



NOUVEAUTÉS DANS LA PRISE EN CHARGE DU TRAUMATISÉ GRAVE

M. DE QUEIROZ
Département Anesthésie-Réanimation Pédiatrique
Hôpital Femme Mère Enfant
Bron / Lyon

Hospices Civils de Lyon

e-ADARPEF



- Trauma center
- Trauma abdominaux
- Choc hémorragique
  - Remplissage
  - Transfusion massive
  - Thérapeutique adjuvante
  - Monitorage
- Afflux massif victimes





EPIDEMIOLOGIE

- 14 % de l'ensemble des traumatismes
- Mais :
  - 1ère cause de mortalité des enfants > 1 an
  - 1/3 mortalité infantile
- 80 % des polytraumatismes sont associés à un TC
- 45-75% des TC graves sont des polytraumatisés
- 50 % des décès sont dus à un TC
- **Décès évitables** : lésions cérébrales / **hémorragie**



LE POLYTRAUMATISE PEDIATRIQUE EST UN TRAUMATISE CRANIEN
LE TRAUMATISE CRANIEN PEDIATRIQUE EST UN POLYTRAUMATISE
Jusqu'à preuve du contraire

Javouhey Urgence 2012



TRAUMA CENTER PEDIATRIQUE OU MIXTE?

Original Investigation

Mortality Among Injured Children Treated at Different Trauma Center Types

Chethan Sathya, MD; Aziz S. Alali, MD, PhD; Paul W. Wales, MD; Damon C. Scales, MD, PhD; Paul J. Karanicolas, MD, PhD; Randall S. Burd, MD, PhD; Michael L. Nance, MD; Wei Xiong, MSc; Avery B. Nathens, MD, PhD, MPH

JAMA surg 2015

Contents lists available at ScienceDirect
Injury
journal homepage: www.elsevier.com/locate/injury
2016

Review

Paediatric trauma systems and their impact on the health outcomes of severely injured children: An integrative review

Amy McCarthy [a,b,*], Kate Curtis [a,c], Andrew J.A. Holland [d,e]

Mortalité : PTC>MTC>ATC

pour les + jeunes < 5 ans et les + sévères

Outcome differences in adolescent blunt severe polytrauma patients managed at pediatric versus adult trauma centers

J Trauma Acute Care Surg 2017

Amelia T. Rogers, Brian W. Gross, Alan D. Cook, MD, Cole D. Rinehart, Caitlin A. Lynch, Eric H. Bradburn, DO, MS, Colin C. Heinle, MD, Shreya Jammula, *and* Frederick B. Rogers, MD, MS, *Lancaster, Pennsylvania*

Pas de différence…



Problématiques

- Peu de trauma center pédiatriques
- **<u>Spécialisation vs volume?</u>**
- Bonne prise en charge trauma center adulte **<u>AVEC formation pédiatrique</u>**

- **<u>Les plus sévères et < 5 ans : trauma center pédiatrique?</u>**

- **Développement des réseaux**
- **Améliorer qualité de PEC dans MTC et ATC / partenariat**
- **Travailler sur pré hospitalier** (Pb du triage, transport)



TRAUMATISMES ABDOMINAUX

Traitement conservateur / Chirurgie

Injury, Int. J. Care Injured 45 (2014) 859–863

Contents lists available at ScienceDirect

Injury

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

Population-based analysis of blunt splenic injury management in children: Operative rate is an informative quality of care indicator☆

Marvin Hsiao [a], Chethan Sathya [a,b,*], Charles de Mestral [a], Jacob C. Langer [a,c], David Gomez [a], Avery B. Nathens [a,b,d,e,f]

PEC chir
ATC > PTC





Statut hémodynamique
Réponse à la réanimation
Environnement pédiatrique

TTT CONSERVATEUR

Non-operative management in splenic injury:

- *NOM is recommended as first-line treatment for hemodynamically stable pediatric patients with blunt splenic trauma (GoR 2A).*
- *Patients with moderate-severe blunt and all penetrating splenic injuries should be considered for transfer to dedicated pediatric trauma centers after hemodynamic stabilization (GoR2A).*
- *NOM of spleen injuries in children should be considered only in an environment that provides capability for patient continuous monitoring, angiography, trained surgeons, an immediately available OR and immediate access to blood and blood products or alternatively in the presence of a rapid centralization system in those patients amenable to be transferred (GoR 2A).*
- *NOM should be attempted even in the setting of concomitant head trauma; unless the patient is unstable, and this might be due to intra-abdominal bleeding (GoR 2B).*

Nonoperative management of blunt liver and spleen injury in children: Evaluation of the ATOMAC guideline using GRADE

Trauma Acute Care Surg. 2015

David M. Notrica, MD, James W. Eubanks III, MD, David W. Tuggle, MD, Robert Earl Maxson, MD, Robert W. Letton, MD, Nilda M. Garcia, MD, Adam C. Alder, MD, MSCS, Karla A. Lawson, PhD, Shawn D. St Peter, MD, Steve Mesison, MD, *and* Pamela Garcia-Filion, PhD, MPH.

