SHOCK IN TRAUMA

Chan Boon Kian

OUTLINES

- DEFINITION OF SHOCK
- EPIDEMIOLOGY
- TYPES
- PATHOPHYSIOLOGY - ACOT
- SIGNS AND SYMPTOMS OF SHOCKS
- APPROACH AND MANAGEMENTS OF SHOCK
- RESUSCITATION GOALS AND COMPONENTS
- DAMAGE CONTROL RESUSCITATIONS
- REFERENCES

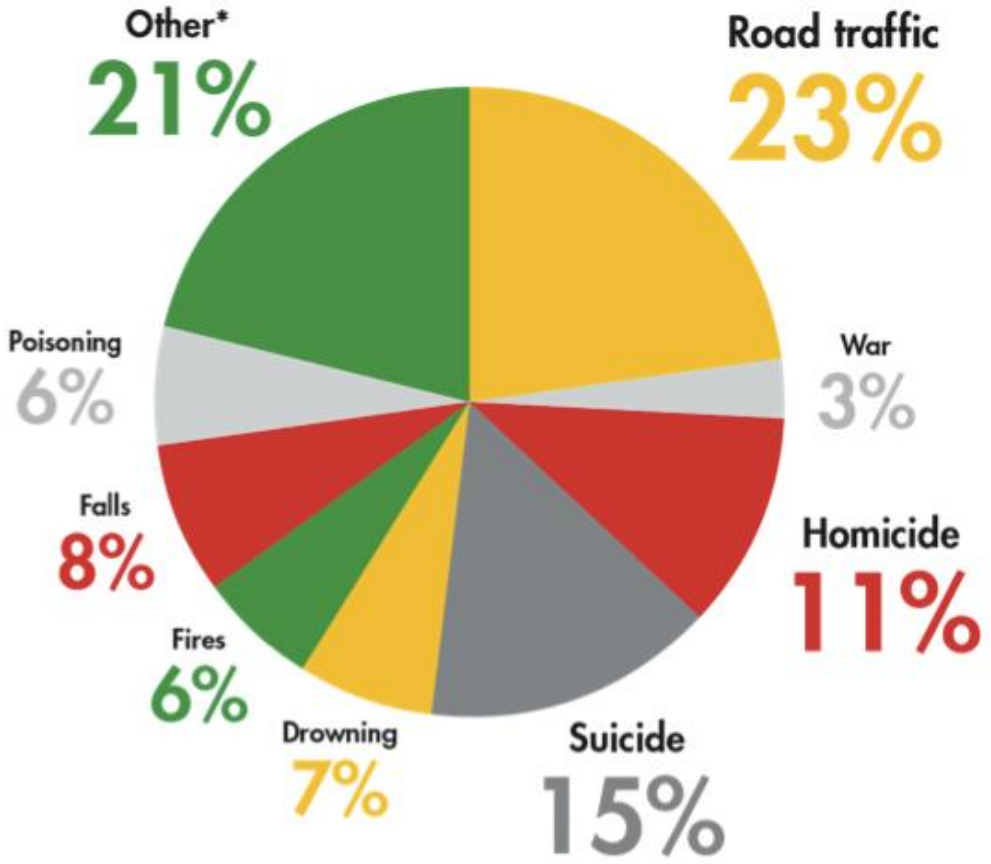
DEFINITION OF SHOCK

PATHOPHYSIOLOGY

Shock is a state of circulatory insufficiency that creates an imbalance between tissue oxygen supply (delivery) and oxygen demand (consumption) resulting in end-organ dysfunction. Reduction in effective perfusion may be due to a local or global delivery deficiency or utilization deficiency with suboptimal substrate at the cellular or subcellular level.[5] The mechanisms that can result in shock are frequently divided into four categories: (1) hypovolemic, (2) cardiogenic, (3) distributive, and (4) obstructive.

