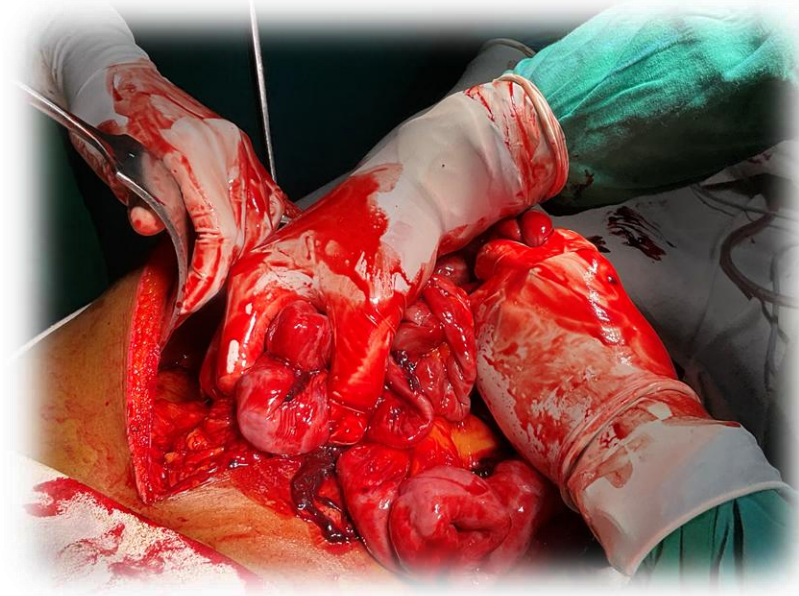


Resuscitation in Trauma
Back to Basics with Updated Evidence