AAST 2016 Plenary Paper

Failure of nonoperative management of pediatric blunt liver and spleen injuries: A prospective Arizona-Texas-Oklahoma-Memphis-Arkansas Consortium study

TTT CHIRURGICAL

0-10% de taux d'échec
Moitié cause hémorragique, moitié autres lésions

Operative management in blunt and penetrating injuries:

- *Patients should undergo to OM in case of hemodynamic instability, failure of conservative treatments, severe coexisting injuries necessitating intervention and peritonitis, bowel evisceration, impalement (GoR 2A).*
- *Splenic preservation (at least partial) should be attempted whenever possible (GoR 2B).*

Chir si échec de stabilisation hémodynamique avec transfusion > 40ml/kg en 24h
Chir nécessaire après H4-5 en moyenne
Echec si lésions associées (foie, intestin, rein, pancréas…)
Blush au TDM si multiples lésions

Coccolini *et al. World Journal of Emergency Surgery* (2017) 12:40
DOI 10.1186/s13017-017-0151-4

World Journal of Emergency Surgery

REVIEW Open Access

Splenic trauma: WSES classification and guidelines for adult and pediatric patients

EMBOLISATION

The role of angiography/angioembolization (AG/AE):

- *The vast majority of pediatric patients do not require AG/AE for CT blush or moderate to severe injuries (GoR 1C).*
- *AG/AE may be considered in patients undergone to NOM, hemodynamically stable with sings of persistent hemorrhage not amenable of NOM, regardless the presence of CT blush once excluded extra-splenic source of bleeding (GoR 1C).*
- *AG/AE may be considered for the treatment of post-traumatic splenic pseudo-aneurysms prior to patient discharge (GoR 2C).*
- *Patients with more than 15 years old should be managed according to adults AG/AE-protocols (GoR 1C).*

Therefore, AG/AE may only be considered in carefully selected patients, such as those with high-grade injuries, transient response to resuscitation, and/or persistent blood requirements [182]. Similarly, the role of

The American Journal of Surgery

Clinical Science

Contrast blush in pediatric blunt splenic trauma does not warrant the routine use of angiography and embolization

Samiksha Bansal, M.D.[a], Frederick M. Karrer, M.D.[b], Kristine Hansen, D.S.[b], David A. Partrick, M.D.[b,*]

Selective Angioembolization in Blunt Solid Organ Injury in Children and Adolescents: Review of Recent Literature and Own Experiences

Eur J Pediatr Surg 2013;23:454–463.

Tobias Schuster[1] Giessbert Leissner[4]

GUIDELINES

J Trauma Acute Care Surg 2015

Nonoperative management of blunt liver and spleen injury in children: Evaluation of the ATOMAC guideline using GRADE

David M. Notrica, MD, James W. Eubanks III, MD, David W. Tuggle, MD, Robert Todd Maxson, MD, Robert W. Letton, MD, Nilda M. Garcia, MD, Adam C. Alder, MD, MSCS, Karla A. Lawson, PhD, Shawn D. St Peter, MD, Steve Megison, MD, *and* Pamela Garcia-Filion, PhD, MPH,
Phoenix, Arizona

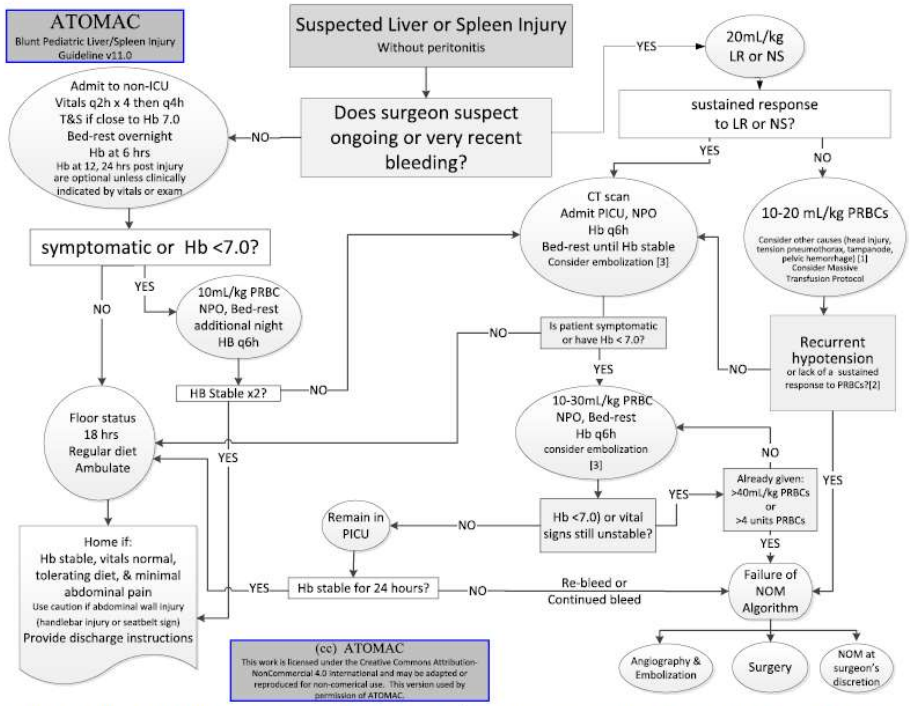


Figure 1. ATOMAC guideline for management of pediatric BLSI. [1]More than 50% of injured children with hypotension have no significant intra-abdominal bleeding but do have severe traumatic brain injury. [2]Recurrent hypotension within the first hour because of intra-abdominal bleeding or an SBP of less than 50 mm Hg after transfusion is an ominous sign, and strong consideration should be given to operative or angiographic intervention. [3]Embolizing CT blush may be considered, but more than 80% of children with blush do not require angiography for successful NOM. [4]Interventional modalities such as ERCP, laparoscopy, angiography, or percutaneous drainage may be required to manage complications of bile leak or hemobilia. Hb, hemoglobin; NPO, "non per os" or nothing per mouth; PICU, pediatric ICU; PRBC, packed red blood cell; q6h, every 6 hours; SBP, systolic blood pressure.



