Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTERE DES AFFAIRES SOCIALES, DE LA SANTE ET DES DROITS DES FEMMES

Direction générale de la santé

RETEX « attentats du 13/11/15 »

Techniques de prise en charge médicale des blessés par armes de guerre

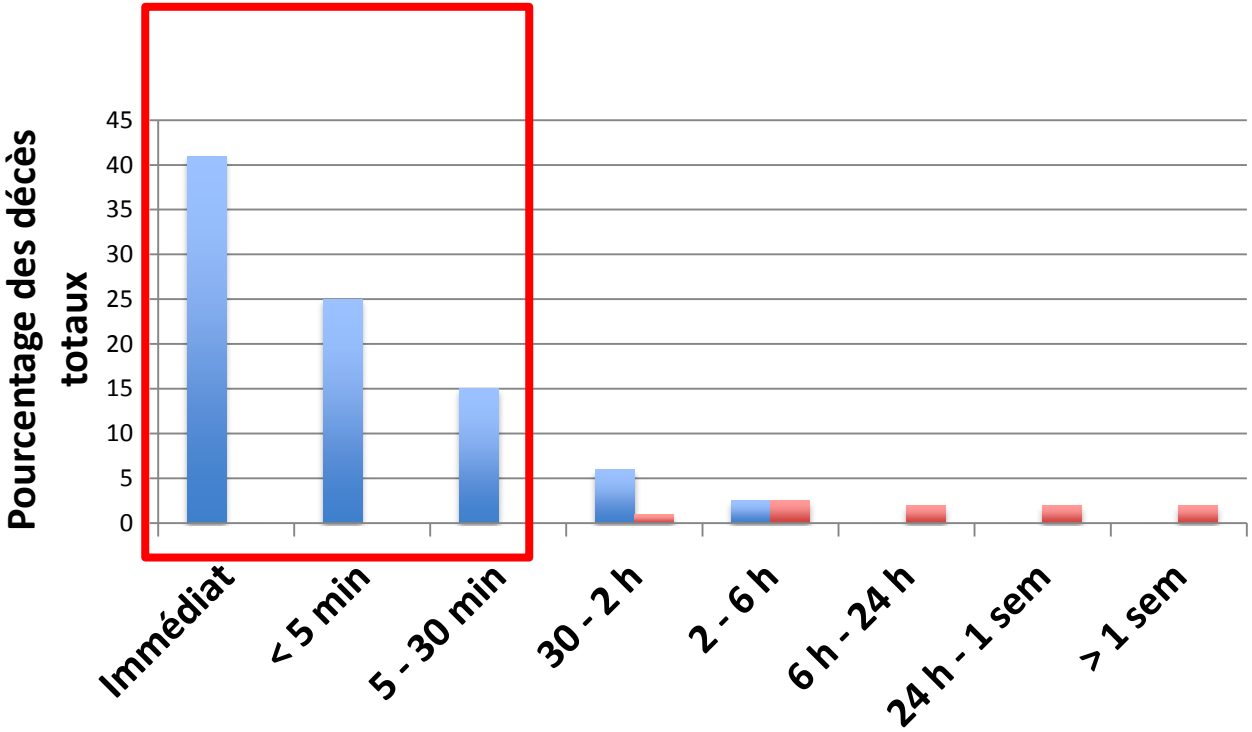
Dr Travers, Frattini, Ramdani, Boizat, Bignand,
Pr Jean-Pierre Tourtier
Ecole du Val-de-Grâce
Brigade de Sapeurs-Pompiers de Paris

BRIGADE DES SAPEURS POMPIERS DE PARIS

Service de Santé des Armées

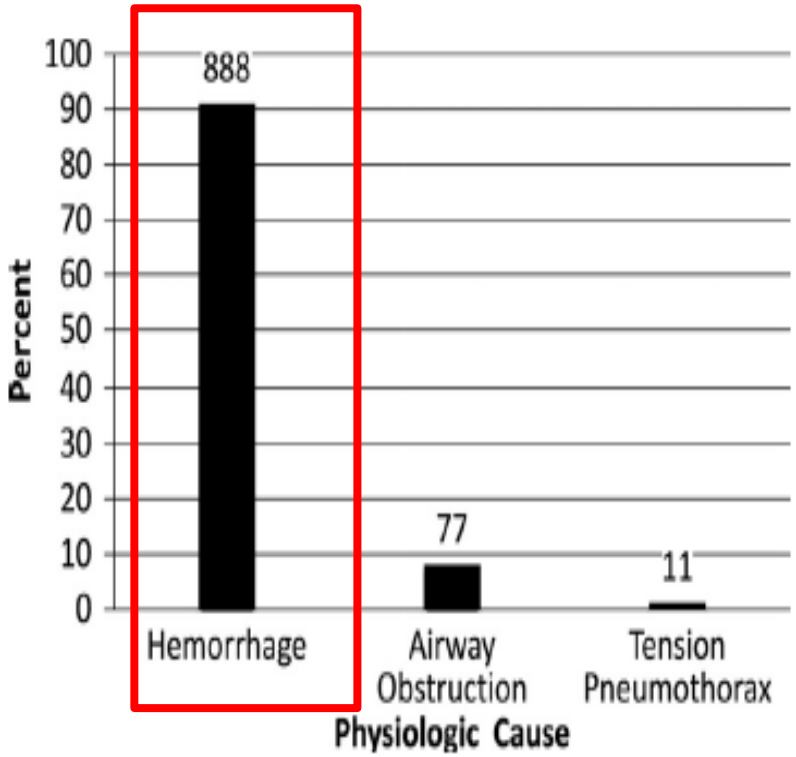
Evolution des modes d’action

Médecine de guerre : médecine préhospitalière



Bellamy RF. Combat Trauma Overview. Textbook of Military Medicine.

