Choc hémorragique :

Prise en charge en 2014

PY Cordier

Service de Réanimation

HIA Laveran - Marseille

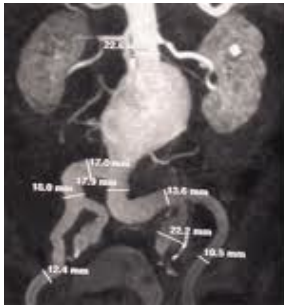
Avril 2014

Tableaux cliniques

Traumatologie

Gynéco-obstétrique

Digestif



Vasculaire

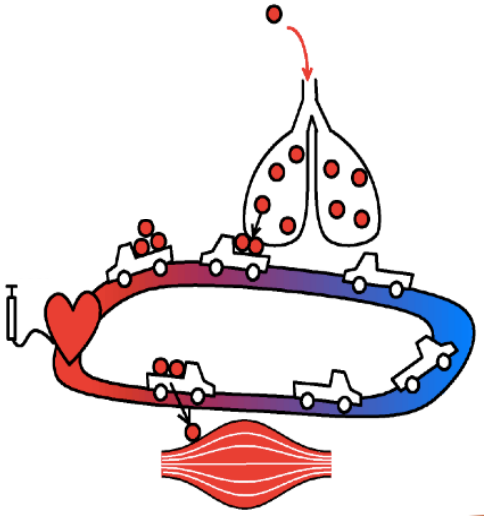
Post-opératoire

Accidents des AC

Définition

Hypoperfusion tissulaire, incapacité à satisfaire la **demande tissulaire en oxygène**

… par diminution du **volume sanguin circulant,** liée à une hémorragie



$$TaO_2 = Qc \times CaO_2$$

$$VES \times FC \times (SaO_2 \times Hb \times 1{,}39 + PaO_2 \times 0{,}0031)$$

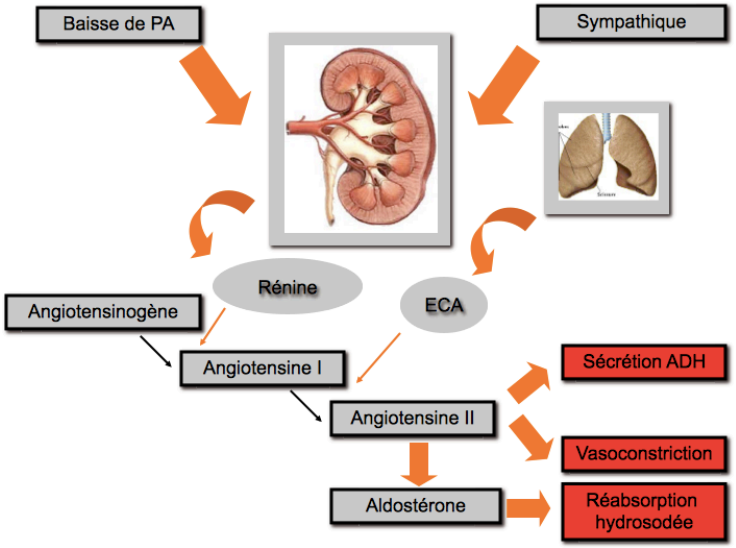
Physiopathologie

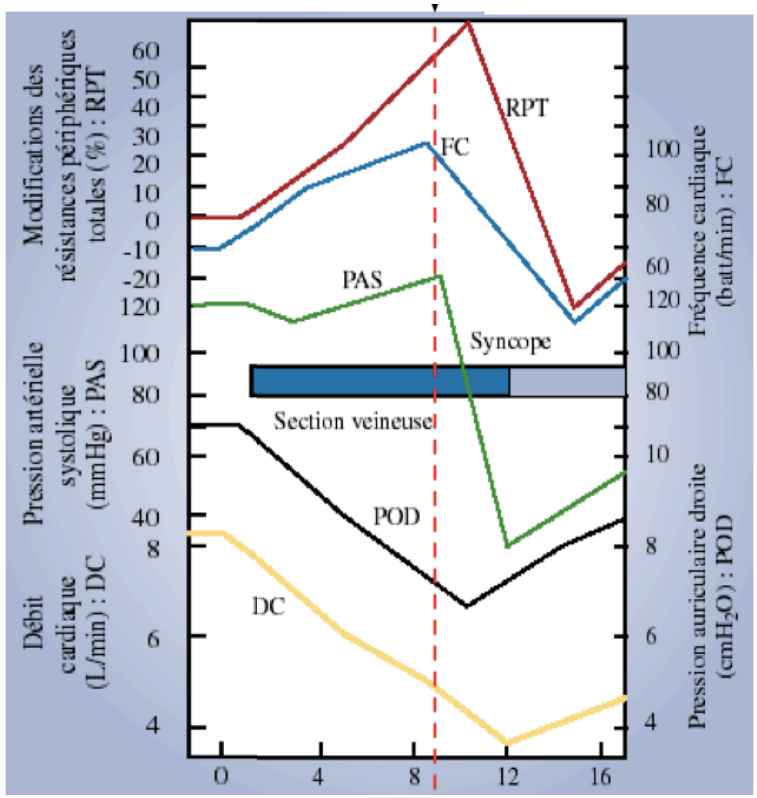
Classification de l'Advanced Trauma Life Support

	Class			
Parameter	I	II	III	IV
Blood loss (ml)	<750	750–1500	1500–2000	>2000
Blood loss (%)	<15%	15–30%	30–40%	>40%
Pulse rate (beats/min)	<100	>100	>120	>140
Blood pressure	Normal	Decreased	Decreased	Decreased
Respiratory rate (breaths/min)	14–20	20–30	30–40	>35
Urine output (ml/hour)	>30	20–30	5–15	Negligible
CNS symptoms	Normal	Anxious	Confused	Lethargic