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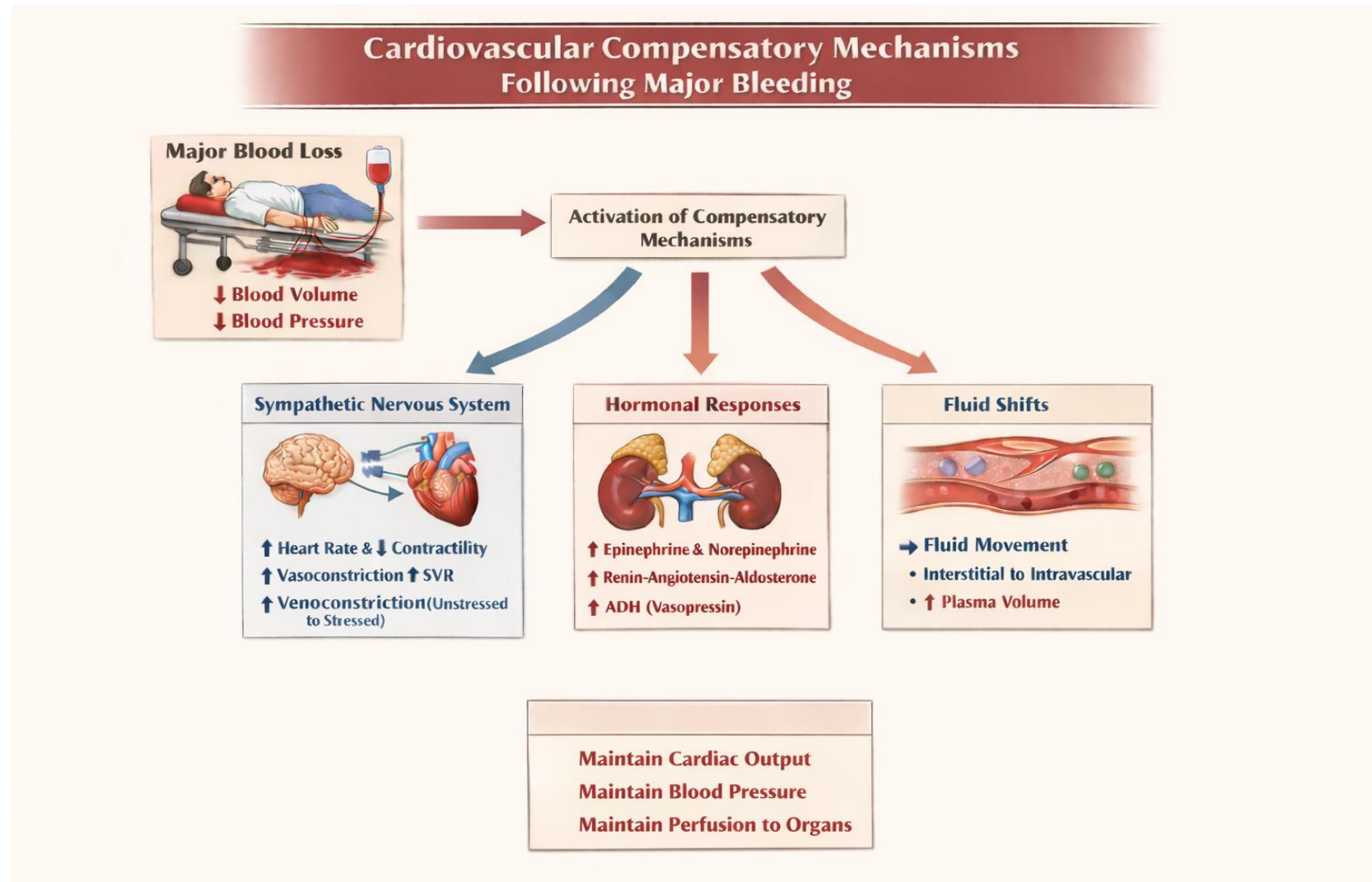
No conflict of interest

