Fluid and Blood Transfusion in Trauma

CAHFER GÜLOĞLU

Dicle University Faculty of Medicine
Department of Emergency Medicine
DIYARBAKIR

Fluid and Blood Transfusion in Trauma

- Definition of shock in trauma
- Recognition of shock in trauma
- Fluid resuscitation in trauma
  - Where is it?
  - Which fluid?
  - Blood and blood products, how and when?
- Developing treatments for hemorrhage?
- Goals of fluid resuscitation in trauma

Fluid and Blood Transfusion in Trauma

- Mortality rate due to acute bleeding after traumatic injury is 30-40 %
- Hemorrhagic shock is pathologic state in which intravascular volume and oxygen delivery are impaired
- Hemorrhage remains the major cause of preventable death after trauma
- The first goal of treatment are controlled of bleeding and resusicaition of intravasculer volüm

Definition of shock in trauma

- Shock refers to inadequate tissue perfusion
- Early diagnosis of shock

Hypovolemic shock: symptoms + signs

Class Blood loss (ml) (%)	Class I < 750 <15 %
Pulse rate	<100 min elevated
Blood pressure	Normal
pulse pressure	Normal
respiratory rate	14-20
Mental status	Slightly anxious

Hypovolemic shock: symptoms + signs

- Shock index is the ratio of systolic blood pressure to heart rate
- Normal values, 0.5-0.7
- Shock index in patients with normal vital signs 0.9 's to be above
  - Quick treatment required
  - Found to be significant in determining admission to the hospital and intensive care unit*

***Rady MY**, Smithline HA, Blake H, Nowak R, Rivers E.
A comparison of the shock index and conventional vital signs to identify acute, critical illness in the emergency department. Ann Emerg Med. 1994 Oct;24(4):685-90.
Erratum in: Ann Emerg Med 1994 Dec;24(6):1208.

Hypovolemic shock: symptoms + signs

Class Blood loss (ml) (%)	Class I < 750 <15 %	Class II 750 -1500 15-30%
Pulse rate	<100 min elevated	>100
Blood pressure	Normal	Normal
pulse pressure	Normal	Decreased
respiratory rate	14-20	20-30
Mental status	Slightly anxious	mildly anxious

***Heart rate** is more sensitive than hypotension for an indicator of poor perfusion,*

Hypotension is a clear indication of decompensated shock
***Limit* < 90 mmHg**

The skin may be cool and clammy,
capillary refill may be delayed(>2 seconds)

Hypovolemic shock: symptoms + signs

Class Blood loss (ml) (%)	Class I < 750 <15 %	Class II 750 -1500 15-30%	Class III 1500-2000 30-40%
Pulse rate	<100 min elevated	>100	>120
Blood pressure	Normal	Normal	Decreased SBP less than 90 mmHg
pulse pressure	Normal	Decreased	Decreased
respiratory rate	14-20	20-30	30-40
Mental status	Slightly anxious	mildly anxious	Anxious+ confused

changes in **mental** status.

urine output is diminished. **Capillary refill** is delayed.

Hypovolemic shock: symptoms + signs

Class Blood loss (ml) (%)	Class I < 750 <15 %	Class II 750 -1500 15-30%	Class III 1500-2000 30-40%	Class IV >2000 >40 %
Pulse rate	<100 min elevated	>100	>120	>140
Blood pressure	Normal	Normal	Decreased	Decreased
pulse pressure	Normal	Decreased	Decreased	Decreased
respiratory rate	14-20	20-30	30-40	>35
Mental status	Slightly anxious	mildly anxious	Anxious+ confused	Confused+ lethargic

Hypovolemic shock: symptoms + signs

Metabolic markers

- Metabolic acidosis
- Increased lactate
- Increased base deficit

Fluid resuscitation in trauma

- Which fluid, where the given?
- Fluid resuscitation: Pre-hospital

Goal
1. Airway protection, adequate ventilation and oxygenation
2. Control of external bleeding (direct pressure, tourniquet)
2. The protection of the spinal cord
3. Rapid transfer to the center of trauma

Pre-hospital

• No need to open the iv route (the exact delay treatment)

• If the iv route is open, fluid administration is limited

Fluid resuscitation in trauma

- Trendelenburg pozisyonu ?
- Does not improve cardiac performance compared with the supine position.
- It may worsen pulmonary gas exchange
- and predispose to aspiration.

