

Massive Transfusion Protocols that support Damage Control Surgery

A new dimension in critical care haematology

ARCBS Transfusion Update 2008

Crown Conference Centre

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Massive Transfusion Protocol



BLOOD BANK INVENTORY								
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Malone DL, Hess JR, Fingerhut A.

Massive Transfusion Practices Around the Globe and a Suggestion for a Common Massive Transfusion Protocol. J Trauma. 2006

Massively transfused major trauma

- Most severely injured
- High risk of death
 - ACS
 - SIRS
 - MOF
 - ARDS
 - Coagulopathy of Trauma
- 7-10% combat
- 1-2% civilian

Holcomb JB, Jenkins D, Rhee et al. Damage Control Resuscitation: Directly Addressing the Early Coagulopathy of Trauma. JTrauma 2007

Death in Trauma

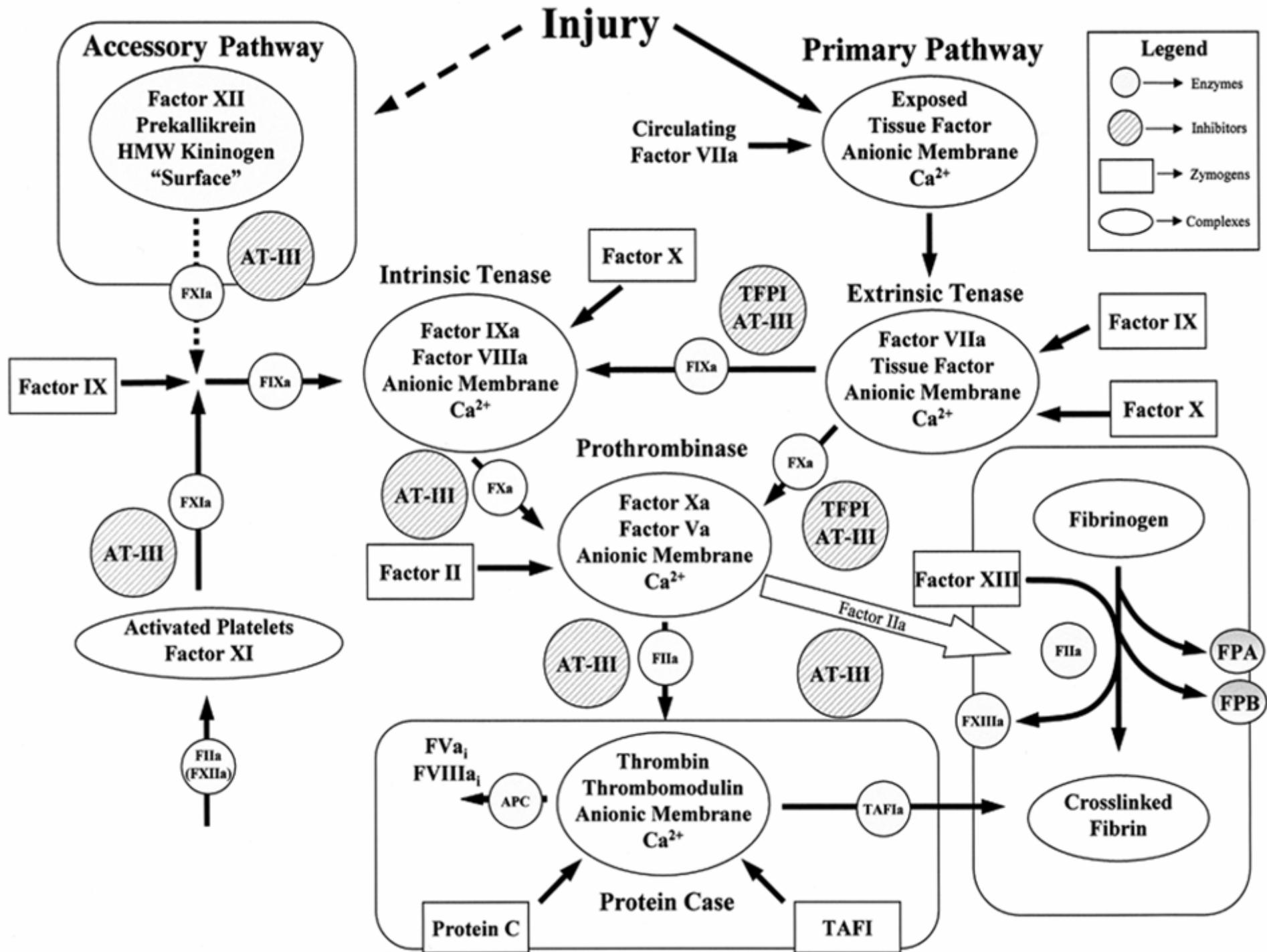
- Exsanguination second cause (37%) after CNS trauma
- 50% in the field: 60% exsanguination from extremity wounds
- 30% early: 30-50% exsanguination
- 20% late: multiple organ failure

