

LA GESTIONE PREOSPEDALIERA DELLO SHOCK EMORRAGICO

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Sistema Sanitario Regione Liguria

**DIPARTIMENTO DI EMERGENZA E ACCETTAZIONE
SERVIZIO 118 GENOVA SOCCORSO
ELISOCCORSO REGIONE LIGURIA**



- Il 10% dei decessi nel mondo sono conseguenti a trauma, percentuale maggiore di HIV, tubercolosi e malaria combinate
- Vale a dire che ogni giorno nel mondo muoiono piu' di 10.000 persone per trauma
- Le cause piu' comuni di morte sono l'emorragia e il trauma cranico (TBI).



Time to Trauma Death

- 50% deaths occur at scene within minutes:
 - CNS injury 40-50%
 - **Hemorrhage 30-40%**
- 50% after hospital arrival:
 - 60% die within first 4 hrs
 - 84% die within first 12 hrs
 - **90% die within first 24 hrs**
- **Hemorrhage accounts for 50% Deaths in the first 24 hours**
median 2-3 hours after presentation

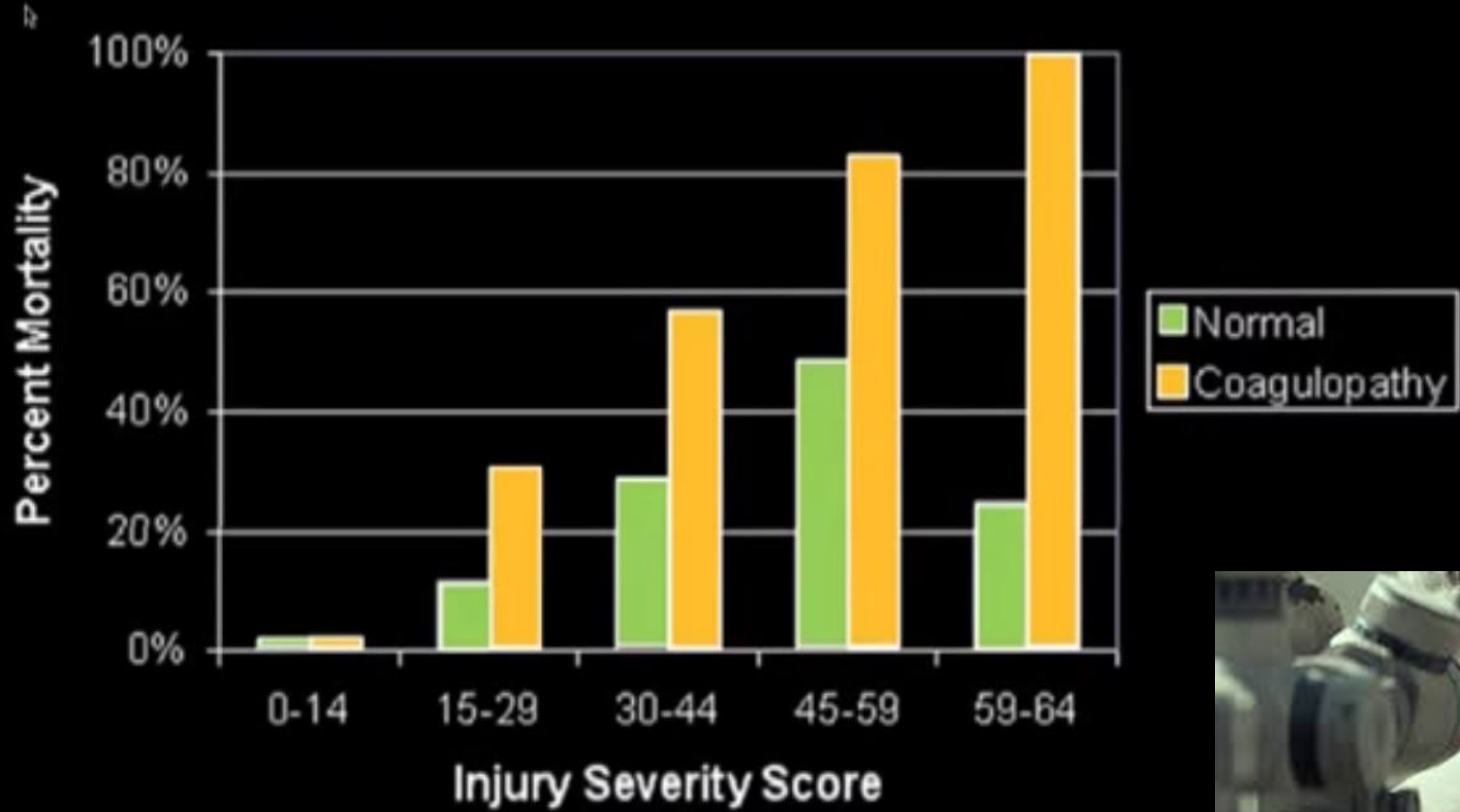


COAGULOPATIA INDOTTA DA TRAUMA (TIC)

- Un quarto dei pazienti traumatizzati civili e un terzo dei pazienti traumatizzati militari presenta una coagulopatia definita dal laboratorio.
- Nel 1969, Simmons ed altri furono i primi a riferire una relazione tra shock e prolungato tempo di protrombina (PT) e tempo parziale di tromboplastina (PTT) in pazienti traumatizzati durante la guerra del Vietnam.
- Il sanguinamento da TIC rappresenta un fallimento nella formazione di coaguli emostatici anche a livello del letto capillare, con conseguente emorragia diffusa che coinvolge siti non lesionati.



Mortality



Acute Traumatic Coagulopathy

Karim Brohi, BSc, FRCS, FRCA, Jasmin Singh, MB, BS, BSc, Mischa Heron, MRCP, FFAEM,
and Timothy Coats, MD, FRCS, FFAEM



Probability of Life-Threatening Coagulopathy Increases with Shock, Hypothermia, and Acidosis

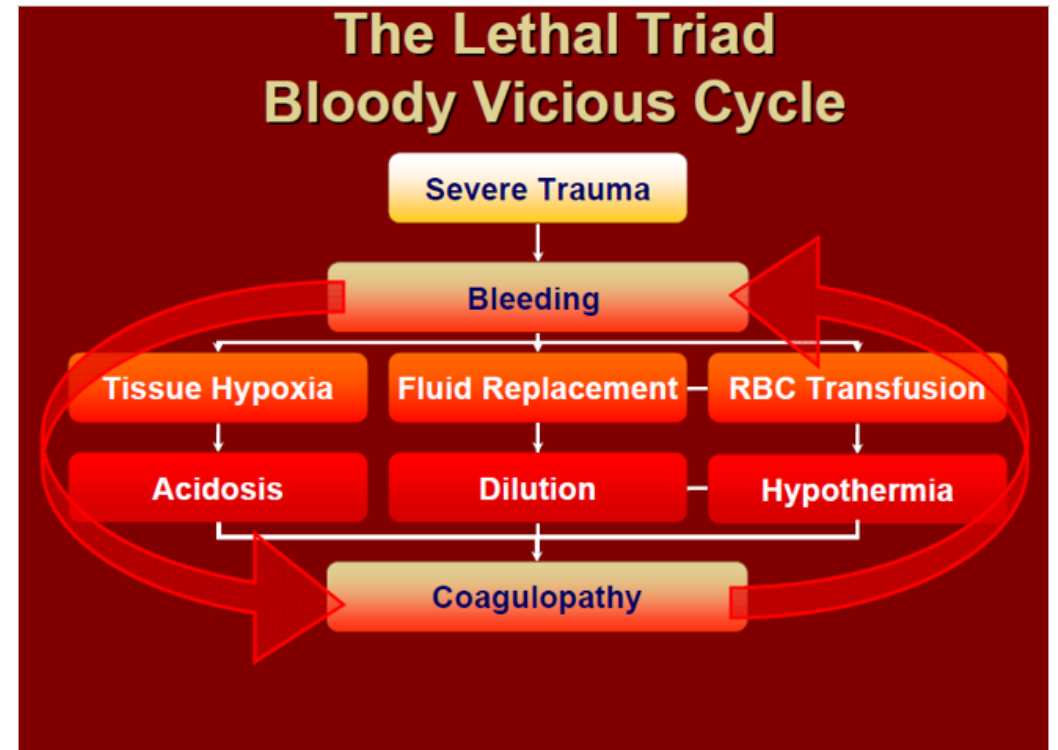
Clinical Status	Conditional Probability of Developing Coagulopathy
No risk factor	1%
ISS > 25	10%
ISS > 25 + SBP < 70 mm Hg	39%
ISS > 25 + pH < 7.1	58%
ISS > 25 + temperature < 34°C	49%
ISS > 25 + SBP < 70 mm Hg + temperature < 34°C	85%
ISS > 25 + SBP < 70 mm Hg + temperature < 34°C + pH < 7.1	98%

COAGULOPATIA DA TRAUMA



Triade fatale:

