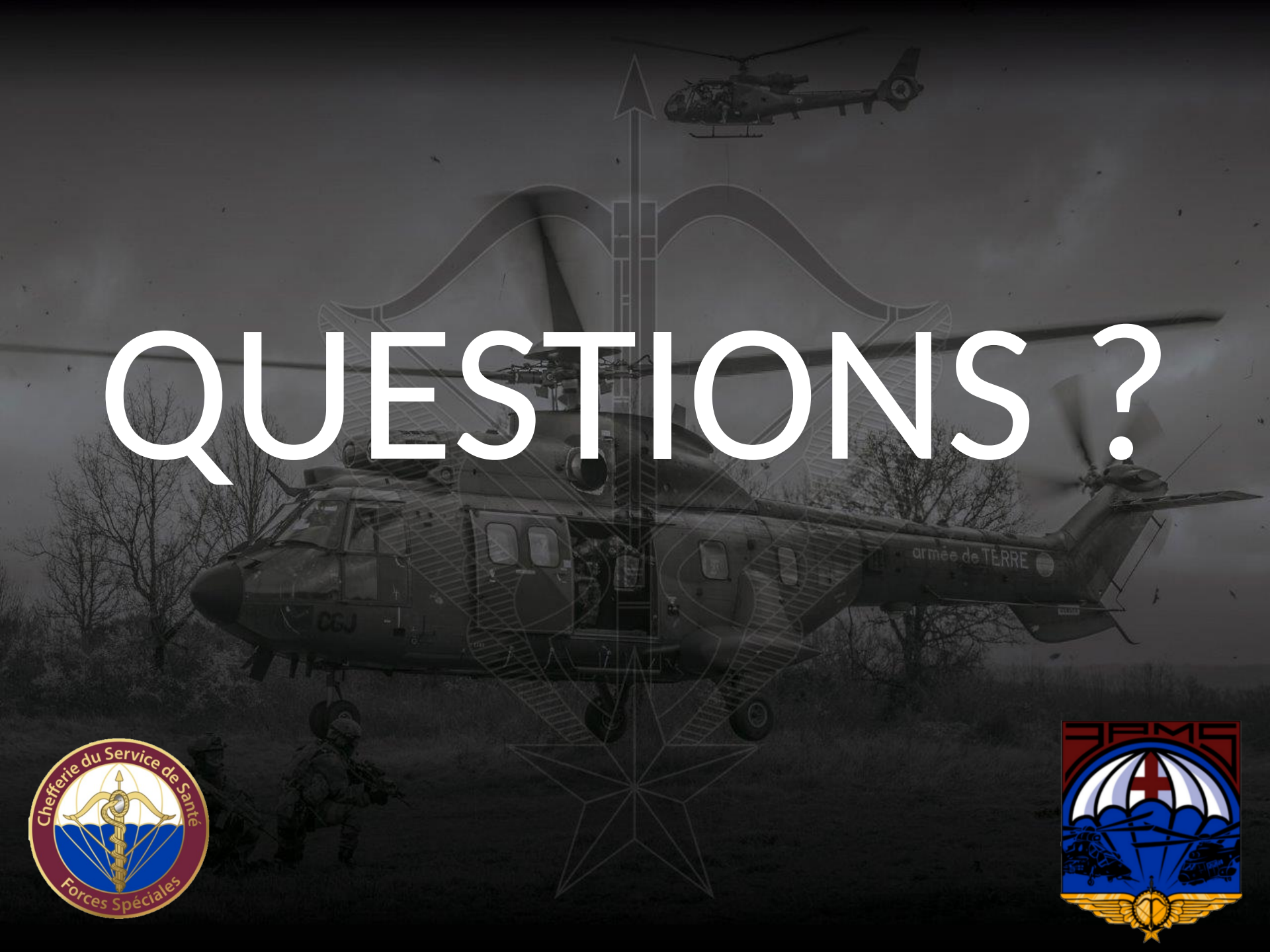
CONCLUSION

In-flight helicopter is an hostile environment
for the wounded
for the medical team

« In-flight DCR » is not really different from « ground DCR »
but requires specific training to be efficient !

Limitations are more medical than technical.

French SOF medical teams are able to provide
safely high level of care in this demanding conditions


armée de TERRE
QUESTIONS ?
Chefferie du Service de Santé
Forces Spéciales

THANK

YOU