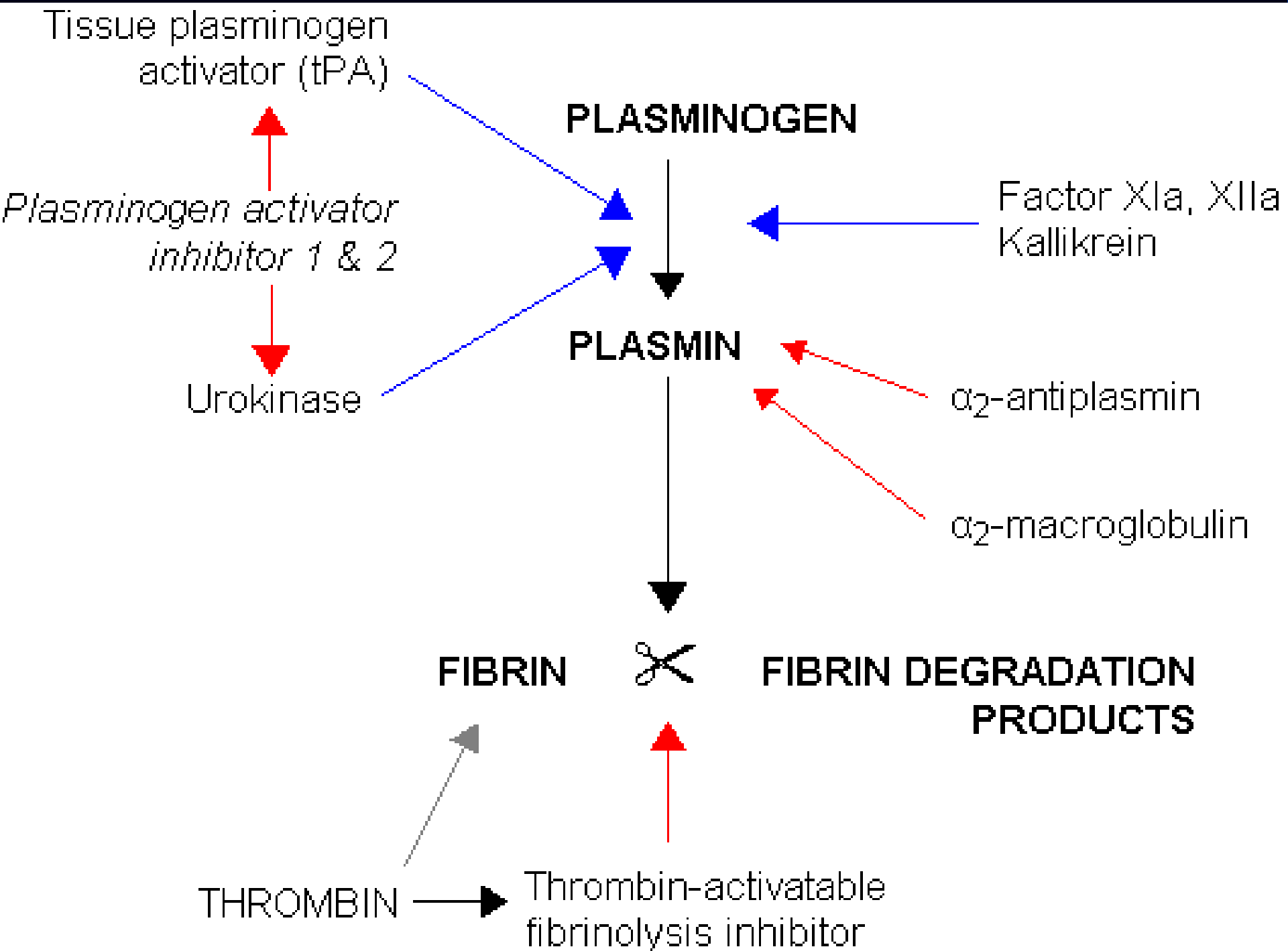
Rossaint R, Cerny V, Coats TJ et al. Key issues in advanced bleeding care in trauma.
Shock. 2006

Coagulopathy of Trauma

- 47% potentially life threatening (hypo)coagulopathy (PT/PTT $>2X$) with massive transfusion
- Function of
 - Acidosis
 - Hypothermia
 - Hypotensive insult and
 - Severity of injury

Cosgriff, Moore, Sauaia et al. Predicting Life-Threatening Coagulopathy in the Massively Transfused Trauma Patient: Hypothermia and Acidoses Revisited. J Trauma 1997





Coagulopathy of Trauma

- Loss and dilution
- Inhibitory effects of acidaemia and hypothermia
- Macro/microvascular injury generating increased Tissue Factor:
 - Increased Thrombin-Thrombomodulin (TT) complexes
 - Consumption and FVII depletion locally
 - Reduced local thrombin generation
 - Increased activation of (hepatic) TAFI (plasma carboxypeptidase B2) increased fibrinolysis

Coagulopathy of Trauma

- Endothelial response to hypoperfusion
 - Increased Thrombomodulin expression, reduced thrombin and increased activated Protein C
 - Increased tPA and reduced PAI-1 increasing fibrinolysis