- Emodiluizione
- Ipotermia
- Acidosi

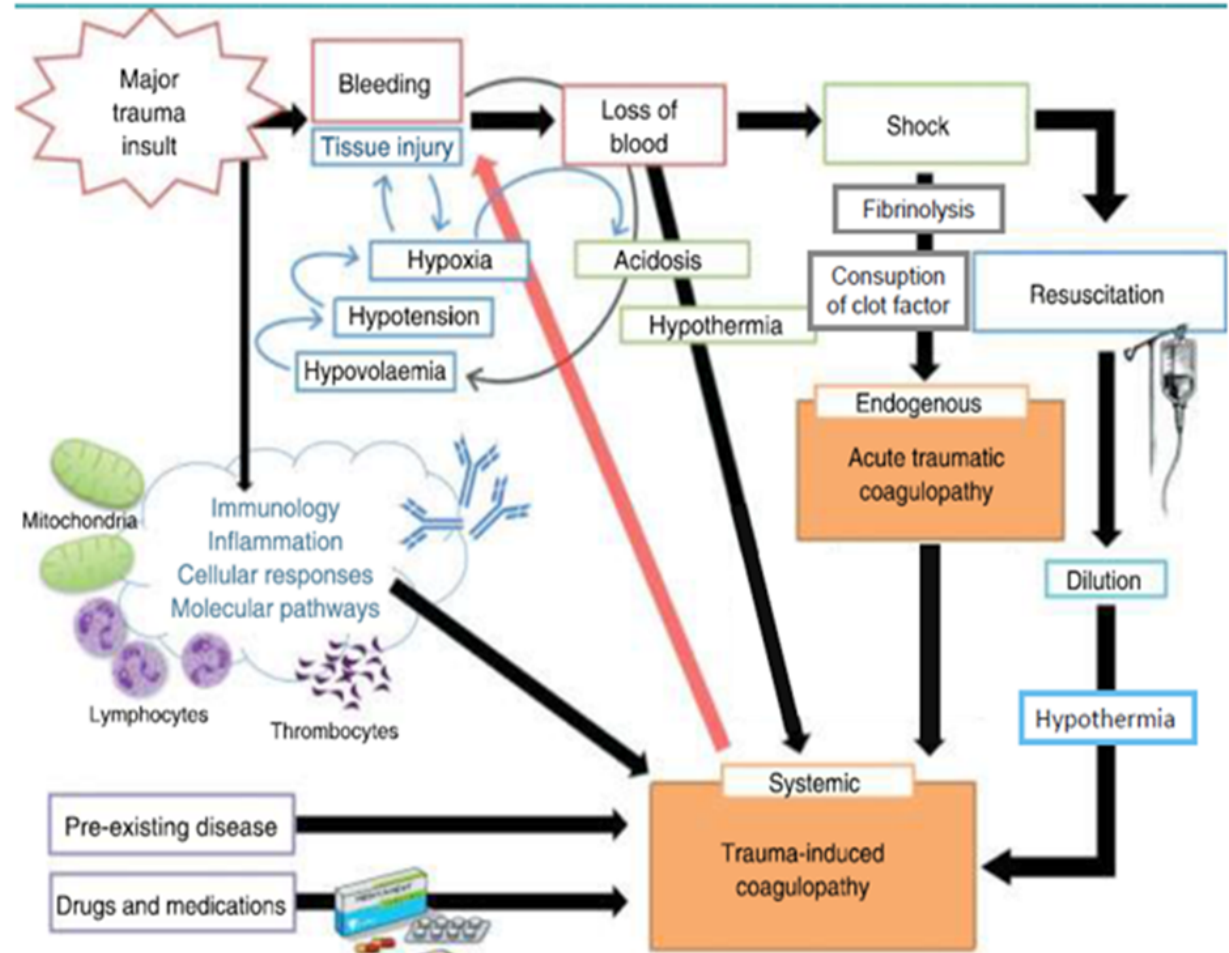


REVIEW

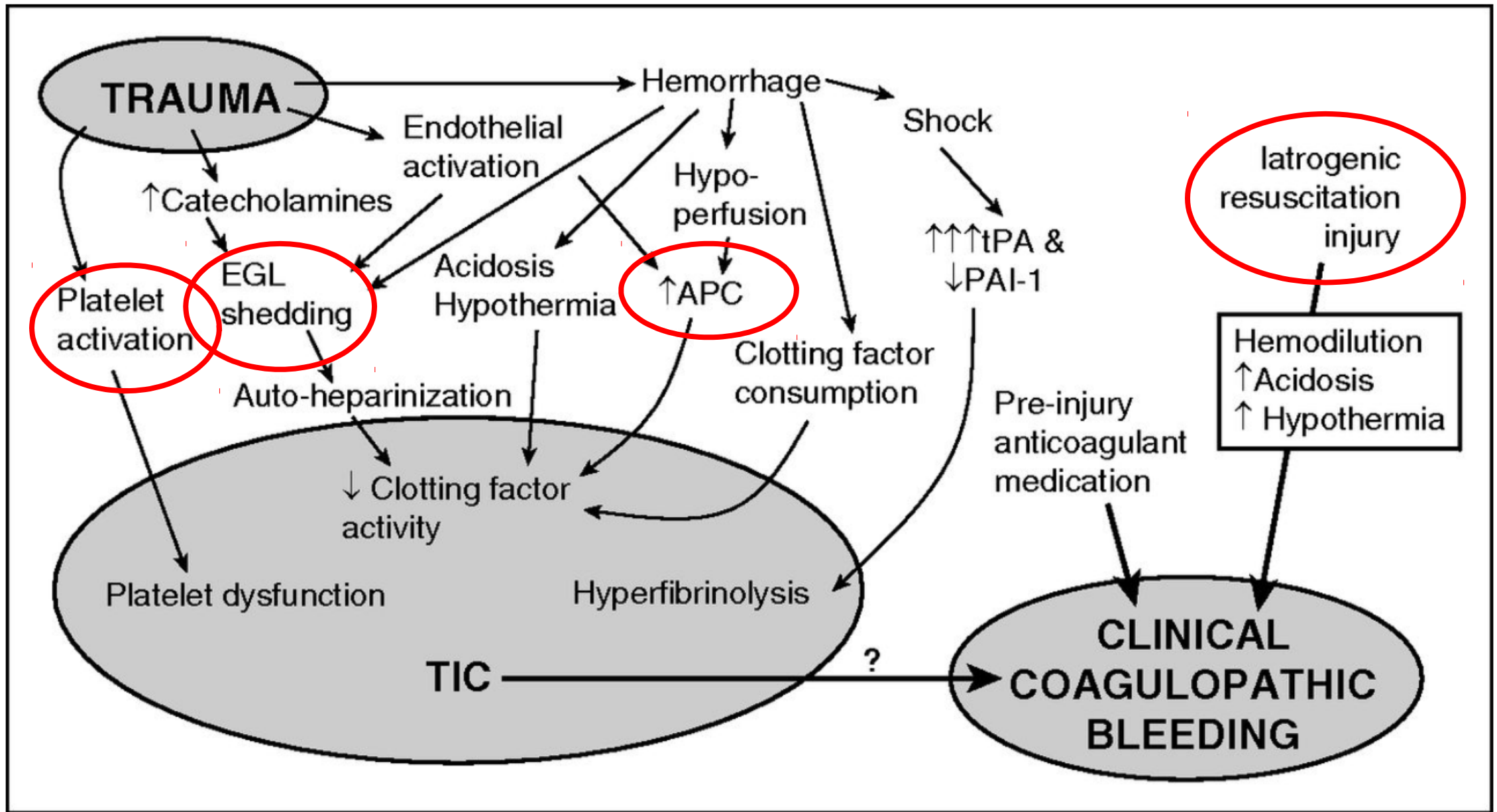
Open Access

Acute traumatic coagulopathy and trauma-induced coagulopathy: an overview

Shigeki Kushimoto^{1,2*}, Daisuke Kudo^{1,2} and Yu Kawazoe^{1,2}



Modified from: *Clinical and cellular effects of hypothermia, acidosis and coagulopathy in major injury*- Thorsen et al- *British Journal of Surgery* 2011



Chin TL, Moore EE, Moore HB, et al. A principal component analysis of postinjury viscoelastic assays: clotting factor depletion versus fibrinolysis. *Surgery* 2014;156(3):570-577.

PROTEINA C ATTIVATA (APC)

- La proteina C attivata (APC) è identificata come uno dei principali fattori di TIC. La proteina C circolante viene attivata legandosi al recettore della proteina C endoteliale in presenza del complesso **trombina-trombomodulina** su endotelio ipoperfuso.
- APC è **anticoagulante** (fattori inattivanti **Va e VIIIa**), profibrinolitico (inibitore dell'inibitore del plasminogeno inibitore [PAI-1]), e citoprotettivo (attivazione delle vie di segnalazione delle cellule antinfiammatorie e antiapoptotiche).
- l'idea che APC sia il driver principale di TIC è stata messa in discussione. **I ricercatori hanno dimostrato che il trauma cranico isolato o la contusione polmonare sono sufficienti a causare coagulopatia in assenza di ipoperfusione.**

Advances in the understanding of trauma-induced coagulopathy

Ronald Chang, Jessica C. Cardenas, Charles E. Wade and John B. Holcomb

Blood 2016 128:1043-1049; doi: <https://doi.org/10.1182/blood-2016-01-636423>

DISFUNZIONE PIASTRINICA

- RUOLO NON CHIARO
- Disfunzione piastrinica può verificarsi quando la conta piastrinica normale.
- Alcuni pazienti con piastrine inibite non hanno sanguinamenti significativi.
- Un'altra domanda aperta è il ruolo delle trasfusioni piastriniche. La trasfusione con alto rapporto plasma / piastrine 1: 1: 1 , rispetto a 1:1:2 ha ridotto il rischio di dissanguamento (9% vs 15%) e ha migliorato il raggiungimento dell'emostasi clinica (86% vs 78%).

Holcomb JB, Tilley BC, Baraniuk S, et al; PROPPR Study Group. Transfusion of plasma, platelets, and red blood cells in a 1:1:1 vs a 1:1:2 ratio and mortality in patients with severe trauma: the PROPPR randomized clinical trial. JAMA 2015;313(5):471-482.

RUOLO DELL'ENDOTELIO

- Come interfaccia tra endotelio e sangue, **componenti dello strato del glicocalice endoteliale (EGL) probabilmente gioca un ruolo chiave nella comparsa della tic.**
- Diversi meccanismi possono indurre **l'attivazione di cellule endoteliali** dopo traumi tra cui catecolamine vasoattive, mediatori dell'infiammazione come fattore di necrosi tumorale α , trombina e **ipossia**.
- Di particolare interesse sono 2 componenti EGL anticoagulanti: **condroitin solfato** ed **eparan solfato**, che aumentano l'efficienza della **trombomodulina** e dell'**antitrombina III**, rispettivamente . Lo spargimento di questi componenti nella circolazione può provocare "autoeparinizzazione" e contribuire al TIC.

FIBRINOGENO, FIBRINA E FIBRINOLISI

- La scissione del fibrinogeno in fibrina e la sua polimerizzazione in una rete di **fibrina** sono gli ultimi passaggi della coagulazione e sono necessari per stabilizzare il coagulo.
- l'iperfibrinolisi sembra strettamente associata a **shock emorragico letale** ed è relativamente indipendente dalla gravità della lesione.
- La tPA è secreta dalle cellule endoteliali in risposta a una varietà di stimoli tra cui catecolamine, bradichinina e trombina. **L'iperfibrinolisi è determinata dall'aumento di tPA e non dall'inibizione di PAI-1**

Moore HB, Moore EE, Lawson PJ, et al. Fibrinolysis shutdown phenotype masks changes in rodent coagulation in tissue injury versus hemorrhagic shock. Surgery 2015;158(2):386-392



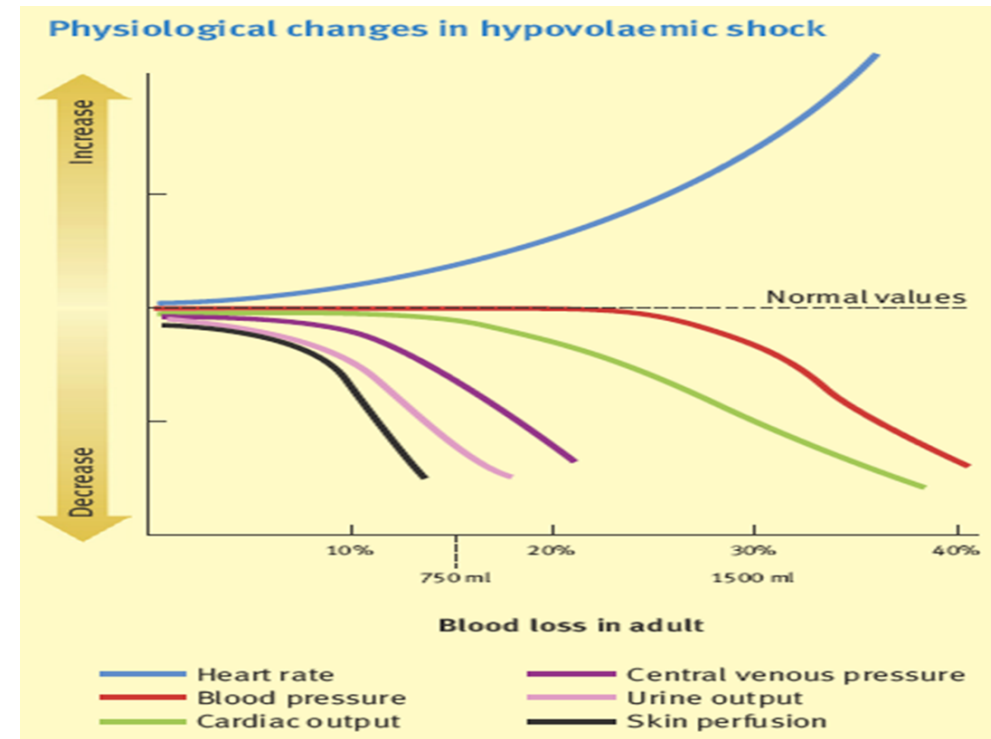
Diagnosis of trauma-induced coagulopathy using these older assays is defined
as: **PT > 18 s, INR > 1.5, PTT > 60 s**

Cause più frequenti delle morti evitabili

- ✓ **Ostruzione delle vie aeree**
- ✓ **Pneumotorace iperteso**
- ✓ **Emorragia non controllata**
- ✓ **Coagulopatia indotta da trauma**

Classic Signs & Symptoms of Shock

- Alterazioni dello stato mentale
- **Tachicardia**
- Diaforesi
- **Aumento del capillary refill**
- Diminuzione della pressione differenziale
- Diminuzione della diuresi
- Ipotensione



ATLS SHOCK IPOVOLEMICO

Class	I	II	III	IV
Blood loss (ml)	≤750	750-1500	1500-2000	≥ 2000
Blood loss (% blood volume)	≤15%	15-30%	30-40%	≥40%
Pulse rate	<100	>100	>120	≥ 140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mmHg)	Normal or increased	Decreased	Decreased	Decreased
Capillary refill test	Normal	Positive	Positive	Positive
Respiratory rate	14-20	20-30	30-40	>35
Urine output (ml/hr)	≥ 30	20-30	5-15	Negligible
CNS-mental status	Slightly anxious	Mildly anxious	Anxious and confused	Confused, lethargic
Fluid replacement (3:1 rule)	Crystalloid	Crystalloid	Crystalloid + Blood	Crystalloid + Blood

**Perdita : fino al 15% della massa ematica circolante
(≅ 750 ml.)**

Hypotension and Paradoxical Bradycardia

it just isn't right" category. It isn't right because it happens far more frequently than we recognize, and contradicts what we have been taught about the body's response to hemorrhage. A definite and significant subset of hypotensive patients will not mount a tachycardia response to hypotension, and a third or more of hypotensive trauma patients will present with bradycardia. (*J Trauma* 1998;45(3):534 and 2009;67(5):1051; *J Am Coll Surg* 2003;196(5):679.)