Physiopathologie

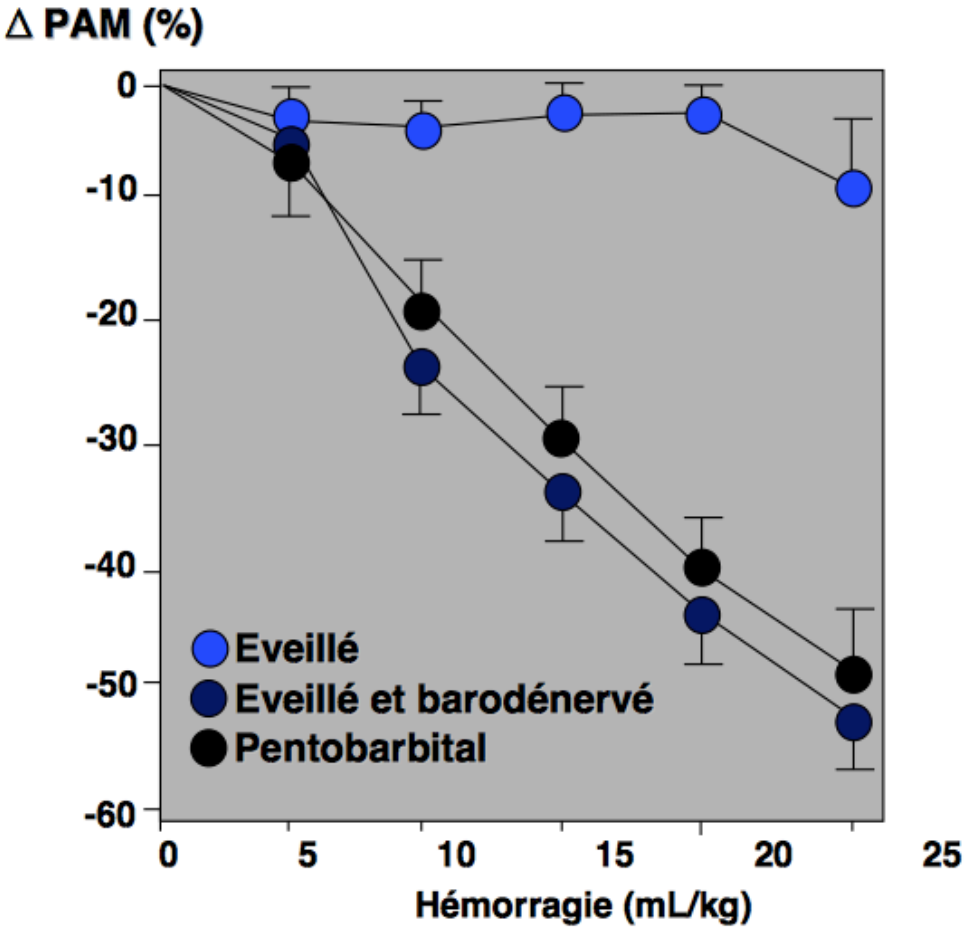
Mécanismes de compensation





Barcroft, et al. Lancet 1944

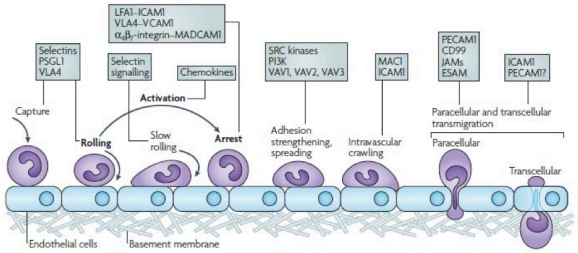
Physiopathologie



WATNER, et al. NEJM. 1975.

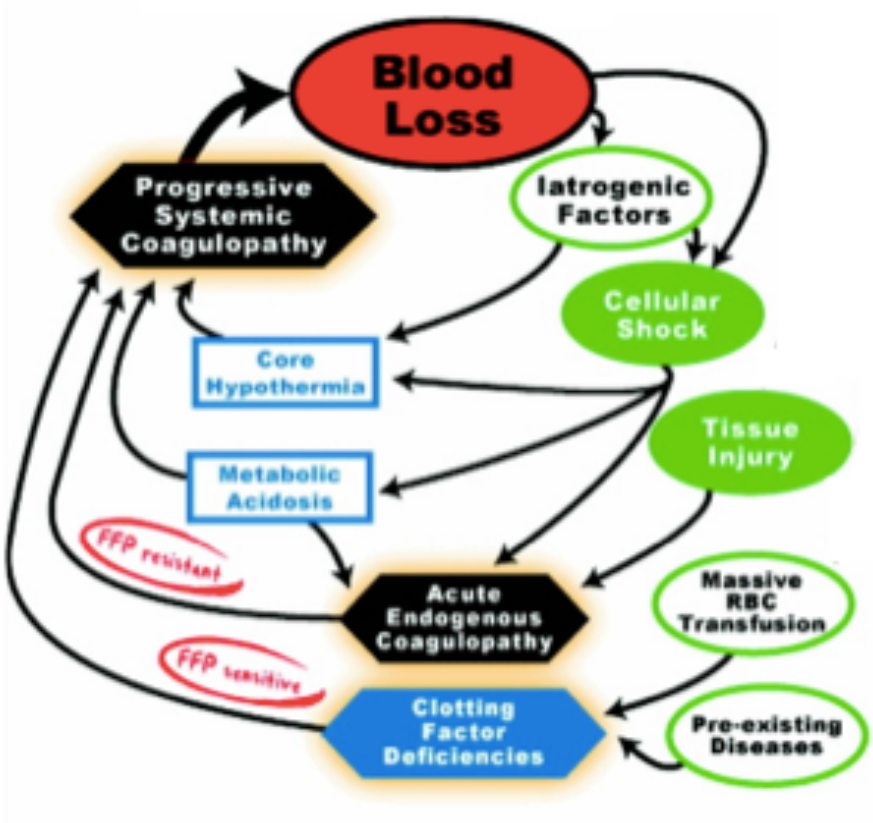
Physiopathologie

Défaillance microcirculatoire



- Adhésion leucocytaire
- Dysfonction de l'endothélium
- **Réponse pro-inflammatoire**
- Perméabilité microvasculaire
- **Ischémie-reperfusion**

Triade létale



« the lethal triad of

hypothermia, acidosis and coagulopathy

is associated with a

significant increase in mortality »

Damage Control Resuscitation

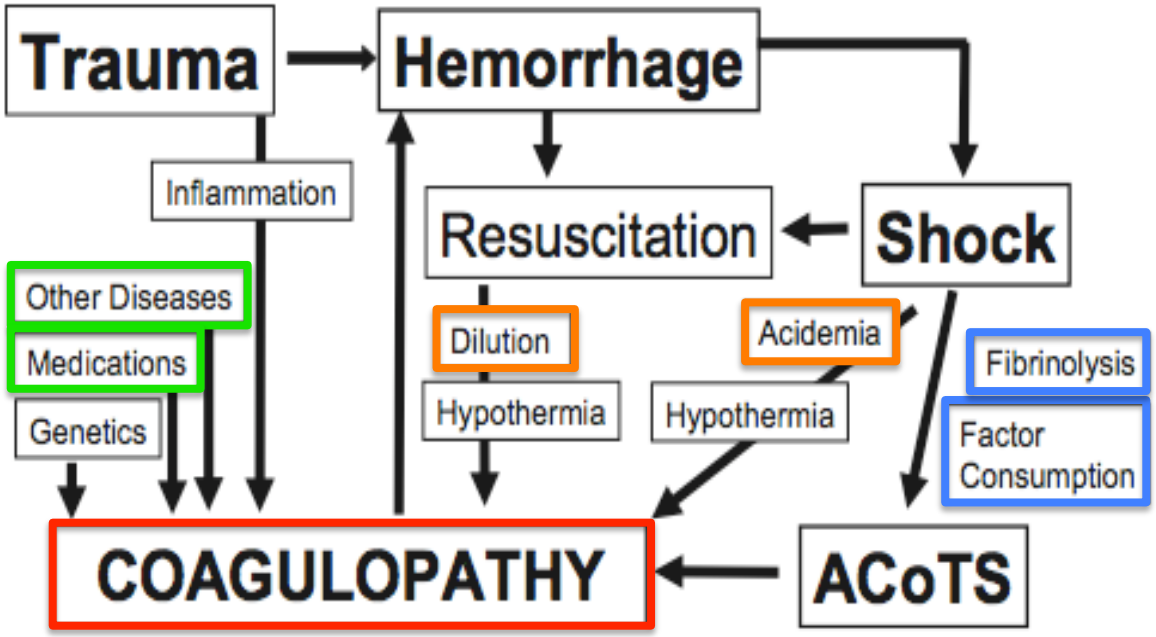
Holcomb, et al. Journal of Trauma. 2007

Coagulopathie

Review Article

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

The Coagulopathy of Trauma: A Review of Mechanisms



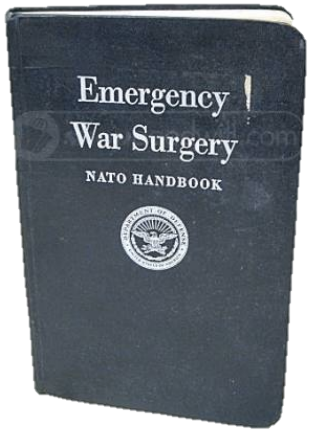
Hess, et al. Journal of Trauma 2008

Damage control

« The capacity of a ship to absorb damage and maintain mission integrity»

Surface Ship Survivability.
Naval War Publication 3–20.31. Washington, DC: Department of Defense; 1996.

