Stratégie de gestion de l'hémostase en préhospitalier
Impact pratique en région ARA

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Hospices Civils de Lyon

UNIVERSITÉ DE LYON

Liens avec l’industrie

- Octapharma

Plan

- Mieux trier les patients à gravité intermédiaire
- Limiter les décès à lésions survivables
- Stratégie d’usage d’antidotes
- Transfusion en préhospitalier ?
- Techniques de « damage control resuscitation »

Les enjeux du système préhospitalier

- Réduire les mauvais pronostics évitables
  - Détecter précocèment le saignement et/ou le besoin d'un acte invasif
  - **Sans méconnaître les autres facteurs d' hémorragie**
    - **Bassin**
    - Thoracique
- Organiser les parcours patients (Alerte-hôpital adapté)
- A l'échelle d'un territoire

Death etiology in Trauma
1997–2008

Dutton RP J Trauma 2010

TBI	**52% (H24)**
Hemorrhage	**30 % (H2)**
Airway	**10%**
MOF	**10 % (J15)**

Preventable deaths in a French regional trauma system: A six-year analysis of severe trauma mortality

E. Girard[a,b,*], Q. Jegousso[c], B. Boussat[b,d], P. François[b,d], F.-X. Ageron[e], C. Letoublon[a,b], P. Bouzat[b,c], For the TRENAU group[1]

J Visc Surg 2018

Lésions survivables

503 deaths were reported :
Seventy-two (14%) deaths were judged as potentially preventable and 36 (7%) deaths as preventable

Table 2 Analysis of errors by the adjudication committee.

	Preventable deaths *n* = 72 patients	Potentially preventable deaths *n* = 36 patients	Total *n* = 108 patients
Triage error	8	14	22
Excessive prehospital time	28	9	37
Incorrect prehospital treatment	2	5	7
Inaccurate diagnosis	9	11	20
Diagnosis delay	5	7	12
Deaths during CT scanning	2	7	9
Incorrect treatment at hospital	10	10	20
Incorrect airway control	6	1	7
Omission of essential procedure	21	13	34
Accidental drain/catheter removal	1	0	1
Equipment failure	0	1	1
Total	92	78	170

One preventable/potentially preventable death may be related to more than one error, so that sum totals of errors exceed the number of deaths.

Accepted Manuscript

Title: Potentially preventable trauma deaths: a retrospective review

Authors: Ben Beck, Karen Smith, Eric Mercier, Stephen Bernard, Colin Jones, Ben Meadley, Toby St Clair, Paul Jennings, Ziad Nehme, Michael Burke, Richard Bassed, Mark Fitzgerald, Rodney Judson, Warwick Teague, Biswadev Mitra, Joseph Mathew, Andrew Buck, Dinesh Varma, Belinda Gabbe, Janet Bray, Susan McLellan, Jane Ford, Josine Siedenburg, Peter Cameron

PII: S0020-1383(19)30100-7
DOI: https://doi.org/10.1016/j.injury.2019.03.003
Reference: JINJ 8076

To appear in: *Injury, Int. J. Care Injured*

Accepted date: 4 March 2019

"Potentially preventable or preventable deaths represented 7% of cases that had attempted resuscitation from paramedics".

Facteur Temps
Détection gravité
Gestes
Orientation

	Number of cases identified where novel intervention may have improved outcome
System-related interventions	
Early notification system (e.g. automatic crash notification or automatic quad-bike rollover notification)	4
Video emergency call	8
Provision of GPS coordinates as part of emergency call	2
Improved protocol around trapped patients	5
Improved protocol for crushed patients	2
Rapid launch protocol for HEMS	3
Clinical interventions	
Prehospital point of care ultrasonography	17
Prehospital resuscitative endovascular balloon occlusion of the aorta (REBOA)	2
Prehospital thoracotomy	0
Prehospital blood products (red cell concentrate / packed red bloods cells) [a]	24
Finger thoracostomy [b]	17
Arterial tourniquets	4
Novel methods of haemorrhage control (abdominal packing)	2
Remote decision-making support (telemedicine) for paramedics	6
Query the benefit of intubating a haemorrhagic/shocked patient, particularly in cases of penetrating chest trauma	6
Provide SAM pelvic binder to all crews [c]	6
Prioritise short on-scene times particularly in penetrating trauma	5

Améliorer le triage

Mr R…

Bilan 1 er secours et d'une IDE correspondante SAMU

- PA 115/63, FC 115,
- SpO_2 92% AA, FR=27
- GCS 13 (M6),
- Hb 10 g/dl,
- T°C 36,8,
- EN = 5/10

Les SP disent que la première PA était à 90 mmhg.. L'IDE du village ne l'a pas constaté

ON Y CROIT OU PAS ??

Prehospital Hypotension is a Predictor of the Need For an Emergent, Therapeutic Operation in Trauma Patients With Normal Systolic Blood Pressure in the Emergency Department

Lipsky AM J Trauma 2006

	All Patients N = 1,028	Hypotensive in Field N = 71	Normotensive in Field N = 957	
Age, years, median (IQR)	28 (18–39)	30 (22–44)	27 (18–39)	$p = 0.01$
Male, N (%)	784 (76)	54 (76)	730 (76)	OR 1.0 (95% CI 0.6–1.7)
Blunt mechanism, N (%)	746 (73)	41 (58)	705 (74)	OR 0.5 (95% CI 0.3–0.8)
ISS, median (IQR)*	4 (1–10)	9 (4–19)	4 (1–10)	$p < 0.0001$
Prehospital i.v. fluid, ml, median (IQR)†	100 (0–300)	400 (100–700)	100 (0–300)	$p < 0.0001$
Underwent surgery				
Any surgery, N (%)	285 (28)	38 (54)	247 (26)	OR 3.3 (95% CI 2.0–5.4)
Within 6 h, N (%)	168 (16)	27 (38)	141 (15)	OR 3.6 (95% CI 2.1–5.9)
Therapeutic, N (%)	135 (13)	26 (37)	109 (11)	OR 4.5 (95% CI 2.7–7.6)
Mortality, N (%)‡	27 (3)	4 (6)	24 (3)	OR 2.3 (95% CI 0.8–6.9)

Mr R…

Bilan 1 er secours et d'une IDE

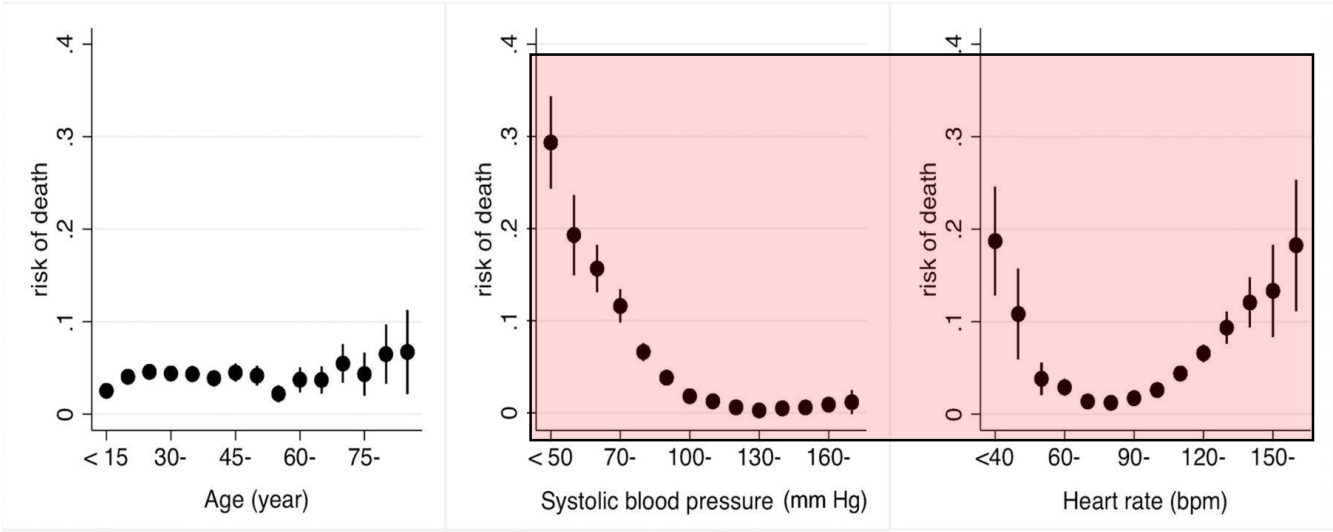
- PA 115/63, FC 115,
- SpO_2 92% AA, FR=27
- GCS 13 (M6),
- Hb 11 g/dl,
- T°C 36,8,
- EN = 5/10

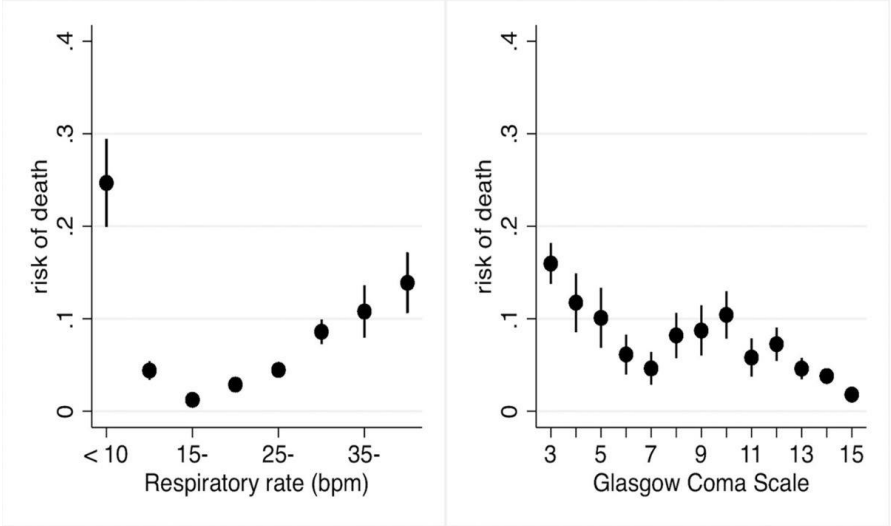
CHOC OU PAS ??

Relationship between death due to bleeding and potential predictors.