Objectives

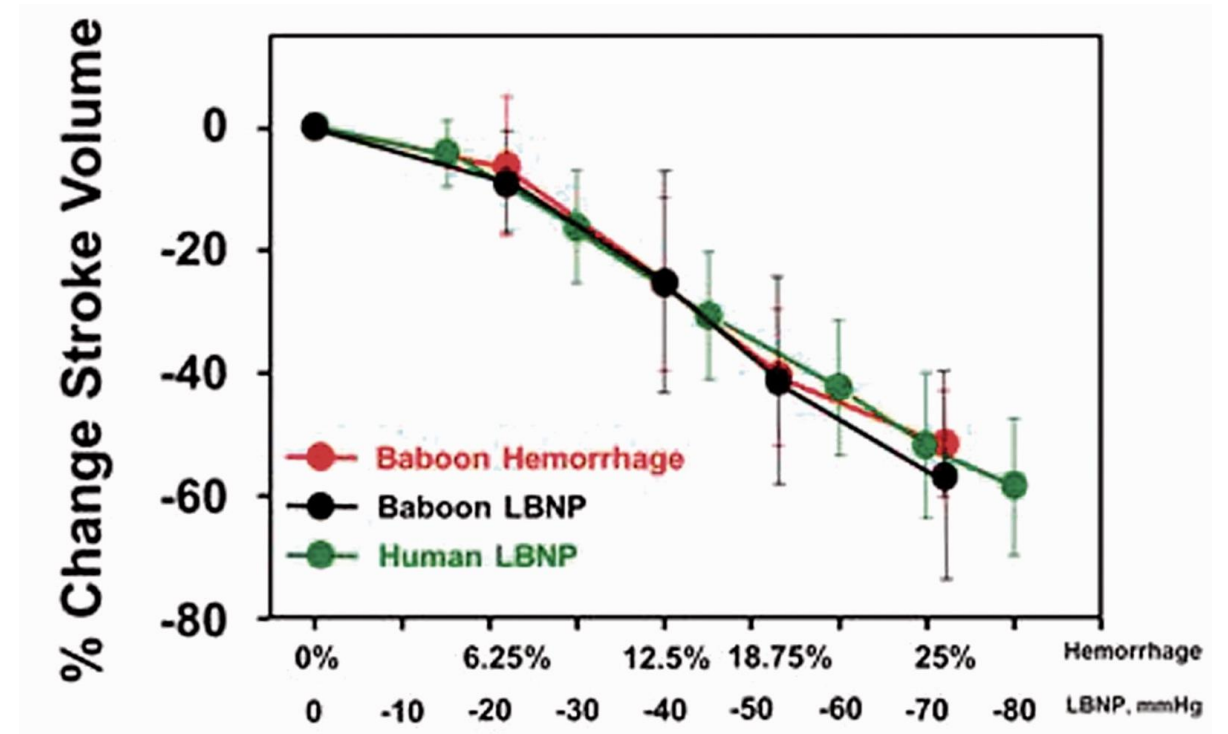
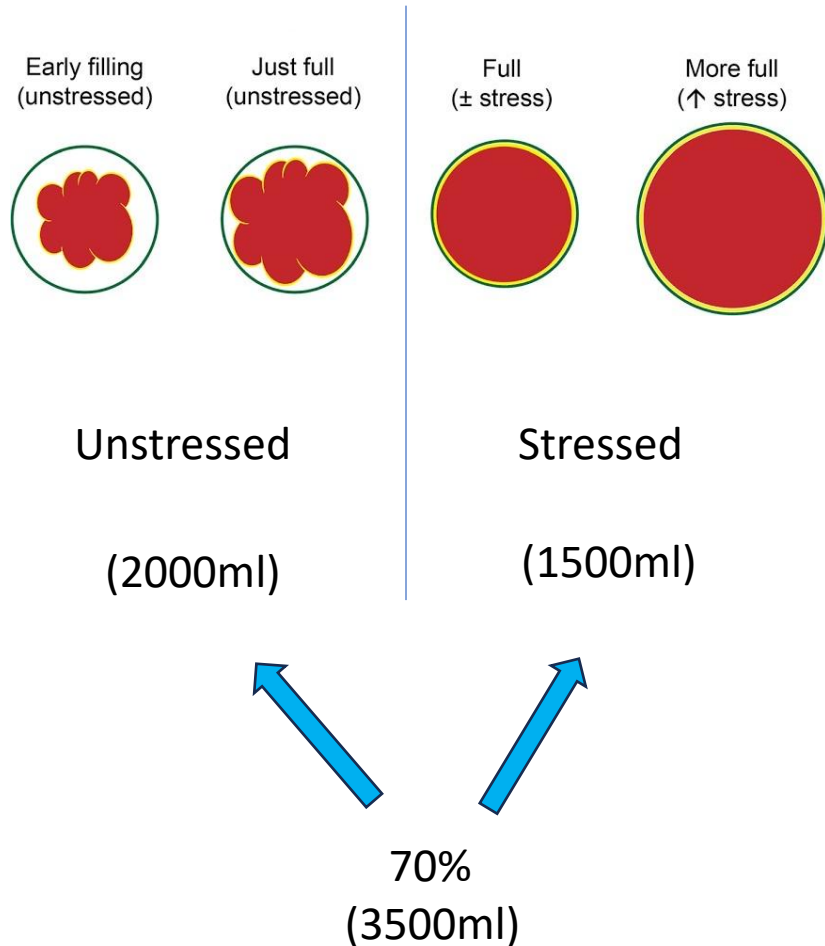
Understand the basic patho-physiology of
bleeding trauma