Tintinalli's Emergency Medicine 8th 2016, Chapter 12, pg. 63

EPIDEMIOLOGY

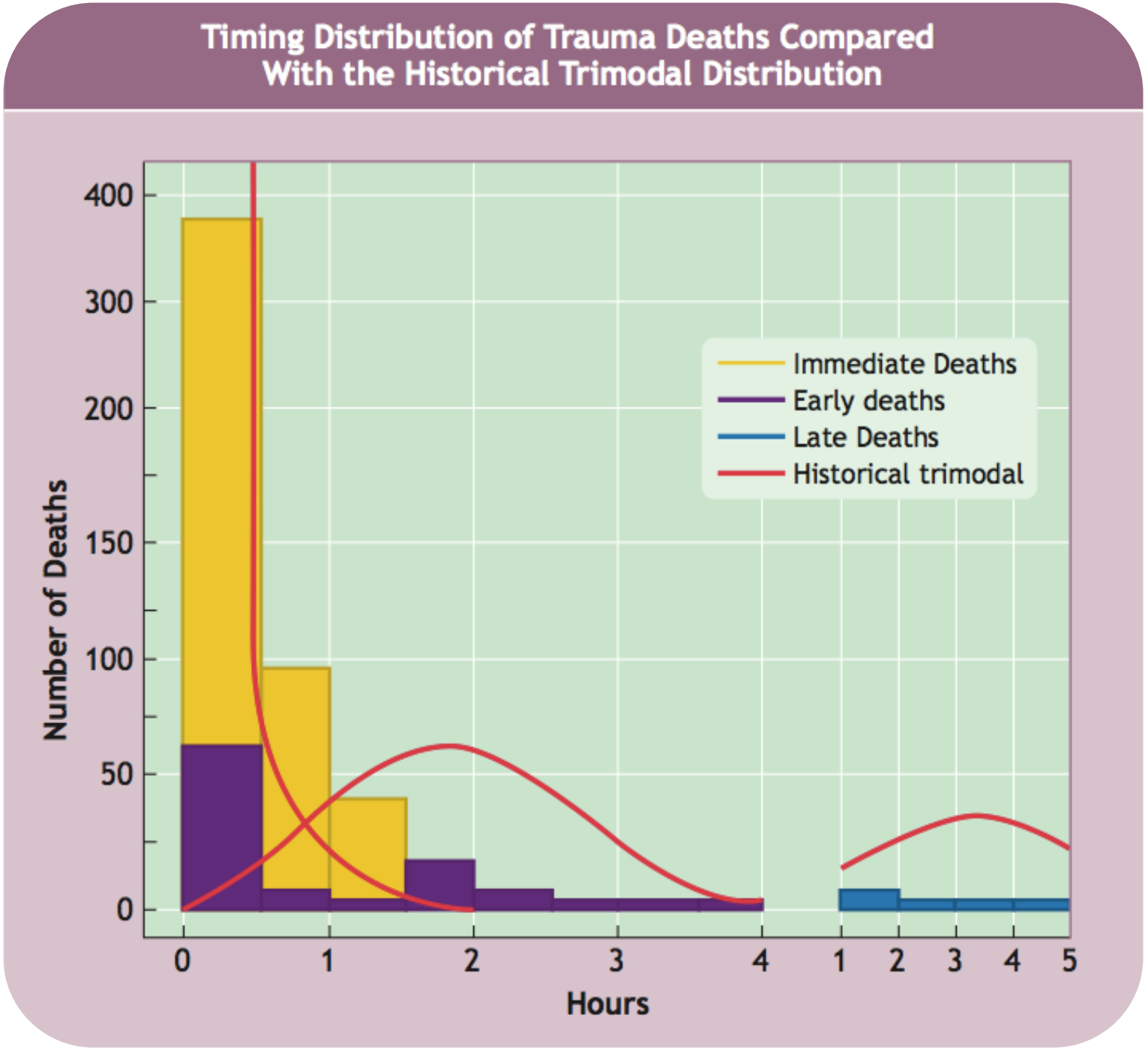


Global Burden of Disease, 2004

GENEVA: WHO Department of Injuries and Violence Prevention, 2010

- *50% die before they reach hospital*
- *Uncontrolled hemorrhage or MOF-related shock is the cause of death in about 40% of deaths*
- *20% of hemorrhagic deaths potentially preventable*