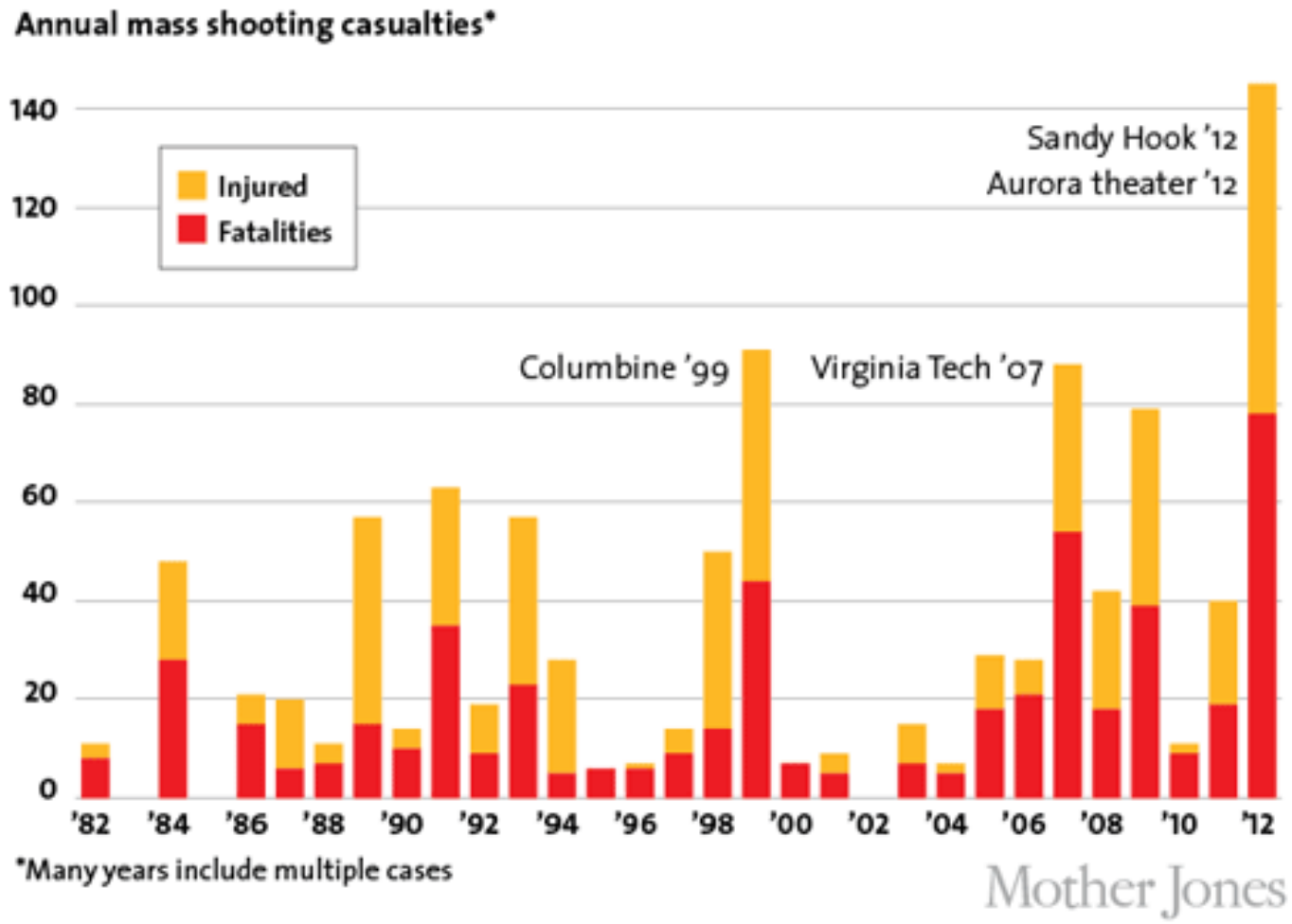
Morts évitables



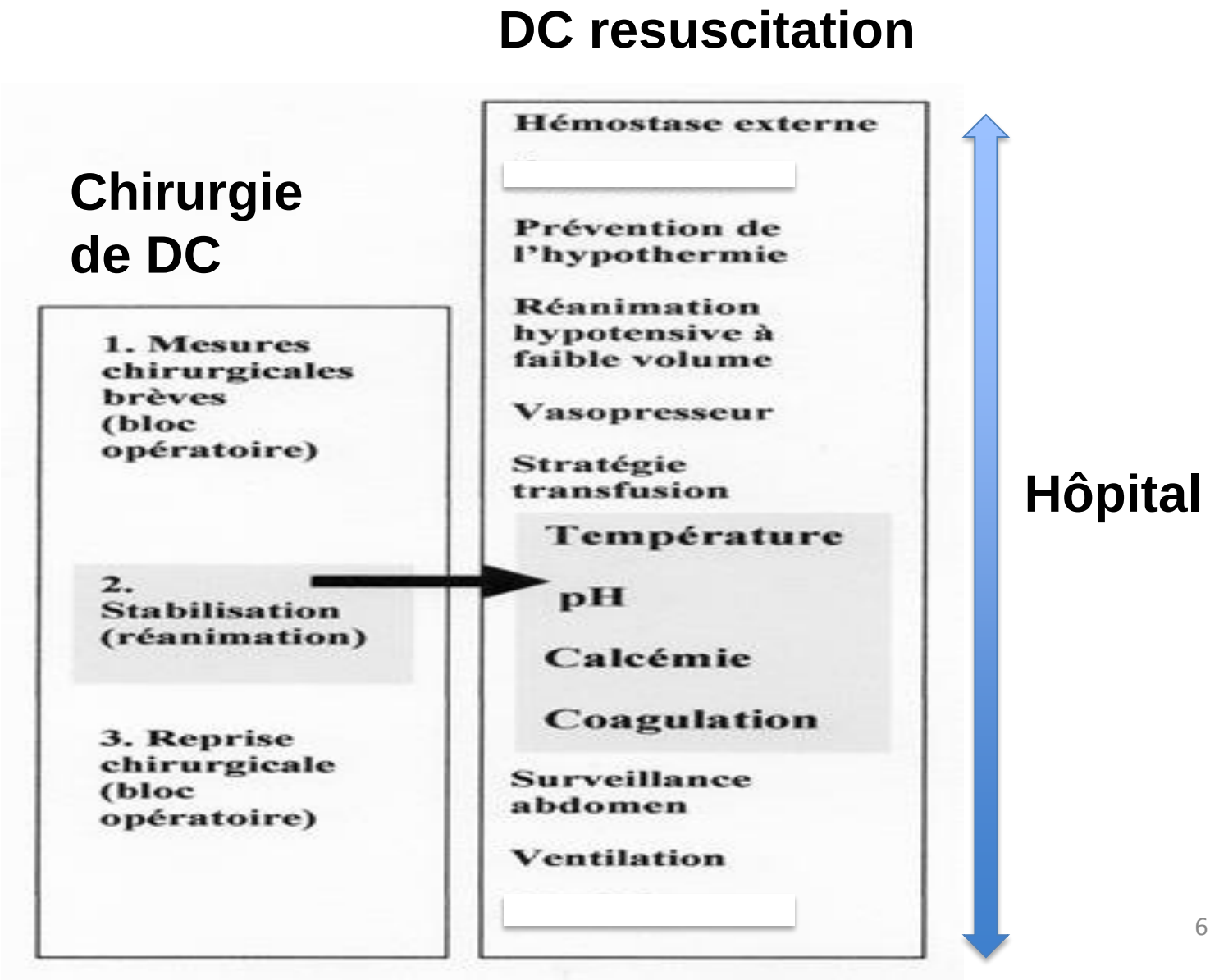
Eastridge et al. Death on the battlefield (2001-2011): Implications for the