Discuss basics behind the treatment with
updated evidence

Pathophysiology- Sympetho-exitatory phase

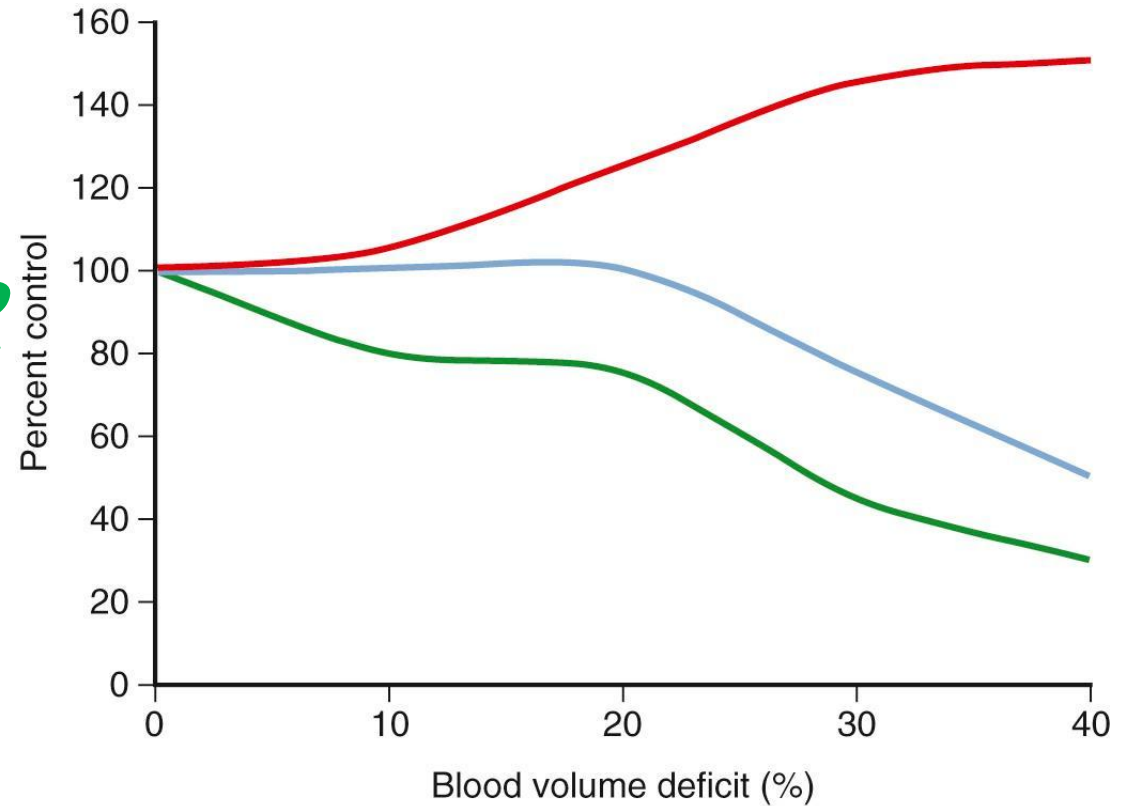
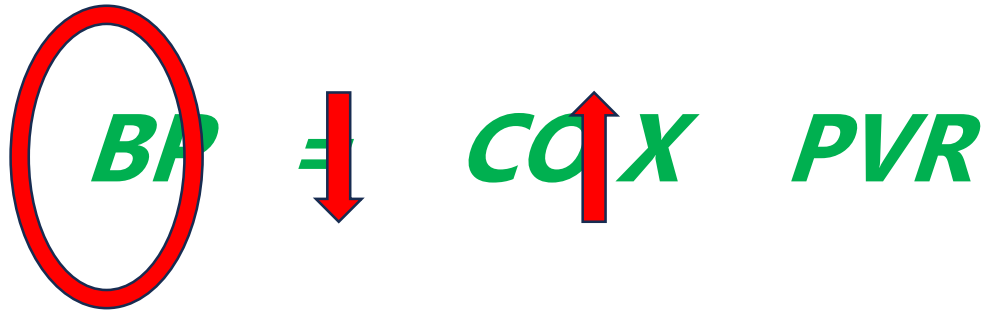


Pathophysiology- Sympetho-exitatory phase



Schiller et al. The physiology of blood loss and shock

Pathophysiology- Sympetho-exitatory phase



- Systemic vascular resistance
- Blood pressure
- Cardiac output

Pathophysiology- Sympetho-inhibitory phase

- Progressive blood loss overwhelms excitatory responses and leads to sympathetic inhibition.
- Shock induced endotheliopathy- vasoplegia, increase vascular permeability, tissue oedema, coagulopathy, MODS