Damage control



« The goal of **damage control** is to restore **normal physiology** rather than **normal anatomy** »

NATO Handbook war surgery

Damage control : historique

1908 : description du packing hépatique

Notes on the arrest of hepatic hemorrhage due to trauma.

Pringle, et al. Ann Surg. 1908.

1983 : laparotomie écourtée

Management of the major coagulopathy with onset during laparotomy.

Stone, et al. Ann Surg. 1983.

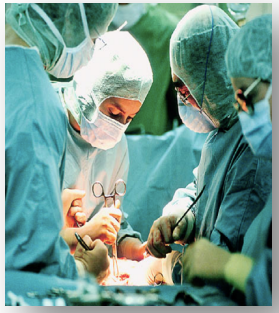
1993 : damage control et second look chirurgical planifié

Damage control: an approach for improved survival in exsanguinating penetrating abdominal injury.

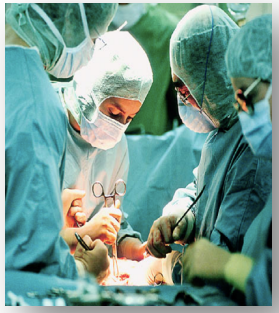
Rotondo M, et al. J Trauma. 1993.

Damage control

Vision actuelle



Damage Control Surgery



Second look chirurgical

Damage Control Ground Zero

Damage Control Resuscitation

Damage Control Hématologique

Pour quels patients ?

Indications individuelles

Pour tout **patient hémorragique instable :**

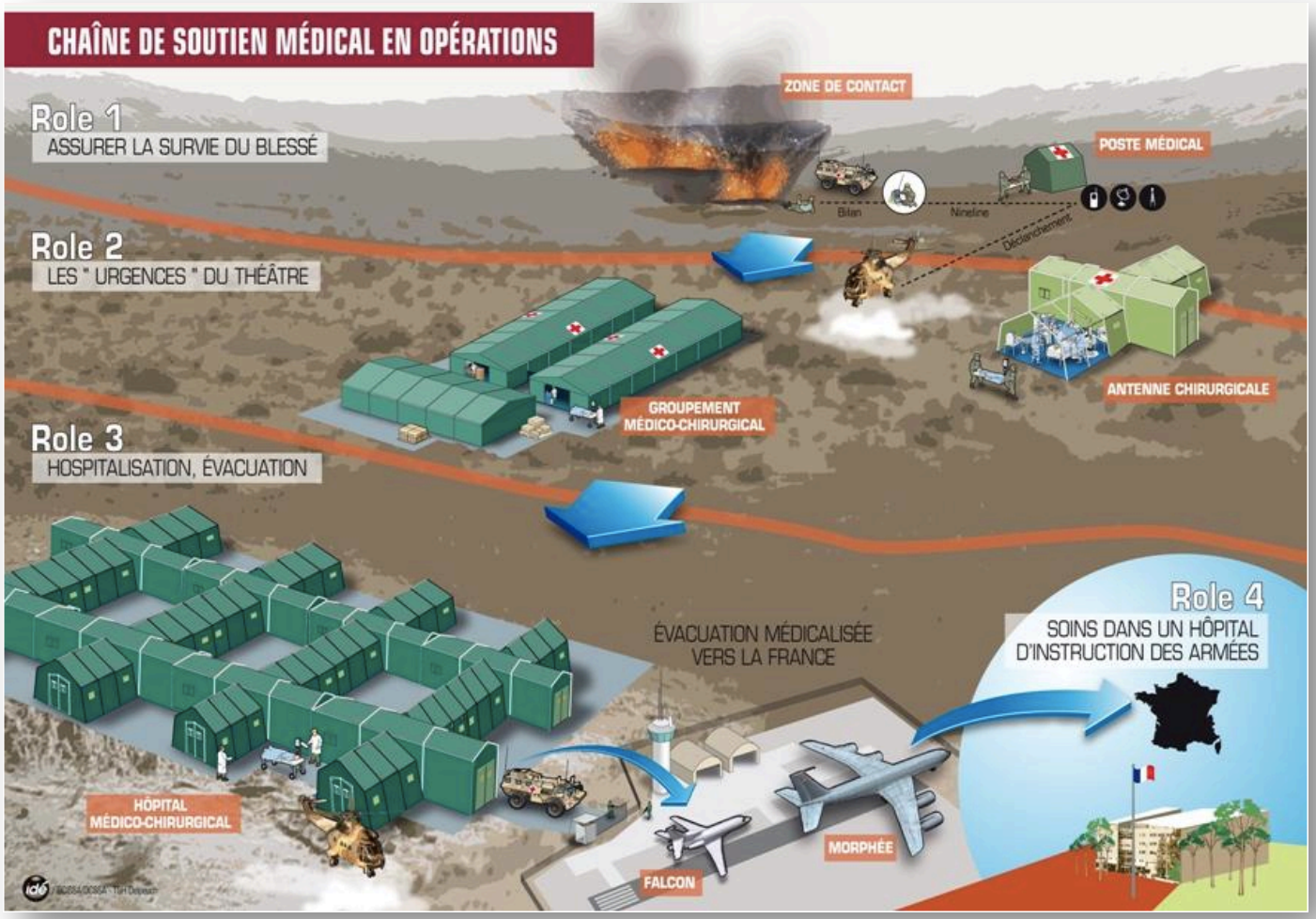
Coagulopathie clinique ou TCA > 2 fois le temps du témoin
Hypothermie < 35 °C
Acidose : pH < 7,20 ou déficit de base > 14
État de choc non contrôlé en moins d'une heure
Transfusion > 10 CGR, remplissage > 10 L, ou hémorragie > 4 L
Plaies veineuses inaccessibles à l'hémostase chirurgicale
Nécessité de traiter une lésion extra-abdominale engageant le pronostic vital
Technique chirurgicale complexe ou de longue durée (> 90 min) sur un patient grave (ISS > 25) répondant mal à la réanimation
Chirurgie non réalisable en un temps, impossibilité de fermer les fascias
Syndrome du compartiment abdominal

Reliable variables in the exsanguinated patient which indicate damage control and predict outcome.

Asensio, et al. Am J Surg. 2001.

Pour quels patients ?

Indications organisationnelles



Pour quels patients ?

Indications collectives

Triage en situation d'afflux saturant :

« faire le mieux pour le plus grand nombre avec le moins de consommation des ressources »

Damage Control Ground Zero

Contrôle des saignements extériorisés

- Le plus **rapidement** possible
- Par tous les moyens !

Damage Control Ground Zero

Garrot

Etude prospective sur 12 mois :

- 499 patients - 862 garrots – 651 membres
- Complication neurologiques transitoires : 1,6%
- Amputations de membres : 0,4%

Table 5. Survival Rates by Prehospital vs. ED Tourniquet Use and Shock Present vs. Absent at the Time of Application

	Shock Absent	Shock Present
Hospital		
Prehospital	90%	20%
Emergency department	93%	23%

Battle casualty survival with emergency tourniquet use to stop limb bleeding

Kragh, et al. Journal of Emergency Medicine 2011

Damage Control Ground Zero

Mise en condition de survie

- **Accès vasculaires**
- Gestes de survie
- Sécurisation des **voies aériennes**
- Oxygénothérapie
- Evaluation complète et protocolisée
- Lutte contre l’hypothermie

Damage Control Resuscitation

Hypotension permissive

- **Objectifs tensionnels modérés** jusqu'au contrôle du saignement

  (PAS 80-90 mmHg ou PAM 80mmHg si traumatisme crânien)

- Réanimation **à faible volume**

IMMEDIATE VERSUS DELAYED FLUID RESUSCITATION FOR HYPOTENSIVE PATIENTS WITH PENETRATING TORSO INJURIES

Variable	Immediate Resuscitation	Delayed Resuscitation	P Value
Survival to discharge — no. of patients/total patients (%)	193/309 (62)*	203/289 (70)†	0.04
Estimated intraoperative blood loss — ml‡	3127±4937	2555±3546	0.11
Length of hospital stay — days§	14±24	11±19	0.006
Length of ICU stay — days§	8±16	7±11	0.30