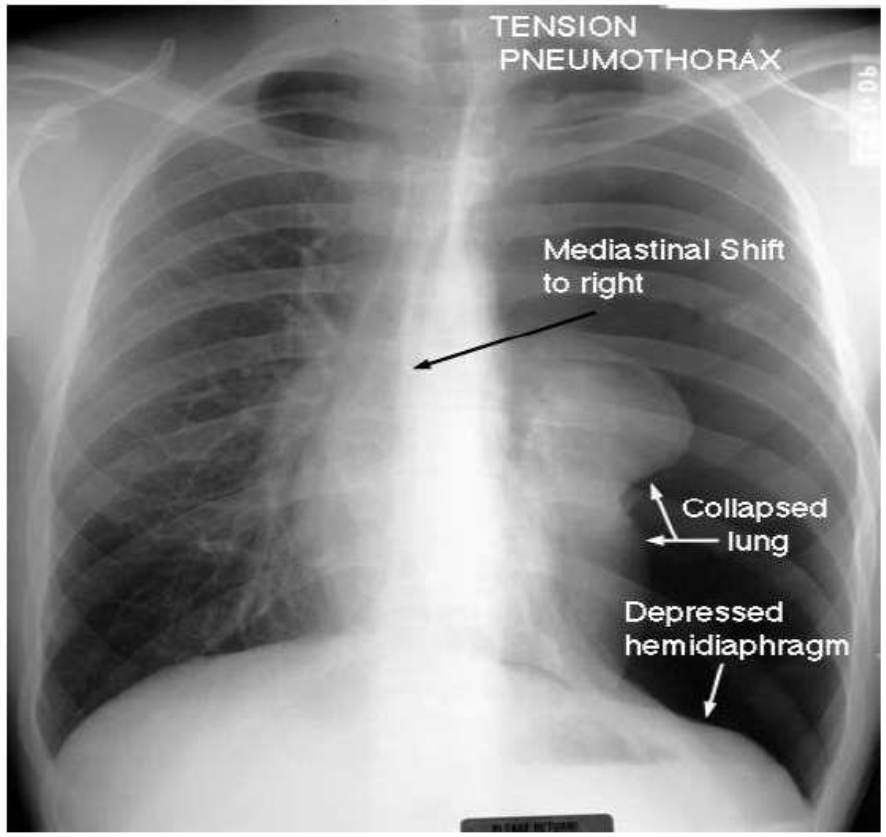
Dubick MA, et al. US Army Institute of Surgical Research, 2006; report # A508184



TRIMODAL DEATH DISTRIBUTION

Gunst M, Ghaemmaghami V, Gruszecki A, et al.

Changing epidemiology of trauma deaths leads to a bimodal distribution. Proc (Baylor Univ Med Cent), 2010.