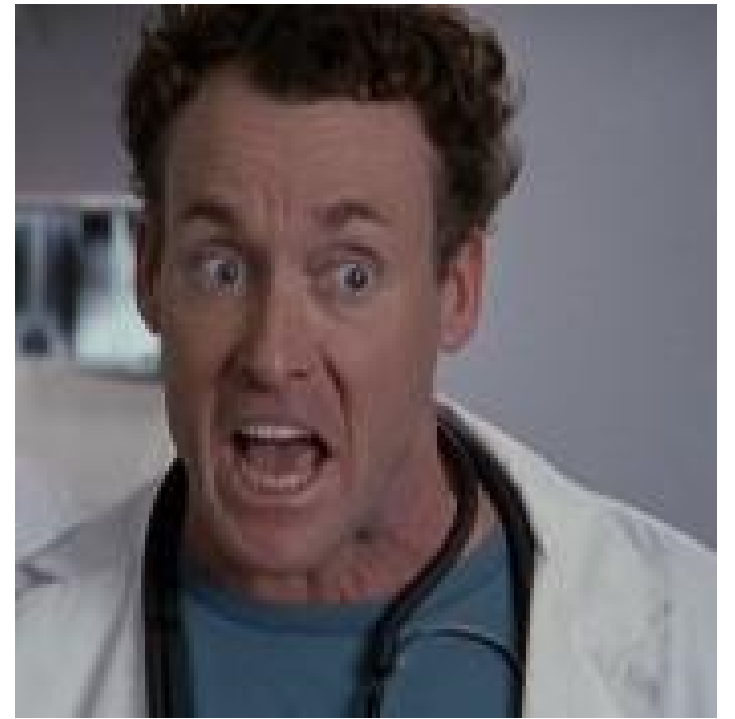
between hemorrhage and tachycardia, it is actually unreliable and nothing like the four classes of hypovolemic shock described in that well-known table published by the Advanced Trauma Life Support course. The evidence shows that the ATLS table is more wishful thinking than reality. (*Resuscitation* 2011;82(5):556; 2010;81(9):1142; 2013;84(3):309.) We still need to respect tachycardia in the face of hypotension, but heart rate is not a reliable indicator in the trauma patient. (*J Am Coll Surg* 2003;196(5):679; *J Trauma* 2007;62(4):812.)

Relative Bradycardia (Paradoxical Bradycardia)

- Defined as Pulse < 90 with SBP < 90

Cause remains unclear:

- **Sign of rapid & severe internal bleeding?**
- **Increased vagal tone from blood in abd cavity?**
- **Protective reflex designed to increase diastolic filing in the presence of severe hypovolemia?**



The ATLS® classification of hypovolaemic shock: a well established teaching tool on the edge?

Mutschler M¹, Paffrath T², Wölfl C³, Probst C², Nienaber U⁴, Schipper IB⁵, Bouillon B², Maegerle M².

Un'analisi retrospettiva dei dati ottenuti dalla Trauma Register DGU ha indicato che solo il **9,3% di tutti i pazienti traumatici potrebbe essere assegnato in una delle classi di shock ATLS (®)** quando una combinazione delle tre segni vitali della frequenza cardiaca, della pressione sistolica e Glasgow Coma Scale è stata valutata.

Di conseguenza, oltre il 90% di tutti i pazienti con trauma non poteva essere classificato in base alla classificazione ATLS (®) di shock ipovolemico.

E QUINDI COME FACCIAMO
A CAPIRE SE IL PAZIENTE E'
IN SHOCK?



ANALIZZATORE PORTATILE EMOGAS



EMOGLOBINA ED
EMATOCRITO NON
SONO INDICI
AFFIDABILI PER
STIMARE UNA
EMORRAGIA ACUTA....



Deficit di basi

Misura sensibile di inadeguata perfusione

Gamma normale da -3 a +3

Eseguibile con EGA

Category	Base Deficit	Mortality
Mild	< 5	11%
Moderate	6-9	23
Severe	10-15	44%
	16-20	53%
	>20	70%

AUMENTO DEI LATTATI

- Indirect measure of oxygen debt
- Normal value = 1.0 mEq/L
- **Values > 1.0 correlate to magnitude of shock**
- **Lactate Levels > 5 = ↑ mortality**
- Ability to clear lactate within 24 hours:
 - Predictive of survival
- Inability to clear lactate within 12 hours:
 - Predictive of multisystem organ failure



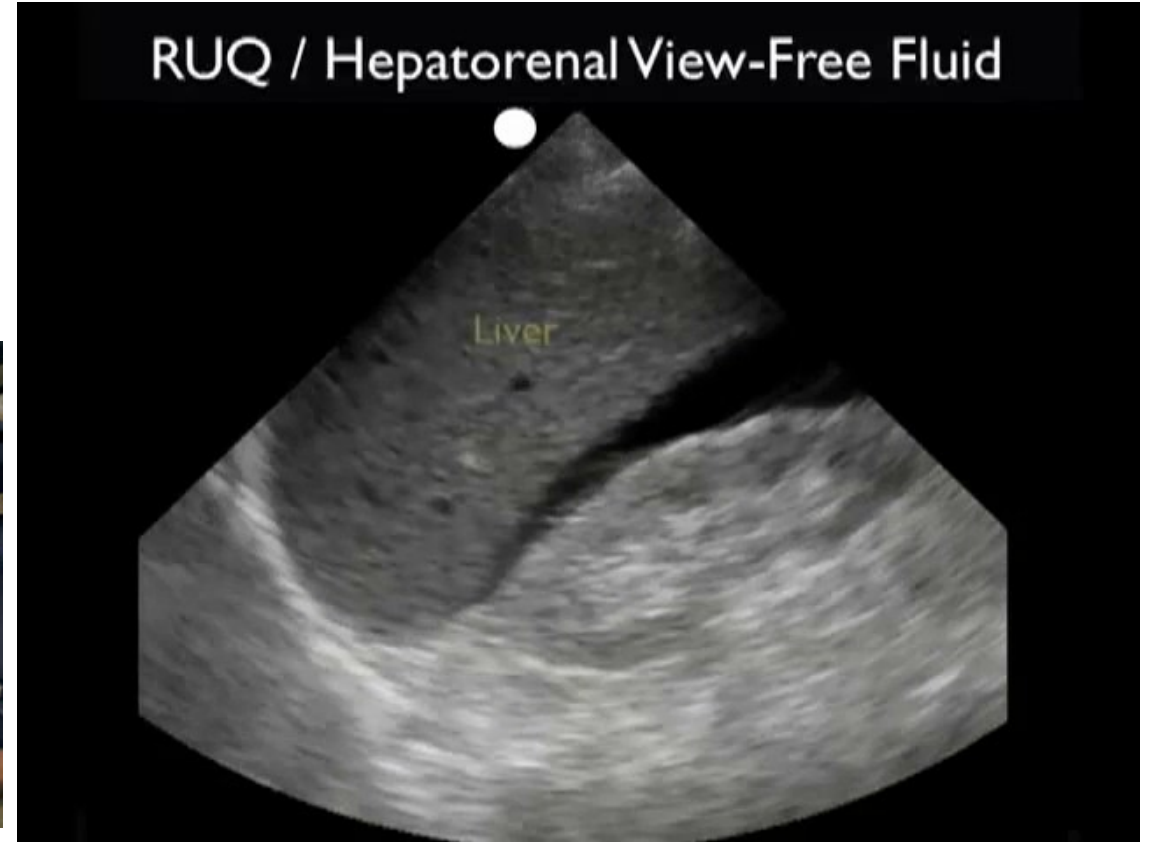
END-TIDAL CO₂

www.capnography.com

> 37 mmHg no acidosis no shock.

< 25mmHg alta probabilità di shock.

ECO FAST ++++



Shock Index (SI)

- **SI = HR / SBP**
- Elevated early in shock
- Normal 0.5 - 0.7
- **SI > 0.9 predicts:**
 - Acute hypovolemia in presence of normal HR & BP
 - Marker of injury severity & mortality
- Caution in Geriatrics
 - May underestimate shock due to higher baseline SBP
- Uses
 - Prehospital use → triage



OK E' IN SHOCK....
QUINDI COSA
FACCIAMO?



“Scoop & run”

- BVM ventilation
- Chest compressions
- IV fluid?
- Needle decompression?



....BENE NON IN FRETTA....

Ann Emerg Med. 2015 Jan 14. pii: S0196-0644(14)01572-8. doi: 10.1016/j.annemergmed.2014.12.004. [Epub ahead of print]

Revisiting the "Golden Hour": An Evaluation of Out-of-Hospital Time in Shock and Traumatic Brain Injury.

Newgard CD¹, Meier EN², Bulger EM³, Buick J⁴, Sheehan K², Lin S⁴, Minei JP⁵, Barnes-Mackey RA⁶, Brasel K⁷; ROC Investigators.

CONCLUSION: Among out-of-hospital trauma patients meeting physiologic criteria for shock and traumatic brain injury, **there was no association between time and outcome.**

Pediatrics. 2009 Jul;124(1):381-3. doi: 10.1542/peds.2008-3596.

Speed isn't everything in pediatric medical transport.

McPherson ML¹, Graf JM.

PRIMA COSA CONTRASTARE L'EMORRAGIA ESTERNA:

- COMPRESSIONE DIRETTA
- UTILIZZO DI TOURNIQUET
- SUTURA E/O CLAMPAGGIO
- UTILIZZO DI EMOSTATICI

The **DDIT** method:

D - Direct Pressure

D - Direct Pressure (more!)