Bickell, et al. NEJM 1994

Damage Control Resuscitation

Solutés de remplissage

THE COCHRANE COLLABORATION®

Comparison 1. Colloid versus crystalloid (add-on colloid)

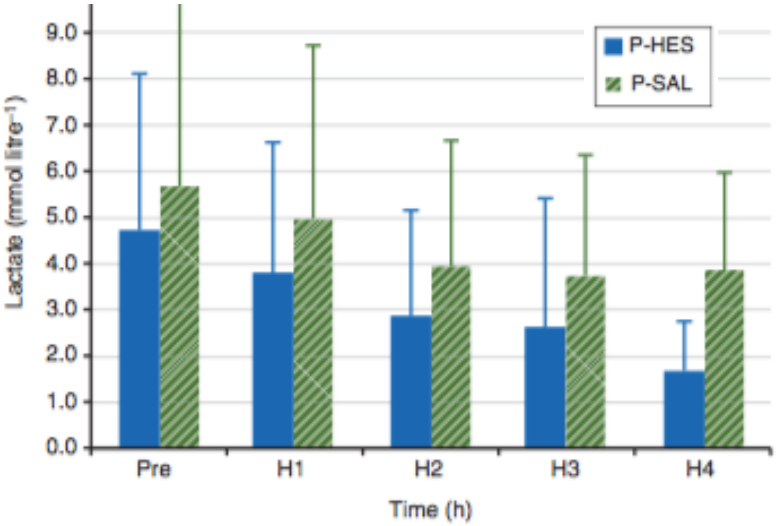
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Deaths	56		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
1.1 Albumin or plasma protein fraction	24	9920	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.93, 1.10]
1.2 Hydroxyethyl starch	25	9147	Risk Ratio (M-H, Fixed, 95% CI)	1.10 [1.02, 1.19]
1.3 Modified gelatin	11	506	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.49, 1.72]
1.4 Dextran	9	834	Risk Ratio (M-H, Fixed, 95% CI)	1.24 [0.94, 1.65]

Perel, et al. The Cochrane Collaboration. 2013

Damage Control Resuscitation

Soluté de remplissage

Resuscitation with hydroxyethyl starch improves renal function and lactate clearance in penetrating trauma in a randomized controlled study: the FIRST trial (Fluids in Resuscitation of Severe Trauma)



	P-HES		P-SAL	
	No	Yes	No	Yes
Risk	35*	1 (3%)	25	6 (19%)
Injury	36†	0 (0%)	26	5 (16%)
Dialysis	36	0	29	2 (6%)

James, et al. BJA 2011

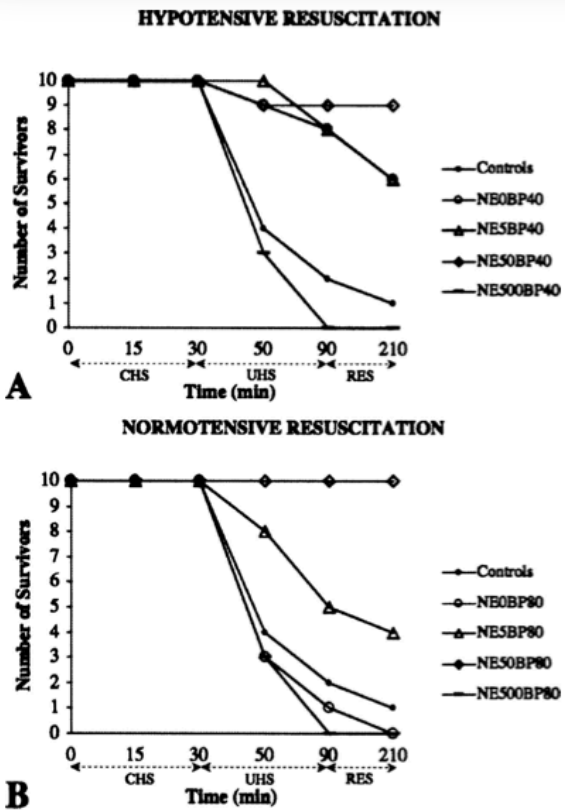
Damage Control Resuscitation

Vasopresseurs

CHOC HÉMORRAGIQUE : VASOPRESSEURS D'EMBLÉE

Early Use of Vasopressors After Injury: Caution Before Constriction

Jason L. Sperry, MD, MPH, Joseph P. Minei, MD, Heidi L. Frankel, MD, Micheal A. West, MD, PhD, Brian G. Harbrecht, MD, Ernest E. Moore, MD, Ronald V. Maier, MD, and Ram Nirula, MD, MPH



- Modèle murin de choc hémorragique non contrôlé
- Différentes posologies de Noradrénaline **+ remplissage vasculaire titré** selon l'objectif tensionnel

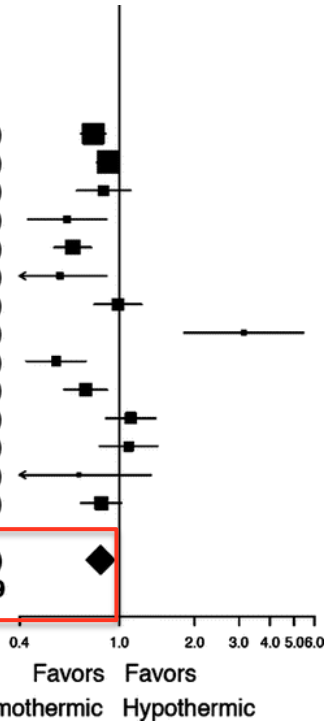
Poloujadoff , et al. Anesthesiology, 2007.

Damage Control Resuscitation

Lutte contre l'hypothermie

The Effects of Mild Perioperative Hypothermia on Blood Loss and Transfusion Requirement

Study	Sample Size (N) N : H	Normothermic (N) mean (sd)	Hypothermic (H) mean (sd)	Outcome (N/H) mean (95%CI)
Schmied	30 : 30	1670 (320)	2150 (550)	0.79 (0.70 , 0.88)
Winkler	75 : 75	1531(1055,1746)	1678(1366,1965)	0.90 (0.82 , 1.00)
Widman	22 : 24	923 (410)	1068 (482)	0.87 (0.68 , 1.11)
Persson	29 : 30	186 (145)	308 (257)	0.62 (0.43 , 0.89)
Hofer	29 : 29	1497 (497)	2300 (788)	0.65 (0.55 , 0.77)
Bock	20 : 20	635 (507)	1070 (803)	0.58 (0.38 , 0.89)
Johansson	25 : 25	1047 (413)	1066 (441)	0.99 (0.80 , 1.23)
Smith	31 : 30	423 (562)	159 (268)	3.14 (1.82 , 5.42)
Frank	142 : 158	390 (834)	520 (754)	0.56 (0.43 , 0.73)
Mason	32 : 32	111 (40)	157 (73)	0.73 (0.60 , 0.89)
Casati	25 : 25	470 (170)	442 (216)	1.11 (0.89 , 1.40)
Murat	26 : 25	160 (61)	161 (100)	1.09 (0.84 , 1.43)
Hohn	43 : 73	660(230,1870)	956(340,5480)	0.69 (0.36 , 1.34)
Nathan	73 : 71	569 (356)	666 (405)	0.85 (0.70 , 1.02)
Summary				**0.84 (0.74, 0.96)**
				Treatment effect P = 0.009



Augmentation des pertes sanguines de 16%

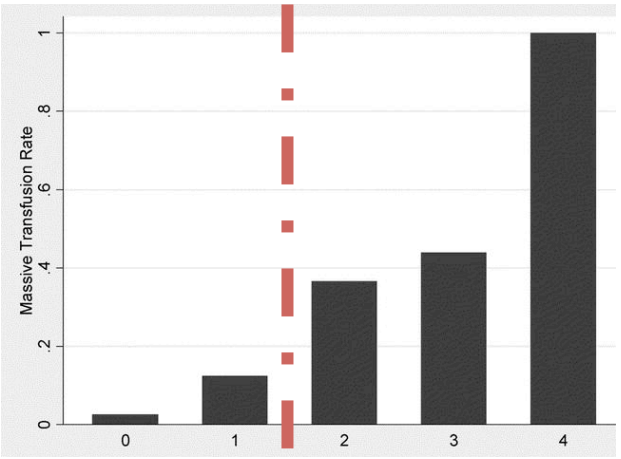
Rajagopalan, et al. Anesthesiology, 2008

Damage Control Hématologique

- Débuter la **transfusion érythrocytaire** au plus vite
- Anticiper une **transfusion massive**

Early Prediction of Massive Transfusion in Trauma: Simple as ABC (Assessment of Blood Consumption)?