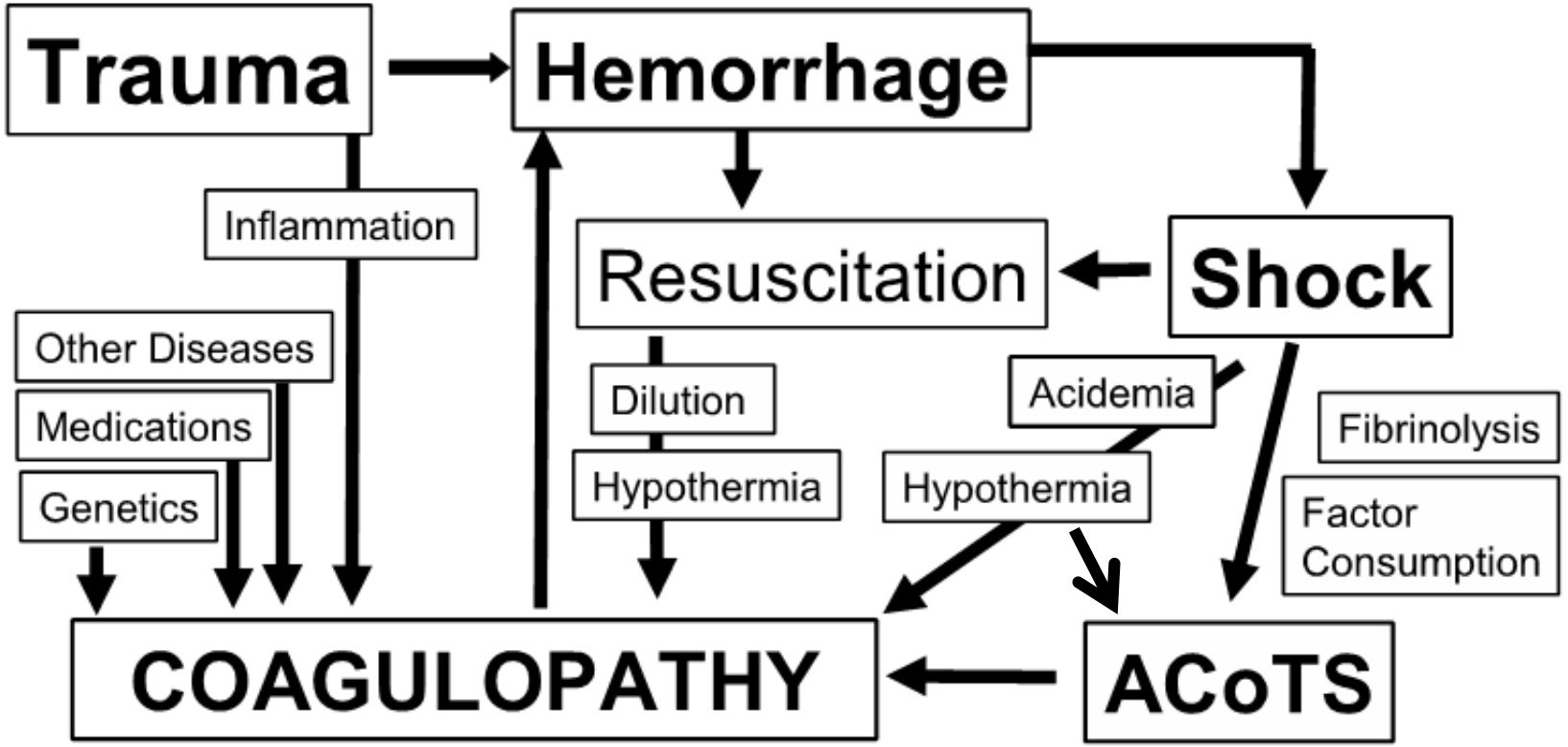
TYPES

- Hypovolemic,
- Cardiogenic (relative),
- Distributive,
- Obstructive.

PATHOPHYSIOLOGY

- Trauma-induced coagulopathy / Acute traumatic coagulopathy (ATC)
  - Tissue trauma, inflammation, hypoperfusion/shock (→ activate protein C), neurohumural system activation.
  - Weibel-Palade bodies (stores vWF & P-selectin) stimulate other glycolayx enzymes, anti-thrombin III, ACE, etc.
- Iatrogenic coagulopathy (IC):
  - too much crystalloid → lethal triads, haemodilution → vicious cycle.

TRAUMA INDUCED COAGULOPATHY



Hess JR, Brohi K, Dutton RP; et al. The coagulopathy of trauma: a review of mechanisms, J Trauma 2008 654 748-754.

ACOTS

ISRN Critical Care
Volume 2013, Article ID 783478, 7 pages
http://dx.doi.org/10.5402/2013/783478

Review Article

Treatment of Acute Coagulopathy Associated with Trauma

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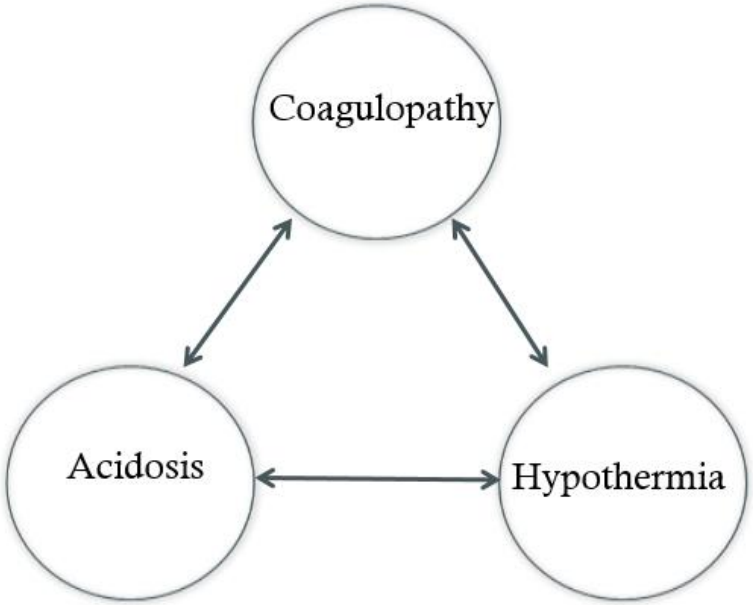
Received 4 April 2013; Accepted 8 May 2013