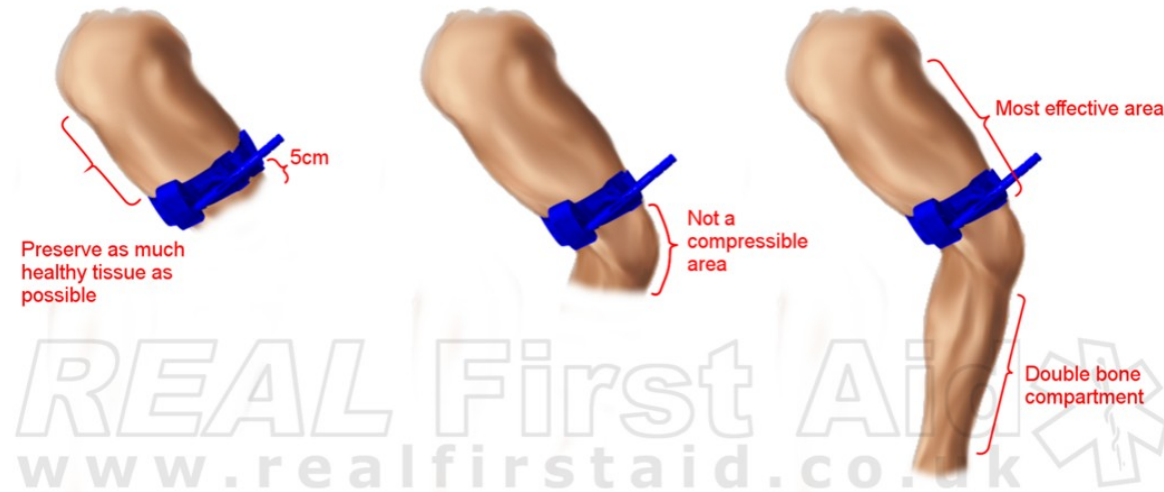
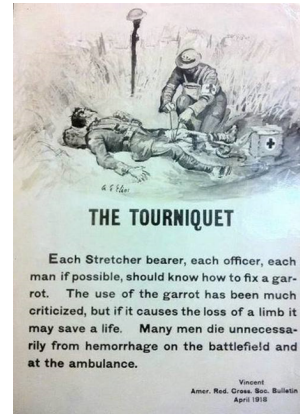
I - Indirect pressure

T - Tourniquet

Tourniquets for hemorrhage control on the battlefield: a 4-year accumulated experience.

Lakstein D¹, Blumenfeld A, Sokolov T, Lin G, Bssorai R, Lynn M, Ben-Abraham R.

CONCLUSION: Tourniquet application is an effective and easily applied (by medical and nonmedical personnel) method for prevention of exsanguination in the military prehospital setting.



SUTURA e/o CLAMPAGGIO





EMOSTATICI

- Semplici ed efficaci
- Molto diffuse in ambito militare
- Efficaci su addome e collo
- Rispetto ai primi prodotti messi in commercio nessuna reazione esotermica
- **Efficace anche in pazienti in terapia con anticoagulanti e/o antiaggreganti**

STOPS SEVERE BLEEDING
CELOXTM
Granular Haemostat



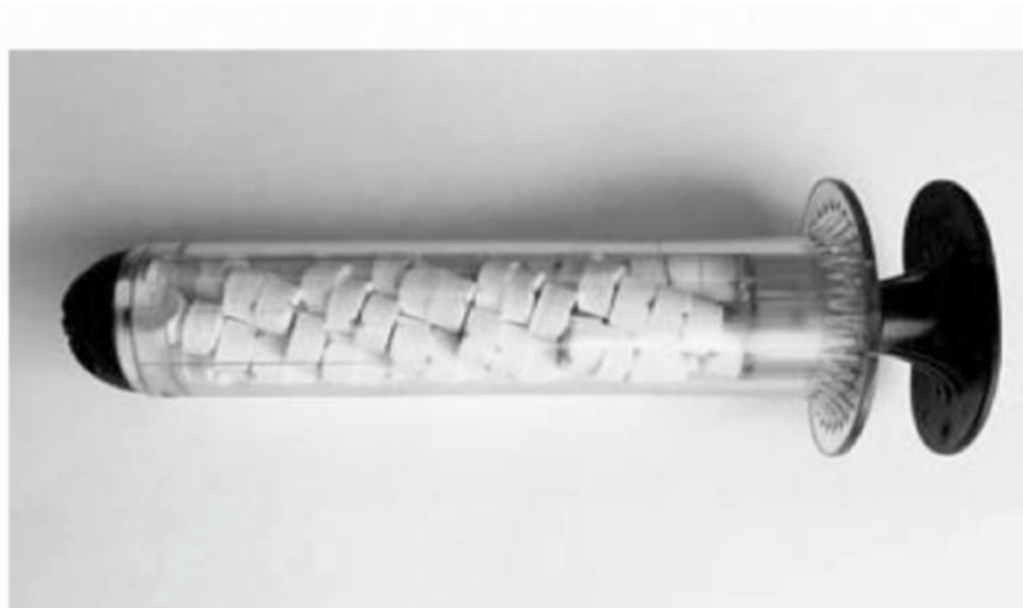
CeloxTM can stop even potentially lethal bleeding fast. It is easy to use (just pour, pack and apply pressure), very safe (tested to class 3 CE Mark standards) and extremely effective. CeloxTM saves lives.

Topical and effective hemostatic medicines in the battlefield

[Yin-Juan Zhang](#),^{1,*} [Bo Gao](#),^{2,*} and [Xi-Wen Liu](#)¹

[Author information](#) ► [Article notes](#) ► [Copyright and License information](#) ►

In summary, Fibrin Sealant Dressing, Celox and Woundstat show more advantages over others proved by the data we collected. J. Granville-Chapman also concluded Celox and WoundStat were effective to stop bleeding caused by pre-hospital trauma in battlefield

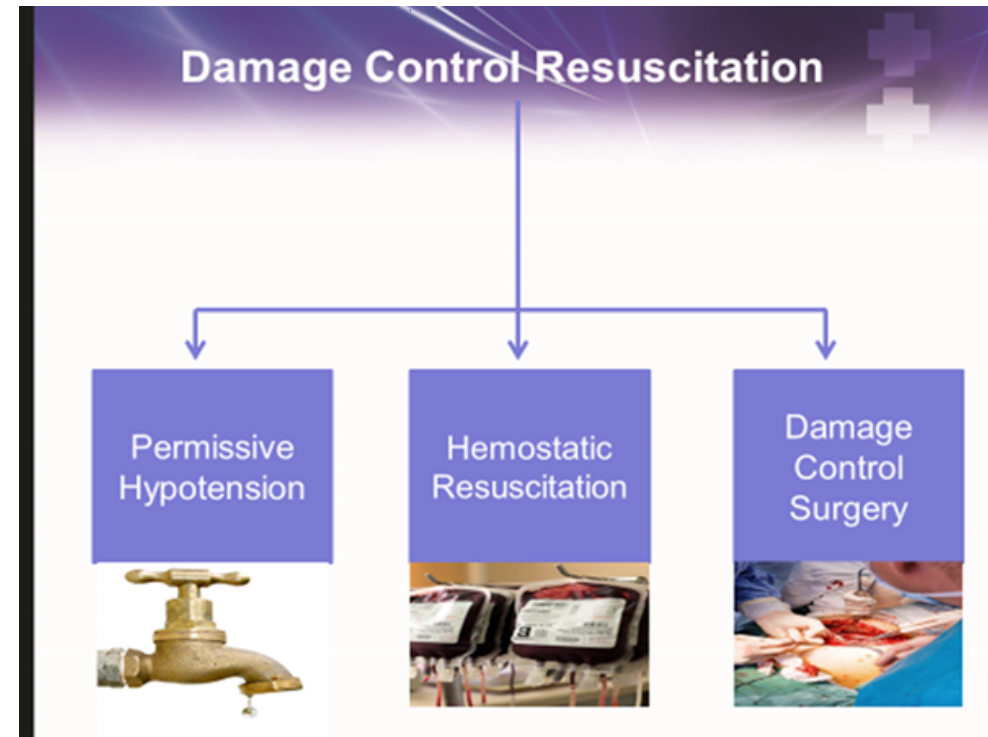
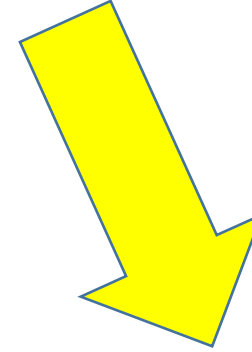


SE L'EMORRAGIA E' INTERNA?

- MINIMA MOBILIZZAZIONE
- STABILIZZAZIONE ESTERNA BACINO
- REBOA
- SUPPORTO AL CIRCOLO
- SUPPORTO ALLA COAGULAZIONE
- MANTENIMENTO NORMOTERMIA

IN OSPEDALE:

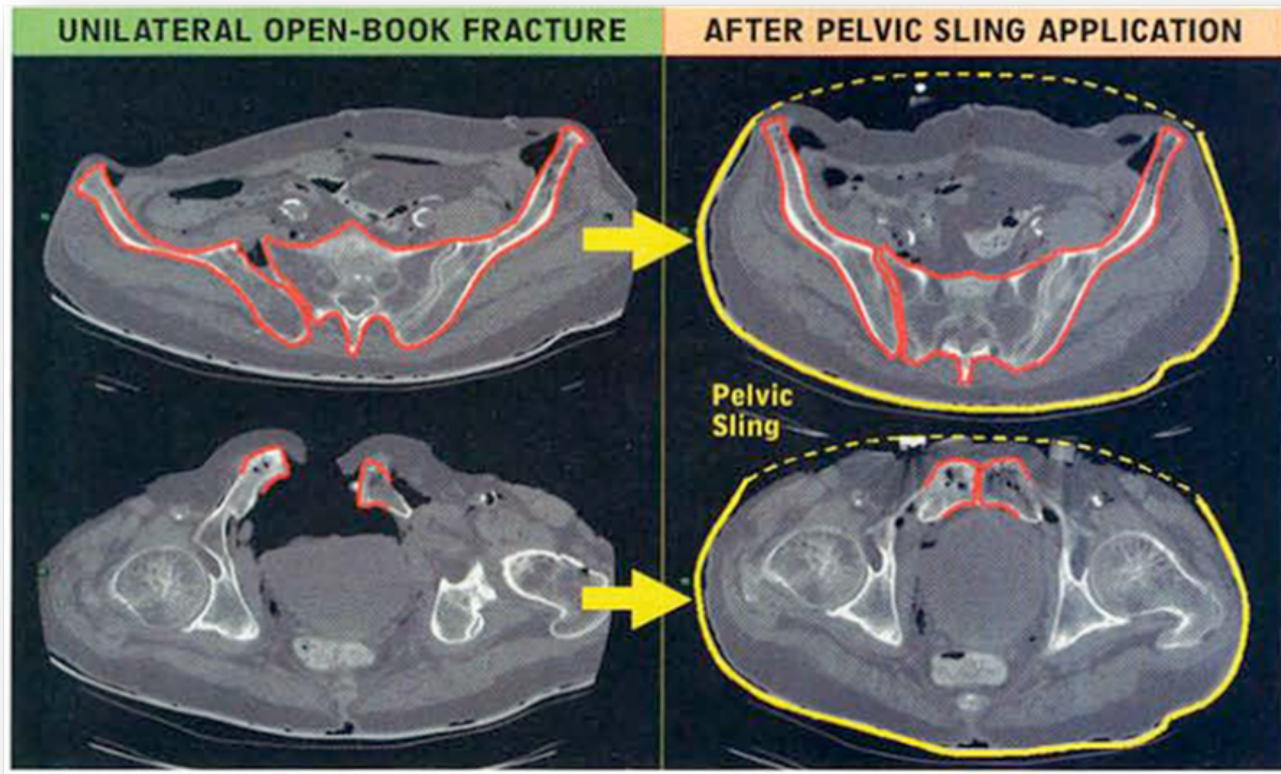
- RADIOLOGIA INTERVENTISTICA
- DAMAGE CONTROL SURGERY



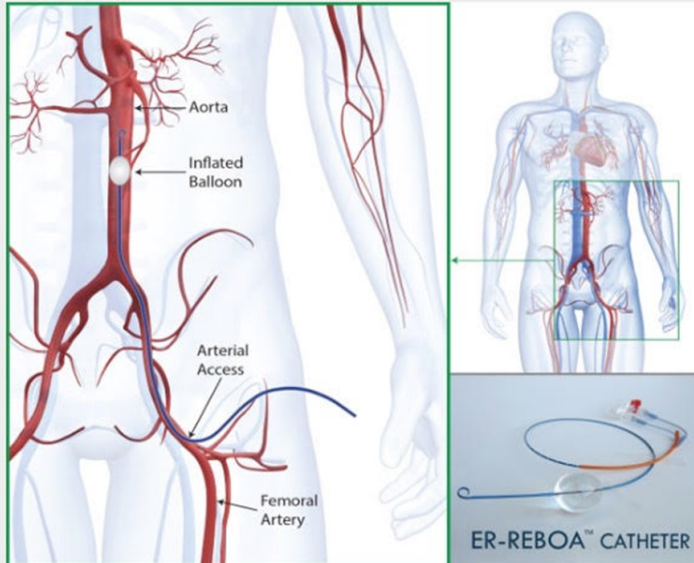
Efficacy and safety of emergency non-invasive pelvic ring stabilisation.