Francois-Xavier Ageron et al. BMJ Open 2019;9:e026823

BMJ Open





Utility of the Shock Index in Predicting Mortality in Traumatically Injured Patients

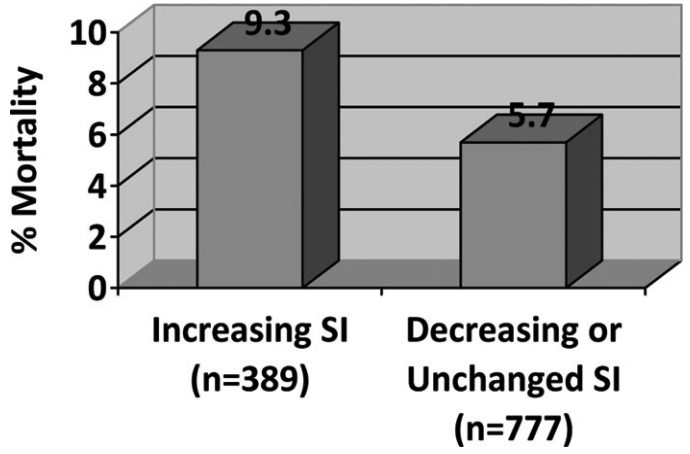
Chad M. Cannon, MD, Carla C. Braxton, MD, FACS, Mendy Kling-Smith, MD, Jonathan D. Mahnken, PhD, Elizabeth Carlton, RN, MSN, and Michael Moncure, MD, FACS

J Trauma 2018

$$\text{Prehospital Shock Index (PHSI)} = \frac{\text{prehospital pulse rate}}{\text{prehospital systolic blood pressure}}$$

TABLE 1. Field (Prehospital), n = 1,166*

	SI >0.9, (n = 392)	SI ≤0.9, (n = 774)	*p*
Mortality	8.9%	5.8%	0.05
Injury Severity Score (median)	10.0	9.0	<0.0001
Penetrating	38.5%	22.8%	<0.0001
Age in years (median)	33.0	28.0	<0.0001
Female	32.4%	22.5%	<0.001



- R… présente un épisode de bradycardie et d’hypotension résolutif après 500 ml de remplissage par sérum physiologique

- Incident mineur ou événement marquant ?

Hypovolémie sévère: bradycardie paradoxale

- 7 % des chocs hémorragiques
- Hémorragie rapide et massive
- Réflexe vago-vagal
- Mécanorécepteurs intracardiaques

Barrriot Intensive Care Med 1987

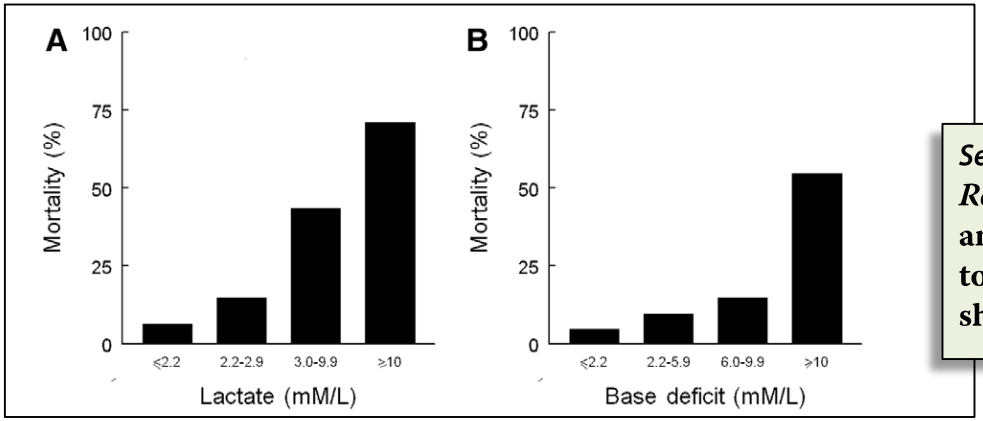
Remplissage vasculaire en urgence

CRITICAL CARE MEDICINE

Comparison of the Prognostic Significance of Initial Blood Lactate and Base Deficit in Trauma Patients

Mathieu Raux, M.D., Ph.D., Yannick Le Manach, M.D., Ph.D., Tobias Gauss, M.D., Romain Baumgarten, M.D., Sophie Hamada, M.D., Anatole Harrois, M.D., Ph.D., Bruno Riou, M.D., Ph.D., for the TRAUMABASE® Group*

ANESTHESIOLOGY ***2017***



Serum lactate and base deficit

Recommendation 11 **We recommend serum lactate and/or base deficit measurements as sensitive tests to estimate and monitor the extent of bleeding and shock. (Grade 1B)**

Normotensive patients

Model (n = 742; AUC = 0.81; optimism < 0.01)		
MGAP (per 1-point decrease)	1.39 (1.29–1.51)	< 0.001
Blood lactate (per 1-mM/l increase)	1.31 (1.08–1.61)	0.01
Base deficit (per 1-mM/l increase)	1.07 (0.96–1.20)	0.21

Original Investigation | Critical Care Medicine

Appropriateness of Initial Course of Action in the Management of Blunt Trauma Based on a Diagnostic Workup Including an Extended Ultrasonography Scan

Fanny Planquart, MD; Emmanuel Marcaggi, MD; Raiko Blondonnet, MD; Olivier Clovet, MD; Xavier Bobbia, MD, PhD; Bastien Boussat, MD, PhD; Julien Pottecher, MD, PhD; Tobias Gauss, MD; Laurent Zieleskiewicz, MD, PhD; Pierre Bouzat, MD, PhD

JAMA Network Open

2022

OBJECTIVE To determine how often an immediate course of action adopted in the resuscitation room based on a diagnostic workup that included an E-FAST and before whole-body computed tomography scanning (WBCT) in patients with blunt trauma was appropriate.

EXPOSURES Diagnostic workup associating E-FAST (including abdominal, thoracic, pubic, and transcranial Doppler ultrasonography scan), systematic clinical examination, and chest and pelvic radiographs.

MAIN OUTCOMES AND MEASURES The main outcome criterion was the appropriateness of the observed course of action (including abstention) in the resuscitation room according to evaluation by a masked expert panel.

Original Investigation | Critical Care Medicine

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JAMA Network Open
2022

Table 3. Decisions Made According to Diagnostic Modality by the Trauma Team Leader[a]

Action taken	Decisions, No. (%)				
	Diagnostic modality				
	Clinical context and examination (n = 125)	Clinical context and E-FAST (n = 263)	Clinical context, E-FAST, and radiograph (n = 98)	Clinical context and radiograph (n = 20)	Total (N = 524)
No action performed	10 (4.3)	151 (64.8)	67 (28.7)	0	233 (44.5)[a]
Optimization CBF					
Norepinephrine	55 (50.9)	43 (39.8)	0	0	108 (20.6)[a]
Osmotherapy	25 (41.7)	33 (55.0)	0	0	60 (11.4)[a]
Thoracic decompression (needle, thoracostomy, drain)	4 (7.0)	26 (45.6)	2 (3.5)	2 (3.5)	57 (10.9)[a]
Thoracotomy	1 (16.7)	3 (50.0)	1 (16.7)	1 (16.7)	6 (1.1)
Pericardial decompression	0	0	0	0	0
Laparotomy	0	4 66.7	0	0	6 (1.1)
Pelvic binder	30 (57.7)	3 (5.8)	16 (30.8)	16 (30.8)	52 (9.9)[a]
Angioembolization	0	0	1 (50.0)	1 (50.0)	2 (0.4)

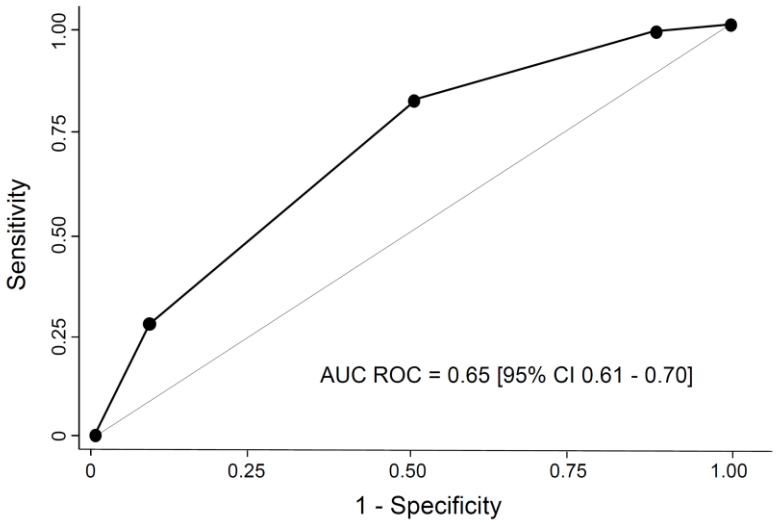
Clinical Judgment Is Not Reliable for Reducing Whole-body Computed Tomography Scanning after Isolated High-energy Blunt Trauma

Thomas Mistral, M.D., Vivien Brenckmann, M.D., Laurence Sanders, M.D.,
Jean-Luc Bosson, M.D., Ph.D., Gilbert Ferretti, M.D., Ph.D., Frederic Thony, M.D.,
Samuel M. Galvagno, M.D., Ph.D., Jean-François Payen, M.D., Ph.D., Pierre Bouzat, M.D., Ph.D.

Anesthesiology 2017

no patient with a strict negative clinical examination had a severe lesion (n = 19 patients)

356 patients, Grade C, 36% AIS ≥ 3…



Physical Sign	No. of Patients (%)
Head	197 (55)
Traumatic brain injury	162 (46)
Temporary loss of consciousness (< 30 min)	88 (25)
Neck	64 (18)
Face	42 (12)
Spine	113 (32)
Thorax	112 (32)
Abdomen	90 (25)
Pelvic ring	61 (17)
Limbs	198 (56)
Patient with at least one physical sign	335 (94)

Bouzat *et al. Critical Care* (2015) 19:111
DOI 10.1186/s13054-015-0835-7

CRITICAL CARE

RESEARCH Open Access

A regional trauma system to optimize the pre-hospital triage of trauma patients

Améliorer notre score triage régional

Pierre Bouzat[1,2*†], François-Xavier Ageron[3†], Julien Brun[1], Albrice Levrat[4], Marion Berthet[1], Elisabeth Rancurel[5], Jean-Marc Thouret[6], Frederic Thony[7], Catherine Arvieux[8], Jean-François Payen[1,2] for TRENAU group

Grade A: *instable despite resuscitation*

- Systolic arterial pressure < 90 mmHg

despite the use of vasopressors and more than 1L crystalloid fluids and/or a pre-hospital blood transfusion

- SpO2 < 90%

despite the use of mechanical ventilation or the use of facial mask with high-flow oxygen

PAS < 110 mmhg
SI < 0,9

Grade B: *stablilized after prehospital resuscitation or anatomic criteria*

- Systolic arterial pressure > 90 mmHg or SpO2 > 90% after initial resuscitation
- Isolated traumatic brain injury GCS <13 or glasgow motor response score < 5
- Suspicion of spinal cord injury
- Multiple thoracic fractures and flail chest
- Severe pelvic trauma
- Penetrating injury
- Amputation or crushed limb

Lactate capillaire

E fast

Grade C: *Stable with high-kinetic circumstances or medical history*

- Fall from more than 6 meters
- Ejected/Projected/Blasted victim
- Death in same passenger compartment
- Assessment of speed accident: vehicle deformation, no seat belt, no helmet
- Medical history: <5 yrs or > 65 yrs, pregnancy, coagulation disorders

Ne pas omettre de procédures essentielles

- Gestes d’hémostase
- Gestion des antidotes
- Transfusion
- Reboa ?