Academic Editors: A. M. Japiassu, A. K. Mankan, and N. Q. Nguyen

*ACoTS is associated with **INCREASED MORTALITY (up to 8 X and 4 X increase at 24 hours and 30 days resp**.), more blood transfusions, longer ICU and hospital stay, and higher incidence of multiple organ failure.*

Lethal Triad



LETHAL TRIAD

(ATLS 10th Edition)

SIGNS & SYMPTOMS OF SHOCK

- Tachycardia
- Tachypnea
- Decreased capillary refill
- Hypotension
- Narrow pulse pressure
- Altered mental status

- Cyanosis, pallor,
- Diaphoresis
- Hypothermia
- Decreased urine output
- Absent pulse oximetry signal*
- +FAST/CT*

SIGNS AND SYMPTOMS IN SUMMARY

TABLE 3-1 SIGNS AND SYMPTOMS OF HEMORRHAGE BY CLASS

PARAMETER	CLASS I	CLASS II (MILD)	CLASS III (MODERATE)	CLASS IV (SEVERE)
Approximate blood loss	<15%	15–30%	31–40%	>40%
Heart rate	↔	↔/↑	↑	↑/↑↑
Blood pressure	↔	↔	↔/↓	↓
Pulse pressure	↔	↓	↓	↓
Respiratory rate	↔	↔	↔/↑	↑
Urine output	↔	↔	↓	↓↓
Glasgow Coma Scale score	↔	↔	↓	↓
Base deficit[a]	0 to –2 mEq/L	–2 to –6 mEq/L	–6 to –10 mEq/L	–10 mEq/L or less
Need for blood products	Monitor	Possible	Yes	Massive Transfusion Protocol

[a] Base excess is the quantity of base (HCO_3^-, in mEq/L) that is above or below the normal range in the body. A negative number is called a base deficit and indicates metabolic acidosis.

Data from: Mutschler A, Nienaber U, Brockamp T, et al. A critical reappraisal of the ATLS classification of hypovolaemic shock: does it really reflect clinical reality? *Resuscitation* 2013,84:309–313.

(ATLS 10th Edition)

TACHYCARDIA

- > 160 – Infants
- > 140 – Preschool child
- > 120 – School age to puberty
- > 100 – Adult

- Age
- Athletes
- Pregnancy
- Medications
- Hypothermia
- Pacemaker

(ATLS 10th Edition)

CATEGORIES	TYPES	SSX	ASSESSMENT	INTERVENTION
HYPOVOLEMIC	Hemorrhagic Chest, Abdomen, Pelvis, Retroperitoneal, Extremities, TAI	Tachy/ Brady Pallor, Weak thready pulse, Cold Clammy Skin Normal/ Low GCS CRT prolonged	External Bleeding source Distended abdomen DPL/ US Vaginal Examination	Haemorrhage control TXA Secure A,B 1-2 L Crystalloids Bloods - MTP
CARDIOGENIC	M. Infarction	SOB/ Chest Pain radiating to arm/ neck Numbness	ECG: STEMI/ NSTEMI Low GCS	Secure A,B Morphine titrate S/L Nitrates 1/1(after volume status addrs) Treat Arrythmias CPR as needed Alert Cardiologist
	Blunt Cardiac Injury	SSX of heart failure	Sternal #/tender Haemo/Pneumothorax Arrythmias	Secure A,B Treat Dysrhythmias Surgical repair(CTC)

(ATLS 9th & 10th Edition)