The patient's legs are removed above level of the heart in the supine position can be effective

Fluid resuscitation in trauma:
Emergency department

- ABC stabilization
- If there is bleeding, identify the source of bleeding (tourniquet in amputation)

Evaluation and treatment of patients with severe trauma are performed simultaneously

Fluid resuscitation in trauma:

Emergency department

- Provided two or more large-diameter lumen of peripheral vascular path
- Infusion rate of crystalloid fluid depends on the pressure applied and the catheter diameter

Diameter of catheter	Colour	length (mm)	mL/min
14 G		45 mm	325 mL / dk
16 G		45 mm	200 mL / dk
18 G		45 mm	100 mL / dk
20 G		32 mm	58 mL / dk
22 G		25 mm	32 mL / dk

when there is difficulty placing an IV catheter, Intraosseous devices can be placed rapidly and offer an effective alternative

Fluid resuscitation in trauma:

Emergency department

- **Diagnostic Studies**
- Hemoglobin/hematocrit
- Type and **cross-match**
- Lactate level and base deficit
- Coagulation profile PT, PTT and INR
- Toxicology studies

LABORATORY VALUE OF ANY NOT ENOUGH SENSITIVE and SPECIFIC

The hct/Hb is most helpful when measured serially to assess ongoing hemorrhage.

Fluid resuscitation in trauma:
Emergency department

- **Imaging Studies**
- Bedside Ultrasound

- extended FAST (eFAST)
  - free intraabdominal fluid , pericardial effusion
  - pneumothorax and hemothorax

- **DPL(diagnostic peritoneal lavage)**

Fluid resuscitation in trauma:
Emergency department

- **Imaging Studies**
- Diagnostic Radiography And Computed Tomography Scans
  - Chest radiography
  - Pelvis and cervical spine x-rays
  - Computed tomography (CT)

CT scans have no role in the initial evaluation or resuscitation of trauma patients with hemorrhagic shock

Fluid resuscitation in trauma:

Emergency department

Fluid resuscitation in trauma:
Emergency department

Colloids

- Dextran
- Gelatin(Gelofusine)
- Hydroxy Ethyl Starch(HES)
- Albumin

- Have high molecular weights
- Plasma oncotic pressure increases
- Colloids are effective to increase intravascular volume and may maintain plasma oncotic pressure

Fluid resuscitation in trauma:

Emergency department

Saline (SF)

- 154 mEq / L **Na**
- 154 mEq / L **Cl**
- 308 mOsm / L
- pH 4 – 5
- No support free water
- hypernatremic & hyperchloremic

Ringer's lactate (LR)

- 130 mEq / L **Na**
- 109 mEq / L **Cl**
- 4.0 mEq / L **K**
- 3.0 meq / L **Ca**
- 28 mEq / L **lactate**
- 273 mOsm / L
- pH 6.5 - 7.0
- In addition to the 100 cc of

There is no evidence showing the superiority of both the fluid to each other (3:1)
Both fluid causes increased activation of neutrophils
LR solution increases cytokine release and may increase metabolic alkalosis when given in large
NS causes hyperchloremic acidosis.

Fluid resuscitation in trauma:
Emergency department

0.5% isotonic

- 77 mEq / L **Na**
- 77 mEq / L **Cl**
- 154 mOsm / L
- pH 4 – 5
- Support the free water has

5 % dextrose

- 5 % glucose (in water)
- 50 Gram /L
- 200 Kalori / L
- pH 4.5
- 252 mOsm / L

Patients who are sensitive to salt loading

Patients who need free water

Fluid resuscitation in trauma:
Emergency department

Hypertonic fluids

- 513 mEq / L Na
- 513meq / L Cl
- 1026 mOsm / L

Seizures due to hyponatremia

Not helpful than saline in trauma, burns and undergoing surgery patients

Fluid resuscitation in trauma:

Emergency department

- Which is the best fluid?