Protocoles fonction capacité et organisation locales…

Coccolini *et al. World Journal of Emergency Surgery* (2017) 12:40
DOI 10.1186/s13017-017-0151-4

World Journal of Emergency Surgery

REVIEW Open Access

Splenic trauma: WSES classification and guidelines for adult and pediatric patients

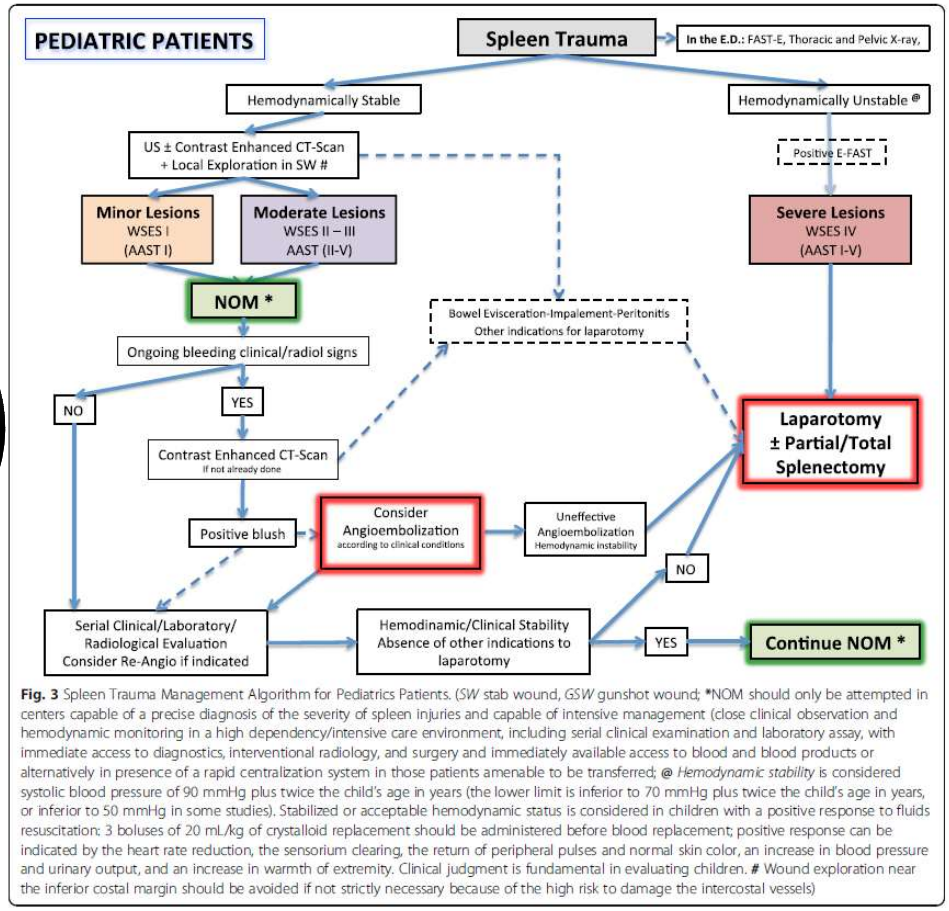


Fig. 3 Spleen Trauma Management Algorithm for Pediatrics Patients. (*SW* stab wound, *GSW* gunshot wound; *NOM should only be attempted in centers capable of a precise diagnosis of the severity of spleen injuries and capable of intensive management (close clinical observation and hemodynamic monitoring in a high dependency/intensive care environment, including serial clinical examination and laboratory assay, with immediate access to diagnostics, interventional radiology, and surgery and immediately available access to blood and blood products or alternatively in presence of a rapid centralization system in those patients amenable to be transferred; @ *Hemodynamic stability* is considered systolic blood pressure of 90 mmHg plus twice the child's age in years (the lower limit is inferior to 70 mmHg plus twice the child's age in years, or inferior to 50 mmHg in some studies). Stabilized or acceptable hemodynamic status is considered in children with a positive response to fluids resuscitation: 3 boluses of 20 mL/kg of crystalloid replacement should be administered before blood replacement; positive response can be indicated by the heart rate reduction, the sensorium clearing, the return of peripheral pulses and normal skin color, an increase in blood pressure and urinary output, and an increase in warmth of extremity. Clinical judgment is fundamental in evaluating children. # Wound exploration near the inferior costal margin should be avoided if not strictly necessary because of the high risk to damage the intercostal vessels)



REMPLISSAGE
Dans choc hémorragique

The effects of balanced blood component resuscitation and crystalloid administration in pediatric trauma patients requiring transfusion in Afghanistan and Iraq 2002 to 2012