Brohi, Cohen, Davenport. Acute coagulopathy of trauma: mechanism, identification, effect. *Curr Opin Crit Care* 2007

Damage Control Surgery

- **Mortality reduction 90% to 50%**
- Lethal triad (depleted physiological reserve) predicts failure of surgical control of bleeding
 - Abbreviated laparotomy
 - Packing
 - Debridement, decontamination, diversion, drainage
 - Haemorrhage Control
 - Temporary abdominal closure
 - Support and re-establish and depleted physiological reserve in ICU
 - Delayed definitive repair

Chain of Survival

- Continuum of care from point of injury
 - Manage potentially reversible causes of death
 - Provide life support
 - PHTLS
 - ATLS
 - Damage Control Surgery (DCS)
 - DCS capability: surgeons, anaesthetists, radiologists, intensivists, transfusion services
 - Damage Control Resuscitation

MTP Models

- Substantial variability
- Gold standard ?
- Local logistic constraints
- Differing case mix and risk management profiles

Malone, Hess, Fingehut. Massive Transfusion practices Around the Globe and a Suggestion for a Common Massive Transfusion Protocol. JTrauma 2006

Spahn DR, Cerny V, Coats TJ et al. The Task Force for Advanced Bleeding Care in Trauma. Management of bleeding following major trauma: a European guideline. Critical Care. 2007

Shinar, Yahalom, Silverman. Meeting blood requirements following terrorist attacks: the Israeli experience. Curr Opin Hematol 2006

**Damage Control Resuscitation: A Paradigm
Shift in the Management of Haemorrhagic
Shock**

(in press)

**Zalstein S, Pearce A, Scott DM,
Rosenfeld JV (Ed).**

Massive Exsanguination

- Haemorrhagic shock (class IV) requiring immediate Damage Control Surgery
- Anticipated massive transfusion
- Manifest or high risk of coagulopathic bleeding (as part of the lethal triad)

Damage Control Resuscitation

Early 1:1:1 transfusion of PRBC, FFP and platelets

- Restricted crystalloid infusion
- Systolic blood pressure (adult) 80-100 mmHg (consider paediatric equivalent) until bleeding surgically controlled
- Immediate Damage (and haemorrhage) Control Surgery (DCS)

Borgman, Spinella, Perkins et al. The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital.

JTrauma 2007

Spahn, Cerny, Duranteau et al. Management of bleeding following major trauma: a European guideline. Crit Care 2007

Damage Control Resuscitation

- Restoration and maintenance of normothermia
 - Active: fluids, gases, convective blankets
 - Ambient: thermoneutral zone 28-30°C
- Consider adjuvant therapy
- Regular assay of targeted laboratory parameters:
 - Full blood examination
 - Coagulation status including serum fibrinogen level
 - Acid-base status including serum base deficit and lactate
 - Serum ionised calcium
- Consider antifibrinolytic therapy

Adjuvants

- Calcium
- Cryoprecipitate
- rFVIIa
- Buffers



Cameron P, Phillips L, Balogh Z et al. The use of recombinant activated factor VII in trauma patients: experience from the Australian and New Zealand Haemostasis Registry. *Injury* 2007

Martinowitz U, Michaelson M, The Israeli Multidisciplinary rFVIIa Task Force, Guidelines for the use of recombinant factor VII (rFVIIa) in uncontrolled bleeding: a report by the Israeli Multidisciplinary rFVIIa Task Force. *J Thromb Haemost.* 2005

Stein, Dutton, O'Connor, Alexander, Scalea. Determinants of Futility of Administration of Recombinant Factor VIIa in Trauma. *JTrauma* 2005

Antifibrinolytics

- Tranexamic Acid
- Aminocaproic Acid
- Aprotinin

Spahn DR, Cerny V, Coats TJ et al. (The Task Force for Advanced Bleeding Care in Trauma) Management of bleeding following major trauma: a European guideline. *Critical Care*. 2007

Mannucci PM, Levi M. Prevention and Treatment of Major Blood Loss. *NEJM* 2007

Exit Strategy

Reversion to restrictive blood component transfusion strategy

- Completion of abbreviated DCS procedure
- Adequate haemostasis
- Optimised intravascular volume state

Admission to ICU

- Ongoing management and monitoring
 - Coagulation
 - Circulatory function
 - Acidosis
 - Body core temperature
 - General stabilisation and care
- Revision of systemic blood pressure target
- Preparation and planning for definitive surgical repair, including transfer and retrieval to specialist centres

Other Applications?

- Exsanguination requiring operative intervention
 - Obstetric
 - GI
 - Surgical
- Exsanguination due to acquired coagulopathy
 - Anticoagulants
 - Antiplatelet agents

Consensus Required

- Critical bleeding
- Massive transfusion
- Massive exsanguination
- Coagulopathy
 - Definition
 - Diagnosis, assessment and monitoring of response to therapy
 - Mechanism
- Risk-benefit profile of interventions

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