Haemorrhage control in severely injured patients

Gruen RL Lancet 2012

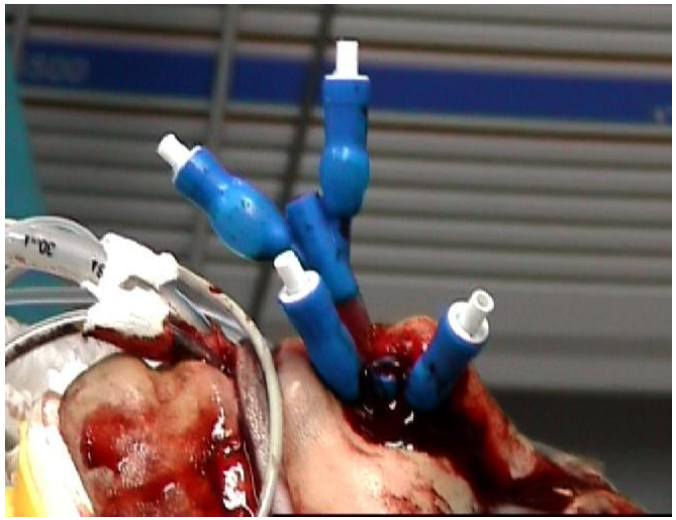
Contemporary approaches to haemorrhage control combine with **early control of bleeding,**

- 1) **management of coagulopathy,**
- 2) **maintenance of critical perfusion,**
- **3) management of the inflammatory response caused by shock and resuscitation**

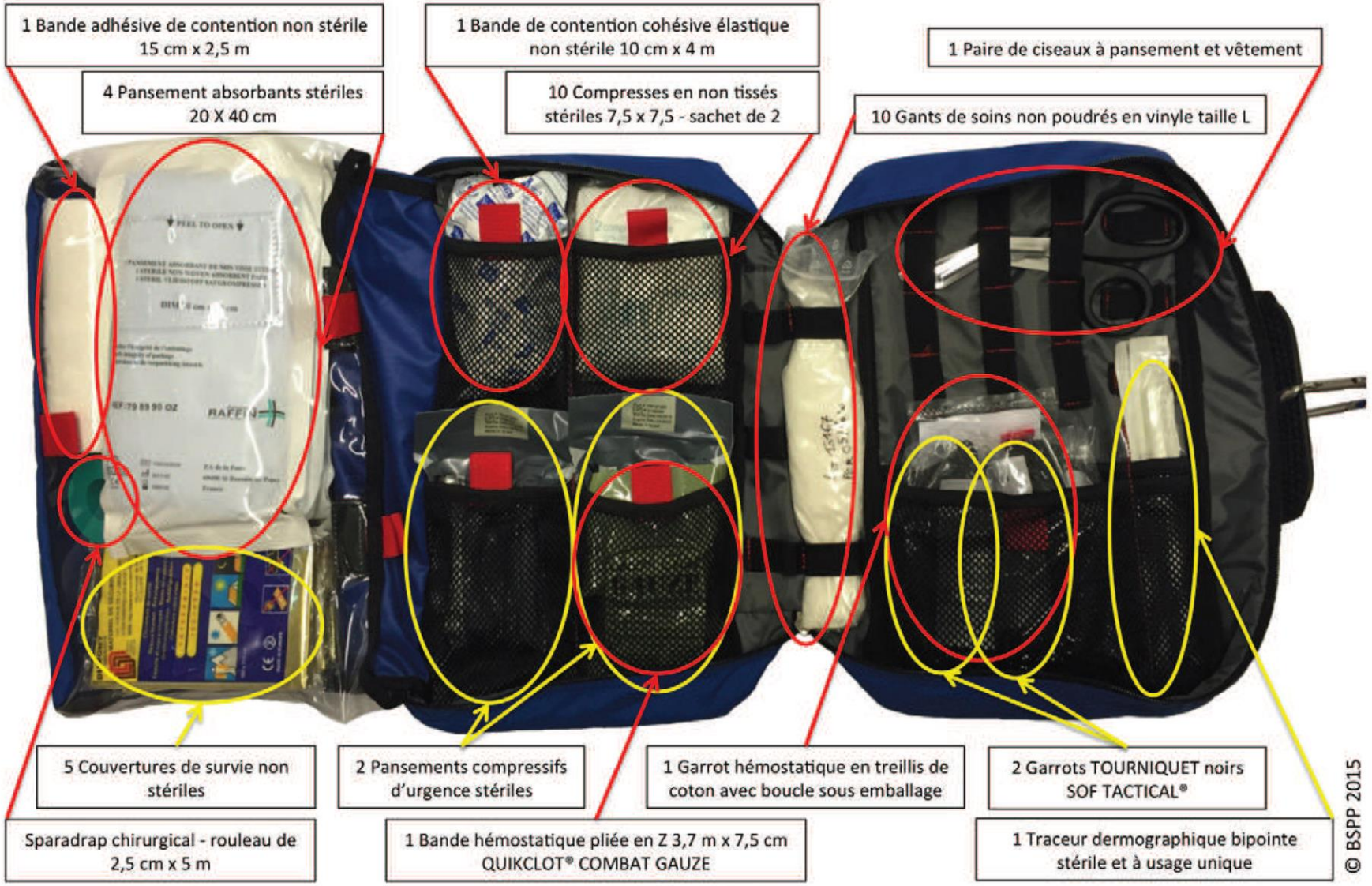
Recommendation 2 We recommend local compression to limit life-threatening bleeding. (Grade 1A)

We recommend adjunct tourniquet use to stop life-threatening bleeding from open extremity injuries in the pre-surgical setting. (Grade 1B)

We recommend the adjunct use of a pelvic binder to limit life-threatening bleeding in the presence of a suspected pelvic fracture in the pre-surgical setting. (Grade 1B)



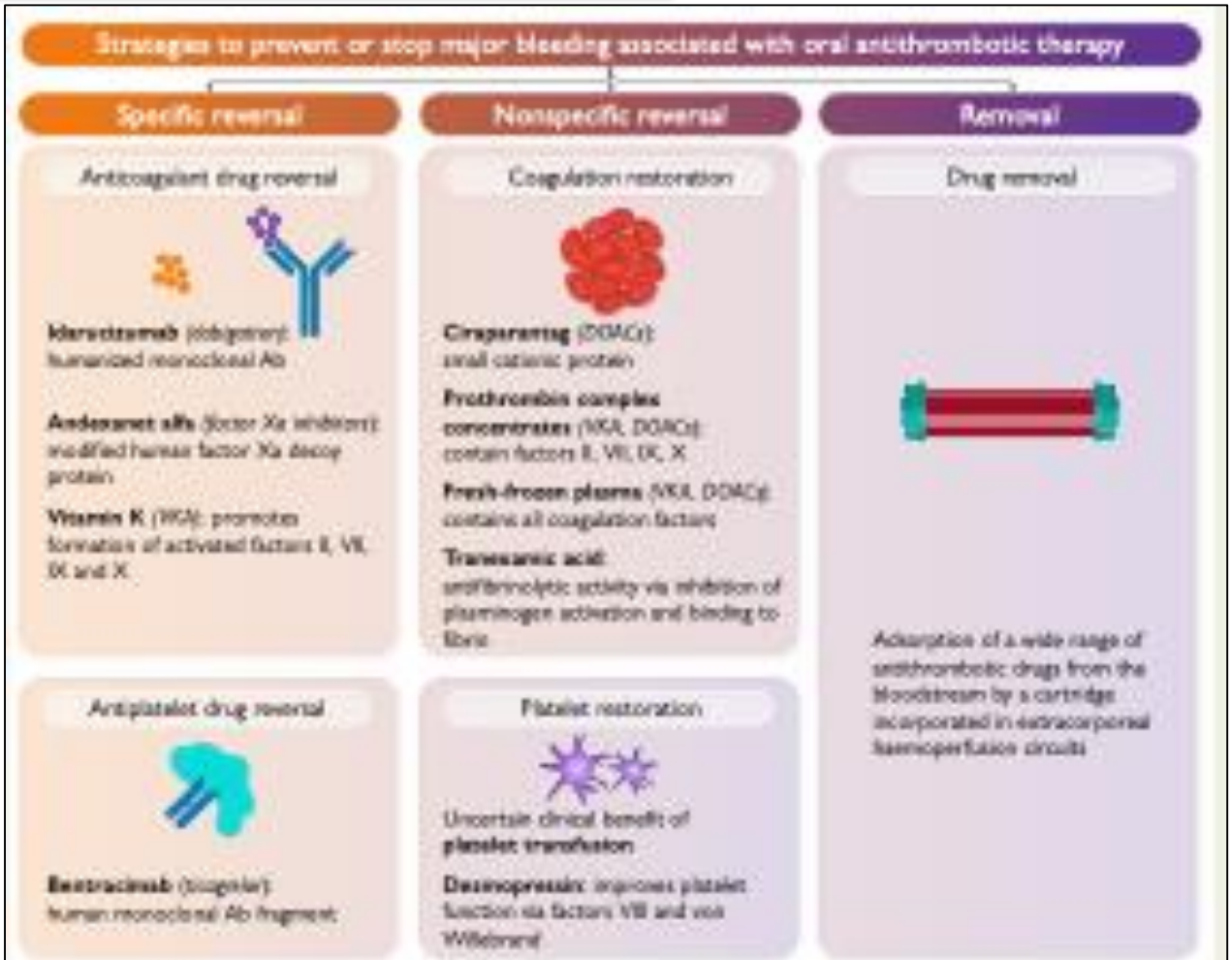
Stop bleeding



ESC European Society of Cardiology
European Heart Journal (2023) 00, 1–15
https://doi.org/10.1093/eurheartj/ehad119