Toth L¹, King KL, McGrath B, Balogh ZJ.

CONCLUSION: The adherence to the guidelines should be improved with further education and system development. The good effect of the technique was evident on radiographs. Although in some lateral compression fracture patterns the deformity increased, no hazards were associated with the use of PB.



NEL GIUGNO 2014 IL PRIMO POSIZIONAMENTO SUL TERRITORIO DA PARTE DEI MEDICI DEL **LONDON'S AIR AMBULANCE !!!!!**



The ER-REBOA™ Catheter is an example of the equipment that can be used to perform the REBOA procedure. Image courtesy of Pryor Medical Devices, Inc. (c) Thinkstock



Abdominal Aortic Tourniquet

TraumaSystemNews

Trauma leadership and management

Combat-tested abdominal/junctional tourniquet proven equivalent to REBOA

BY TRAUMA NEWS ON JUNE 4, 2018

SOI

The median and modal pressure at which flow occluded was less than **250 mm Hg**.



Abdominal aortic tourniquet.



POI PENSIAMO AL REINTEGRO VOLEMICO...





So, what can we do
pre-hospital?

**Preserve, Don't
Replace!**

NO LIQUIDI IN ECCESSO!!!!

UN AUMENTO DELLA PRESSIONE ARTERIOSA OTTENUTA IN QUESTO MODO DETERMINEREBBE:

- AZIONE NEGATIVA SUL COAGULO IN FORMAZIONE
- DILUIZIONE DEI FATTORI DELLA COAGULAZIONE E DELL'EMOGLOBINA
- ABBASSAMENTO LA TEMPERATURA CORPOREA CHE HA UN EFFETTO NEGATIVO SULLA COAGULAZIONE

*The National Institute for Health and Clinical Excellence
(NICE 2015)*

ATLS SHOCK IPOVOLEMICO

Class	I	II	III	IV
Blood loss (ml)	≤750	750-1500	1500-2000	≥ 2000
Blood loss (% blood volume)	≤15%	15-30%	30-40%	≥40%
Pulse rate	<100	>100	>120	≥ 140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mmHg)	Normal or increased	Decreased	Decreased	Decreased
Capillary refill test	Normal	Positive	Positive	Positive
Respiratory rate	14-20	20-30	30-40	>35
Urine output (ml/hr)	≥ 30	20-30	5-15	Negligible
CNS-mental status	Slightly anxious	Mildly anxious	Anxious and confused	Confused, lethargic
Fluid replacement (3:1 rule)	Crystalloid	Crystalloid	Crystalloid + Blood	Crystalloid + Blood

Perdita : fino al 15% della massa ematica circolante
(≅ 750 ml.)

DOGMA DEL 3

shock ipovolemico senza utilizzo di colloidii
 classe 1 : volume teorico perso cristalloidi X 3
 classe 2 : volume teorico perso cristalloidi X 3
 classe 3 e 4 : cristalloidi e sangue
 (volume teorico perso regola 3 : 1)

- Paziente traumatizzato di 70 kg., ipoteso
- Perdita ematica stimata: circa 1.500 ml.
- Reintegro con 4.500 ml. di cristalloidi

Colloids versus crystalloids for fluid resuscitation in critically ill patients.

Perel P¹, Roberts I, Ker K.

AUTHORS' CONCLUSIONS: There is no evidence from randomised controlled trials that resuscitation with colloids reduces the risk of death, compared to resuscitation with crystalloids, in patients with trauma, burns or following surgery. Furthermore, the use of hydroxyethyl starch might increase mortality. As colloids are not associated with an improvement in survival and are considerably more expensive than crystalloids, it is hard to see how their continued use in clinical practice can be justified.

Cochrane Database Syst Rev. 2011 Mar 16;(3):CD001319. doi: 10.1002/14651858.CD001319.pub3.

Colloid solutions for fluid resuscitation.

Bunn F¹, Trivedi D, Ashraf S.

AUTHORS' CONCLUSIONS: From this review, there is no evidence that one colloid solution is more effective or safe than any other, although the confidence intervals are wide and do not exclude clinically significant differences between colloids. Larger trials of fluid therapy are needed if clinically significant differences in mortality are to be detected or excluded.

Recentemente l'ESICM ha pubblicato una review in cui viene sottolineata la mancanza di superiorità dei colloidi rispetto ai cristalloidi e si ribadisce l'effetto nefrotossico dei primi.

Reinhart K, Perner A, Sprung CL, Jaeschke R, Schortgen F, Groeneveld A B J, Beale R, Hartog CS: Consensus Statement of the ESICM Task Force on Colloid Volume Therapy in Critically Ill Patients. *Intensive Care Med* 2012; 38: 368-383.

JAMA. 2013 Nov 6;310(17):1809-17. doi: 10.1001/jama.2013.280502.

Effects of fluid resuscitation with colloids vs crystalloids on mortality in critically ill patients presenting with hypovolemic shock: the CRISTAL randomized trial.

Annane D¹, Siame S, Jaber S, Martin C, Elatrous S, Declère AD, Preiser JC, Outin H, Troché G, Charpentier C, Trouillet JL, Kimmoun A, Forceville X, Darmon M, Lesur O, Reignier J, Abroug F, Berger P, Clec'h C, Cousson J, Thibault L, Chevret S; CRISTAL Investigators.

CONCLUSIONS AND RELEVANCE: Among ICU patients with hypovolemia, the use of colloids vs crystalloids did not result in a significant difference in 28-day mortality. Although 90-day mortality was lower among patients receiving colloids, this finding should be considered exploratory and requires further study before reaching conclusions about efficacy.

These studies do, however, demonstrate a trend toward less synthetic colloid fluid required to achieve hemodynamic goals compared to crystalloids with a ratio (volume of colloid to crystalloid that results in similar physiological effects) varying between 1:1.1 and 1:1.6 (colloids:crystalloids).

This ratio is smaller than previously thought (ATLS teaches a ratio of 1:3), and significance in subgroups of patients is yet to be determined. Concerns still exist about the adverse effects of hydroxyethyl starch 130/0.4 on renal function and coagulopathy although crystalloid fluids are not without complications

BOLO DI RINGER LATTATO 250 ML

(FISIOLOGICA NEL TRAUMA CRANICO)

Eventuale associazione con colloidi 1:1,1 – 1:1,6 ?

SURGICAL SYMPOSIUM CONTRIBUTION

Strategies for Intravenous Fluid Resuscitation in Trauma Patients

Robert Wise^{1,2,3} · Michael Faurie⁴ · Manu L. N. G. Malbrain⁵ · Eric Hodgson^{3,6}

SYSTOLIC BLOOD PRESSURE GOALS DURING RESUSCITATION

- PENETRATING: BP 50-70 mmHg
 - BLUNT: BP 80-90 mmHg
 - +/- TBI: BP 100-110 mmHg / MAP > 70
- 

- Clearing of lactate with target < 2.0
- Base Deficit (BD) < -5
- Improving pH to > 7.3
- Normothermia or at least T > 35.5 degrees Celsius

$$P_m = (2(P_d) + P_s) / 3$$

PA 90/60 = (60 x 2 + 90) / 3
MAP = 70 mmHg

Review

Resuscitation and coagulation in the severely injured trauma patient

Mark J. Midwinter^{1,*} and Tom Woolley²

¹*Academic Department of Military Surgery and Trauma, and* ²*Department of Military Anaesthesia and Critical Care, Royal Centre for Defence Medicine, Birmingham, UK*

In caso di **trauma cranico**....

Novel hybrid resuscitation :

- Hypotensive strategy 80 mmHg per 60 minuti
- Normotensive strategy 120 mmHg per 60 minuti

Questa strategia riduce il sanguinamento e la mortalità a 8 ore.

LA SOLUZIONE IPERTONICA?

Shock. 2015 Jul;44(1):25-31. doi: 10.1097/SHK.0000000000000368.

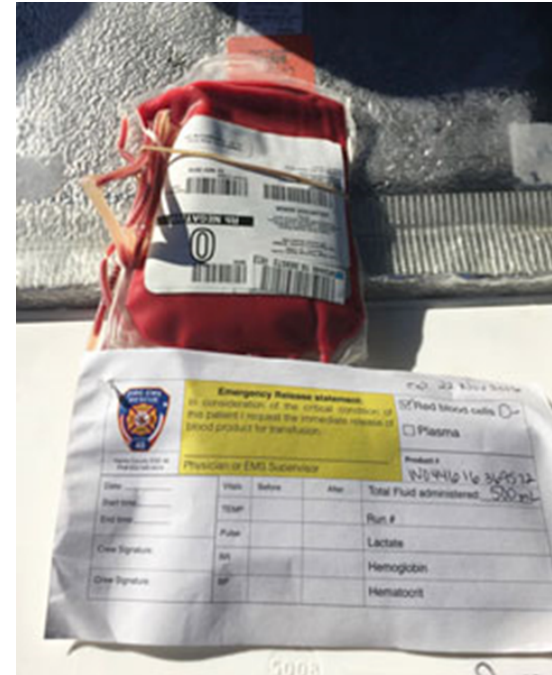
Prehospital Resuscitation of Traumatic Hemorrhagic Shock with Hypertonic Solutions Worsens Hypocoagulation and Hyperfibrinolysis.

Delano MJ¹, Rizoli SB, Rhind SG, Cuschieri J, Junger W, Baker AJ, Dubick MA, Hoyt DB, Bulger EM.

Abbiamo concluso che la rianimazione con soluzioni ipertoniche, in particolare HSD, **peggiora l'ipocoagulabilità e l'iperfibrinolisi dopo lo shock emorragico nel trauma** attraverso gli squilibri sia nei procoagulanti che negli anticoagulanti e nelle attività sia profibrinolitiche che antifibrinolitiche.

Considerations for Using Blood Products for Prehospital Trauma Patients

Wed, Mar 1, 2017 | By Mark E.A. Escott, MD, MPH, FACEP, Eric A. Bank, LP, NRP, Faroukh Mehkri, BA, AEMT, Brett J. Monroe, MD



Shock. 2016 Jul;46(1):3-16. doi: 10.1097/SHK.0000000000000569.

Prehospital Blood Product Resuscitation for Trauma: A Systematic Review.

Smith IM¹, James RH, Dretzke J, Midwinter MJ.

CONCLUSIONS:

While PHBP resuscitation **appears logical**, the clinical literature is limited, provides only poor quality evidence, and **does not demonstrate improved outcomes**. No conclusions as to efficacy can be drawn. The results of randomized controlled trials are awaited.

Tuttavia ha dimostrato un ridotto numero di disturbi acido-base, **una ridotta mortalità a sei ore** e un ridotto utilizzo di prodotti sanguigni in ospedale e una ridotta incidenza di coagulopatia.