J Acute Trauma Care Surg 2014

Mary J. Edwards, MD, Michael B. Lustik, MS, Margaret E. Clark, MD, Kevin M. Creamer, MD, *and* **David Tuggle, MD,** *San Antonio, Texas*

Journal of Pediatric Surgery 49 (2014) 1852–1855

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

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

Injured children are resistant to the adverse effects of early high volume crystalloid resuscitation☆

Shannon N. Acker [a,*], James T. Ross [a], David A. Partrick [a], Peter DeWitt [b], Denis D. Bensard [a,c]

Journal of Pediatric Surgery 53 (2018) 2202–2208

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

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

High volume crystalloid resuscitation adversely affects pediatric trauma patients☆,☆☆,★

Barbara E. Coons [a], Sophia Tam [a], Jeanne Rubsam [b], Steven Stylianos [b], Vincent Duron [b,*]

Volume > 150ml/kg/24h en cas de choc hémorragique => augmentation mortalité

Réanimation petit volume

Volume > 60ml/kg/24h => augmentation durée séjour, durée ventilation



Multicenter study of crystalloid boluses and transfusion in pediatric trauma—When to go to blood?

J Trauma Acute Care Surg 2018

Stephanie F. Polites, MD, Rachel M. Nygaard, PhD, Pooja N. Reddy, MS, Martin D. Zielinski, MD, Chad J. Richardson, MD, Terri A. Elsbernd, MSN, Branden M. Petrun, MD, Sean L. Weinberg, MD, Sherrie Murphy, BSN, Donald D. Potter, MD, Denise B. Klinkner, MD, *and* Christopher R. Moir, MD, *Rochester, Minnesota*

Trigger Transfusion?
si nécessité de **> 20-40ml/kg** ou d'emblée si choc hémorragique avéré ou **shock index (FC/PAS) élevé**

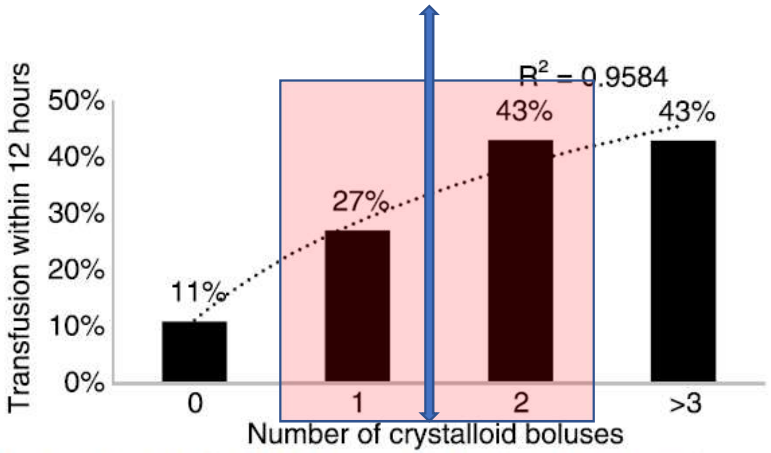


Figure 1. Crystalloid boluses were defined as 20 ± 10 mL/kg of crystalloid received prehospital through 12 hours after arrival



TRANSFUSION MASSIVE

3% de MT…

- Définition ?
  - Transfusion de 50% de la masse sanguine en 3 h ou 100 % en 24h? *Livingston. Injury. 2014*
  - Transfusion >40 ml/kg de tous les produits sanguins en 24h ? *Neff J Trauma Acute Care Surg. 2015*
  - **Définition pour étude ≠ pratique clinique pour démarrer une TM…**

Clearly defining pediatric massive transfusion: Cutting through the fog and friction with combat data

J Trauma Acute Care Surg 2014

Lucas P. Neff, MD, Jeremy W. Cannon, MD, Jonathan J. Morrison, MRCS, Mary J. Edwards, MD, Philip C. Spinella, MD, *and* Matthew A. Borgman, MD, *San Antonio, Texas*



The effect of massive transfusion protocol implementation on pediatric trauma care

Transfusion 2016

Ruth S. Hwu,[1,3] Philip C. Spinella,[1,2] Martin S. Keller,[1,2] David Baker,[1] Michael Wallendorf,[2] and Julie C. Leonard[1,2,4]

Protocole => ratio + élevé, + rapidement
Pas de différence mortalité retrouvée

Hendrickson Transfusion 2012
Nosanov the American journal of Surgery 2013

Développer protocoles locaux



Pediatric Massive Transfusion

A Systematic Review

Pediatric Emergency Care 2018

Graeme Maw, FACEM and Claire Furyk, FANZCA†*

Based on the current available evidence in bleeding pediatric trauma patients, we would recommend early use of viscoelastic hemostatic assays (eg, ROTEM) to guide blood transfusion requirements. Should ROTEM be unavailable, then we suggest red blood cells/FFP/platelet ratios to be in the order of 1:1:1 if large volumes of greater than 40 mL/kg are to be replaced. This recommendation is based upon very low quality evidence. Early goal-directed use of fibrinogen supplements is also encouraged.