future of combat, J Trauma 2012

Gisement de progrès = préhospitalier

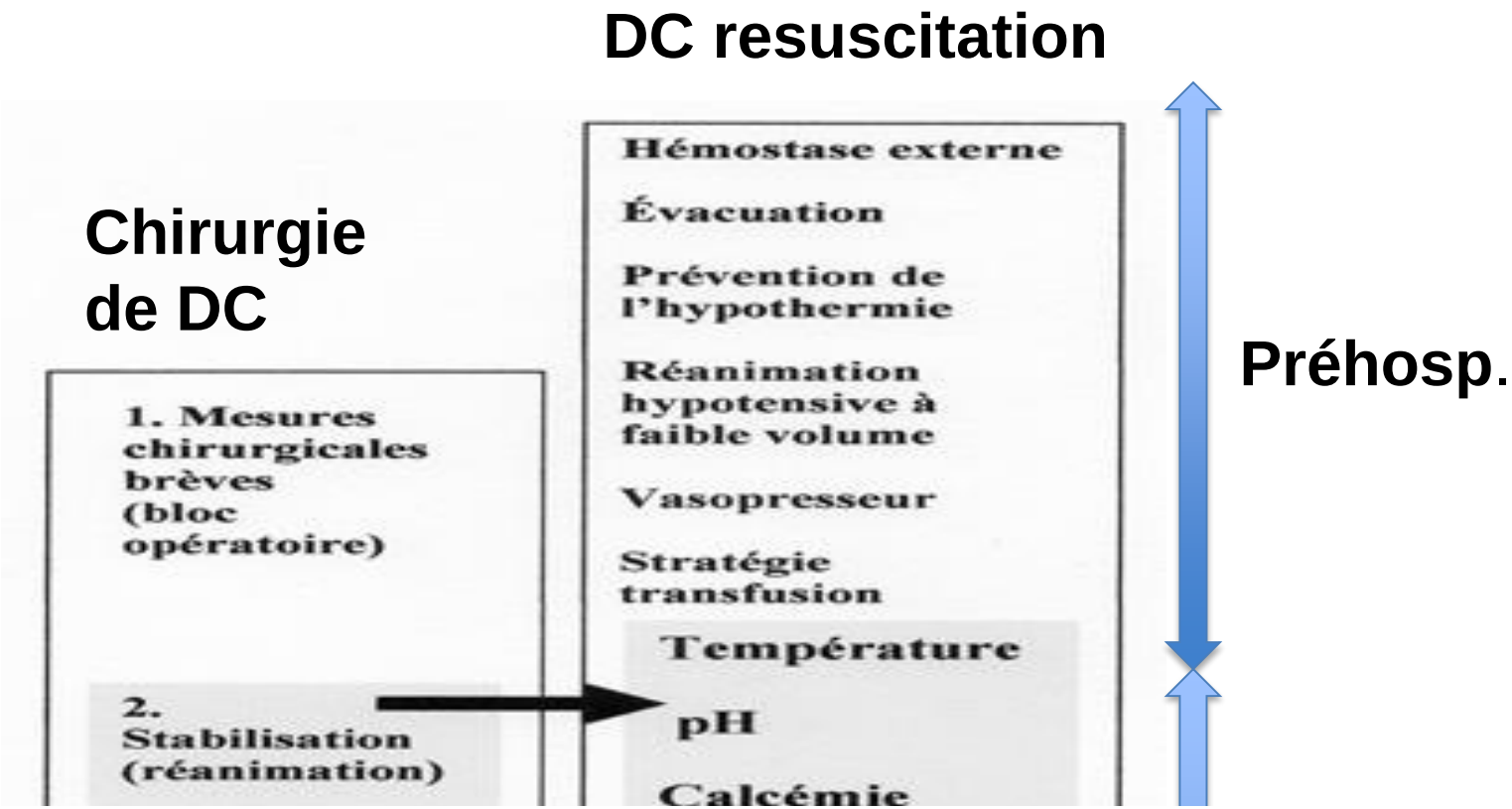
Spécificité des fusillades en milieu civil : une létalité importante