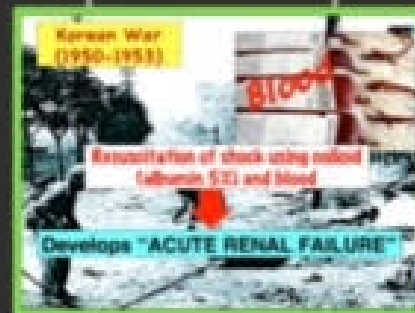
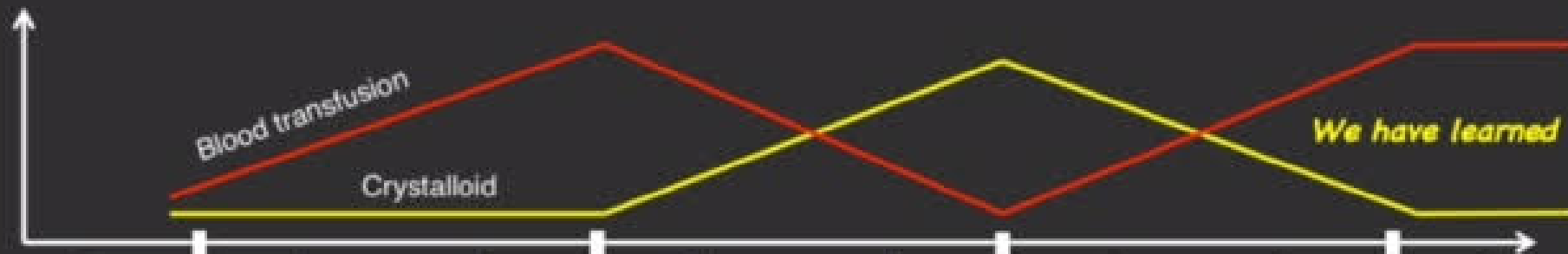
The goal of resuscitation recommendations for the concept of massive transfusions suggest:

Plasma:Platelets:Red blood cells in a ratio of 1:1:1 or 1:1:2



THE HISTORY OF THE FLUID AND BLOOD MANAGEMENT IN HEMORRHAGIC SHOCK.

'learn from the military trauma'



Shoemaker 1980-1990

MEDIAN VALUE OF SURVIVORS IN SHOEMAKER OBSERVATIONAL STUDIES

Cardiac Index (CI)	4.5 L/min/m ²
Oxygen delivery (DO ₂)	600 ml/min/m ²
Oxygen consumption (VO ₂)	170 ml/min/m ²

"supernormal" value using fluid and transfusion

HEMOGLOBIN SOLUTIONS

Emoglobina di origine bovina modificata, trasporta ossigeno ma senza essere in possesso delle funzioni metaboliche degli eritrociti. Si conserva a temperatura ambiente per 3 anni. Non ci sono studi su larga scala che ne supportino l'uso. Attualmente in commercio (HEMOPURE) in Russia e Sud Africa..

[Arch Trauma Res](#). 2016 Jun; 5(2): e30610.

Published online 2016 Feb 2. doi: [10.5812/atr.30610](#)

Hemoglobin-Based Oxygen Carrier for Traumatic Hemorrhagic Shock Treatment in a Jehovah's Witness

[Joseph A. Posluszny](#)¹ and [Lena M. Napolitano](#)^{1,*}

Conclusions:

Early HBOC administration can be used in the treatment of severe hemorrhagic shock in trauma patients who refuse allogeneic blood.

[JAMA](#). 2008 May 21;299(19):2304-12. doi: 10.1001/jama.299.19.jrv80007. Epub 2008 Apr 28.

Cell-free hemoglobin-based blood substitutes and risk of myocardial infarction and death: a meta-analysis.

[Natanson C](#)¹, [Kern SJ](#), [Lurie P](#), [Banks SM](#), [Wolfe SM](#).

CONCLUSION: Based on the available data, use of HBBSs is associated with a significantly increased risk of death and MI.



PERFLUOROCARBURI

Effect of supplemental perfluorocarbon administration on hypotensive resuscitation of severe uncontrolled...

CONCLUSION

In this model of near-fatal hemorrhage in the presence of a vascular injury, supplementation of crystalloid hypotensive resuscitation with a perfluorocarbon emulsion significantly improved arterial oxygen content and delivery. Expected associated improvements in serum bicarbonate and lactate levels were not found, probably because of the limitations of this protocol. Administration of a synthetic oxygen-carrying perfusate during hypotensive resuscitation may be a reasonable approach to the preoperative management of acute hemorrhage.



[Artif Cells Blood Substit Immobil Biotechnol. 2005;33\(1\):47-63.](#)

Understanding the fundamentals of perfluorocarbons and perfluorocarbon emulsions relevant to in vivo oxygen delivery.

[Riess JG¹.](#)

Significant oxygen delivery has been established in animal models and through Phase II and III human clinical trials.

Vasopressors: Do they have any role in hemorrhagic shock?

Babita Gupta¹, Neha Garg², Rashmi Ramachandran²

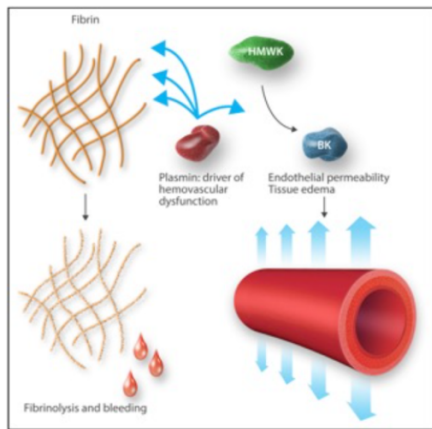
Il loro utilizzo è pratica comune anche se non è raccomandato in base ai principi di gestione avanzati di Trauma Life Support .

Il ruolo dei vasopressori è controverso senza indicazioni chiare sul timing, il tipo e la dose di questi farmaci nello shock emorragico.

Studi su animali dimostrano netta riduzione della mortalità ma sugli esseri umani i benefici sono meno evidenti....

Tuttavia con la finalità di ridurre la quantità di liquidi da somministrare e con la **finalità di mantenere al PA ai limiti minimi proposti rianimazione ipovolemica l'uso può essere razionale.**

NORADRENALINA è stata suggerita come vasopressore di prima linea nello shock emorragico.
Dosaggio medio 0,1 – 0,5 mcg/Kg/min.



CRASH-2 Lancet 2010 Wu AJP 2015, Cap Blood 2017 Marcos-Contreras Blood 2017.

ACIDO TRANEXAMICO



L'efficacia della somministrazione precoce del **anti-fibrinolitico (acido tranexamico, TXA)**, è evidente nello studio **CRASH-2** pubblicato su The Lancet 2010.

Pertanto il suo utilizzo è raccomandato dalle linee guida europee in **classe I con livello di evidenza A.**

TXA è un derivato sintetico dell'aminoacido lisina, **inibisce la fibrinolisi bloccando i siti di legame della lisina sul plasminogeno.**

Military Application of Tranexamic Acid in Trauma Emergency Resuscitation (MATTERs) Study.

Morrison JJ¹, Dubose JJ, Rasmussen TE, Midwinter MJ.

Il gruppo TXA aveva una mortalità inferiore al gruppo NON TXA (17,4% vs 23,9%).

Tale beneficio è stato maggiore nel sottogruppo di pazienti talmente gravi da richiedere trasfusione ematica

(14,4% nel gruppo TXA vs una mortalità del 28,1% nel gruppo NON TXA).....
TXA andrebbe usato nei pazienti traumatizzati a rischio di importante sanguinamento **entro le 3 ore** dall'insorgenza dal trauma alla dose di **1 g in 10 minuti e 1 g nelle restanti 8 ore.**

Gli effetti collaterali includono:

- Ipotensione se fatto in bolo
- Alterazione della visione dei colori e disturbi visivi aspecifici.
- **Convulsioni, probabilmente legate all'inibizione neuronale di GABA**
- Insufficienza renale, ostruzione ureterale

RESEARCH

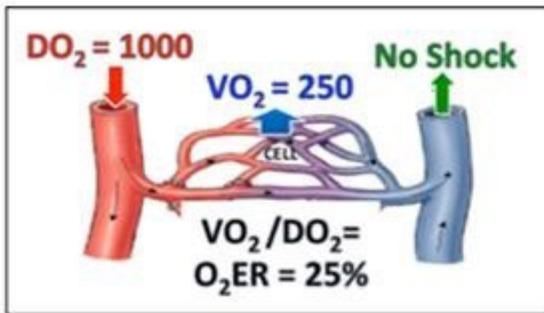
Open Access



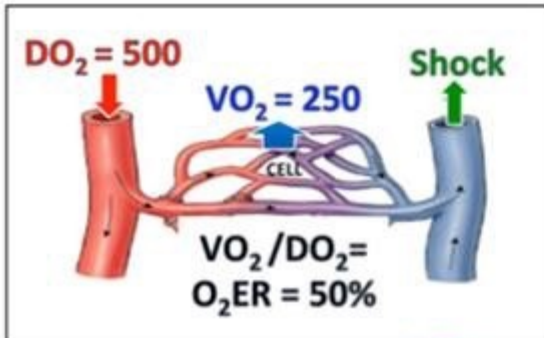
Prehospital administration of tranexamic acid in trauma patients

Arasch Wafaisade^{1*}, Rolf Lefering², Bertil Bouillon¹, Andreas B. Böhmer³, Michael Gäßler⁴, Matthias Ruppert⁴
and TraumaRegister DGU

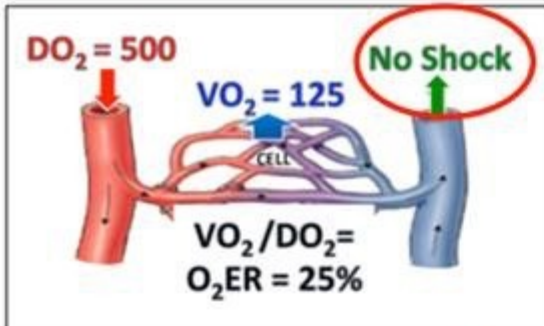
Conclusions: This is the first civilian study, to our knowledge, in which the effect of prehospital TXA use in trauma patients has been examined. TXA was associated with prolonged time to death and significantly improved early survival. Until further evidence emerges, the results of this study support the use of TXA during prehospital treatment of severely injured patients.



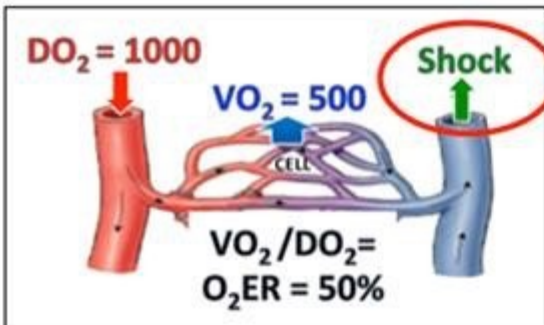
Normal DO₂ = 1000 and
VO₂ = 250



Decreased DO₂ with
constant VO₂

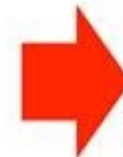


Decreased DO₂ with
decreased VO₂



Normal DO₂ with
increased VO₂

**Shock is not about
reduced of DO₂ but
shock is the imbalance
between VO₂ and DO₂**



Decrease VO ₂
Mechanical Ventilation
Sedation
Minimal invasive surgery
Beta blocker
Mediator removal
Anesthesia

Increase VO ₂
Breathing spontaneously
Tachycardia
Agitation/delirium
Trauma injury
Fever

Decrease VO ₂
Mechanical Ventilation
Sedation
Minimal invasive surgery
Beta blocker
Mediator removal
Anesthesia

Which Trauma Patients Should I Intubate?