Crystalloid

Transfusion can be started if patient is hemodynamically unstabl and the blood is ready,

-- There is no difference between them in terms of survival
- Because of the high cost of colloidal agents,
- Crystalloid solutions remains the recommended fluids

Fluid resuscitation in trauma:
Emergency department

- **Early and aggressive fluid therapy in the patients with bleeding;**
  - lead to the dislodging of soft clots
  - Dilutional coagulopathy
  - Leads to an increase in mortality and hemorrhage

Fluid resuscitation in trauma:

Emergency department

Delayed fluid resuscitation

- is no given fluid until definitively control of bleeding

Controlled hypotension

- is given fluid to be as target blood pressure lower than normal

No useful these approaches is sufficient evidence that

contraindicated in patients with Traumatic brain injury (TBI) increased mortality

Patients with penetrating trauma to the chest or abdomen for whom definitive care is immediately available may benefit from delayed resuscitation.

These approaches are appropriate when determining whether

The patient's mental status and Traumatic brain injury,
Type of injury (penetrating versus blunt),
Severity of injury (eg, ongoing hemorrhage),
and proximity to a trauma center.

Blood transfusion

- Red blood cells (PRBC) be transfused if hemodynamics fail to improve after the administration of 2 to 3 L (or greater than 50 mL/kg) of crystalloid.
  - Typed and cross-matched PRBCs are best (40 min ???)
  - If there is not enough time group-specific blood (<20 minutes), or O (-) blood is preferred
    - rh-positive 0 blood for man and women who are not in childbearing age
    - Rh-negative 0 blood for women who are in childbearing age.
  - Ototransfusion

Massive Bleeding

- Massive blood transfusion
- Anticipation that > 10 units PRBCs will be required in resuscitation
- Patient will require 4 or more units of PRBCs over one hour


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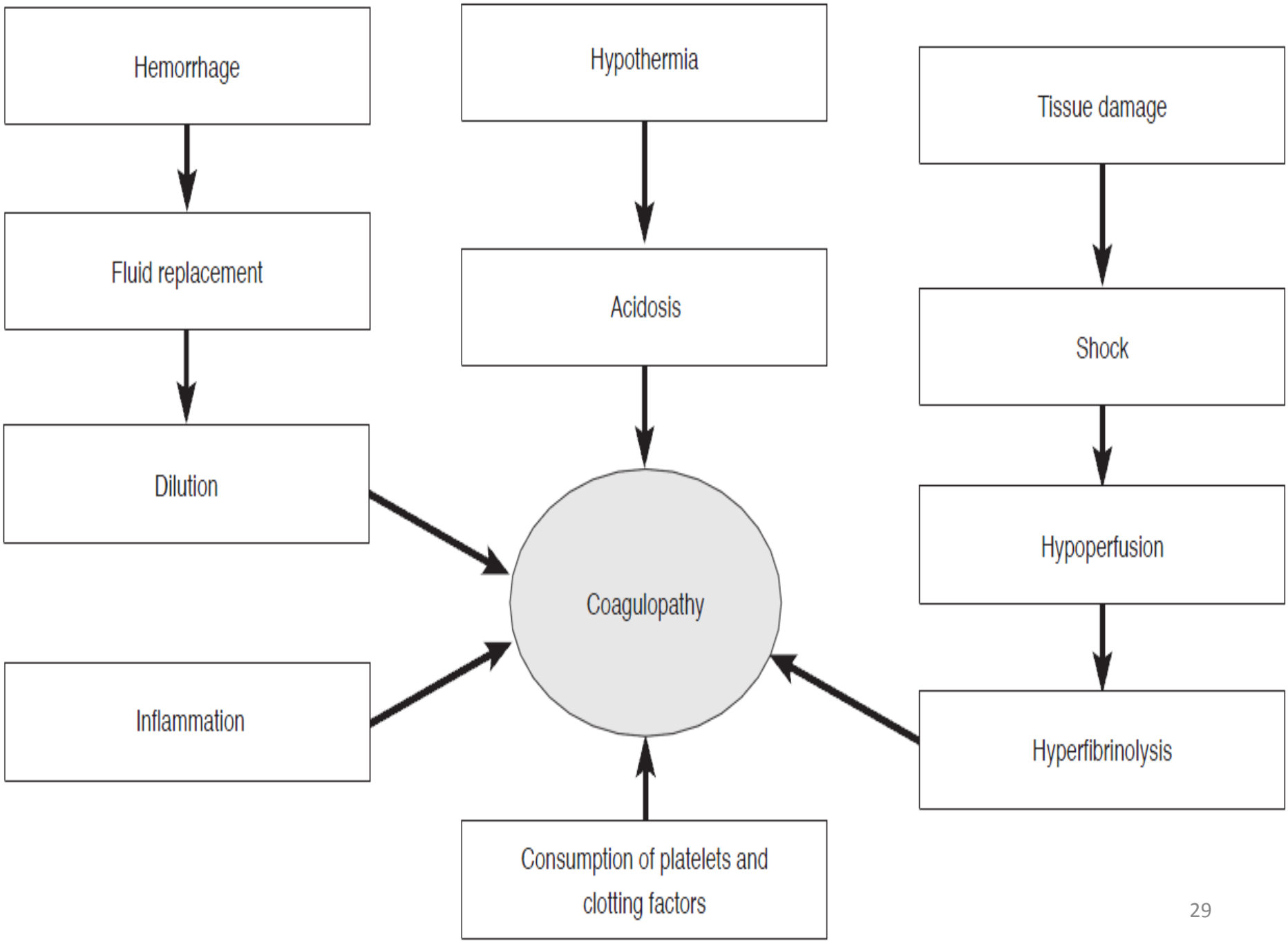