Coagulopathy in trauma

- Trauma Induced Coagulopathy
- Dilutional
- Consumptive
- Hypothermia
- Acidosis
- DIC
- Massive transfusion

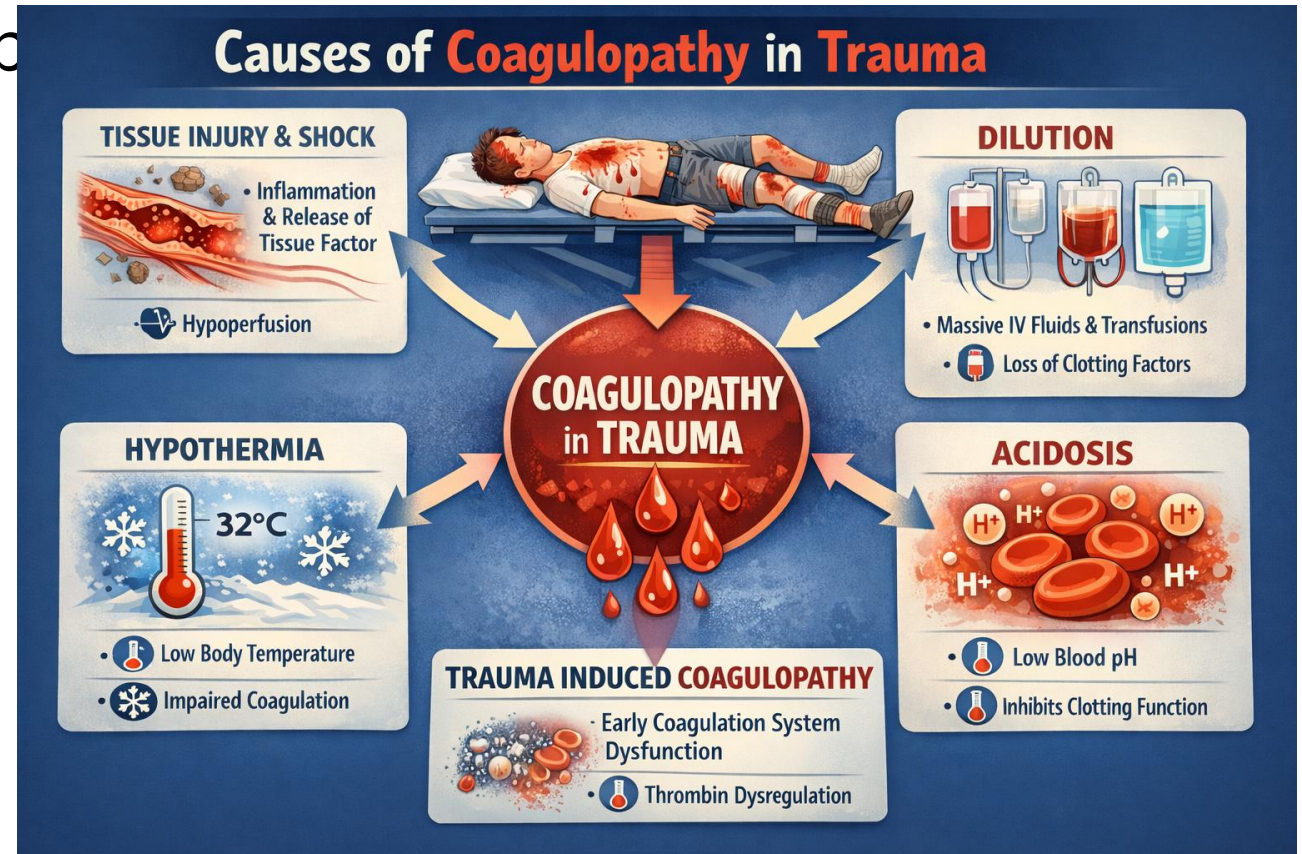


Image courtesy-ChatGPT

Bleeding

Basics- Stop the bleeding

Evidence-

- A review of six studies involving 3232 pts
- Implementing DOR is likely to have a beneficial effect on mortality and can facilitate rapid intervention in patients with severe shock.
- Prospective evaluation of 2956 severely injured paed. trauma patients in level I trauma centre
- A selective policy of resuscitating the most severely injured children in the OR can decrease mortality.