Eastern Association for the Surgery of Trauma
Advancing Science, Fostering Relationships, and Building Careers

The EAST guidelines 2015 make a **Level 1 recommendation** for endotracheal intubation in trauma patients with the following traits:

- **Airway obstruction**
- **Hypoventilation**
- **Persistent hypoxemia ($SaO_2 \leq 90\%$) despite supplemental oxygen**
- **Severe cognitive impairment (GCS score ≤ 8)**
- **Severe hemorrhagic shock**
- **Cardiac arrest**



PROPOFOL
ASSASSINS

SOMETIMES THE WHITE
JUST AIN'T RIGHT



ROCKETamine

Oxygen: Breath of Life or Kiss of Death?

Villar, Jesús MD, PhD, FCCM; Kacmarek, Robert M. PhD, RRT, FCCM

Critical Care Medicine:
February 2017 - Volume 45 - Issue 2 - p 368–369
doi: 10.1097/CCM.0000000000002113
Editorials

E' noto che $PaO_2 < 60$ mmHg aumenta il rischio di AAC e morte

Studi recenti evidenziano però i danni dell'iperossiemia!

(normossia 60-120 mmHg → Sat O₂ 97%)

- Lesioni cellulari da iperossia
- Estensione del danno tissutale
- Aumento del rischio settico
- Effetto proinfiammatorio
- **Aumento incidenza di disfunzione sistemica multiorgano**
- **Svantaggi emodinamici**
- **> MORTALITA'**



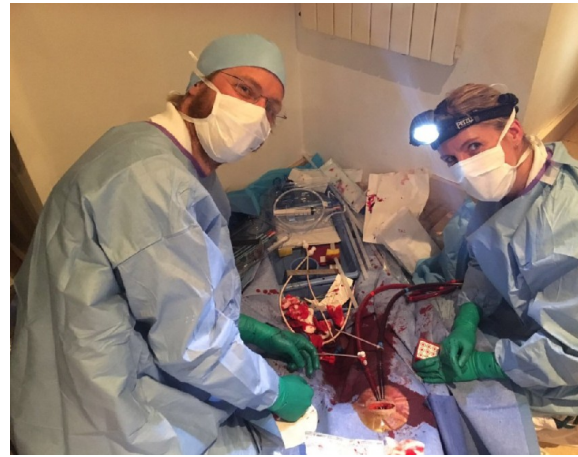
SI PUÒ FARE DI PIÙ ?





EDECMO 38 – ECMO and Trauma – with Pal Ager-Wick and Magnus Larsson

POSTED ON AUGUST 27, 2017 // LEAVE A COMMENT



CARDIOHELP System

The world's smallest portable heart-lung support system.



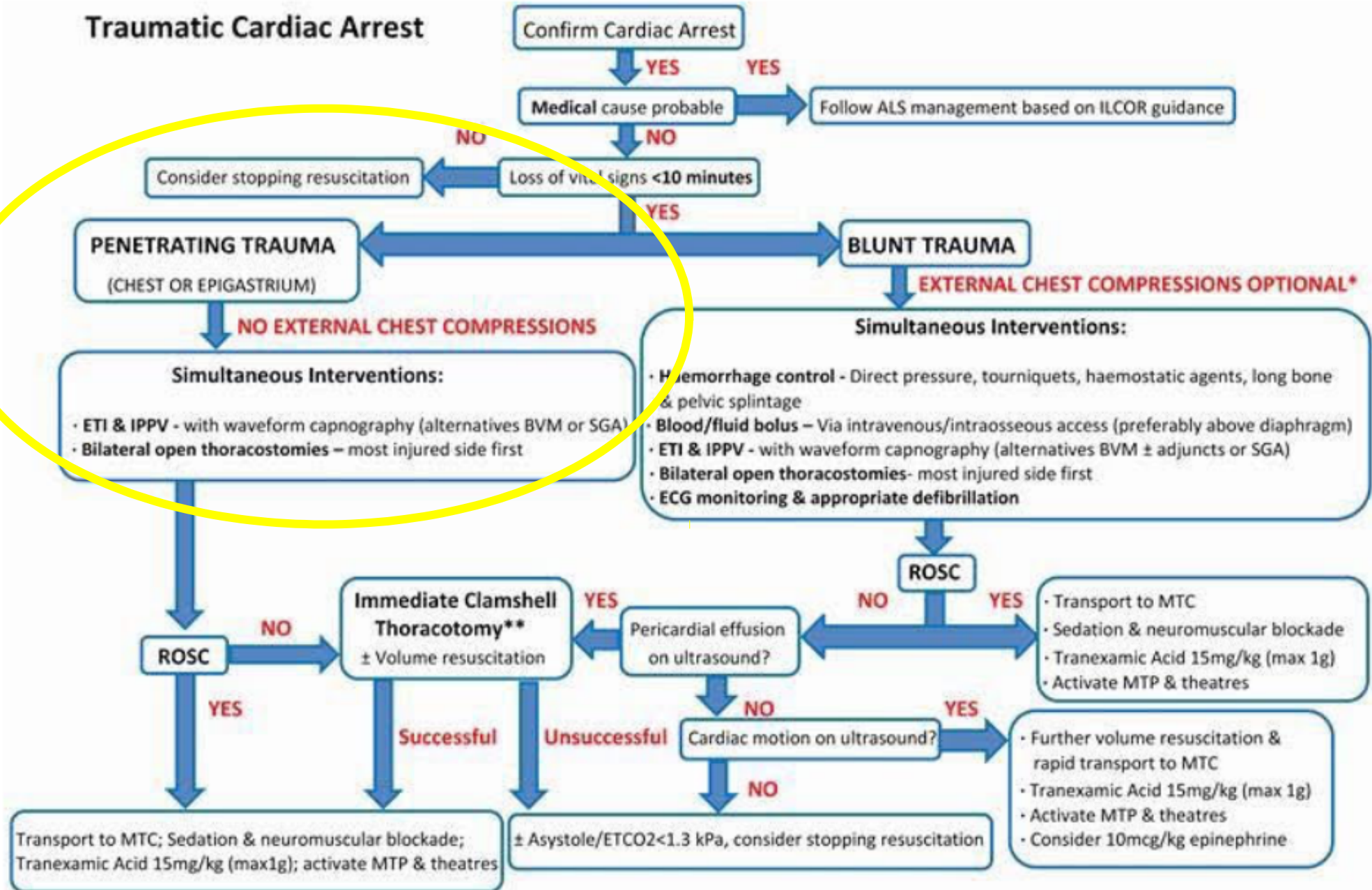
ECMO può migliorare tutti e tre i componenti della triade letale (ipotermia, emodiluizione, acidosi).

Riduce la pressione venosa con riduzione dei sanginamenti interni.

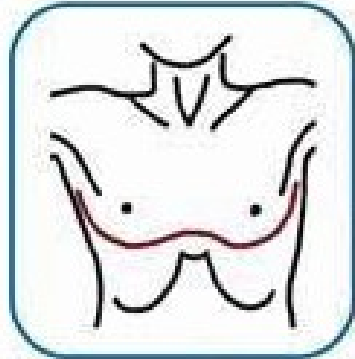
Nessun paziente con trauma cranico grave è morto durante il trasporto.



Traumatic Cardiac Arrest



Clamshell Thoracotomy



Immediate Thoracotomy required

RAPID ANTISEPTIC CLEAN

Scalpel down to intercostal muscles, joining the bilateral open thoracostomies

Concurrent actions

- Intravenous/intraosseous access with **blood/fluid bolus**
- ECG monitoring through **defibrillation pads**
- Attach waveform **capnography**
- **DO NOT** delay thoracotomy to achieve these

Stop IPPV. Extend thoracostomies posteriorly to poster axillary line & then anteriorly to the sternum with mayo scissors or trauma shears. Cut through sternum with trauma shears or Gigli saw

Tent & incise the pericardium vertically in the midline, avoiding phrenic nerves (<60 seconds after commencing thoracotomy)

YES

HAEMOPERICARDIUM?

NO

- Evacuate haemopericardium
- Inspect anterior & posterior heart for wounds
- Control haemorrhage with finger, sutures or staples. **LESS IS MORE**

- Occlude descending aorta against thoracic vertebra
- **CONTROL haemorrhage:**
Lung – Hilar control; divide inferior pulmonary ligament & rotate lower lobe anteriorly over upper lobe (hilar twist). Consider staples for parenchymal injuries
Intercostal vessels – direct pressure ± packing
Great vessels – limited options, but attempt to suture

ROSC

NO

YES

- Two handed internal cardiac compressions
- VF/VT – Close chest & use external defibrillation pads for cardioversion
- Further volume resuscitation ± 10mcg/kg epinephrine if heart is full

NO

ROSC

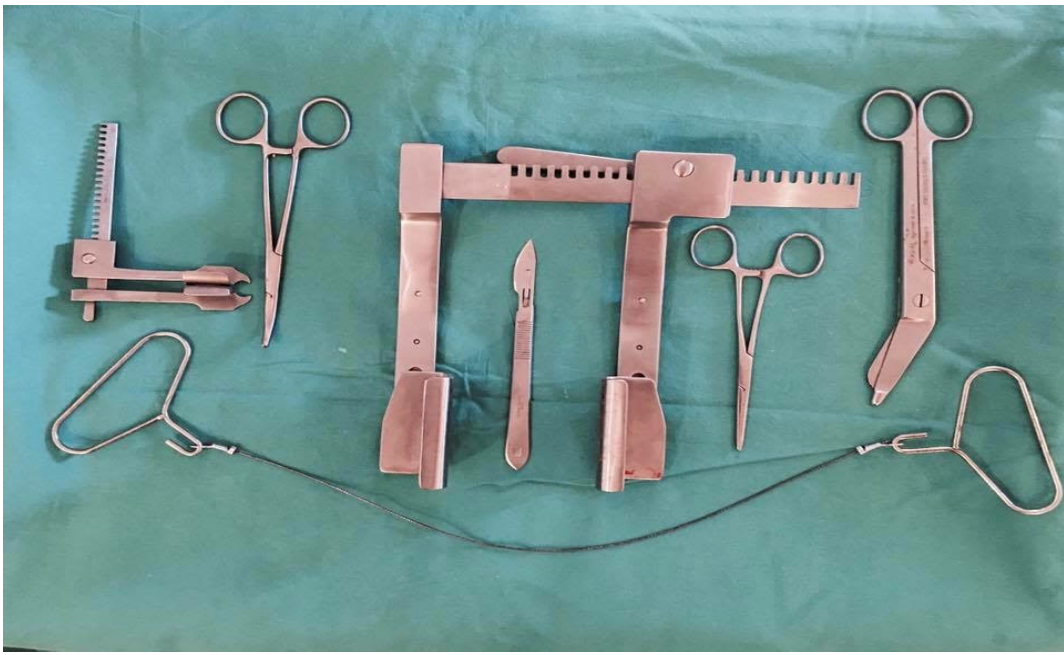
YES

- Clamp internal mammary arteries if required
- Transport to MTC, activate MTP & theatres
- Sedation & neuromuscular blockade as needed
- Tranexamic Acid 15mg/kg (max 1g)