CATEGORIES	TYPES	SSX	ASSESSMENT	INTERVENTION
OBSTRUCTIVE	T. Pneumothorax	Tachycardia, SOB/ Chest pain Asymptomatic	Tracheal Deviation Distended neck vein Tympany Absent breath sounds	Needle Decompression Chest Tube
	Cardiac Tamponade	Crackles, Tachypnoea	Beck Triad ECG: Electrical Alternans / PEA Pulsus Paradoxus Ultrasound	Pericardiocentesis Activate CTS IV Dopamine 0.5mcg/kg/min IV NS 500cc
	Massive Hemothorax	Tachycardia SOB/Chest Pain	Tracheal Deviation Flat neck veins Dullness percussion Absent breath sounds	Chest tube, Fluids + Bloods Alert surgical team
DISTRIBUTIVE	Neurogenic shock	Full bounding pulse, Wide pulse pressure Tachypnoea, Bradycardia Pink, Warm,	Paradoxical breathing	B – intubate if respiratory failure C – Fluids + Vasopressor

(ATLS 9th & 10th Edition)

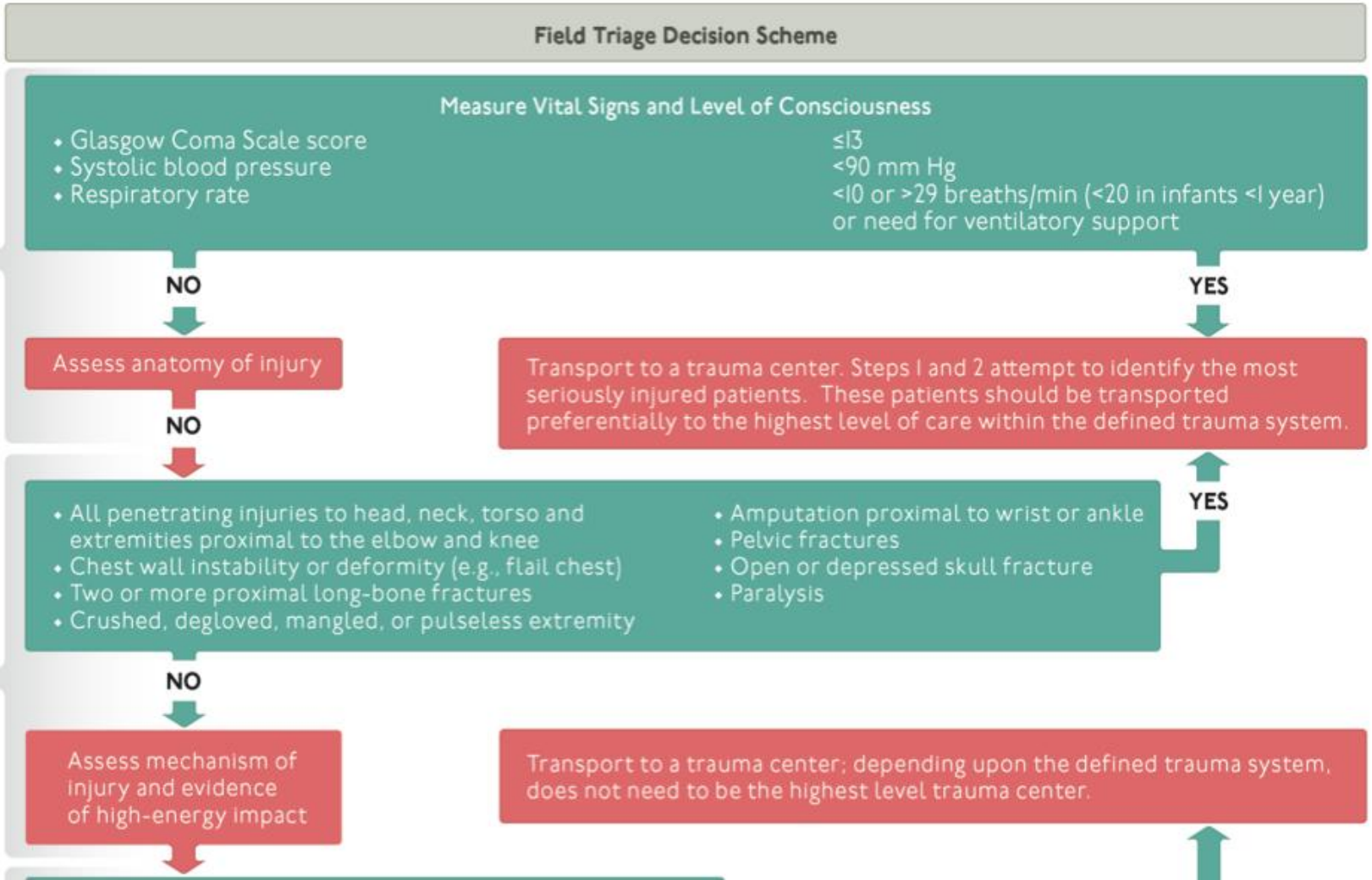
MANAGEMENT

PRE-HOSPITAL

- Catastrophic Hemorrhage Control
- ABCDE - 10s
- Maintain Airway, Oxygen
- C-Spine, Splints
- IV assess and Fluids on the way
- Alert receiving center for preparation.

- Remember information on time of injury, event/ mechanism of injury and patient's history is important!

