Haemostatic resuscitation??

It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.

Kerry Gunn
Department of Anaesthesia and Perioperative Medicine
Auckland City Hospital
Haemostatic Resuscitation

- Does not stop bleeding
- Is part of a paradigm shift in trauma management
  - Rapid triage
  - Damage Controlled Surgery
  - Limited crystalloid
- Is stealing the thunder!
10 units RBC in 4 hrs

10 units RBC in 24 hrs
The components of damage control resuscitation

- Permissive hypotension
- Haemostatic resuscitation
- Damage control surgery

Acute Traumatic Coagulopathy

![Graph A](image1)

![Graph B](image2)

- **Graph A**: Prothrombin ratio vs. ISS and base deficit (mmol L⁻¹).
  - Base deficit categories: >12, 6.1-12, 0.1-6.
  - Prothrombin ratio values: 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.
  - * indicates statistical significance.

- **Graph B**: Mortality (%) vs. ISS and base deficit (mmol L⁻¹).
  - Same ISS categories as Graph A.
  - Base deficit categories as Graph A.
  - Mortality (%) values: 0, 10, 20, 30, 40, 50, 60, 70.
  - * indicates statistical significance.

Auckland District Health Board
Hemostatic resuscitation is neither hemostatic nor resuscitative in trauma hemorrhage

Sirat Khan, MD, Karim Brohi, MD, Manik Chana, MD, Imran Raza, MD, Simon Stanworth, MD, Christine Gaarder, MD, PhD, Ross Davenport, MD, PhD, on behalf of the International Trauma Research Network (INTRN), London, United Kingdom

- ACIT study (Activation of Coagulation and Inflammation in Trauma)
- 106 patients
- Lactate and ROTEM during MTP
Figure 1. Lactate clearance during hemorrhage. A–C box and whisker plots, median, IQR and adjusted range. *Versus Time 0.
A, Patients receiving 4 U to 7 U of PRBC. B, Patients receiving 8 U to 11 U of PRBC. C, Patients receiving 12 U or more PRBCs.
Figure 2. Change in CA5 (mm) during bleeding episode in coagulopathic patients (CA5 \leq 35 \text{ mm}) stratified by transfusion requirements. Dotted line is diagnostic threshold for ATC (CA5 \leq 35 \text{ mm}). A, Patients receiving 4 U to 7 U of PRBC. Time 0: CA5, 35 mm versus Day 1: CA5, 39 mm (p < 0.05). B, Patients receiving 8 U to 11 U of PRBC. Time 0: CA5, 33 mm versus Day 1: CA5, 32 mm (p = 0.78). C, Patients receiving 12 U or more PRBCs. Time 0: CA5, 27 mm versus Day 1: CA5, 39 mm (p < 0.05). D, Individual response in all patients receiving four or more PRBC units.
Figure 4. Change in CT (seconds) during bleeding episode in coagulopathic patients (CT > 94 seconds) stratified by transfusion requirements. *Dotted line* is diagnostic threshold for ATC (CT > 94 seconds). A, Patients receiving 4 U to 7 U of PRBC. Time 0: CT, 108 seconds versus Day 1: CT, 69 seconds (p < 0.05). B, Patients receiving 8 U to 11 U of PRBC. Time 0: CT, 107 seconds versus Day 1: CT, 69 seconds (p = 0.07). C, Patients receiving 12 U or more PRBCs. Time 0: CT, 126 seconds versus Day 1: CT, 63 seconds (p < 0.05). D, Individual response in all patients receiving four or more PRBC units.
Multisystem failure and transfusion

Fresh Frozen Plasma Is Independently Associated With a Higher Risk of Multiple Organ Failure and Acute Respiratory Distress Syndrome

Gregory A. Watson, MD, Jason L. Sperry, MD, MPH, Matthew R. Rosengart, MD, MPH, Joseph P. Minei, MD, Brian G. Harbrecht, MD, Ernest E. Moore, MD, Joseph Cuschieri, MD, Ronald V. Maier, MD, Timothy R. Billiar, MD, and Andrew B. Peitzman, MD,
The Inflammation and the Host Response to Injury Investigators

Figure 1. Independent outcome risks attributable to FFP transfusion (per unit).

Figure 3. Independent MOF risk attributable to FFP transfusion (categorized by quartiles).
Transfusion of fresh frozen plasma in critically ill surgical patients is associated with an increased risk of infection

Babak Sarani, MD, FACS; W. Jonathan Dunkman, BA; Laura Dean; Seema Sonnad, PhD; Jeffrey I. Rohrbach, RN, MSN; Vicente H. Gracias, MD, FACS

Figure 1. Patients who received fresh frozen plasma (FFP) were significantly more likely to develop an infection than those who did not receive FFP in a univariate model (p < .01).
Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage
<table>
<thead>
<tr>
<th>Vascular occlusive events*</th>
<th>Tranexamic acid (n=10 060)</th>
<th>Placebo (n=10 067)</th>
<th>RR (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any vascular occlusive event</td>
<td>168 (1.7%)</td>
<td>201 (2.0%)</td>
<td>0.84 (0.68-1.02)</td>
<td>0.084</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>35 (0.3%)</td>
<td>55 (0.5%)</td>
<td>0.64 (0.42-0.97)</td>
<td>0.035</td>
</tr>
<tr>
<td>Stroke</td>
<td>57 (0.6%)</td>
<td>66 (0.7%)</td>
<td>0.86 (0.61-1.23)</td>
<td>0.42</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>72 (0.7%)</td>
<td>71 (0.7%)</td>
<td>1.01 (0.73-1.41)</td>
<td>0.93</td>
</tr>
<tr>
<td>Deep vein thrombosis</td>
<td>40 (0.4%)</td>
<td>41 (0.4%)</td>
<td>0.98 (0.63-1.51)</td>
<td>0.91</td>
</tr>
</tbody>
</table>