Reversal and removal of oral antithrombotic drugs in patients with active or perceived imminent bleeding

Davide Cao [1,2,3], Nicolas Amabile [4], Mauro Chiarito [2,5], Victoria T. Lee[6], Dominick J. Angiolillo[7], Davide Capodanno [8], Deepak L. Bhatt[9], Michael J. Mack[10], Robert F. Storey[11], Michael Schmoeckel[12], C. Michael Gibson[13], Efthymios N. Deliargyris[14], and Roxana Mehran [1]*



Research

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Efficacy and Safety of Early Administration of 4-Factor Prothrombin Complex Concentrate in Patients With Trauma at Risk of Massive Transfusion

The PROCOAG Randomized Clinical Trial

Pierre Bouzat, MD, PhD; Jonathan Charbit, MD; Paer-Selim Abback, MD; Delphine Huet-Garrigue, MD; Nathalie Delhaye, MD; Marc Leone, MD, PhD; Guillaume Marcotte, MD; Jean-Stéphane David, MD, PhD; Albrice Levrat, MD; Karim Asehnoune, MD, PhD; Julien Pottecher, MD, PhD; Jacques Duranteau, MD, PhD; Elie Courvalin, MD; Anais Adolle, MSc; Dimitri Sourd, MSc; Jean-Luc Bosson, MD, PhD; Bruno Riou, MD, PhD; Tobias Gauss, MD; Jean-François Payen, MD, PhD; for the PROCOAG Study Group

2023

Intérêt des CPP hors antagonisation des AC ?

Consecutive patients with trauma at risk of massive transfusion.

INTERVENTIONS Intravenous administration of 1 mL/kg of 4F-PCC (25 IU of factor IX/kg) vs 1 mL/kg of saline solution (placebo). Patients, investigators, and data analysts were blinded to treatment assignment. All patients received early ratio-based transfusion (packed red blood cells:fresh frozen plasma ratio of 1:1 to 2:1) and were treated according to European traumatic hemorrhage guidelines.

Aucun effet sur la survie
ni sur la consommation de CG

Characteristic	Median (IQR) [total No.]	
	4F-PCC (n = 164)	Placebo (n = 160)
Transfusion of ≥10 U of RBCs within the first 24 h	42 (26)	43 (28)
Fibrinogen concentrate treatment	141 (86)	129 (81)
Total dose of fibrinogen concentrate, median (IQR), g	3 (3-7.5)	3 (3-6)
Time from arrival to transfusion of FFP, min	73 (56-105) [122]	91 (59-142) [130]

Mais un risque accru MTE

Table 3. Thromboembolic Events by Treatment Group

Thromboembolic event	No. (%)		Absolute difference (95% CI), %[a]	Relative risk (95% CI)	*P* value[b]
	4F-PCC (n = 164)	Placebo (n = 160)			
Patients with at least 1 thromboembolic event, No. (%) [No.]	56 (35) [161]	37 (24) [157]	11 (1 to 21)	1.48 (1.04 to 2.10)	.03
Superficial venous thrombosis	5 (3.1)	1 (0.6)	2 (−1 to 5)		
Deep venous thrombosis	27 (16.8)	23 (14.6)	2 (−6 to 10)		
Pulmonary embolism	20 (12.4)	17 (10.8)	2 (−5 to 9)		
Stroke[c]	2 (1.2)	0	1 (−1 to 3)		
Other[d]	9 (5.6)	5 (3.2)	2 (−2 to 7)		

JAMA Surgery | Original Investigation

Tranexamic Acid During Prehospital Transport in Patients at Risk for Hemorrhage After Injury

A Double-blind, Placebo-Controlled, Randomized Clinical Trial

Francis X. Guyette, MD, MPH; Joshua B. Brown, MD, MSc; Mazen S. Zenati, MD, PhD; Barbara J. Early-Young, BSN; Peter W. Adams, BS; Brian J. Eastridge, MD; Raminder Nirula, MD, MPH; Gary A. Vercruysse, MD; Terence O'Keeffe, MD; Bellal Joseph, MD; Louis H. Alarcon, MD; Clifton W. Callaway, MD, PhD; Brian S. Zuckerbraun, MD; Matthew D. Neal, MD; Raquel M. Forsythe, MD; Matthew R. Rosengart, MD, MPH; Timothy R. Billiar, MD; Donald M. Yealy, MD; Andrew B. Peitzman, MD; Jason L. Sperry, MD, MPH; and the STAAMP Study Group

2020

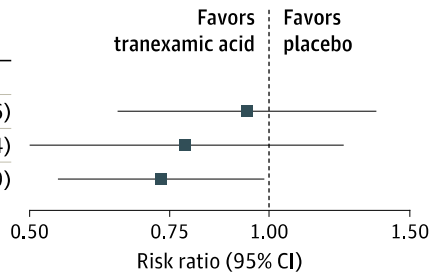
B Mortality risk by time from injury and shock severity

Subgroup	No./total No. (%) of patients: Placebo	No./total No. (%) of patients: Tranexamic acid	Risk ratio (95% CI)
Time from injury, h			
≤1	18/238 (7.6)	10/219 (4.6)	0.60 (0.44-0.83)
>1	27/214 (12.6)	26/223 (11.7)	0.92 (0.52-1.64)
Shock severity			
Tachycardia only	21/320 (6.6)	18/316 (5.7)	0.87 (0.56-1.34)
SBP <90 mm Hg	13/101 (12.9)	13/99 (13.1)	1.02 (0.55-1.90)
SBP <70 mm Hg	11/31 (35.5)	5/27 (18.5)	0.52 (0.34-0.80)

The abbreviated dose represents a single 1-g bolus dose. The standard dose represents a 2-g dose administered as a 1-g bolus dose followed by a 1-g infusion during 8 hours. The repeat dose represents a 3-g dose administered as 2 separate 1-g boluses followed by a 1-g infusion during 8 hours.

A Mortality risk by tranexamic acid prespecified dosing regimens

Tranexamic acid dose	No./total No. (%) of patients	Risk ratio (95% CI)	*P* value
Placebo (reference)	45/452 (10.0)		
Abbreviated	14/150 (9.3)	0.94 (0.65-1.36)	.74
Standard	11/141 (7.8)	0.78 (0.50-1.24)	.30
Repeat	11/151 (7.3)	0.73 (0.54-0.99)	.04



JAMA Surgery | Original Investigation

Association of Whole Blood With Survival Among Patients Presenting With Severe Hemorrhage in US and Canadian Adult Civilian Trauma Centers

Crisanto M. Torres, MD, MPH; Alistair Kent, MD, MPH; Dane Scantling, DO, MPH; Bellal Joseph, MD; Elliott R. Haut, MD, PhD; Joseph V. Sakran, MD, MPH, MPA

2023

Findings In this cohort study of 2785 patients who presented with severe traumatic hemorrhage, whole blood as an adjunct to MTP compared with MTP alone was associated with lower mortality at 24 hours and 30 days, with a survival benefit found as early as 5 hours after emergency department arrival.

Meaning The findings suggest that whole-blood resuscitation as an adjunct to component–based MTP is associated with improved survival among adult patients presenting to trauma centers with severe hemorrhage, with a benefit found early after administration.

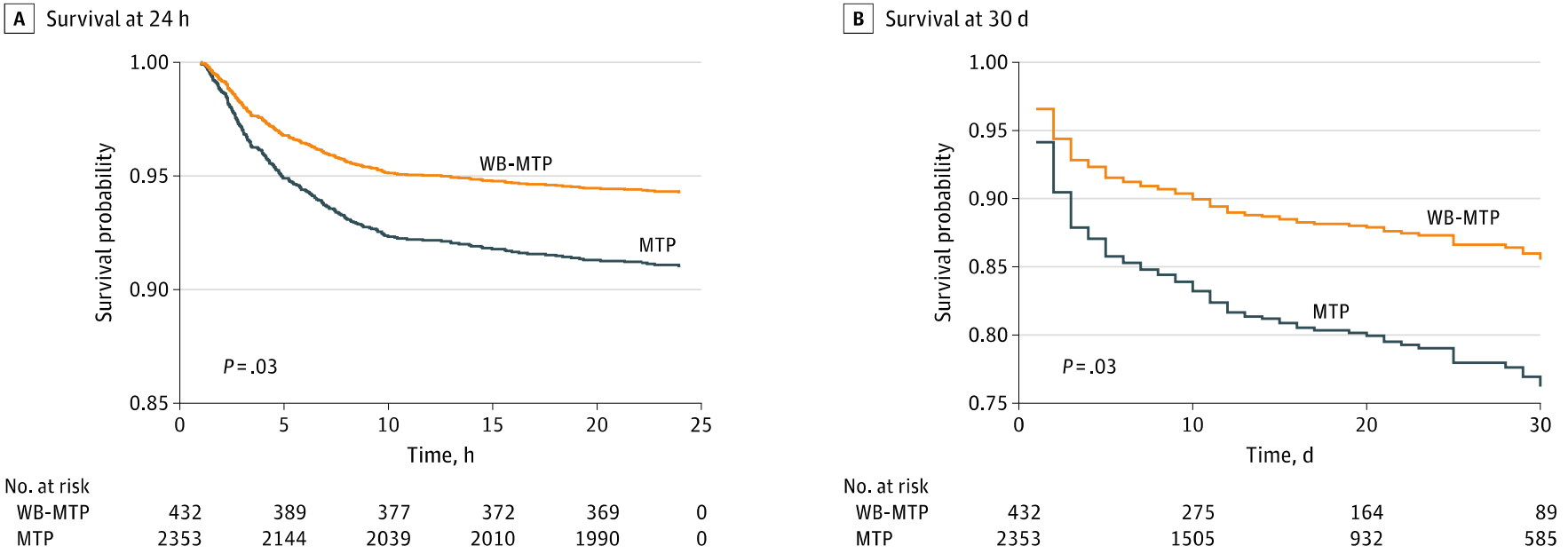
JAMA Surgery | Original Investigation

2023

Association of Whole Blood With Survival Among Patients Presenting With Severe Hemorrhage in US and Canadian Adult Civilian Trauma Centers

Crisanto M. Torres, MD, MPH; Alistair Kent, MD, MPH; Dane Scantling, DO, MPH; Bellal Joseph, MD; Elliott R. Haut, MD, PhD; Joseph V. Sakran, MD, MPH, MPA

Figure 2. Adjusted Kaplan-Meier Survival Estimates by Transfusion Group



MTP indicates massive transfusion protocol and WB-MTP, whole blood as an adjunct to component therapy–based MTP.