Successful

Unsuccessful

Consider stopping resuscitation



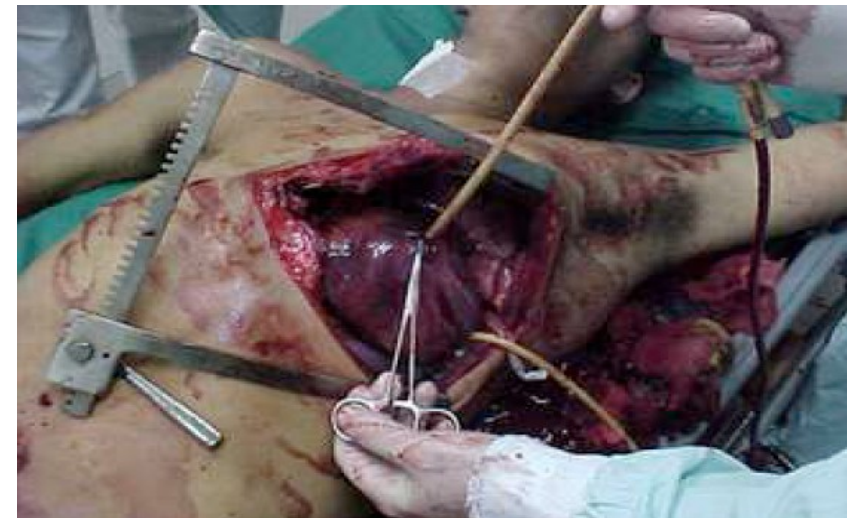
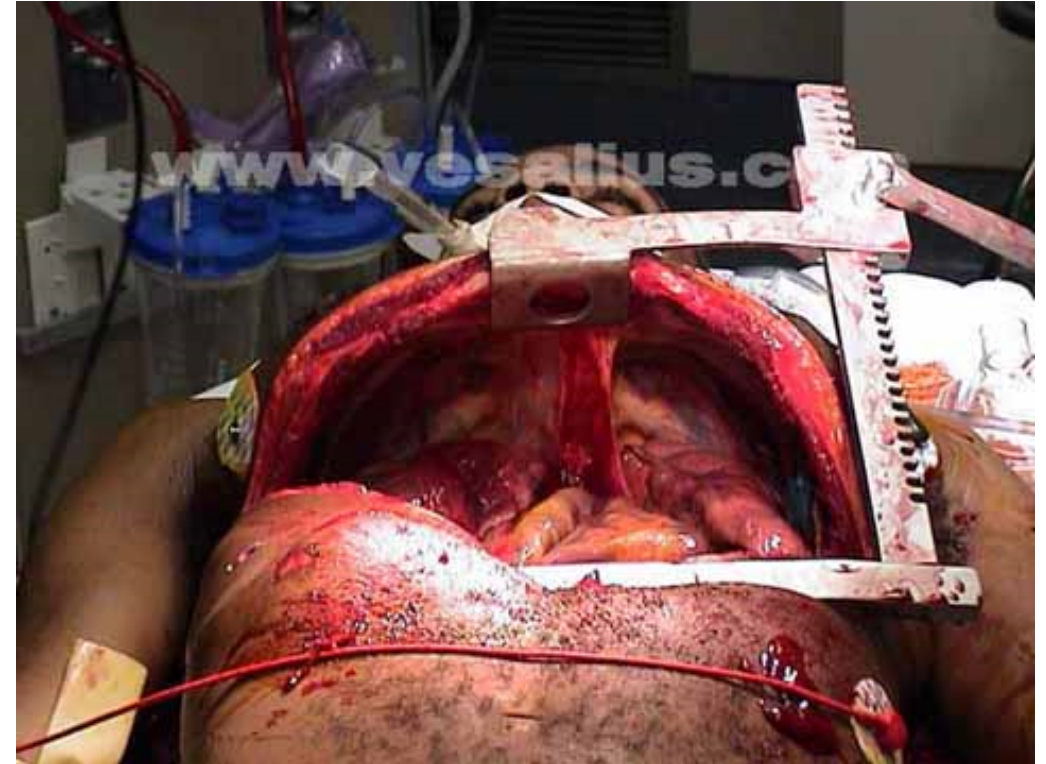
**“A good plan executed now,
is better than a perfect
plan executed next week”**
– *George Patton*

Opening the chest “clamshell” approach

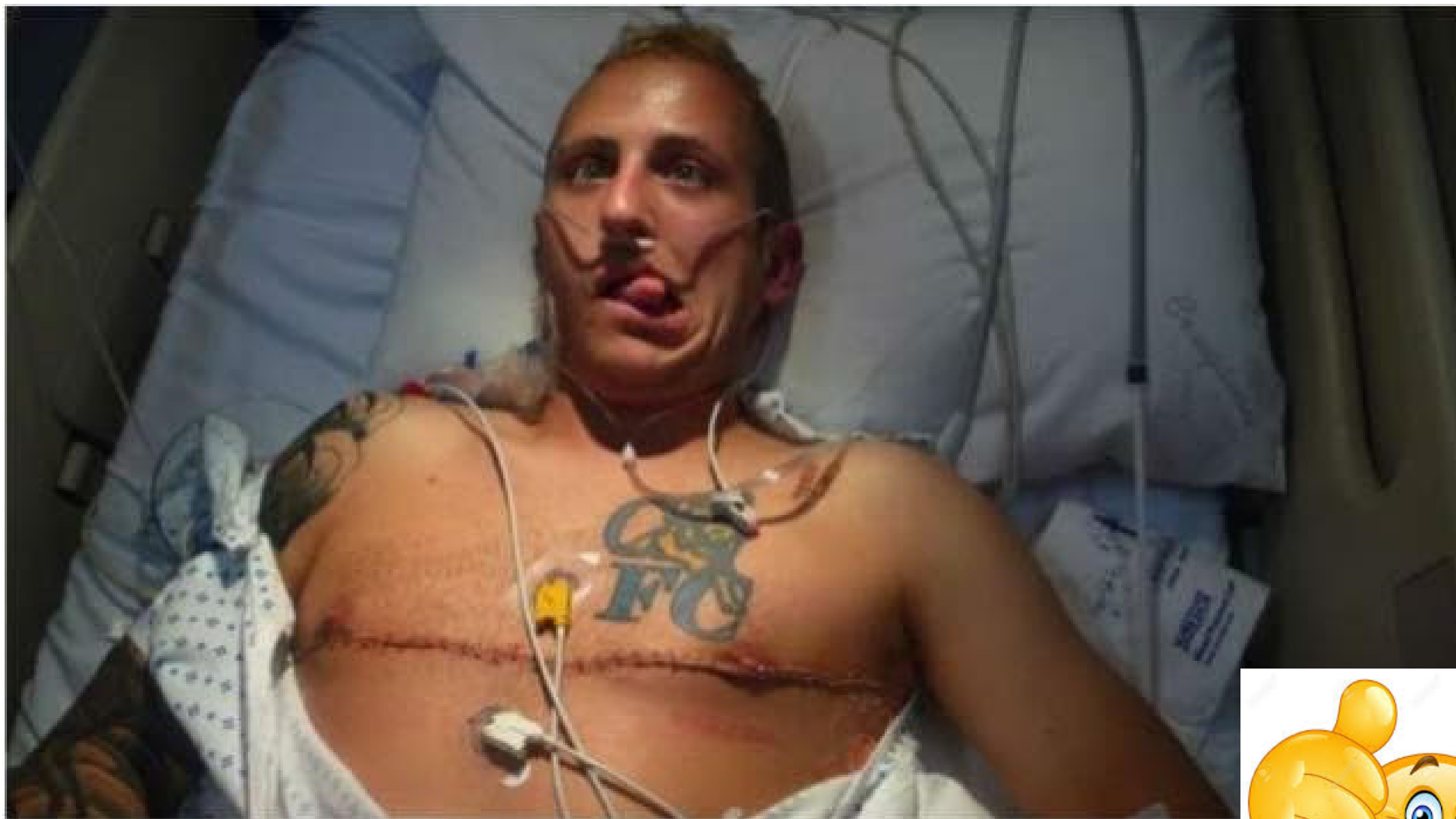
The Royal London HEMS team has had greater success with a more aggressive approach to early resuscitative thoracotomy (RT).

Audit data, HEMS London, G Davies, 2013

	Penetrating Trauma	Blunt Trauma
Best Survival Rates	60%	10%
Average Survival	40%	2%
Overall Survival	<u>For All Groups 10%</u>	



CERTO PER ALCUNI PUO' SEMBRARE FOLLIA.....

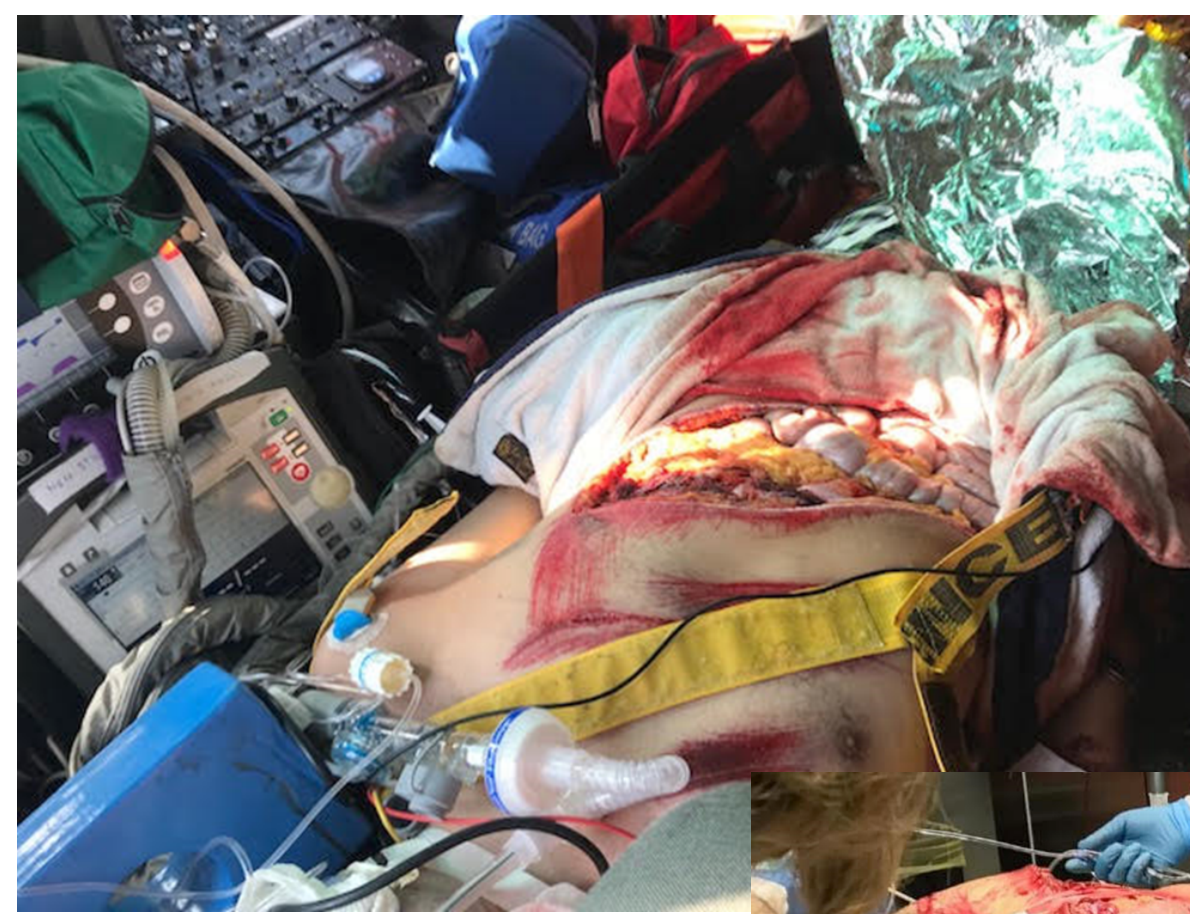


MA LORO NON SONO D'ACCORDO.....









Il più grande nemico della conoscenza non è l'ignoranza, è l'illusione della conoscenza.

(Daniel J. Boorstin)



GRAZIE PER L' ATTENZIONE