**Need for transfusion and surgery**

<table>
<thead>
<tr>
<th></th>
<th>Tranexamic acid</th>
<th>Placebo</th>
<th>RR (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood product transfused</td>
<td>5067 (50.4%)</td>
<td>5160 (51.3%)</td>
<td>0.98 (0.96-1.01)</td>
<td>0.21</td>
</tr>
<tr>
<td>Any surgery</td>
<td>4814 (47.9%)</td>
<td>4836 (48.0%)</td>
<td>1.00 (0.97-1.03)</td>
<td>0.79</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>1040 (10.3%)</td>
<td>1059 (10.5%)</td>
<td>0.98 (0.91-1.07)</td>
<td>0.67</td>
</tr>
<tr>
<td>Chest surgery</td>
<td>1518 (15.1%)</td>
<td>1525 (15.1%)</td>
<td>1.00 (0.93-1.06)</td>
<td>0.91</td>
</tr>
<tr>
<td>Abdominal surgery</td>
<td>2487 (24.7%)</td>
<td>2555 (25.4%)</td>
<td>0.97 (0.93-1.02)</td>
<td>0.28</td>
</tr>
<tr>
<td>Pelvic surgery</td>
<td>683 (6.8%)</td>
<td>648 (6.4%)</td>
<td>1.05 (0.95-1.17)</td>
<td>0.31</td>
</tr>
</tbody>
</table>

**Median (IQR) units of blood product transfused†**

<table>
<thead>
<tr>
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<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood product transfused</td>
<td>3 (2-6)</td>
<td>3 (2-6)</td>
<td>...</td>
<td>0.59†</td>
</tr>
</tbody>
</table>

**Dependency**

<table>
<thead>
<tr>
<th></th>
<th>Tranexamic acid</th>
<th>Placebo</th>
<th>RR (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms</td>
<td>1483 (14.7%)</td>
<td>1334 (13.3%)</td>
<td>1.11 (1.04-1.19)</td>
<td>0.0023</td>
</tr>
<tr>
<td>Minor symptoms</td>
<td>3054 (30.4%)</td>
<td>3061 (30.4%)</td>
<td>1.00 (0.96-1.04)</td>
<td>0.94</td>
</tr>
<tr>
<td>Some restriction</td>
<td>2016 (20.0%)</td>
<td>2069 (20.6%)</td>
<td>0.97 (0.92-1.03)</td>
<td>0.36</td>
</tr>
<tr>
<td>Dependent (not requiring constant attention)</td>
<td>1294 (12.9%)</td>
<td>1273 (12.6%)</td>
<td>1.02 (0.95-1.09)</td>
<td>0.63</td>
</tr>
<tr>
<td>Fully dependent</td>
<td>696 (6.9%)</td>
<td>676 (6.7%)</td>
<td>1.03 (0.93-1.14)</td>
<td>0.57</td>
</tr>
<tr>
<td>Alive (disability status not known)</td>
<td>54 (0.5%)</td>
<td>41 (0.4%)</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

**Dead**

<table>
<thead>
<tr>
<th></th>
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<th>Placebo</th>
<th>RR (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead</td>
<td>1463 (14.5%)</td>
<td>1613 (16.0%)</td>
<td>0.91 (0.85-0.97)</td>
<td>0.0035</td>
</tr>
</tbody>
</table>

Data are number (%), unless otherwise indicated. Counts are for numbers of patients with at least one such event. RR=relative risk. *Includes both fatal and non-fatal events. †Transfused patients only. †Analysis used logarithmic transformation of mean units of blood products transfused.

Table 3: Vascular occlusive events, need for transfusion and surgery, and level of dependency.
Give TXA before 3 hrs after injury.
The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving Massive Transfusions at a Combat Support Hospital

Matthew A. Borgman, MD, Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Thomas Repine, MD, Alec C. Beekley, MD, James Sebesta, MD, Donald Jenkins, MD, Charles E. Wade, PhD, and John B. Holcomb, MD

![Mortality diagram](image)
Do you survive because of early plasma, or because you survive you get plasma?
It you look at when plasma was available the advantage of 1:1:1 disappears.

Snyder: J Trauma, Volume 66(2). February 2009. 358-364
Liberal Versus Restricted Fluid Resuscitation Strategies in Trauma Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials and Observational Studies

Chih-Hung Wang, MD; Wen-Han Hsieh, MS; Hao-Chang Chou, MD; Yu-Sheng Huang, MD; Jen-Hsiang Shen, MS; Yee Hui Yeo, MS; Huai-En Chang, MS; Shyr-Chyr Chen, MD, MBA; Chien-Chang Lee, MD, MSc

* Indicates a contribution to the study.
Restrictive Fluids are the key

Figure 2. A. Forest plot for randomized controlled trials. Comparison of the effects of liberal versus restricted fluid resuscitation on overall mortality, expressed as risk ratio (RR) and 95% CI. B. Forest plot for randomized controlled trials after exclusion of the trial by Turner et al (25). Comparison of the effects of liberal versus restricted fluid resuscitation on overall mortality, expressed as RR and 95% CI.
So if it isn’t the blood products who are saving the patients what is it?
Everything revolves the ultimate good guy - the surgeon