TRIAGE



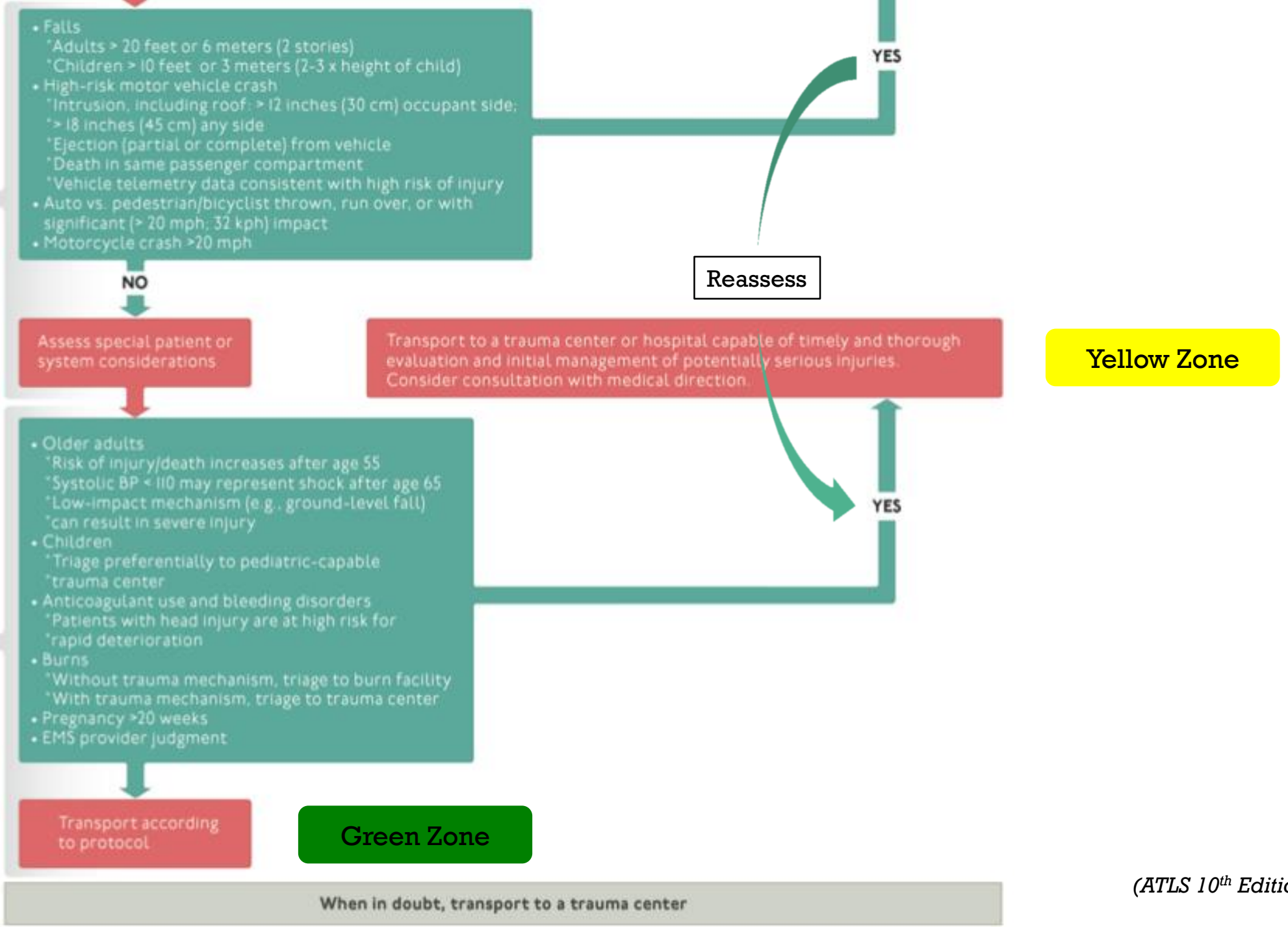
Step 1

Step 2

Red Zone
Step 1 & 2 attempt to identify most injured patient

Red Zone

Yellow Zone



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THE 6 KILLERS

Airway	Issues	Intervention
Airway	Airway Obstruction	Basic and advanced airway management
Breathing	Tension pneumothorax	O2, needle decompression and chest tube
	Open Pneumothorax	O2, 3 way seal bandage and chest tube
	Massive Hemothorax	O2, Chest Tube
	Tracheo-branchial injury	O2, Expect difficult airway , Surgical treatment
Circulation	Cardiac Tamponade	O2, Pericardiocentesis

INJURY PREDICTION

TABLE 1-1 MECHANISMS OF INJURY AND SUSPECTED INJURY PATTERNS

MECHANISM OF INJURY	SUSPECTED INJURY PATTERNS	MECHANISM OF INJURY	SUSPECTED INJURY PATTERNS
BLUNT INJURY			
Frontal impact, automobile collision • Bent steering wheel • Knee imprint, dashboard • Bull's-eye fracture, windscreen	• Cervical spine fracture • Anterior flail chest • Myocardial contusion • Pneumothorax • Traumatic aortic disruption • Fractured spleen or liver • Posterior fracture/dislocation of hip and/or knee • Head injury • Facial fractures	**Rear impact,** automobile collision	• Cervical spine injury • Head injury • Soft tissue injury to neck
		Ejection from vehicle	• Ejection from the vehicle precludes meaningful prediction of injury patterns, but places patient at greater risk for virtually all injury mechanisms.