1. Penetrating mechanism
2. ED SBP of 90 mmHg or less
3. ED HR of 120 bpm or greater
4. Positive FAST



Nunez, et al. Journal of Trauma. 2009

Damage Control Hématologique

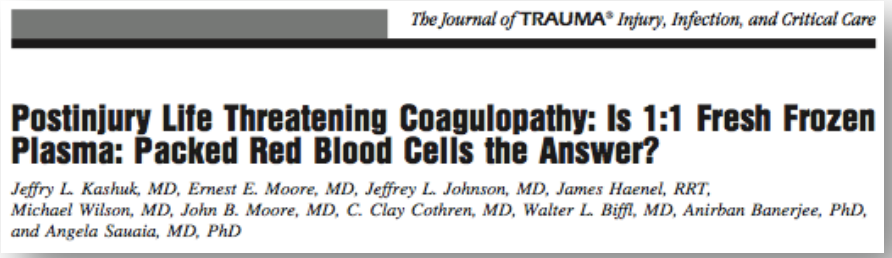
Stratégie transfusionnelle ?

Stratégie basée sur des seuils

Délai des examens biologiques standards

Stratégie basée sur des ratios

- Protocoles de **transfusion massive**
- « packs transfusionnels »



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

Postinjury Life Threatening Coagulopathy: Is 1:1 Fresh Frozen Plasma: Packed Red Blood Cells the Answer?

Jeffry L. Kashuk, MD, Ernest E. Moore, MD, Jeffrey L. Johnson, MD, James Haenel, RRT, Michael Wilson, MD, John B. Moore, MD, C. Clay Cothren, MD, Walter L. Biffl, MD, Anirban Banerjee, PhD, and Angela Sauaia, MD, PhD

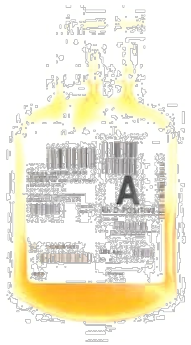
The Journal of TRAUMA® *Injury, Infection, and Critical Care*

An FFP:PRBC Transfusion Ratio ≥1:1.5 Is Associated With A Lower Risk Of Mortality After Massive Transfusion

Jason L. Sperry, MD, MPH, Juan B. Ochoa, MD, Scott R. Gunn, MD, Louis H. Alarcon, MD, Joseph P. Minei, MD, Joseph Cuschieri, MD, Matthew R. Rosengart, MD, MPH, Ronald V. Maier, MD, Timothy R. Billiar, MD, Andrew B. Peitzman, MD, Ernest E. Moore, MD, and The Inflammation the Host Response to Injury Investigators

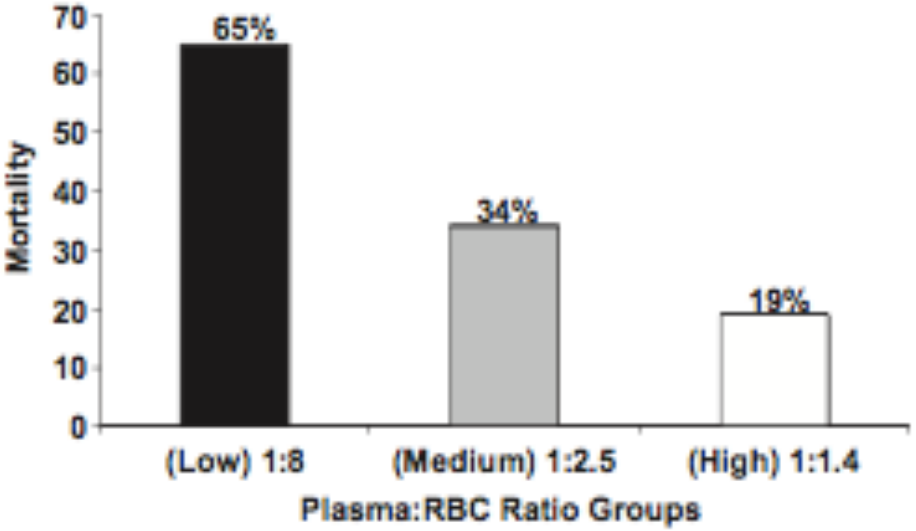
Damage Control Hématologique

Administration de plasma



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

The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving Massive Transfusions at a Combat Support Hospital



Borgman, et al. Journal of trauma 2007

Damage Control Hématologique

Administration de plasma

Revue générale

Le ratio transfusionnel PFC/CGR 1/1 : un phénomène de mode basé sur des preuves ?

1/1 plasma to red blood cell ratio: An evidence-based practice?

A. Godier [a], Y. Ozier [b], S. Susen [c,*], pour le Groupe d'intérêt en hémostase périopératoire (GIHP)

Godier, AFAR 2011

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

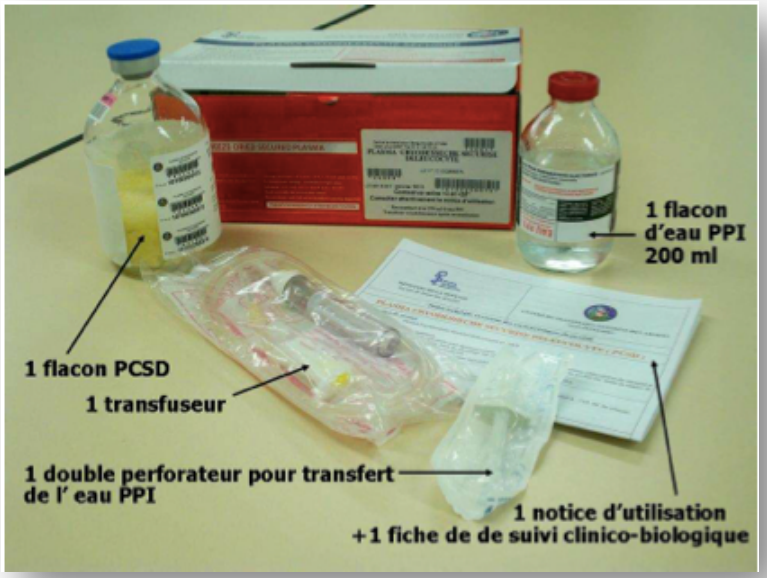
The Relationship of Blood Product Ratio to Mortality: Survival Benefit or Survival Bias?