Hemorrhage
Fluid replacement
Dilution
Hypothermia
Acidosis
Tissue damage
Shock
Hypoperfusion
Coagulopathy
Inflammation
Hyperfibrinolysis
Consumption of platelets and clotting factors

Massive Bleeding: **Coagulopathy**

- Begin treatment of trauma-associated coagulopathy as soon as the patient arrives in the ED.

- Without delay in patients undergoing massive blood transfusion blood products
  - Fresh frozen plasma (FFP)
  - Platelet transfusions should be

Massive Bleeding: **Coagulopathy**

Table 4. Examples Of Massive Transfusion Protocols

Protocol	Salient Features
Riskin et al[102]	• Definition of massive transfusion: anticipation that > 10 units PRBCs will be required in resuscitation • Who can activate the protocol: anyone • FFP:PRBC ratio: 1:1.5 • Given in packages of 6 units PRBCs, 4 units FFP, and 1 unit apheresis platelets
Cotton et al[103]	• Definition of massive transfusion: attending surgeon thinks patient will need > 10 units of blood • Who can activate the protocol: attending surgeon • FFP:PRBC ratio: initially ~1:2.5; subsequently, 1:1.5 • Given in packages. Initial package: 10 units PRBCs, 4 units FFP, and 2 units single-donor platelets. All subsequent packages: 6 units PRBCs, 4 units FFP, and 2 units single-donor platelets
Dente et al[104]	• Definition of massive transfusion: > 10 units of PRBCs anticipated in 24 hours • Who can activate the protocol: ED, surgery, anesthesia, ICU • FFP:PRBC ratio: 1:1 • Given in packages of 6 units PRBCs, 6 units FFP; 1 unit apheresis platelets given with every other package delivery

EB MEDICINE
EMERGENCY MEDICINE PRACTICE
EBMEDICINE.NET
AN EVIDENCE-BASED APPROACH TO EMERGENCY MEDICINE
Traumatic Hemorrhagic Shock: Advances In Fluid Management
November 2011
Volume 13, Number 11
Author
David Cherkas, MD, FACEP
Assistant Residency Director, Department of Emergency Medicine,

- ***Recommended rate;***
- ***PRBC, FFP, and random donor platelets***
- ***1:1:1***

- **If you use apheresis platelet**
- ***6:6:1***

- 1 unit of apheresis platelets is equivalent to 6 units of nonapheresis (ie, random donor or whole-blood derived) platelets.