JAMA Network Open

Original Investigation | Emergency Medicine

Prehospital Lyophilized Plasma Transfusion for Trauma-Induced Coagulopathy in Patients at Risk for Hemorrhagic Shock

A Randomized Clinical Trial

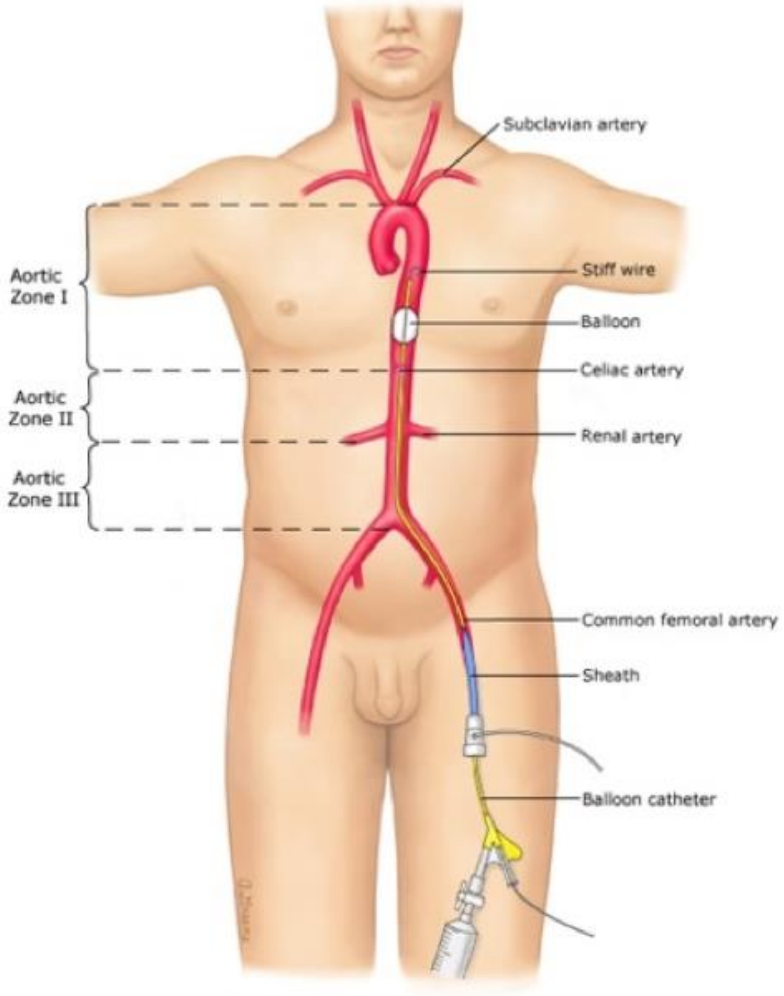
Daniel Jost, MD; Sabine Lemoine, MD; Frédéric Lemoine, CRA; Clément Derkenne, MD; Sébastien Beaume, MD; Vincent Lanoë, CRA; Olga Maurin, MD; Emilie Louis-Delaurière, CRA; Maëlle Delacote, MD; Pascal Dang-Minh, MD; Marilyn Franchin-Frattini, MD; René Bihannic, PharmD; Dominique Savary, MD; Albrice Levrat, MD; Clémence Baudouin, MD; Julie Trichereau, MD; Marina Salomé, CRA; Benoit Frattini, MD; Vivien Hong Tuan Ha, MD; Romain Jouffroy, MD; Edouard Seguineau, MD; Rudy Titreville, MD; Florian Roquet, MD, PhD; Olivier Stibbe, MD; Benoit Vivien, MD, PhD; Catherine Verret, MD, PhD; Michel Bignand, MD; Stéphane Travers, MD; Christophe Martinaud, MD, PhD; Michel Arock, MD, PhD; Mathieu Raux, MD, PhD; Bertrand Prunet, MD, PhD; Sylvain Ausset, MD, PhD; Anne Sailliol, MD, PhD; Jean-Pierre Tourtier, MD, PhD; for the Prehospital Lyophilized Plasma (PREHO-PLYO) Study Group

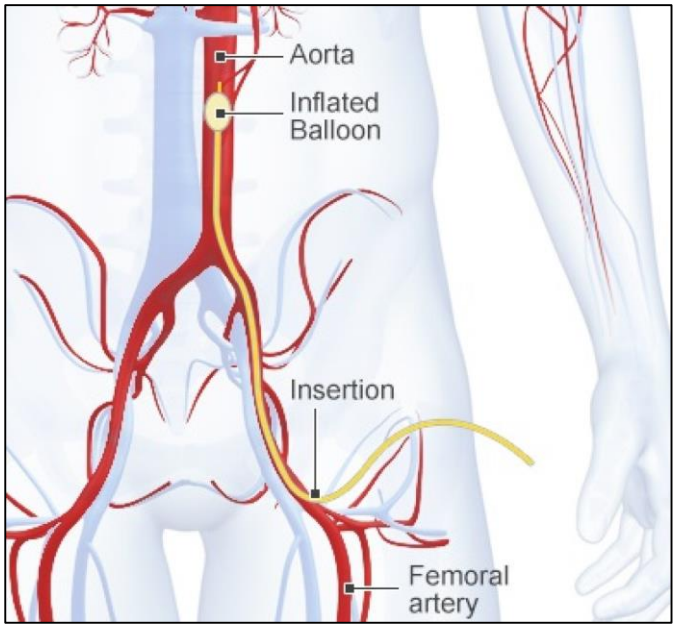
2022

Pas d'effets sur l'hémostase, ni sur mortalité

Outcome[b]	Treatment group[a]		Effect size (95% CI)[c]	*P* value
	Control (n = 66)	Plasma (n = 68)		
Primary				
Laboratory INR, median (IQR)	1.20 (1.10-1.39)	1.21 (1.12-1.49)	-0.01 (-0.09 to 0.08)	.88
Laboratory INR in a given range[d]				
<1.20	26 (39.4)	31 (45.6)	1.29 (0.61 to 2.71)	.51
1.20-1.50	25 (37.9)	19 (27.9)	0.64 (0.29 to 1.40)	
>1.50	15 (22.7)	18 (26.5)	1.12 (0.48 to 2.65)	

Les techniques d'exception
REBOA





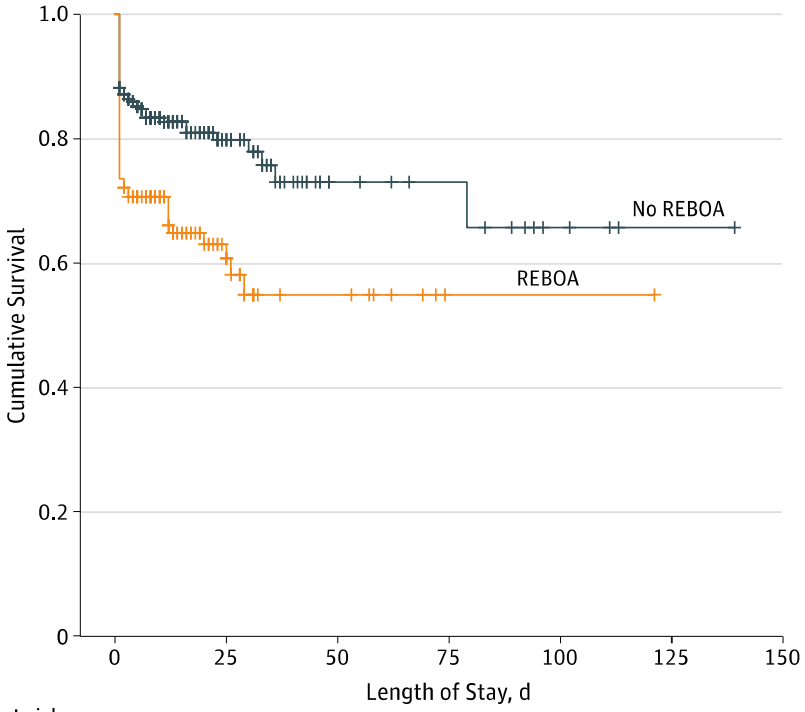
JAMA Surgery | Original Investigation

Nationwide Analysis of Resuscitative Endovascular Balloon Occlusion of the Aorta in Civilian Trauma

Bellal Joseph, MD; Muhammad Zeeshan, MD; Joseph V. Sakran, MD, MPH; Mohammad Hamidi, MD; Narong Kulvatunyou, MD; Muhammad Khan, MD; Terence O'Keeffe, MD; Peter Rhee, MD

JAMA Surg 2019

Figure. Survival Curve Analysis



No. at risk							
REBOA	140	28	8	1	1	0	0
No REBOA	280	58	13	10	4	1	0

Key Points

Question Is there a benefit of placement of resuscitative endovascular balloon occlusion of the aorta for resuscitation of severely injured trauma patients?

Findings In this case-control study that included 420 patients (resuscitative endovascular balloon occlusion of the aorta, 140; no resuscitative endovascular balloon occlusion of the aorta, 280), the patients who received resuscitative endovascular balloon occlusion of the aorta had significantly higher rates of acute kidney injury and lower-limb amputation and higher mortality compared with similarly injured patients who did not receive resuscitative endovascular balloon occlusion of the aorta.

Meaning The use of resuscitative endovascular balloon occlusion of the aorta in severely injured trauma patients may increase the risk of complications and mortality.