Snyder, Journal of trauma 2009

Damage Control Hématologique

Administration de plasma

Plasma lyophilisé (PLYO) - French Lyophilised Plasma (FLYP)



ORIGINAL ARTICLE

The evolving role of lyophilized plasma in remote damage control resuscitation in the French Armed Forces Health Service

Saillol,et al. Transfusion. 2013

Damage Control Hématologique

Plaquettes

ANESTHESIA & ANALGESIA

unknown, but current data support the use of plasma:RBC:platelet ratio of 1:1:1. Future prospective

Shaz,et al. 2009

- **Seuil biologique ?**
- **Ratios transfusionnels ?**

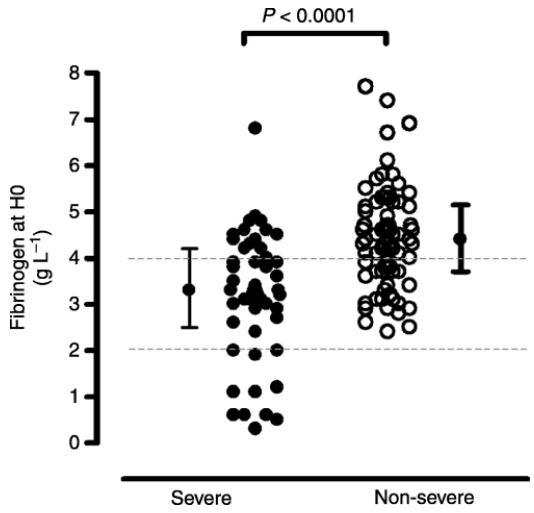
R28
Platelets
***

Platelets should be administered to maintain a platelet count above 50×10^9/l. A platelet count above 100×10^9/l in patients with ongoing bleeding and/or traumatic brain injury may be maintained. An initial dose of 4-8 platelet concentrates or one aphaeresis pack may be used.

Spahn,et al. 2013

Damage Control Hématologique

Fibrinogène



ORIGINAL ARTICLE

The decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage

Charbit,et al. J of Thromb and Haem,,2006

- **Marqueur de gravité** du choc hémorragique
- Aucun intérêt démontré d'une administration systématique
- **Monitorer** et **compenser** les hypofibrinogènémies < 1,5 – 2g/L

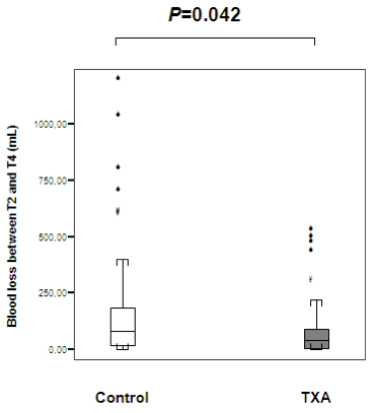
Damage Control Hématologique

Acide tranexamique

CRASH2

- Etudié chez les traumatisés sévères
- **Administration précoce** 1g sur 10min puis 1g sur 8H
- Réduction de la mortalité si débuté dans les 3 heures

Shakur, et al. Lancet 2010



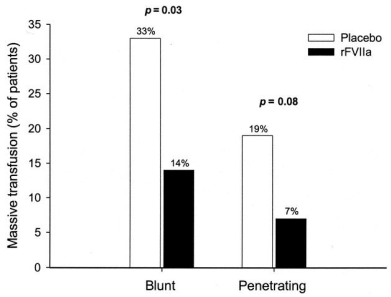
High-dose tranexamic acid reduces blood loss in postpartum haemorrhage

Ducloy-Bouthors, et al. Critical Care 2011

Damage Control Hématologique

Facteur rVIIa

- Diminution des besoins transfusionnels pour les **traumatismes fermés**
- Pas de différence de survie



Boffard, et al. Journal of Trauma 2005.

- Efficacité non clairement démontrée
- Coût important
- Place en **seconde intention**

Recommendations on the use of recombinant activated factor VII as an adjunctive treatment for massive bleeding. A European perspective.

Vincent, et al. AFAR 2006.

Damage Control Hématologique

Calcium

- Hypocalcémie fréquente par **dilution**, **consommation** et **chélation**

  => Diminution de la contractilité myocardique

  => Vasoplégie

  => Troubles de l'hémostase

- Monitorer et supplémenter en cas de transfusion massive

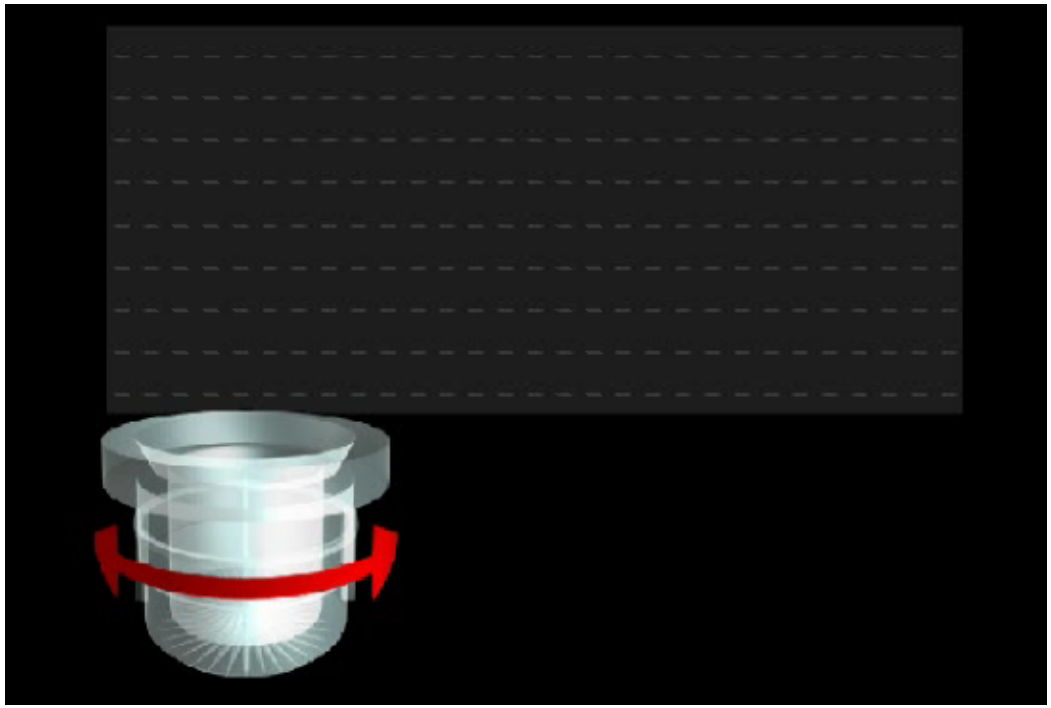
Early hypocalcemia in severe trauma.

Vivien, et al. Crit Care Med, 2005.