Principes de damage control



Principes de damage control



Ann Fr Anesth Reanim. 2013 Jul-Aug;32(7-8):520-6. doi: 10.1016/j.annfar.2013.07.012. Epub 2013 Jul 31.

The concept of damage control: extending the paradigm in the prehospital setting.

Tourtier JP[1], Palmier B, Tazarourte K, Raux M, Meaudre E, Ausset S, Sailliol A, Vivien B, Domanski L, Carli P.

1. Hémostase externe : garrot

2000

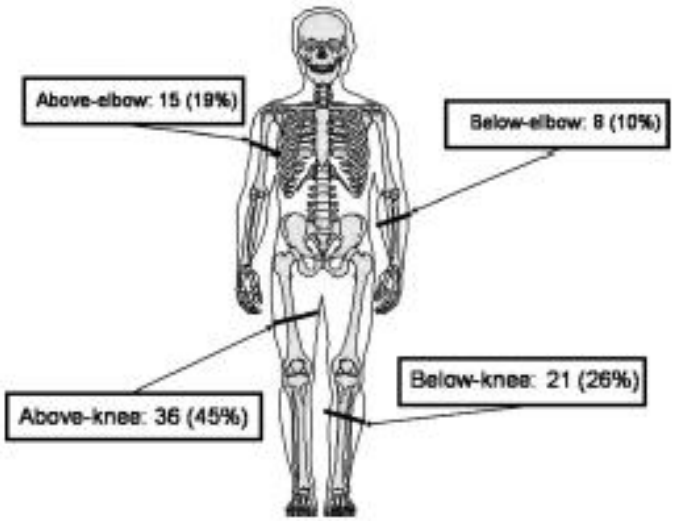
Evolutions techniques et conceptuelles

2010

Redécouverte du garrot

Irak, 2004. 31st Combat support hospital

Rétrospectif : 80 garrots sur 67 patients



57% des décès par hémorragie des membres auraient pu être évitées par un garrot + précoce

	Tourniquet (%)	No Tourniquet (%)	p^*
No bleeding on arrival	83.3	60.7	0.033
No bleeding on arrival (injuries requiring primary or debridement amputations)	92	50	0.058 (NS)
No bleeding on arrival (reconstructable vascular injuries)	69	60	0.456 (NS)
No bleeding on arrival (upper extremity injuries)	85	40	0.037
No bleeding on arrival (lower extremity injuries)	83	72	0.308 (NS)
No bleeding on arrival (ISS >15)	85	17	<0.0001

Beekley AC et all. J Trauma 2008

Efficacité du garrot

Irak, 2006

Prospectif: 232 patients, 309 plaies de membres, 428 garrots

Table 6 Effectiveness of Tourniquets by Limb Region

Body Region	Patients; N	Limb Regions; N	Tourniquets; N	Effective; N (%)	Ineffective; N (%)
Forearm	9	9	13	12 (92)	1 (8)
Arm	62	71	97	79 (81)	18 (19)
Leg	22	27	32	32 (100)	0 (0)
Thigh cuisse	162	205	285	209 (73)	76 (27)

* Patients had 1–4 limbs injured with 1–4 tourniquets used per limb; 3 patients had tourniquets on their ipsilateral thigh and leg. There were 8 limbs with unknown tourniquet effectiveness.

Kragh JF et al, J Trauma 2008

Choix du type de Garrot

Table 5 Tourniquet Device Counts, Effectiveness, and Morbidity

Tourniquet Name	Patients; N*	Devices; N*	Limbs; N*	Effective; N (%)	Ineffective (%)	Morbidity; N*(%)	Back-Up (%)
CAT	156	210	202	166 (79)	44 (21)	43 (21)	5
EMT	91	115	115	106 (92)	9 (8)	9 (8)	0
SOFT	50	62	61	41 (66)	21(34)	20 (33)	2
SATS	2	2	2	0 (0)	2 (100)	2 (100)	0
RMT	2	2	2	0 (0)	2 (100)	2 (100)	0
London bridge	1	1	1	1 (100)	0 (0)	1 (100)	0
Improvised	15	16	15	4 (25)	12 (75)	12 (80)	17
Unknown	14	19	17	14 (74)	5 (26)	3 (18)	0

Kragh JF et al, J Trauma 2008

Utilisation du Garrot : formation des personnels

Israël 1997-2001
Rétrospectif . 110 garrots posés sur 91 patients
Délai de pose : < 15 min dans 88% des cas : formation

Table 4 Data on Tourniquets Used by Different Medical Care Providers

	Physicians (%)	Medics (%)	Soldiers		Total (%)
			Fellow Soldier (%)	Self-Application (%)	
Indicated	8 (44.4)	41 (55.4)	6 (40.0)	3 (100)	58 (53)
Nonindicated	10 (55.6)	33 (44.6)	9 (60.0)	0 (0)	52 (47)
Effective	15 (83.3)	58 (78.4)	11 (73.3)	2 (66.7)	86 (78)
Noneffective	3 (16.7)	16 (21.6)	4 (26.7)	1 (33.3)	24 (22)
Total	18	74	15	3	110 (100)

Lakstein et al, J Trauma 2003

Quand poser le garrot ?