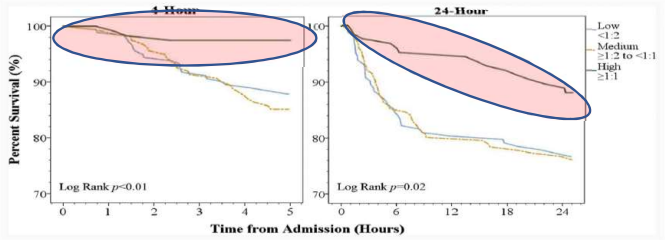
JOURNAL OF SURGICAL RESEARCH • JANUARY 2019 (233) 213–220

Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.JournalofSurgicalResearch.com
ELSEVIER
JSR

Association for Academic Surgery

A High Ratio of Plasma: RBC Improves Survival in Massively Transfused Injured Children

Megan E. Cunningham, MD,[a] Eric H. Rosenfeld, MD,[a] Huirong Zhu, PhD,[a] Bindi J. Naik-Mathuria, MD,[a] Robert T. Russell, MD, MPH,[b] and Adam M. Vogel, MD[a,]*



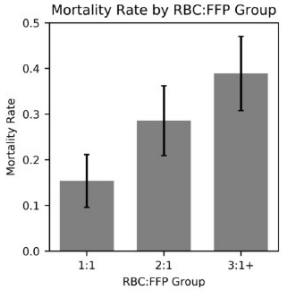
Journal of Pediatric Surgery 54 (2019) 345–349

Contents lists available at ScienceDirect
Journal of Pediatric Surgery
journal homepage: www.elsevier.com/locate/jpedsurg
ELSEVIER

Massive transfusion in pediatric trauma: An ATOMAC perspective

Daniel K. Noland [a], Nadja Apelt [a], Cynthia Greenwell [a,*], Jefferson Tweed [a], David M. Notrica [b], Nilda M. Garcia [c], R. Todd Maxson [d], James W. Eubanks III [e], Adam C. Alder [a]

Etudes rétrospectives…



The effects of balanced blood component resuscitation and crystalloid administration in pediatric trauma patients requiring transfusion in Afghanistan and Iraq 2002 to 2012
J Acute Trauma Care Surg 2014

Mary J. Edwards, MD, Michael B. Lustik, MS, Margaret E. Clark, MD, Kevin M. Creamer, MD, *and* David Tuggle, MD, *San Antonio, Texas*

Mortalité + élevée groupe 1/1/1 SI PAS DE NECESSITE DE TM



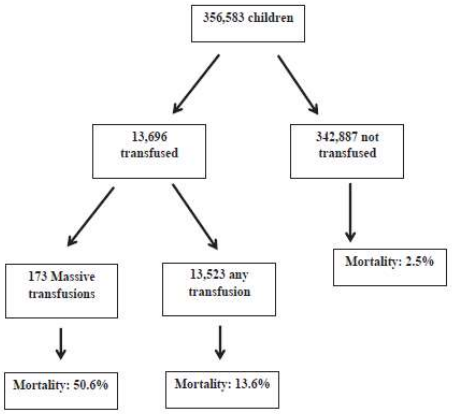
PREDIRE MT?

JOURNAL OF SURGICAL RESEARCH • ■ 2016 (■) 1–7

Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.JournalofSurgicalResearch.com

Massive transfusion in pediatric trauma: analysis of the National Trauma Databank

Michelle C. Shroyer, MPH,[a] Russell L. Griffin, PhD,[b] Vincent Mortellaro, MD,[a] and Robert T. Russell, MD, MPH[a,]*



- Facteurs prédictifs
  - > 5 ans
  - Hypothermie
  - Glasgow < 5
  - ISS> 25



DETECTER ET TRAITER COAGULOPATHIE

Acute traumatic coagulopathy in a critically injured pediatric population: Definition, trend over time, and outcomes

J Trauma Acute Care Surg 2016

Christine M. Leeper, MD, Matthew Kutcher, MD, Isam Nasr, MD, Christine McKenna, MSN, CRNP, Timothy Billiar, MD, Matthew Neal, MD, Jason Sperry, MD MPH, *and* **Barbara A. Gaines, MD**, *Pittsburgh, Pennsylvania*

- Incidence élevée > 50% chez trauma sévère (surtout TC)
- Facteur de risque de
- Transfusion massive
- Morbidité
- Mortalité



ROTEM?

Seminars in Pediatric Surgery 26 (2017) 8–13

Contents lists available at ScienceDirect

Seminars in Pediatric Surgery

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

Viscoelastic hemostatic assays in the management of the pediatric trauma patient

Christine M. Leeper, MD, MS, Barbara A. Gaines, MD*

Pediatric Massive Transfusion
A Systematic Review

2018

Graeme Maw, FACEM and Claire Furyk, FANZCA†*

Rapidité délai d'obtention

Fibrinolyse = prédictif de mortalité

Leeper CM, The journal of trauma and acute care surgery. 2016, Vogel 2013, Liras Surgery 2015

Manque d'études pédiatriques pour stratégie transfusionnelle

Based on the current available evidence in bleeding pediatric trauma patients, we would recommend early use of viscoelastic hemostatic assays (eg, ROTEM) to guide blood transfusion requirements. Should ROTEM be unavailable, then we suggest red blood cells/FFP/platelet ratios to be in the order of 1:1:1 if large volumes of greater than 40 mL/kg are to be replaced. This recommendation is based upon very low quality evidence. Early goal-directed use of fibrinogen supplements is also encouraged.