Complications			
Acute kidney injury	9 (3.2)	15 (10.7)	.02
Amputation of lower limb	2 (0.7)	5 (3.6)	.04
Deep venous thrombosis	14 (5.0)	6 (4.3)	.42
Pulmonary embolism	5 (1.8)	2 (1.4)	.28
Stroke	3 (1.1)	2 (1.4)	.37
Myocardial infarction	1 (0.4)	0	.51
Extremity compartment syndrome	2 (0.7)	1 (0.7)	.39

Anaesth Crit Care Pain Med xxx (xxxx) xxx

Contents lists available at ScienceDirect

Anaesthesia Critical Care & Pain Medicine

journal homepage: www.elsevier.com

Guidelines

Prehospital trauma flowcharts — Concise and visual cognitive aids for prehospital trauma management from the French Society of Emergency Medicine (SFMU) and the French Society of Anaesthesia and Intensive Care Medicine (SFAR)

Karim Tazarourte [a,b,*], François-Xavier Ageron [c], Aurélie Avondo [d], Edward Barnard [e,f,g], Xavier Bobbia [h], Eric Cesareo [b], Charlotte Chollet-Xemard [i], Sonja Curac [j], Thibaut Desmettre [k,l], Carlos E.L. Khoury [m], Tobias Gauss [n], Cédric Gil-Jardine [o], Tim Harris [p,q], Matthieu Heidet [i,r], Frédéric Lapostolle [s], Catherine Pradeau [t], Aurélien Renard [u], David Sapir [v], Jean-Pierre Tourtier [w], Stéphane Travers [x]

Anaesth Crit Care Pain Med 41 (2022) 101069

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Anaesthesia Critical Care & Pain Medicine

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Guidelines

Intrahospital trauma flowcharts — Cognitive aids for intrahospital trauma management from the French Society of Anaesthesia and Intensive Care Medicine (SFAR) and the French Society of Emergency Medicine (SFMU)

Tobias Gauss [a,*], Hervé Quintard [b], Benjamin Bijok [c], Guillaume Bouhours [d], Thomas Clavier [e], Fabrice Cook [f], Hugues de Courson [g], Jean-Stéphane David [h], Caroline Duracher-Gout [i], Delphine Garrigue [c], Thomas Geeraerts [j], Sophie Hamada [k], Olivier Joannes-Boyau [l], Romain Jouffroy [m], Antoine Lamblin [n], Olivier Langeron [o], Pierre Lanot [p], Sigismond Lasocki [d], Marc Leone [q], Sébastien Mirek [r], Laurent Muller [s], Pierre Pasquier [t,u], Bertrand Prunet [v], Sébastien Perbet [w], Mathieu Raux [x], Justin Richards [y], Claire Roger [z], Antoine Roquilly [A], Emmanuel Weiss [B], Pierre Bouzat [a], Julien Pottecher [C]

AIDE COGNITIVE– STRUCTURE PRISE EN CHARGE PRÉ-HOSPITALIÈRE.

ANTICIPER

QUE SAVONS-NOUS ? | ATTRIBUER RÔLES | UTILISER CHECK-LIST et SCORES d'ACTIVATION | BESOINS ET PRÉPARATION MATÉRIEL/RESSOURCES

$T_{0\text{-}5\ min}$

ASSURER SA PROPRE SÉCURITÉ ET CELLE DE SON EQUIPE ET ÉVALUER LA SITUATION GLOBALE

IDENTIFIER ET TRAITER LES BESOINS IMMÉDIATS DU PATIENT
A/B/C/D/E
PRIORISER GESTES ESSENTIELS ET DEFINIR LES OBJECTIFS THERAPEUTIQUES
TRANSPORT RAPIDE SANS DÉLAIS

A= Airway (Voies ariennes).
B= Breathing (Ventilation).
C= Circulation (Hémodynamique).
D= Disability (Conscience/GCS).
E= Extended (Exposition/Autres/Glycémie)

Voies aériennes > Libération
Ventilation > Oxygénation
Pouls radial/Hémorragie > Garrot/Compression
Conscience > Position latérale de sécurité
Exposition/autres lésions > Extraction
Maintien axe tête-cou-tronc si indiqué

$T_{5\text{-}15\ min}$

TRANSMISSION PRÉ-BILAN

POINT DE SITUATION avec partenaires / équipe sur place
- Priorités et Objectifs?
- Suggestions?/Etablir un plan (Extraction, traitement, vecteur…)
- Attribuer rôles/tâches
- Utiliser communication en boucle fermée

IMPLÉMENTER LE PLAN

INITIER LES TRAITEMENTS EN FONCTION DES PRIORITÉS

BILAN COMPLET
> Orientation Trauma Center si critères de gravité

$T_{15\text{-}30\ min}$

POURSUIVRE PLAN ET TRAITEMENTS

RÉÉVALUATION EFFICACITÉ MESURES

ÉVALUATION ⇄ **MESURES**

LIMITER TEMPS SUR PLACE (30 MINUTES)

VERIFIER SI LES OBJECTIFS THERPEUTIQUES SONT ATTEINTS

$T_{30\text{-}60\ min}$

POURSUIVRE TRAITEMENTS
pendant transport

RÉÉVALUATION
Donner pré-alerte, si choc ou trauma crânien grave

Transmission structurée à l'arrivée
ATMASTER
(Age/Temps/Mécanisme/Atteintes/Signes/ Traitements/Recommandations)

Injury, Int. J. Care Injured 48 (2017) 5–12

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Trends in 1029 trauma deaths at a level 1 trauma center: Impact of a bleeding control bundle of care

Blessing T. Oyeniyi, Erin E. Fox, Michelle Scerbo, Jeffrey S. Tomasek, Charles E. Wade, John B. Holcomb*

Center for Translational Injury Research, Division of Acute Care Surgery, Department of Surgery, Medical School, The University of Texas Health Science Center at Houston, Houston, TX, USA

Take Home Message

Bleeding control bundle of care.

- Identify the bleeding patient
- Prehospital and hospital damage control resuscitation
- Prehospital and hospital extremity and junctional tourniquets
- Prehospital and hospital pelvic binders
- Prehospital and hospital hemostatic dressings
- Resuscitative endovascular balloon occlusion of the aorta
- Coagulation monitoring with thromboelastography
- TXA for patients with significant fibrinolysis
- Decreased time to operating room
- Decreased time to interventional radiology
- Goal directed resuscitation with blood products as bleeding slows

Cause of death 1 h and 24 h post injury for major causes of death.

	Total	2005–2006	2012–2013	p
1 h post Injury	N = 265	N = 136	N = 129	
Head Injury, n (%)	119/265 (44.9)	51/136 (37.5)	68/129 (52.7)	0.02
Hemorrhage, n (%)	131/265 (49.4)	82/136 (60.3)	49/129 (38.0)	<0.01
24 h post Injury	N = 610	N = 302	N = 308	
Head Injury, n (%)	347/610 (56.9)	158/302 (52.3)	189/308 (61.4)	0.03
Hemorrhage, n (%)	253/610 (41.5)	147/302 (48.7)	106/308 (34.4)	<0.01

VIEWPOINT

A National Trauma Care System to Achieve Zero Preventable Deaths After Injury

Recommendations From a National Academies of Sciences, Engineering, and Medicine Report

Donald M. Berwick, JAMA 2016

Leadership and a Culture of Learning

Digital Capture of the Trauma Patient Care Experience

Coordinated Performance Improvement and Research to Generate Evidence-Based Best Trauma Care Practices

Timely Dissemination of Trauma Knowledge

Transparency and Incentives for Quality Trauma Care

Patient-Centered Trauma Care

Systems for Ensuring an Expert Trauma Care Workforce

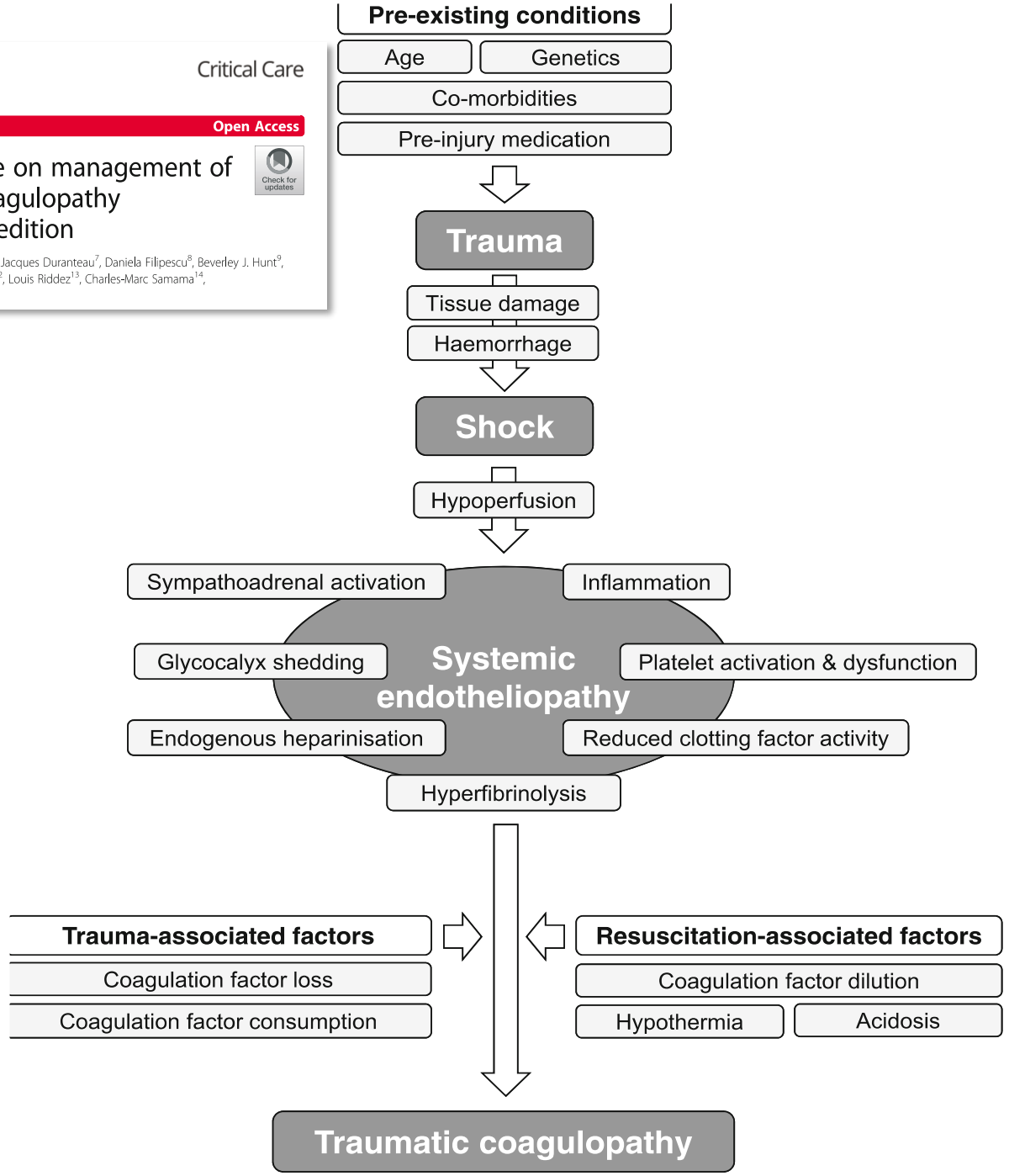
Spahn et al. Critical Care (2019) 23:98
https://doi.org/10.1186/s13054-019-2347-3