Irak 2006-2007

499 patients et 862 garrots posés sur le terrain ou en structure chirurgicale

13 nationalités

Survie 90% si pose du garrot avant le choc et 18% si posé après le choc

Table 6. Shock, Survival, and Setting Results from 2-by-2 Contingency Testing

Given shock presence, prehospital vs. ED use was not associated with survival	$p = 1.0$
Given shock absence, prehospital vs. ED use was not associated with survival	$p = 0.5$
Given survivors, prehospital vs. ED use was associated with shock (absent vs. present)	$p < 0.001$
Given non-survivors, prehospital vs. ED use was associated with shock (absent vs. present)	$p < 0.001$
Given prehospital use, shock (absent vs. present) was associated with survival	$p < 0.001$
Given ED use, shock (absent vs. present) was associated with survival	$p < 0.001$
Prehospital vs. ED use was associated with survival without considering shock	$p = 0.015$
Shock (absent vs. present) was associated with prehospital vs. ED use without considering survival	$p < 0.001$
Shock (absent vs. present) was associated with survival without considering prehospital vs. ED use	$p < 0.001$

ED = emergency department.

Kragh JF et al. J Emerg Med 2011

Utilisation du garrot : complications

- **Beekley J Trauma 2008 / US**
  80 garrots, temps moyen 70 minutes
  Pas de complication

- **Lakstein J Trauma 2003 / Israël**
  91 garrots
  5, 5% de complications neuro (tous pour durée entre 109 et 180 min) / Pas d'amputation

- **Kragh JF J Trauma 2008 / US**
  428 garrots, temps moyen 80 min
  1,7 % de troubles neurologiques transitoires
  Pas d'amputation, de défaillance rénale, de complication neuro mais augmentation fasciotomie (38 vs 28%) si temps > 120min

Garrot : enseignements

ELSEVIER SAUNDERS

SURGICAL CLINICS OF NORTH AMERICA

Surg Clin N Am 87 (2007) 157–184

Lessons Learned from Modern Military Surgery

Alec C. Beekley, MD*, Benjamin W. Starnes, MD, James A. Sebesta, MD

US Army Medical Corps, Madigan Army Medical Center, 9040 Fitzsimmons Avenue, Fort Lewis, WA 98431, USA

- Objectif = arrêt du saignement et disparition du pouls
- Mise en place AVANT état de choc
- Sous le feu = à la racine du membre
- Sinon : 1 main au dessus de ce qui saigne
- Si possible apparent
- Efficace y compris jambe et avant bras …
- Réévaluation médicale systématique
- Possibilité de cumuler les garrots
- Attention à la récidive de saignement
    - lors du remplissage …
    - sous les couvertures ou les pansements …

Pansements hémostatiques : utilisation clinique

- **Expérience militaire**

  Irak, Afghanistan, Gazah

The Journal of TRAUMA® *Injury, Infection, and Critical Care*

QuikClot Use in Trauma for Hemorrhage Control: Case Series of 103 Documented Uses

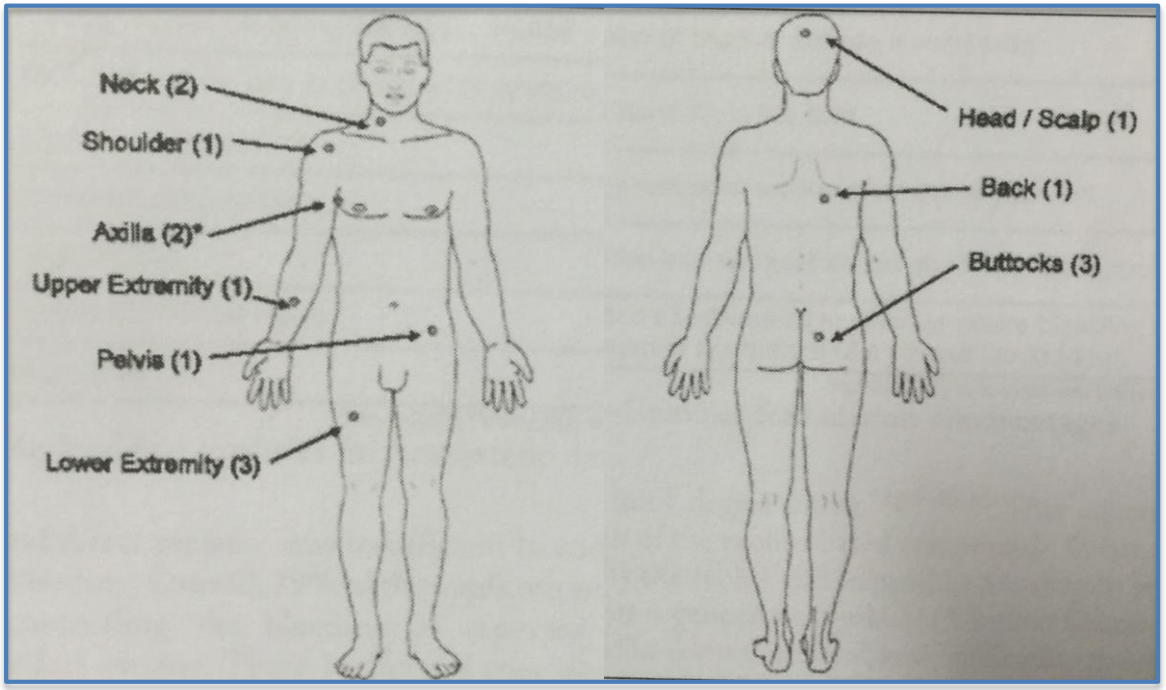
Peter Rhee, MD, MPH, Carlos Brown, MD, Matthew Martin, MD, Ali Salim, MD, Dave Plurad, MD, Donald Green, MD, Lowell Chambers, MD, Demetrios Demetriades, MD, PhD, George Velmahos, MD, and Hassan Alam, MD