Seminars in Pediatric Surgery 28 (2019) 61–66

Contents lists available at ScienceDirect

Seminars in Pediatric Surgery

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

Pediatric trauma-related coagulopathy: Balanced resuscitation, goal-directed therapy and viscoelastic assays

Natalie A. Drucker[a], S. Keisin Wang[a], Christopher Newton[b,*]

Au déchoc?
En réa?
Au bloc?



AC TRANEXAMIQUE

Beno *et al. Critical Care* 2014, 18:313
http://ccforum.com/content/18/4/313

CRITICAL CARE

VIEWPOINT

Tranexamic acid in pediatric trauma: why not?

Suzanne Beno[1*], Alun D Ackery[2], Jeannie Callum[3] and Sandro Rizoli[2]

Table 2 Tranexamic acid dosing in pediatric trauma

Age	Loading dose (administer within 3 hours)	Subsequent dose
≥12 years::adult protocol	1 g intravenously over 10 minutes	1 g intravenous infusion over 8 hours
<12 years	15 mg/kg intravenously over 10 minutes (maximum dose 1 g)	2 mg/kg/hr intravenous infusion over 8 hours or until bleeding stops

The Hospital for Sick Children Massive Hemorrhage Protocol for the use of tranexamic acid in pediatric trauma. April 2014. Adapted from Royal College of Paediatrics and Child Health: Evidence statement - Major trauma and the use of tranexamic acid in children [39].



J Trauma Acute Care Surg *Volume 77, Number 6* *2015*

Tranexamic acid administration to pediatric trauma patients in a combat setting: The pediatric trauma and tranexamic acid study (PED-TRAX)

Matthew J. Eckert, MD, Thomas M. Wertin, MD, Stuart D. Tyner, PhD, Daniel W. Nelson, DO, Seth Izenberg, MD, *and* **Matthew J. Martin, MD,** *Tacoma, Washington*

- 766 enfants, age moy=11 ans
  - 35% transfusion, 10% TM
  - 9% mortalité
  - 9% (n=66) Exacyl (1g): trauma abdo et extrémités

- Pas de complication
- Diminution durée VM et amélioration statut neuro
- Diminution mortalité



Nishijima *et al. Trials* (2018) 19:593
https://doi.org/10.1186/s13063-018-2974-z

Trials

STUDY PROTOCOL Open Access

Traumatic injury clinical trial evaluating tranexamic acid in children (TIC-TOC): study protocol for a pilot randomized controlled trial



AFFLUX MASSIF VICTIMES PEDIATRIQUES

CHARGE ÉMOTIONNELLE

Et si c'était des enfants ? Adaptation de la prise en charge médicale en cas d'attentats terroristes avec de nombreux enfants victimes

Archives de Pédiatrie 2017;

And if it happened to children? Adapting medical care during terrorist attacks with multiple pediatric victims

L. Alix-Séguin[a,b,*], N. Lodé[a], G. Orliaguet[c], E. Chamorro[a], F. Kerroué[a], C. Lorge[a], A. Moreira[a]



VULNERABILITE PEDIATRIQUE

- Physiologique
- Anatomique
- Organisationnelle :
  - Moindre ressource médicale, moindre capacité d'accueil
  - Type de lésions inhabituel : pénétrant
  - Formation difficile
  - Charge émotionnelle
- Mortalité + élevée
- Littérature militaire, pays en conflit

Matos Pediatrics 2008, Borgman J Trauma Acute Care Surg 2012

Tableau III
Vulnérabilités organisationnelles de l'enfant victime d'acte de terrorisme.

Particularité organisationnelle	Conséquence sur le traitement médical
Soignants d'adultes moins familiers avec la pédiatrie	Risque d'erreur au niveau des doses ou de la reconnaissance des signes vitaux anormaux Moins familier avec les particularités de la prise en charge pédiatrique
Soignants d'enfants peu exposés aux traumatismes pénétrants ou par explosion	Peu d'études sur les prises en charge optimales, beaucoup de recommandations dérivées de la médecine pour adultes
Peu d'expérience ou de littérature en médecine pédiatrique militaire	Moins d'expositions au quotidien
Nécessité d'équipements de tailles multiples	Dotation parfois insuffisante en cas de multiples victimes du même âge
Antidotes ou antibiotiques à utiliser en cas d'attaque NRBC ne sont pas toujours homologués pour une utilisation en pédiatrie	Réticence à administrer un médicament particulier Erreur de dosage
Ressources pré-hospitalières et hospitalières pédiatriques moindres comparées aux ressources pour les adultes	Nécessité de recourir aux équipes et structures dédiées aux soins des adultes
N'obéit pas aux consignes	Triage et gestion de la foule plus difficile
Difficulté d'identification	Rarement papiers d'identité sur soi
Contexte psychotraumatisant	Pour les victimes, les familles, les soignants

Alix-Séguin Archives de Pédiatrie 2017



Epidemiology of Terror-Related Versus Non–Terror-Related Traumatic Injury in Children

Pediatrics 2003

Limor Aharonson-Daniel, PhD*; Yehezkel Waisman, MD‡; Yehuda L. Dannon, MD§; and Kobi Peleg, PhD, MPH*; and Members of the Israel Trauma Group