Critical Care

RESEARCH Open Access

The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition

Donat R. Spahn[1], Bertil Bouillon[2], Vladimir Cerny[3,4,5,6], Jacques Duranteau[7], Daniela Filipescu[8], Beverley J. Hunt[9], Radko Komadina[10], Marc Maegele[11], Giuseppe Nardi[12], Louis Riddez[13], Charles-Marc Samama[14], Jean-Louis Vincent[15] and Rolf Rossaint[16*]



Recommendation 12 We recommend permissive hypotension with a target systolic blood pressure of 80–90 mmHg (mean arterial pressure 50–60 mmHg) until major bleeding has been stopped in the initial phase following trauma without brain injury. (Grade 1C)

In patients with severe TBI (GCS ≤ 8), we recommend that a mean arterial pressure ≥ 80 mmHg be maintained. (Grade 1C)


Spahn *et al. Critical Care* (2019) 23:98
https://doi.org/10.1186/s13054-019-2347-3

Critical Care

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Recommendation 13 We recommend use of a restricted volume replacement strategy to achieve target blood pressure until bleeding can be controlled. (Grade 1B).

Remplissage vasculaire non libéral

Recommendation 14 In the presence of life-threatening hypotension, we recommend administration of vasopressors in addition to fluids to maintain target arterial pressure. (Grade 1C)

Vasopressor

Canadian Journal of Emergency Medicine
https://doi.org/10.1007/s43678-023-00447-9

ORIGINAL RESEARCH

2023

The efficacy of prehospital IV fluid management in severely injured adult trauma patients: a systematic review and meta-analysis

Samuel Hébert[1] · Erica Kohtakangas[1,2] · Alanna Campbell[1] · Robert Ohle[1,2]

Intervention	Average fluid in each arm (ml)	Outcome
High—Immediate resuscitation, mean	High—870 ml	Decreased mortality in delayed resuscitation
Low—Delayed resuscitation, mean	Low—92 ml	
High—High dose (> 500 ml) fluids	High—U	Increased mortality and coagulopathy with high dose, SBP increased with high dose
Low—Low dose (< 500 ml) fluids	Low—U	
High— >500 ml fluids	High—U	No association between fluid level and mortality
Low— <500 ml to no fluids	Low—U	
Both High + Low grouped on ISS and SBP, mean 620–1554 ml	High—1245—1554 ml Low—0 ml	No association between fluid level and mortality
High—standard resuscitation (1000 ml) + crystalloid to achieve SBP > 110 mm Hg	High—2000 ml	No association between fluid level and mortality
Low—controlled resuscitation (250 ml) if SBP < 70 mm Hg	Low—1000 ml	
High— > 100 ml	High—500 ml	No association between fluid level and mortality
Low— < 100 ml	Low— <100 ml	
High— > 1000 ml	High—500–2000 ml	No association between fluid level and mortality
Low— < 1000 ml	Low—0–1000 ml	

CONCISE CLINICAL REVIEW

Balanced Crystalloid Solutions

Matthew W. Semler[1] and John A. Kellum[2]

[1]Division of Allergy, Pulmonary and Critical Care Medicine, Vanderbilt University Medical Center, Nashville, Tennessee; and [2]The Center for Critical Care Nephrology, Department of Critical Care Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania

Am J Respir Crit Care Med 2019

Une évidence conceptuelle
À l'usage des cristalloides balancés

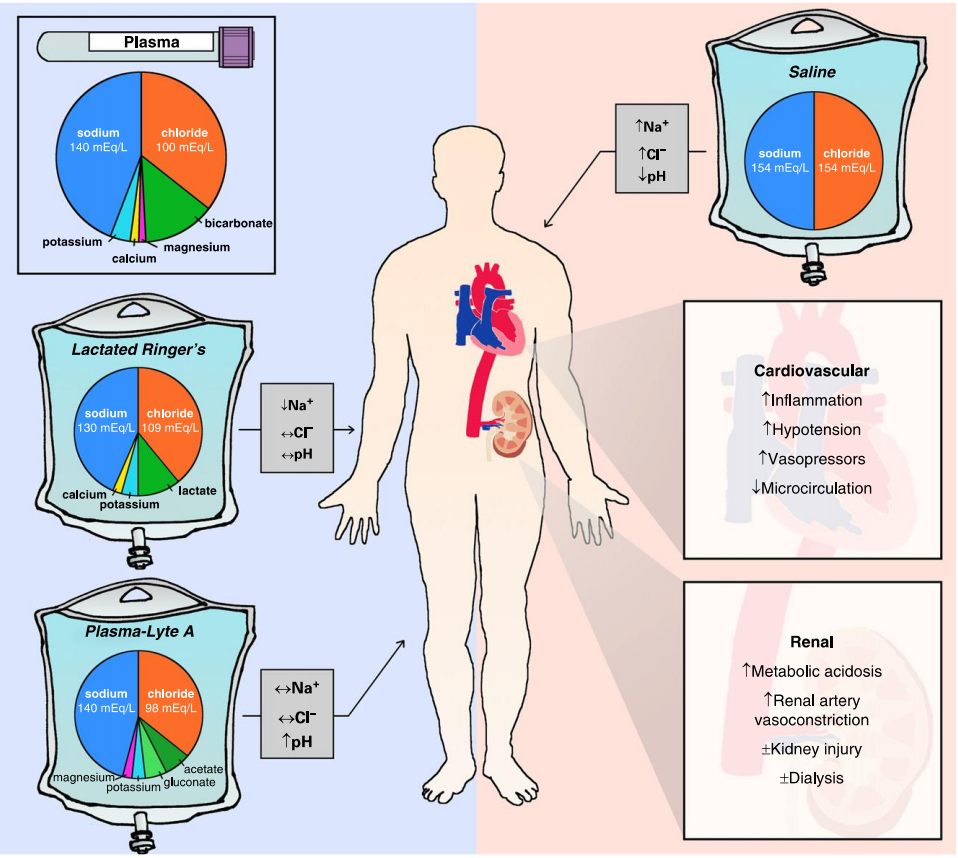


Table 1. Composition of Crystalloid Solutions

Fluid	Sodium	Potassium	Calcium	Magnesium	Chloride	Acetate	Gluconate	Malate	Lactate	Osmolarity
Plasma	135–145	4.5–5.0	2.2–2.6	0.8–1.0	94–111	0.02–0.2			1–2	275–295
Plasma-Lyte A	140	5.0		3.0	98	27	23			294
Normosol-R	140	5.0		3.0	98	27	23			295
Isolyte S	141	5.0		3.0	98	27	23			295
Ringer's acetate	145	4.0	2.5	1.0	127	24		5		309
Lactated Ringer's	130	4.0	2.7		109				28	273
Hartmann's solution	131	5.4	1.8		112				28	280
0.9% sodium chloride	154				154					308

Original Investigation | Emergency Medicine

Association of Early Norepinephrine Administration With 24-Hour Mortality Among Patients With Blunt Trauma and Hemorrhagic Shock

Tobias Gauss, MD; Justin E. Richards, MD; Costanza Tortù, PhD; François-Xavier Ageron, MD, PhD; Sophie Hamada, MD, PhD; Julie Josse, PhD; François Husson, PhD; Anatole Harrois, MD, PhD; Thomas M. Scalea, MD; Valentin Vivant; Eric Meaudre, MD, PhD; Jonathan J. Morrison, MD; Samue Galvagno, MD, PhD; Pierre Bouzat, MD, PhD; for the French Trauma Research Initiative

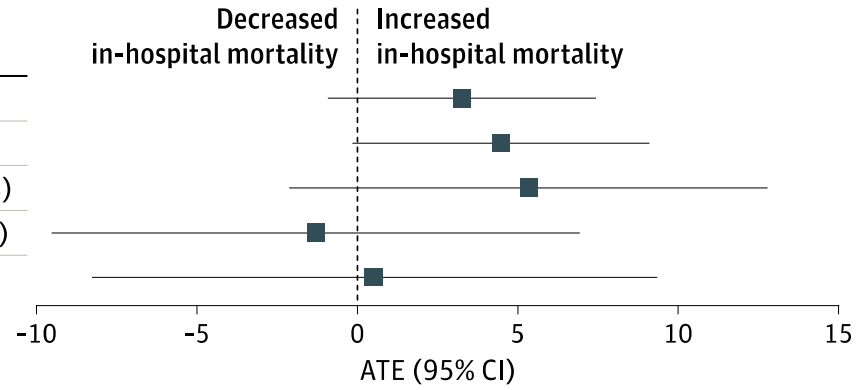
JAMA Network Open

2022

Meaning This study suggests that norepinephrine administration is not associated with 24-hour mortality among patients with blunt trauma and hemorrhagic shock.

Figure 3. Average Treatment Effect (ATE) Estimation of Association of Norepinephrine With In-Hospital Mortality

Model	ATE (95% CI)
1: No correction	3.3 (-0.9 to 7.4)
2: Regression adjustment	4.5 (-0.1 to 9.1)
3: Weighted regression adjustment	5.3 (-2.1 to 12.8)
4: Matching by covariable	-1.3 (-9.5 to 6.9)
5: Matching by cohort	0.5 (-8.3 to 9.3)



Findings In this cohor study of 2164 patients with blunt trauma and hemorrhagic shock from the US and France, according to 5 distinct statistica simulations, the average treatment effect showed no association between norepinephrine administration and 24-hour mortality.

Imach et al. Crit Care (2021) 25:277
https://doi.org/10.1186/s13054-021-03701-7

Critical Care

RESEARCH Open Access

The impact of prehospital tranexamic acid on mortality and transfusion requirements: match-pair analysis from the nationwide German TraumaRegister DGU®

Sebastian Imach[1*], Arasch Wafaisade[1], Rolf Lefering[2], Andreas Böhmer[3], Mark Schieren[3], Victor Suárez[4], Matthias Fröhlich[1] and TraumaRegister DGU[5]

Massive transfusion rate was significantly lower in the TXA group (5.5% versus 7.2%, $p = 0.015$)

Mortality was similar except for early mortality after 6 h ($p = 0.004$) and 12 h ($p = 0.045$)

Among non-survivors hemorrhage as leading cause of death was less in the TXA group (3.0% vs. 4.3%, $p = 0.021$).