Table 3 Effectiveness by Mechanism

Mechanism	Reported Efficacy for Hemorrhage Control
Blunt trauma	6/8
Blast (artillery, rockets, improvised explosive devices)	21/22
Penetrating	
Stab wound	3/5
Gunshot wounds	65/68

Pansements hémostatiques : utilisation clinique

Israël, Gaza 2009
14 utilisations de QuilClot Combat Gauze
Efficace 11/14 ; pas d'effets secondaires



Yuval Ran et al. Prehosp and Disaster Medicine 2010

BSPP : 30 utilisations 2011-2014 :

Hemostatic dressings in civil prehospital practice: 30 uses of QuikClot Combat Gauze.

Travers S, Lefort H, Ramdani E, Lemoine S, Jost D, Bignand M, Tourtier JP.

Eur J Emerg Med. 2015 Sep 8. [Epub ahead of print]

- Arme à feu 15/30
- Saignement artériel 19/30

- Utilisations après échec autres techniques (26/30) et/ou sur zone inaccessible au garrot (14/30)

Arrêt complet du saignement : 22/30
Diminution du saignement : 6/30
Echec : 2/30

- 3 retraits garrots possibles après pose du pansement Quicklot gauze

Pansements hémostatiques : en pratique

ELSEVIER SAUNDERS

SURGICAL CLINICS OF NORTH AMERICA

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- **Très faible niveau de preuve**
  (études animales, cas cliniques ou séries non comparatives…)
- **Mais importante expérience militaire depuis plus de 10 ans**
- **Plusieurs modèles disponibles**
- **Importance de la forme / Rôle du packing**
- **Nécessite 5 minutes de compression**

2. Contrôle précoce de l'hypothermie

Chaque degré perdu ampute de 10% les fonctions d'hémostase

- Impact sur la survie significatif dès T < 35-36° C

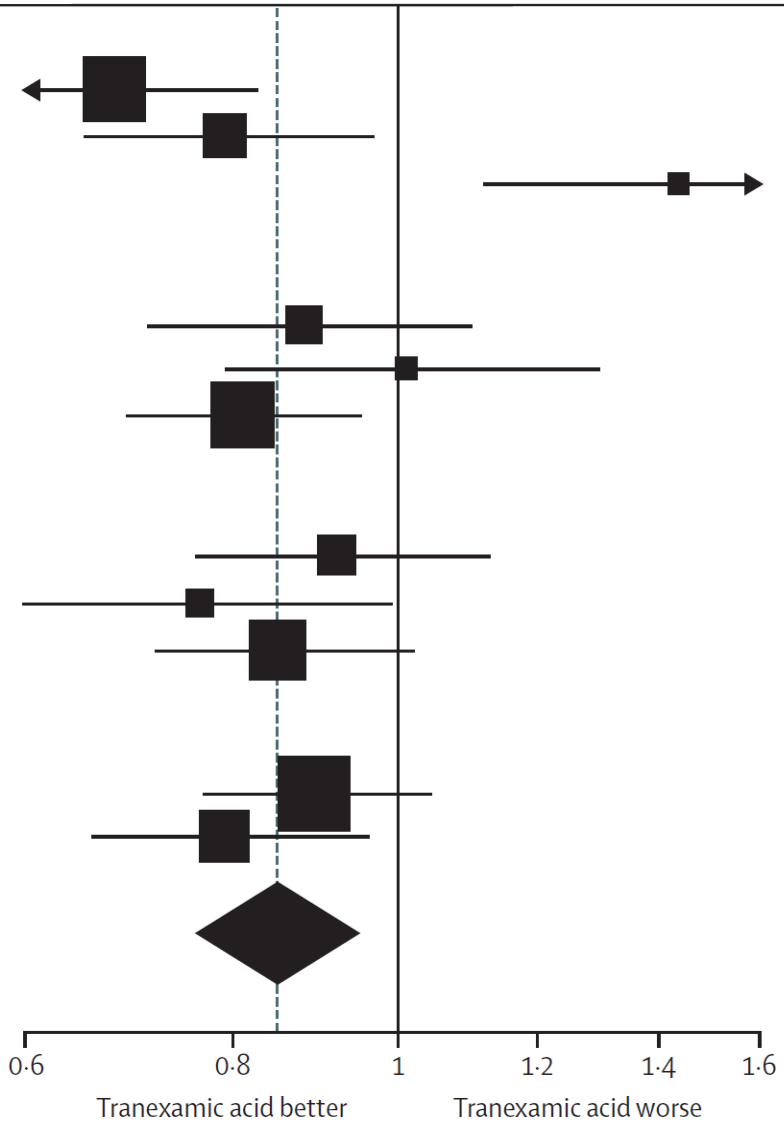
- Pas ou peu de survivants si T< 32-34° C

Rotondo et al. J Trauma 1993
Johnson et al. J Trauma 2001
Sessler. Anesthesiology 2001
Vincent et al. Crit Care 2006
Inaba et al. Wold J Surg 2009
Arthurs et al. Am J Surg 2006