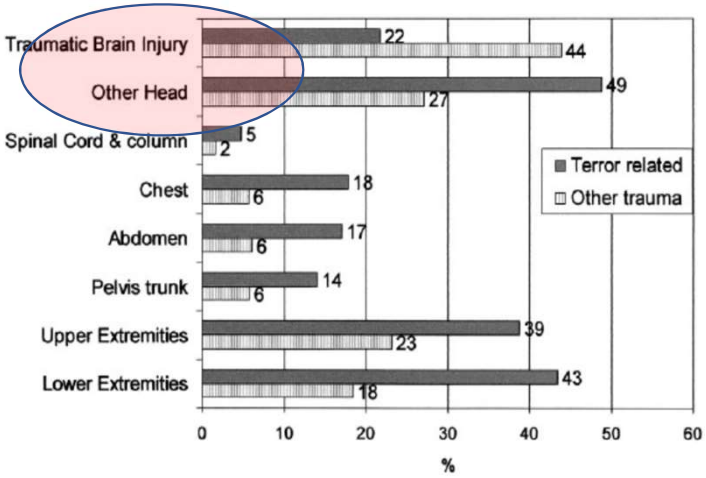


TABLE 2. Comparison of Resource Utilization Between Children Injured in Terror-Related and Children Injured in Non–Terror-Related Trauma

	Terror*		Non-Terror*	
	n	%	*n*	%
Total	138	100	8363	100
Operations/procedures				
Yes	77	55.8	1908	22.8
No	61	44.2	6455	77.2
ICU stay				
Yes	45	32.6	633	7.6
No	93	67.4	7726	92.4
Total length of hospital stay				
<7 d	83	61.5	7466	89.7
≥8 d	52	38.5	861	10.3
Median (IQR; d)	5	(1-11)	2	(1-4)
Destination at discharge				
Home	89	65.0	8036	96.1
Rehabilitation	23	16.7	80	1.0
Death	7	5.1	57	0.7
Transfer	9	6.5	112	1.3
Other	10	6.7	78	0.9

Trauma terrorisme / autres trauma
- Majorité multiples lésions
- Trauma pénétrants
- Plaies par balles
- ISS + élevé
- + de chir
- Jeune âge <8 ans = FDR de mortalité

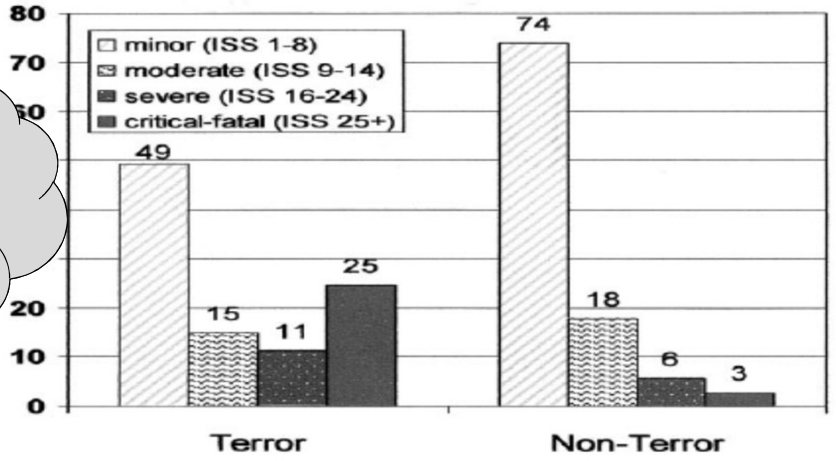
(atteintes cérébrale et respi)

Matos Pediatrics 2008

Décès évitables :
- 90,9 % = hémorragie externe
- 7,9 %obstruction des voies aériennes
- 1,1 % pneumothorax sous tension

Eastridge J Trauma Acute Care Surg. 2012

Lésions différentes aux trauma « habituels »





Terror Explosive Injuries

A Comparison of Children, Adolescents, and Adults

Annals of surgery 2010

Dena H. Jaffe, PhD, Kobi Peleg, PhD,*† and the Israel Trauma Group*

TABLE 1. Patient and Injury Descriptors for Hospitalized Victims of Terror Explosions by Age Group, Israel, October 1, 2000 to December 31, 2005

	Children (0–10 yr) N = 49%	Adolescents (11–15 yr) N = 65%	Adults (16–45 yr) N = 723%
Type of injury			
Blunt	61.2	47.7	48.7
Penetrating	55.1	69.2	65.3
Burn	18.4	13.8	14.7
AIS ≥3*†	52.1	40.0	46.1
ISS*			
Mild (1–8)	45.8	58.5	52.5
Moderate (9–14)	10.4	12.3	17.4
Severe (16–24)	27.1‡	13.8	11.7
Critical (25+)	16.7	15.4	18.4
Body region of injury			
TBI	34.7§	13.8	19.6
Other head and neck	51.0	55.4	55.6
Spine and back	2.0	4.6	4.4
Torso	42.9	32.3	43.7
Extremities	34.7‡	66.2	56.7
Multiple	46.9	52.3	50.1
Nature of injury			
Fracture	30.6	36.9	36.4
Internal injury	40.8	21.5§	33.5
Open wound	38.8‡	58.5	59.1
Contusion/superficial	30.6	50.8	38.7
Burn	18.4	13.8	15.2
System-wide injury	38.8	44.6	42.3
Other¶	8.2	15.4	19.1
No. injuries			
1	32.7	30.8	26.7
2	18.4	13.8	19.2
3	16.3	20.0	14.0
4+	32.7	35.4	40.1