Bleeding

Guidelines

- Stop the Bleed campaign by ACS
- The time elapsed between injury and bleeding control be minimised (Grade 1B).
- Local compression of open wounds to limit life-threatening bleeding (Grade 1B). (< X > ABCDE in ATLS- 2025)
- Adjunct tourniquet use to stop life-threatening bleeding from open extremity injuries in the pre-surgical setting (Grade 1B).
- Patients with an obvious bleeding source and those presenting with haemorrhagic shock in extremis and a suspected source of bleeding undergo an immediate bleeding control procedure (Grade 1B).

Fluids

Basics- loose whole blood → transfuse fresh whole blood

Evidence- “What is old is new again”

- A prospective cross-sectional cohort study on 1377 consecutive trauma patients USA
- Whole blood (WB) group vs products-based transfusion
- In patients experiencing haemorrhagic shock, WB transfusion is associated with both improved survival and decreased overall blood utilization.

Fluids- Whole blood

- Retrospective cohort study used the ACS Trauma Quality Improvement Program databank from 2019-2020 (1394 pts).
- Receipt of a WB transfusion earlier at any time point within the first 24 hours of ED arrival was associated with improved survival in patients presenting with severe hemorrhage
- No recommendation from European guidelines
- Require strong evidence

Fluids-Whole Blood

Guidelines-

- Practice Management Guideline from the Eastern Association for the Surgery of Trauma. Sep 2024
- The risk to benefit ratio of receiving WB vs balanced component therapy was considered acceptable. They conditionally recommend using WB in adult civilian trauma patients receiving blood transfusions.

Fluids- Early PrBC and blood component therapy (BCT)

Evidence-

- A review of 309 MTP activation in a single centre with large ED
- Making blood components available quickly was associated with low rates of total component usage and low mortality for trauma patients and was not associated with overuse.
- Meta-analysis on MTP over 15 years to understand present standards of resuscitation
- Massive transfusion protocols are effective in decreasing mortality. Better resuscitation efforts were seen when blood products were readily available in the trauma bay when the patient arrived and the faster the replacement of blood, the better the outcomes

Fluids- Early PrBC and blood component therapy (BCT)

Guidelines-

Patient Blood Management Guideline for adults with critical bleeding: National Blood Authority, 2023

- In patients with critical bleeding, it is recommended that institutions use a **major haemorrhage protocol** that includes a multidisciplinary approach to haemorrhage control, correction of coagulopathy and normalisation of physiological derangement.
- European Guidelines on management of major bleeding
- ACS-Trauma Quality Improvement Program (TQIP)
- International Society of Blood Transfusion
- ATLS guidelines

Optimal ratio of blood components

Basic- Loose whole blood, but transfuse components. Requires appropriate

ratio to be determined

Evidence-

- Higher Plasma(1):Platelets(1):pRBC(2) ratio in early in resuscitation decreased mortality (PROMMTT study)
- No difference in mortality between 1:1:2 with 1:1:1 ratio (PROPPR- RCT 608 pts)

Guidelines-

- FFP or pathogen-inactivated FFP in FFP/pRBC ratio of at least 1:2 as needed (Grade 1C)
- In addition, high platelet/pRBC ratio (Grade 1 B)

Crystalloids and colloids

Basics- Loose blood, not water and electrolytes

- Dilution, Coagulopathy, acidosis, hypothermia, SE disturbances, tissue oedema, allergic reactions, AKI

Evidence-

- RCT- 598 pts (USA). Standard fluid resuscitation vs no fluid resuscitation prior to surgery
- For hypotensive patients with penetrating torso injuries, delay of aggressive fluid resuscitation until operative intervention improves the outcome

Immediate vs delayed fluid resuscitation for hypotensive patients with penetrating torso injuries: William H Bickell et.al. New England Journal of Medicine, Oct 1994.