3. Acide tranéxamique

Lancet 2011

	Tranexamic acid allocated	Placebo allocated	Risk ratio (95% CI)
Time to treatment (h)			
≤1	198/3747 (5·3%)	286/3704 (7·7%)	0·68 (0·57–0·82)
>1–3	147/3037 (4·8%)	184/2996 (6·1%)	0·79 (0·64–0·97)
>3	144/3272 (4·4%)	103/3362 (3·1%)	1·44 (1·12–1·84)
χ^2=23·516; p<0·0000			
Systolic blood pressure (mm Hg)			
>89	146/6878 (2·1%)	163/6761 (2·4%)	0·88 (0·71–1·10)
76–89	110/1609 (6·8%)	114/1689 (6·7%)	1·01 (0·79–1·30)
≤75	233/1562 (14·9%)	295/1599 (18·4%)	0·81 (0·69–0·95)
χ^2=2·235; p=0·33			
Glasgow coma score			
Severe (3–8)	168/1789 (9·4%)	186/1830 (10·2%)	0·92 (0·76–1·13)
Moderate (9–12)	93/1349 (6·9%)	121/1344 (9·0%)	0·77 (0·59–0·99)
Mild (13–15)	228/6915 (3·3%)	265/6877 (3·8%)	0·86 (0·72–1·02)
χ^2=1·275; p=0·53			
Type of injury			
Blunt	308/6788 (4·5%)	347/6817 (5·1%)	0·89 (0·77–1·04)
Penetrating	181/3272 (5·5%)	227/3250 (7·0%)	0·79 (0·66–0·96)
χ^2=0·923; p=0·34			
All deaths	**489/10 060 (4·9%)**	**574/10 067 (5·7%)**	**0·85 (0·76–0·96)**
Two-sided p=0·0077			



4. Hémodynamique Lancet 2011

Maintenir un Ta02 minimal

- Hypotension artérielle permissive
  - PAM 60 mmhg ou 50 mmHg **Morrison C J Trauma 2011**
- Remplissage vasculaire modéré et adapté...**Mapstone 2003**

  cristalloides

- Introduction **précoce** de catécholamines associée à un remplissage vasculaire : noradrénaline

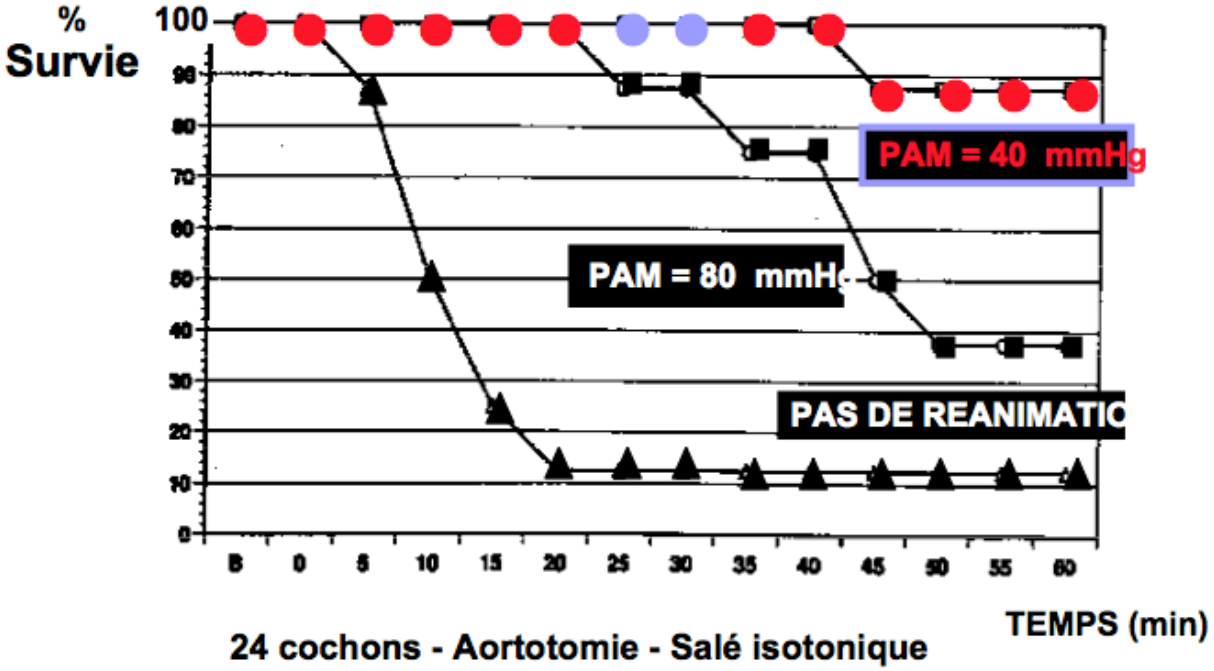
  Poloujadoff MP,Anesthesiology 2007

Ann Fr Anesth Reanim. 2013 Jul-Aug;32(7-8):520-6. doi: 10.1016/j.annfar.2013.07.012. Epub 2013 Jul 31.

The concept of damage control: extending the paradigm in the prehospital setting.

Tourtier JP[1], Palmier B, Tazarourte K, Raux M, Meaudre E, Ausset S, Sailliol A, Vivien B, Domanski L, Carli P.