Thromboembolic events were not significantly different between both groups (TXA 6.1%, control 4.9%, $p = 0.080$).

Le patient STABLE : RV simple
le patient Stabilisé : KTCO
le patient instable : PAS < 80 mmHg

RESUSCITATION ROOM PRINCIPLES MAJOR TRAUMA – INTRAHOSPITAL

aidescognitivestrauma@protonmail.com

PREPARE

- TEAM BRIEFING
- WHAT DO WE KNOW?
- ROLE AND TASK ALLOCATION
- USE CHECK-LIST AND SCORES
- PREPARE REQUIRED KIT AND RESOURCES

$T_{0\text{-}5\ min}$

IDENTIFY AND ATTEND IMMEDIATE NEEDS

A (Airway) = check and open airway, protect airway if required, maintain spinal control
B (Breathing) = check breathing and efficacy, oxygenate, assist if required
C (Circulation) = check pulse and haemorrhage, apply tourniquet/compression if required
D (Disability) = check conscious level, use recovery (semi prone) position as appropriate
E (Exposure) = check and reduce exposure, look for other injuries

STRUCTURED HANDOVER - *ATMISTER*
(Age / Time / Mechanism / Injury / Signs-Symptoms / Treatment / Estimated Time of Arrival / Requests)

$T_{5\text{-}15\ min}$

TEAM TIME OUT

- Priority and objectives?
- Suggestions? / Share plan
- Allocate roles and tasks
- Use closed loop communication

CONCURRENT ACTIVITY

IMPLEMENT PLAN INITIATE CARE

CLINICAL AND ADDITIONAL EXAMINATIONS (RADIOLOGY/eFAST/Point of Care Labs,...)
Keep in-line stabilisation

$T_{15\text{-}30\ min}$

DEFINE PRIORITIES AND OBJECTIVES

RESPIRATORY FAILURE AND SHOCK CONTROLLED?

REVIEW REPEATEDLY

$T_{30\text{-}60\ min}$

TEAM TIME OUT

ESTABLISH PLAN/STRATEGY according to situation and patient condition

AIM FOR CONTROL OF SHOCK AND RESPIRATORY DISTRESS

REASSESSMENT A/B/C/D/E*

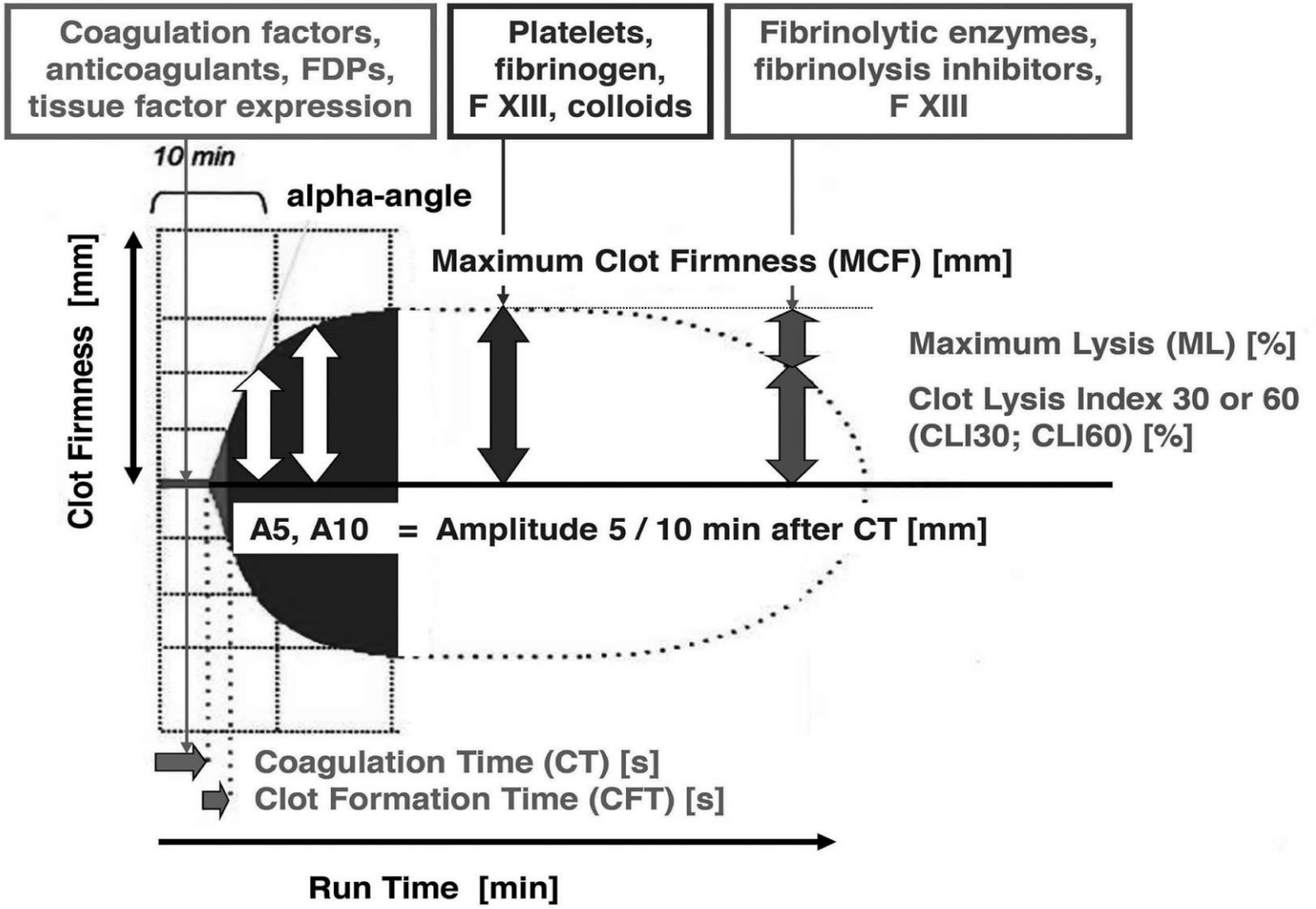
$T_{24\text{-}48\ h}$

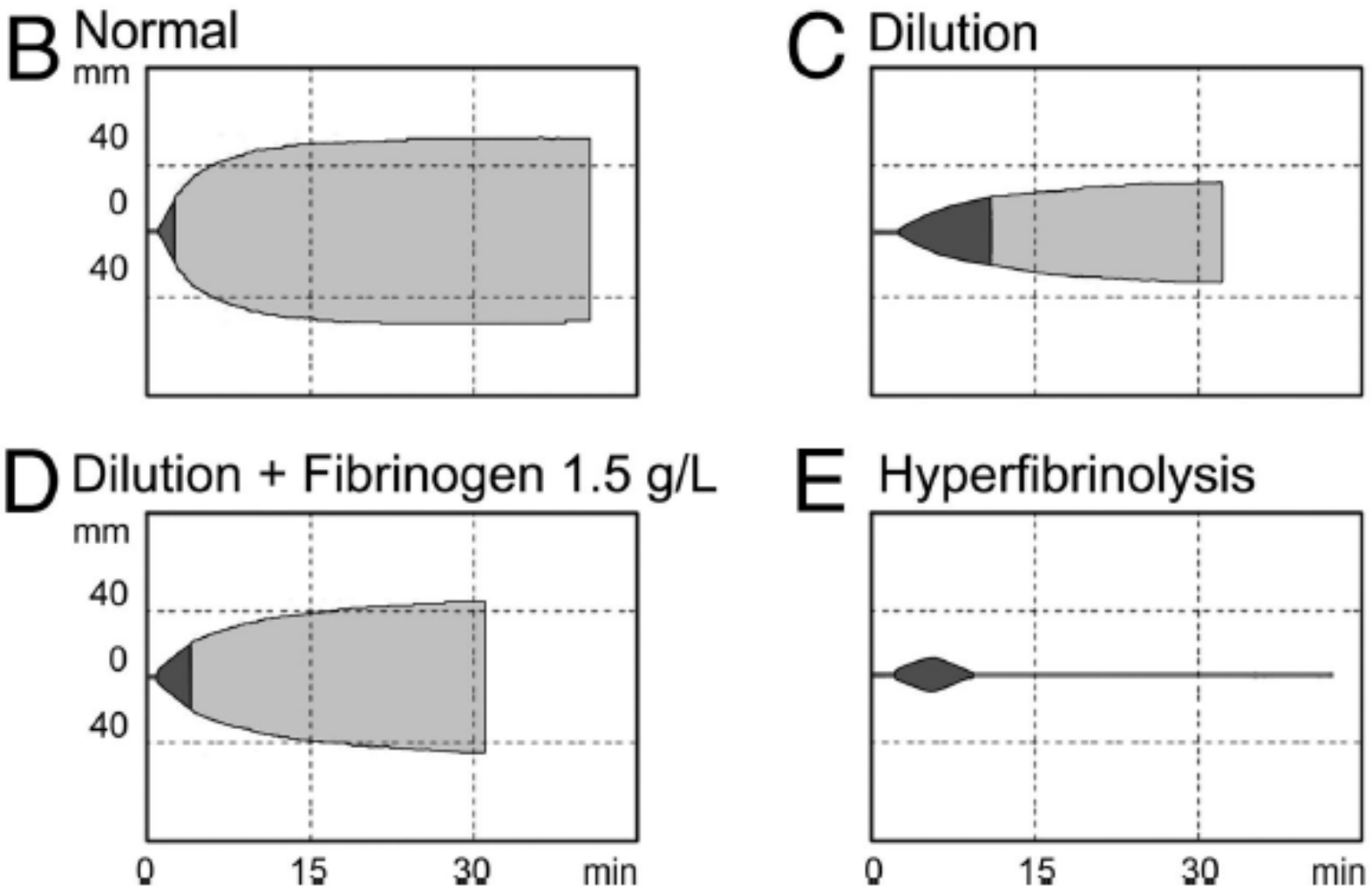
DEBRIEF

SHARE FEEDBACK

Place des thromboélastogrammes

Haas T Minervia Anesthesiol 2014





Bolliger D BJA 2009