Crystalloids and colloids

Guidelines-

- European guidelines on major bleeding
- Hypotensive resuscitation is to **avoid overzealous use of all types of fluids especially crystalloids/colloids** until bleeding is controlled.
- In the initial phase following trauma, we recommend the use of a **restricted volume replacement strategy** with a target systolic blood pressure of 80–90 mmHg (mean arterial pressure 50–60 mmHg) until major bleeding has been stopped.
- 0.9% saline or balanced crystalloids (avoid colloids)
- ATLS- limited to 0.5-1.0 l

Use of vasopressors

Basics- Vassopressors- Convert unstressed to stressed
Sympetho-inhibitory phase- may have a place **if volume is optimised**

vasoconstriction, perfusion reduced.

cellular hypoperfusion, false sense of security (BP)

Evidence-

- Retrospective cohort study. >3500 traumatic haemorrhagic shock patients in 260 emergency hospitals in Japan over 10 years
- **Use of vasopressor for traumatic haemorrhagic shock was associated with mortality after controlling for biases (trauma severity; volume of fluid resuscitation).**

Use of vasopressors

- > 1300 pts admitted to single level 1 ICU
- Mortality was 43.6% (153) in the Vaso (+) versus 4.2% (42) in the Vaso (–) group. **Vasopressor exposure was associated with death independent of injury severity** and mortality is increased regardless of fluid status.

Early vasopressor use in critical injury is associated with mortality independent from volume status: David S Plurad et.al. The Journal of Trauma, Infection and Critical care 71(3):p565-572, September 2011

Use of vasopressors

- Small randomised study (78 pts)
- Infusion of low-dose vasopressin maintained elevated serum vasopressin levels and decreased fluid requirements after injury. no difference in mortality

Impact of Low-dose Vasopressin on Trauma Outcome: Prospective Randomized Study Stephen M. et.al. World J Surg (2011)

- Single centre RCT on 100 pts
- Low-dose AVP during the resuscitation of trauma patients in hemorrhagic shock decreases blood product requirements. Both groups had similar mortality and complication rates

Effect of Low-Dose Supplementation of Arginine Vasopressin on Need for Blood Product Transfusions in Patients With Trauma and Hemorrhagic Shock.A Randomized Clinical Trial:Carrie A. Sims et.al. JAMA Surg. August 28, 2019

Use of vasopressors

Guidelines-

- If a restricted volume replacement strategy does not achieve the target blood pressure, we recommend the administration of noradrenaline in addition to fluids to maintain target arterial pressure (grade 1 C)

Vasopressors should be added cautiously in the presence of vasoplegia after assurance of adequate fluid resuscitation.

Tranexamic acid

Basic- Hyperfibrinolysis- coagulopathy

Evidence-

- CRASH 2/ CRASH 3
- Early administration of TXA safely reduced the risk of death in bleeding trauma patients and is highly cost-effective. (16% vs 14.5%)
- Treatment given after 3 hours seemed to increase the risk of death due to bleeding [144 out of 3272 patients (4.4%) died in the TXA group vs 103 out of 3362 patients (3.1%) in the placebo group.

Guidelines- All most all guidelines of Trauma resuscitation

Prevention of coagulopathy, acidosis, hypothermia, hypocalcemia (lethal diamond)

Result of “good” trauma care

- Early identification and bleeding control
- Early tranexamic acid
- Minimising crystalloids
- Haemostatic resuscitation
- Prevention of hypothermia

Summary

- Resuscitation of trauma requires meticulous understanding of basic pathophysiology and the knowledge of updated evidence
- Treatment is to stop the bleeding with haemostatic resuscitation while preventing hypothermia, coagulopathy, acidosis and hypocalcemia