- ***Hypothermia must be controlled during transfusions***

Traumatic fluid resuscitation : developing treatments for hemorrhage

- Hemostatic agents
  - chitosan dressing,
  - QuickClot® powder,
  - and fibrin sealant dressing
- Recombinant factor VIIa
- Red blood cell substitutes
  - hemoglobin-based oxygen carriers,
  - Perfluorocarbons
- Antifibrinolytic agents
  - Tranexamic acid

The Role Of Tranexamic Acid In Hemorrhagic Shock

- **Tranexamic Acid**

- In 2010, CRASH-2 (Shakur et al ‘s) trial was done to evaluate Tranexamic acid (TXA) for the treatment of significant hemorrhage.

Shakur H, Roberts I, Bautista R, et al. Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial. *Lancet.* 2010;376(9734):23-32. **(Prospective randomized doubleblind; 20,211 patients)**

The Role Of Tranexamic Acid In Hemorrhagic Shock

- Tranexamic acid is an antifibrinolytic that inhibits both plasminogen activation and plasmin activity and
- had previously been shown to reduce bleeding in patients undergoing elective surgery.
  - 1 gram over 10 minutes
  - followed by a 1-g infusion over 8 hours.

The Role Of Tranexamic Acid In Hemorrhagic Shock

Lancet. 2010 Jul 3;376(9734):23-32. doi: 10.1016/S0140-6736(10)60835-5. Epub 2010 Jun 14.

Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial.

CRASH-2 trial collaborators, Shakur H, Roberts I, Bautista R, Caballero J, Coats T, Dewan Y, El-Sayed H, Gogichaishvili T, Gupta S, Herrera J, Hunt B, Iribhogbe P, Izurieta M, Khamis H, Komolafe E, Marrero MA, Mejía-Mantilla J, Miranda J, Morales C, Olaomi O, Olldashi F, Perel P, Peto R, Ramana PV, Ravi RR, Yutthakasemsunt S

Conclusion:

- TXA (given in the first hour) reduce the risk of death by 32% in trauma patients with severe bleeding

--The use of TXA in bleeding patients is recommended

(myocardial infarction, stroke and pulmonary embolism), multiorgan failure, head injury, and other. All analyses were by intention to treat. This study is registered as ISRCTN86750102, Clinicaltrials.govNCT00375258, and South African Clinical Trial RegisterDOH-27-0607-1919.