TC



Évaluation initiale - TCCC		Évaluation initiale - ATLS	
M	MASSIVE BLEEDING CONTROL (Contrôle des hémorragies massives)	A	AIRWAY (Voies aériennes)
A	AIRWAY (Voies aériennes)	B	BREATHING (Respiration)
R	RESPIRATION	C	CIRCULATION (Système cardiovasculaire)
C	CIRCULATION (Choc)	D	DISABILITY (État neurologique)
H	HEAD/HYPOTHERMIA (Neuro/hypothermie)	E	EXPOSURE AND ENVIRONMENTAL CONTROL (Déshabiller le patient et prévenir l'hypothermie)
E	EVACUATION		

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ELSEVIER MASSON — SFAR Société Française d'Anesthésie et de Réanimation

Monothematic meeting of Sfar

The concept of damage control: Extending the paradigm in the prehospital setting☆,☆☆

Le concept de damage control *: extension préhospitalière du paradigme*

J.-P. Tourtier[a,*], B. Palmier[b], K. Tazarourte[c], M. Raux[d], E. Meaudre[b], S. Ausset[e], A. Sailliol[e], B. Vivien[f], L. Domanski[b], P. Carli[f]

Journal Européen des Urgences et de Réanimation (2017) 29, 89–90

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Disponible en ligne sur ScienceDirect www.sciencedirect.com
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ÉDITORIAL

Damage control resuscitation : pour les enfants aussi !☆

Damage control resuscitation: For children as well!

PEC pré-hospitalière rapide : gestes essentiels, évacuation rapide (risques liés au contexte)



Trauma crânien

- **Contrôle externe des hémorragies** : attention à la volémie, estimation pertes, utilisation de garrot tactiques > 8ans, pneumatiques < 8 ans
- **Réanimation à petit volume** 10-20 ml/kg max + vasopresseurs : attention posologie, NAD 0,1µg/kg/min, titration
- **Ac Tranexamique** : 15mg/kg en 10 min puis 10 mg/kg/8h (protocole adulte > 10ans)
- **Gestion des VAS :**
  - Si VS : oxygéothérapie
  - Libération : position, aspiration
  - IOT..
- **Prévention hypothermie**
- Analgésie minimum : morphine 25-50 µg/kg, kétamine 0,1-0,3 mg/kg

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Damage control Ground zero

- **Contrôle des saignements extériorisés**
- **Hypotension permissive sauf si TC**
- **Lutte contre l'hypothermie (rechauffement solutés, externe, environnement)**
- Mise en condition: abords vasculaires,,airways, oxygénothérapie
- Acide tranexamique IV
- Titration sedation/analgésie

Damage control ressuscitation

- Oxygénothérapie => ISR puis ventilation avec petit VT, ZEEP, FiO2 100%
- Renforcer la lutte contre l'hypothermie +++
- Contrôle de l'hémorragie puis hémostase interventionnelle
- Abord vasculaires: intra-osseux, veineux et artériel fémoraux, ou cave supérieur si clampage cave inférieur
- Perfusion de base et remplissage vasculaire: NaCl0,9%
- Groupe/RAI (sans attendre pour transfuser en O-)
- **Limiter les volumes perfusés avec hypotension permissive**
  - **PAM ≥40 mmHg jusqu'à 2 ans et ≥50 mmHg jusqu'à 10 ans en l'absence de neurotrauma**
  - **PAM ≥55 mmHg jusqu'à 2 ans et ≥65 mmHg jusqu'à 10 ans en cas de neurotrauma**
- **Introduction precoce Noradrénalineà dose titrée (0.1 à 5 mcg/kg/min)**
- **Activer le protocole de transfusion massive**
- Hemostatiques: acide tranexamique, calcémie, fibrinogène

Damage control surgery

- **Traitement chirurgical ne visant pas un rétablissement anatomique mais un rétablissement physiologique**
- Durée du geste chirurgical limitée
- Contre-indication de tout acte "non hémostatique"
- Réalisation du traitement chirurgical définitif après stabilisation des désordres physiologiques (H24-H36)

C Duracher AFAR/ACCM 2016

DAMAGE CONTRÔLE CHIRURGICAL < 60 min

	≤ 2 ans	> 2 ans (10ans)
Si Neurotrauma	PAM ≥ 55 mmHg	PAM ≥ 65 mmHg
Si absence de Neurotrauma	PAM ≥ 45 mmHg	PAM ≥ 55 mmHg



- Pas d'improvisation
  - Protocoles
  - Simulation
  - Organisation en fonction des capacités de chaque région
  - Mise en commun des compétences techniques et personnelles



CONCLUSION

- Nouveautés
  - Plus de littérature pédiatrique

=> amélioration de la prise en charge, qualité des soins donc qualité de vie de l'enfant polytraumatisé

Il faut qu'on travaille encore…. Tous ensemble!