Damage Control Hématologique

Monitoring de la coagulation

Caractéristiques visco-élastiques du caillot : Thromboélastogramme

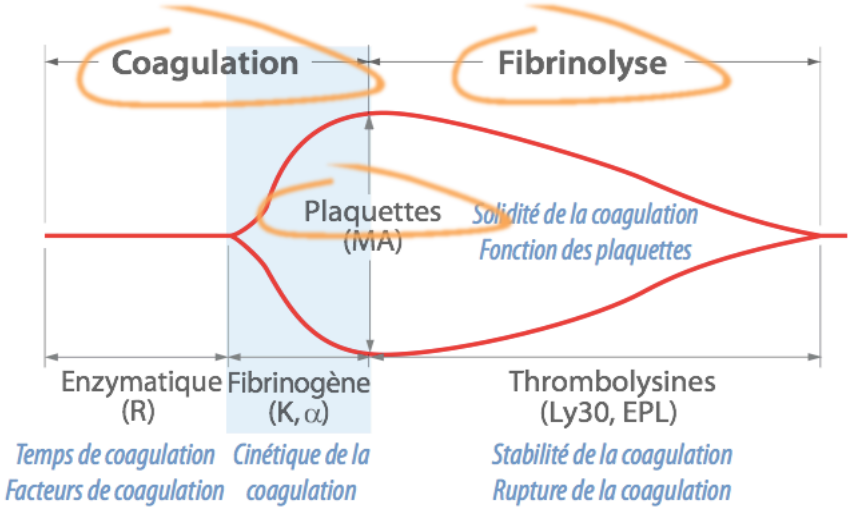


Damage Control Hématologique

Monitoring de la coagulation

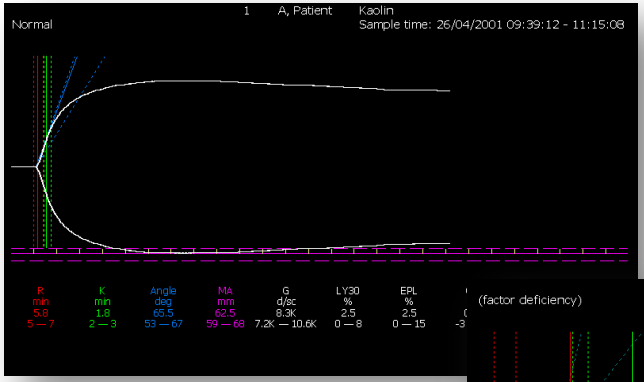
Caractéristiques visco-élastiques du caillot : Thromboélastogramme

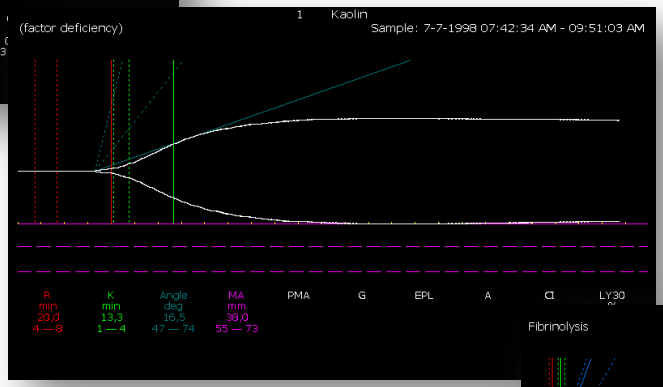
- Monitorage **global** de la coagulation, sur **sang total**
- Analyse **fonctionnelle** du processus hémostatique
- Résultats rapides et en **temps réel**

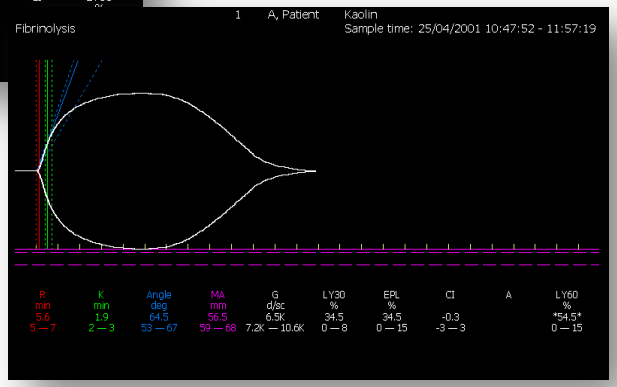


Damage Control Hématologique

Monitoring de la coagulation





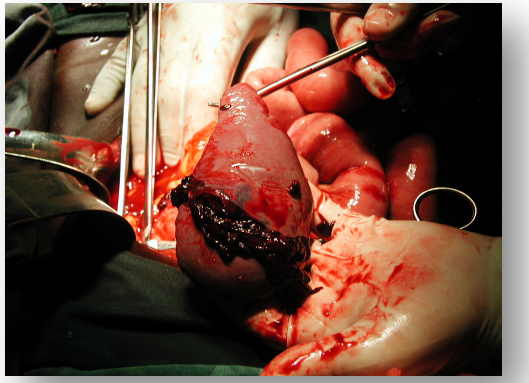


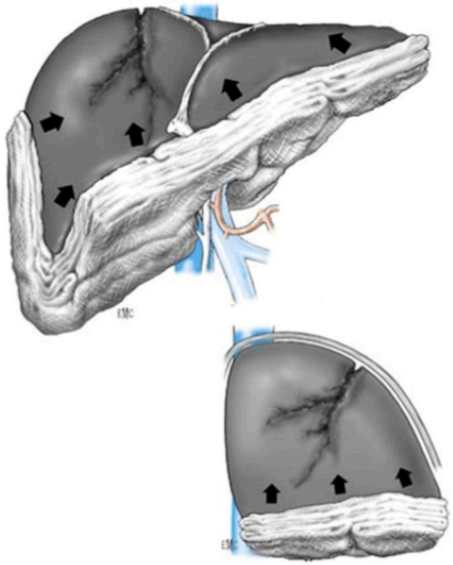
Damage Control Chirurgical

Viscéral

Laparotomie écourtée : réalisation de **l'hémostase**

- Exposition large : laparotomie médiane
- Tamponnement péri-hépatique
- Splénectomie, …



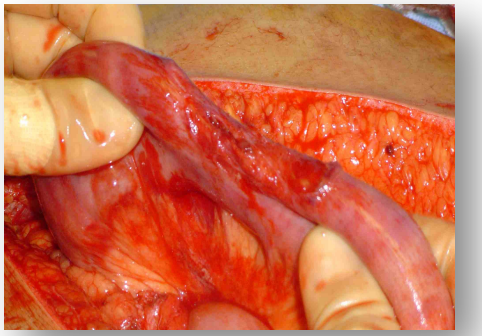


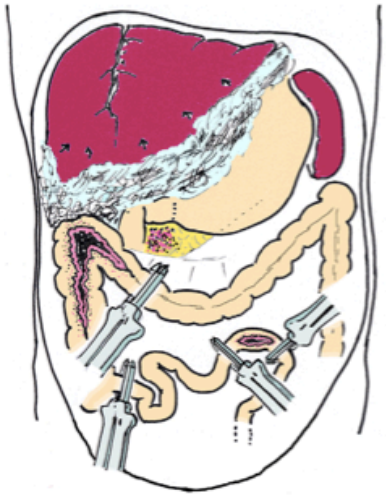
Damage Control Chirurgical

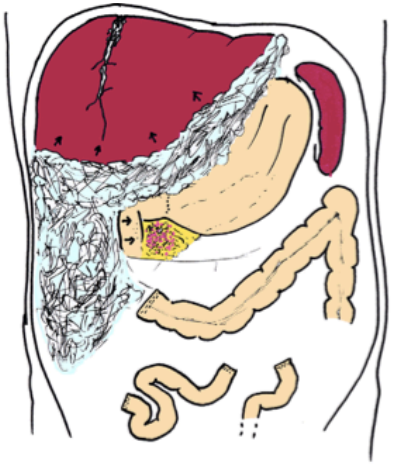
Viscéral

Laparotomie écourtée : réalisation de **la coprostase**

- Fermeture des lésions contaminantes
- Pas de réparation digestive
- Toilette péritonéale-drainage