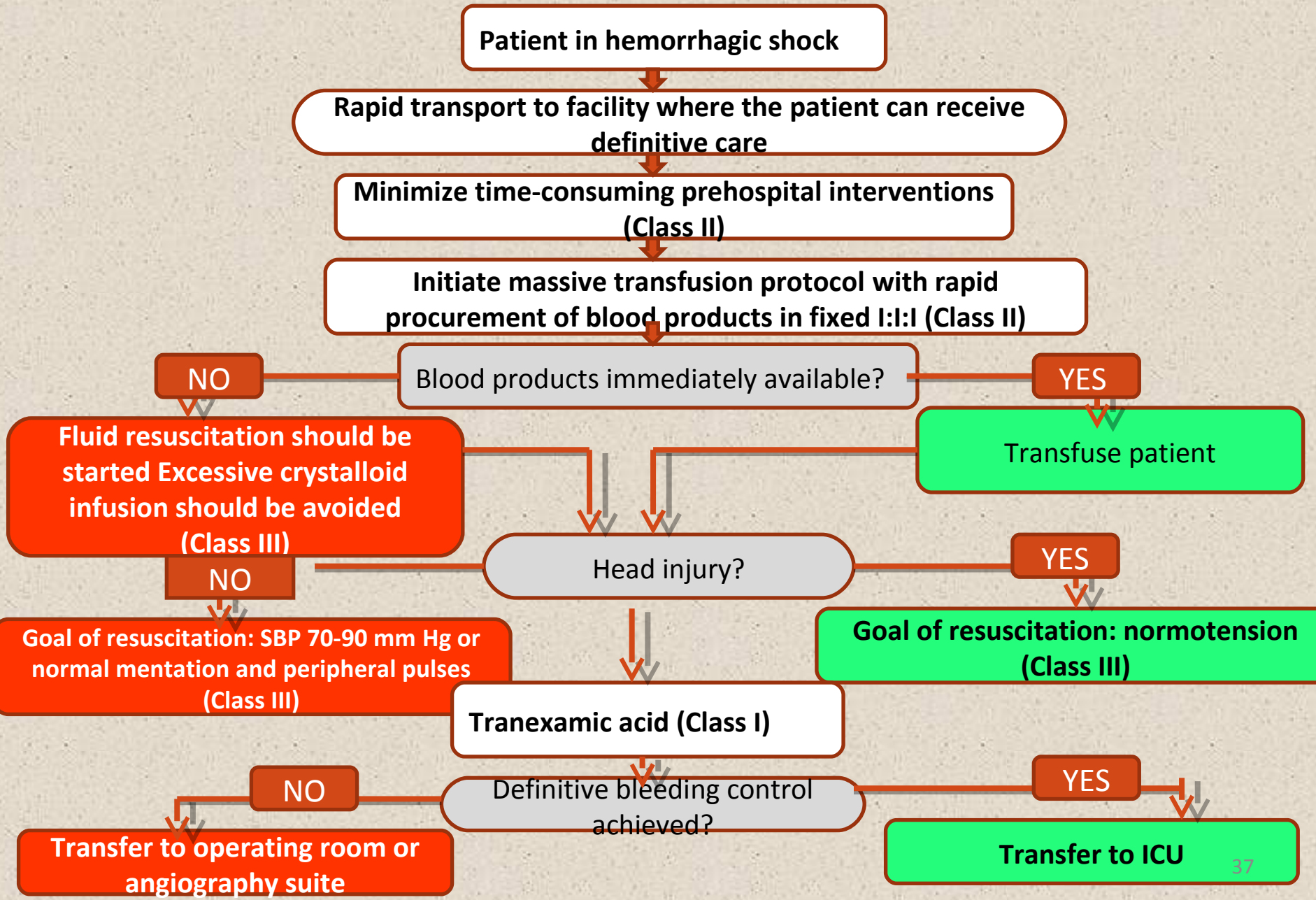
FINDINGS: 10 096 patients were allocated to tranexamic acid and 10 115 to placebo, of whom 10 060 and 10 067, respectively, were analysed. All-cause mortality was significantly reduced with tranexamic acid (1463 [14.5%] tranexamic acid group vs 1613 [16.0%] placebo group; relative risk

However, tranexamic acid appeared to increase the risk of fatal hemorrhage when it was administered after three hours.

Traumatic fluid resuscitation gaols

- Blood pressure: maintain MAP above 65 mmHg for penetrating trauma, and above 105 mmHg for blunt trauma (particullarly TBI)
- Heart rate: maintain between 60 and 100 beats per minute
- Oxygen saturation: maintain above 94 percent
- Urine output: maintain above 0.5 mL/kg/hour
- Central venous pressure: maintain between 8 and 12 mmHg
- Lactate and base deficit: Monitor serum lactate and serum bicarbonate every four hours to ensure end-organ perfusion is adequate or improving with resuscitation
- Mixed central venous oxygen saturation: maintain above 70 percent

There is no a parameter to assess perfusion. All parameters must be used


Patient in hemorrhagic shock
Rapid transport to facility where the patient can receive definitive care
Minimize time-consuming prehospital interventions (Class II)
Initiate massive transfusion protocol with rapid procurement of blood products in fixed I:I:I (Class II)
Blood products immediately available?
NO
YES
Fluid resuscitation should be started Excessive crystalloid infusion should be avoided (Class III)
Transfuse patient
Head injury?
NO
YES
Goal of resuscitation: SBP 70-90 mm Hg or normal mentation and peripheral pulses (Class III)
Goal of resuscitation: normotension (Class III)
Tranexamic acid (Class I)
Definitive bleeding control achieved?
NO
YES
Transfer to operating room or angiography suite
Transfer to ICU

THANK YOU


İNSAN KENDİ KABUĞUNA ÇEKİLMİŞSE
İÇİNDE FIRTINALAR KOPUYOR DEMEKTİR