Réanimation « à petit volume»



Kowalenko et al. J Trauma 2012

Blood Pressure at which Rebleeding Occurs after Resuscitation in Swine with Aortic Injury

Jill L. Sondeen, PhD, Valerie G. Coppes, BS, and John B. Holcomb MD,

J Trauma 2003 62 cochons

Punch size (mm)	All pigs including non resuscitated		No NE	
	Hem. Vol. (ml/kg)	n	Rebleed MAP (mmHg)	n
1.5	10.5 ± 1.1*	14	62 ± 5	9
2.0	16.6 ± 0.8	38	66 ± 3	20
2.8	19.3 ± 1.4	10	61 ± 5	9

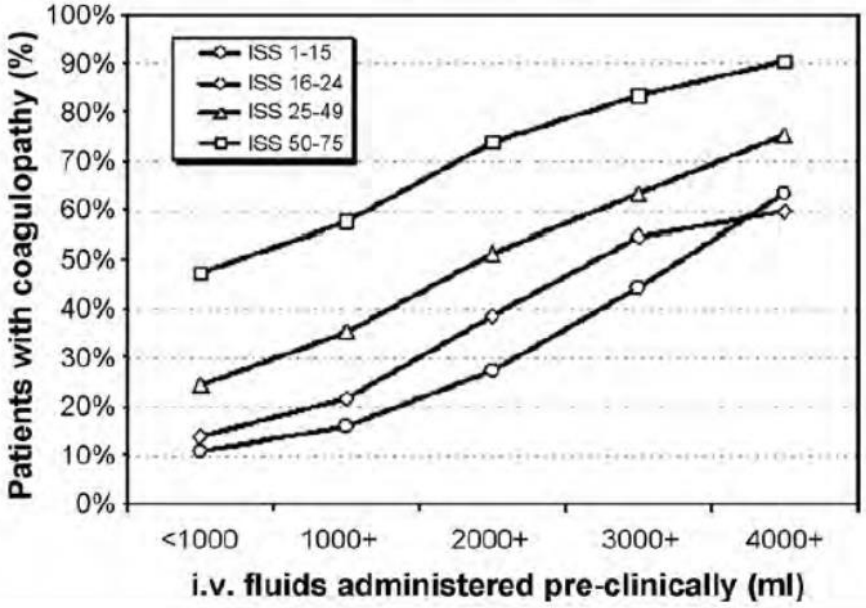
D’après le Pr Tazarourte

Remplissage et coagulopathie

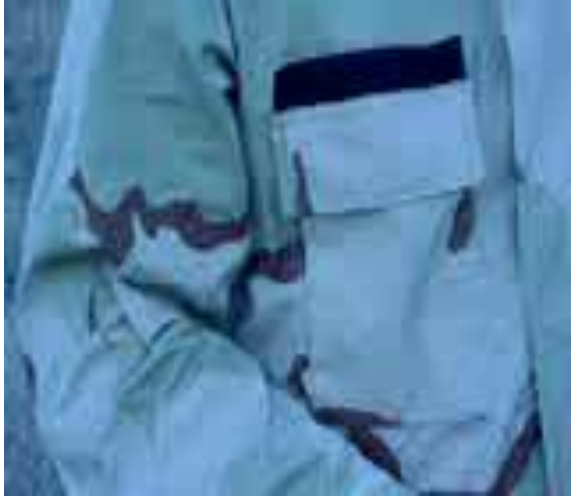
REMPLISSAGE VASCULAIRE

Early coagulopathy in multiple injury: An analysis from the German Trauma Registry on 8724 patients Injury, Int. J. Care Injured (2007) 38, 298–304

Marc Maegele [a,*], Rolf Lefering [b], Nedim Yucel [a], Thorsten Tjardes [a],



Blessé de guerre : Est-ce que ça marche ?



- Hémorragie de membre
  - Avant garrot tactique: 23,3 morts /an
  - Après garrot tactique: 3,5 morts /an

Eastridge BJ, J Trauma 2012

Lethality of War Wounds among U.S. Soldiers.*

War	No. Wounded or Killed in Action	No. Killed in Action	Lethality of War Wounds %
Revolutionary War, 1775–1783	10,623	4,435	42
War of 1812, 1812–1815	6,765	2,260	33
Mexican War, 1846–1848	5,885	1,733	29
Civil War (Union Force), 1861–1865	422,295	140,414	33
Spanish-American War, 1898	2,047	385	19
World War I, 1917–1918	257,404	53,402	21
World War II, 1941–1945	963,403	291,557	30
Korean War, 1950–1953	137,025	33,741	25
Vietnam War, 1961–1973	200,727	47,424	24
Persian Gulf War, 1990–1991	614	147	24
War in Iraq and Afghanistan, 2001–present	10,369	1,004	10

* Data are from the Department of Defense.[1,3]

Gawande A, NEJM 2004

Conclusion

DC resuscitation

Chirurgie de DC

1. Mesures chirurgicales brèves (bloc opératoire)
2. Stabilisation (réanimation)
3. Reprise chirurgicale (bloc opératoire)

Hémostase externe

Évacuation

Prévention de l'hypothermie

Réanimation hypotensive à faible volume

Vasopresseur

Stratégie transfusion

Température

pH

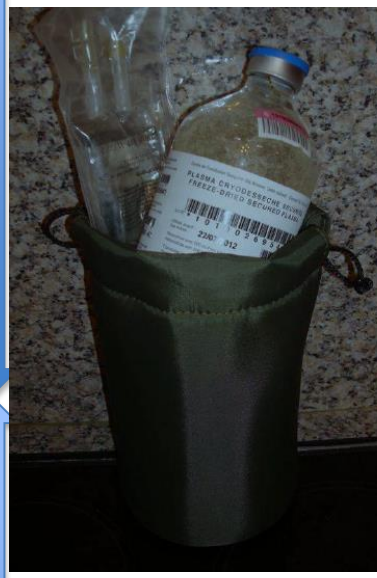
Calcémie

Coagulation

Surveillance abdomen

Ventilation

Préhosp.



Hôpital