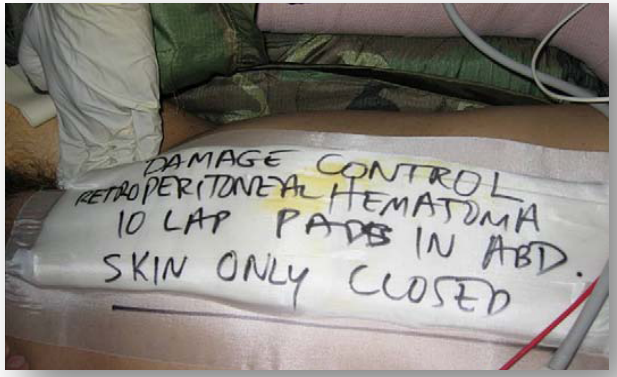


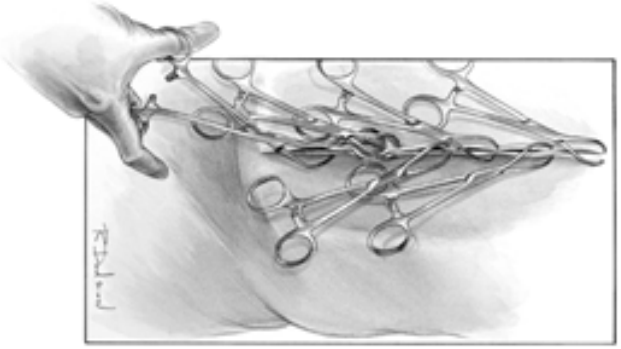


Damage Control Chirurgical

Viscéral

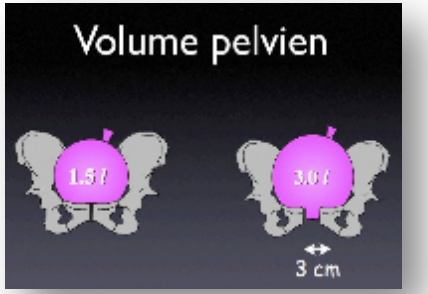
Laparotomie écourtée : fermeture provisoire



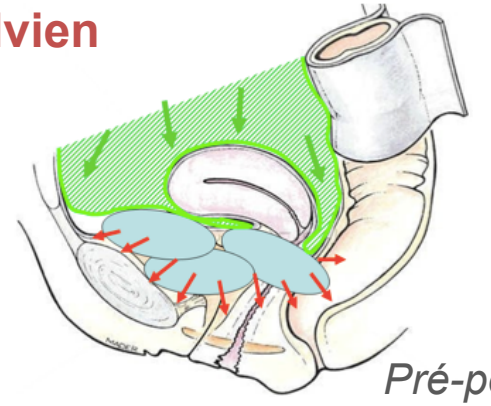


Damage Control Chirurgical
Pelvien

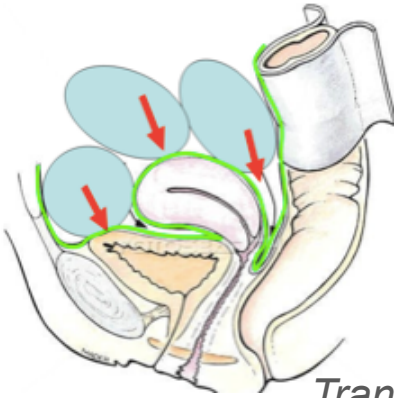
Fermeture et stabilisation de l'anneau pelvien



Packing pelvien



Pré-péritonéal



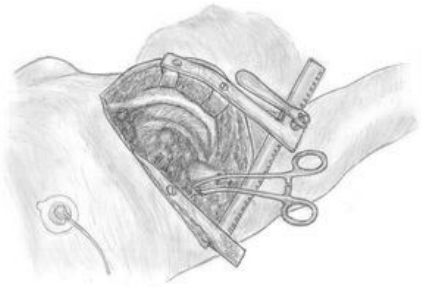
Trans-péritonéal

Damage Control Chirurgical

Thoracique

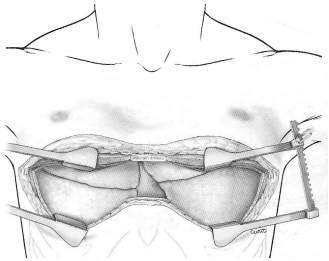
Thoracotomie antérolatérale

Clampage aorte descendante, MCI



Bi-thoracotomie : « clamshell incision »

Exposition la plus large

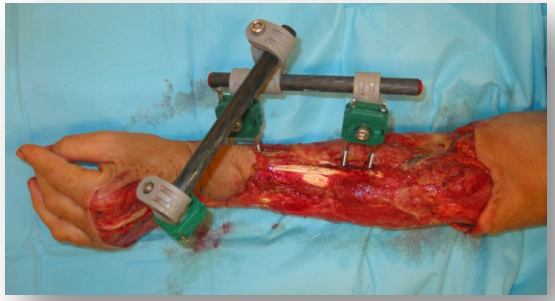


Damage Control Chirurgical

Orthopédique

Amputation ou traitement conservateur ?

- Faire l'hémostase
- Faire bref
- Limiter le risque d'emboles graisseux
- Parage, **exofixation**, couverture



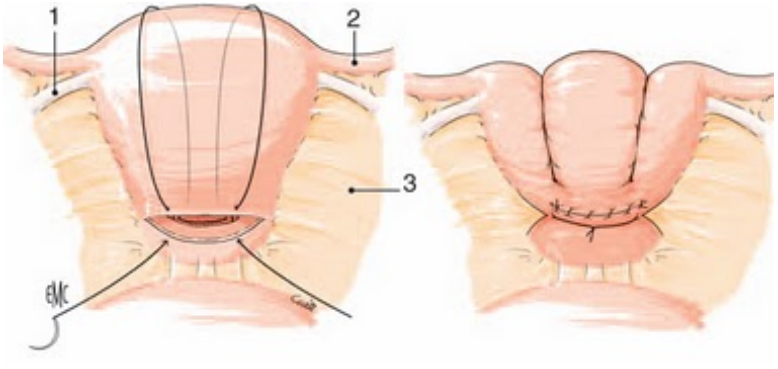
Damage control orthopaedics: lessons learned.

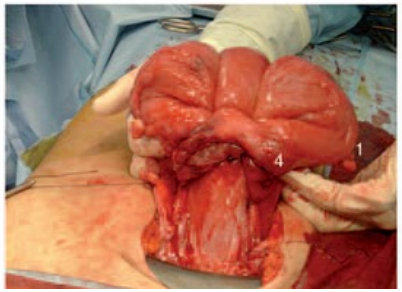
Giannoudis PV, et al. Injury. 2009.

Damage Control Chirurgical

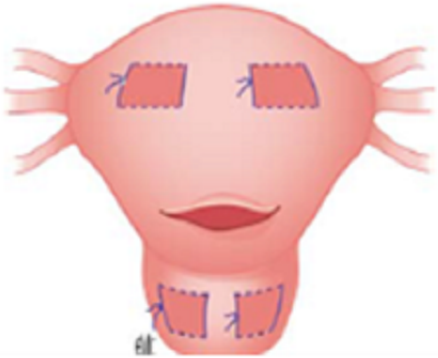
Obstétrique

Plicature utérine

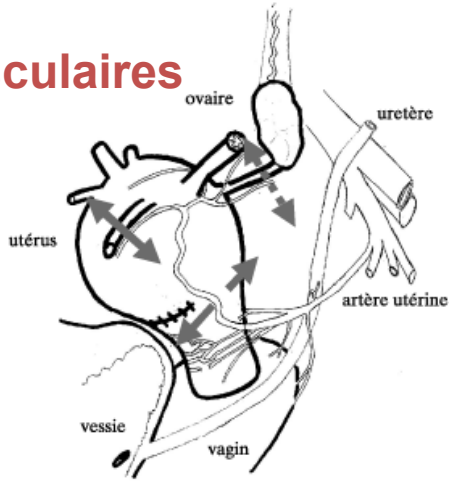




Capitonnage utérin



Ligatures vasculaires



Damage Control : la suite

Réanimation per et post opératoire

- Lutte contre la triade létale
- Surveillance et traitements des complications

Second look chirurgical

… **programmé** après stabilisation

… **anticipé** si complication

Conclusion

- Course contre la montre et prise en charge pluridisciplinaire
- **« Le mieux est l'ennemi du bien »**
- Stratégie transfusionnelle prenant en compte la **coagulopathie**
- Réanimation : **lutte contre la triade létale**
- Interventions dans un premier temps strictement **limitées aux lésions menaçant le pronostic vital**