Side impact, automobile collision	• Contralateral neck sprain • Head injury • Cervical spine fracture • Lateral flail chest • Pneumothorax • Traumatic aortic disruption • Diaphragmatic rupture • Fractured spleen/liver and/or kidney, depending on side of impact • Fractured pelvis or acetabulum	**Motor vehicle impact with pedestrian**	• Head injury • Traumatic aortic disruption • Abdominal visceral injuries • Fractured lower extremities/pelvis
		Fall from height	• Head injury • Axial spine injury • Abdominal visceral injuries • Fractured pelvis or acetabulum • Bilateral lower extremity fractures (including calcaneal fractures)

(ATLS 10th Edition)

MECHANISM OF INJURY	SUSPECTED INJURY PATTERNS
PENETRATING INJURY	
Stab wounds • Anterior chest	• Cardiac tamponade if within "box" • Hemothorax • Pneumothorax • Hemopneumothorax
• Left thoraco-abdominal	• Left diaphragm injury/spleen injury/hemopneumothorax
• Abdomen	• Abdominal visceral injury possible if peritoneal penetration
Gunshot wounds (GSW) • Truncal	• High likelihood of injury • Trajectory from GSW/retained projectiles help predict injury
• Extremity	• Neurovascular injury • Fractures • Compartment syndrome

MECHANISM OF INJURY	SUSPECTED INJURY PATTERNS
THERMAL INJURY	
Thermal burns	• Circumferential eschar on extremity or chest • Occult trauma (mechanism of burn/means of escape)
Electrical burns	• Cardiac arrhythmias • Myonecrosis/compartment syndrome
Inhalational burns	• Carbon monoxide poisoning • Upper airway swelling • Pulmonary edema

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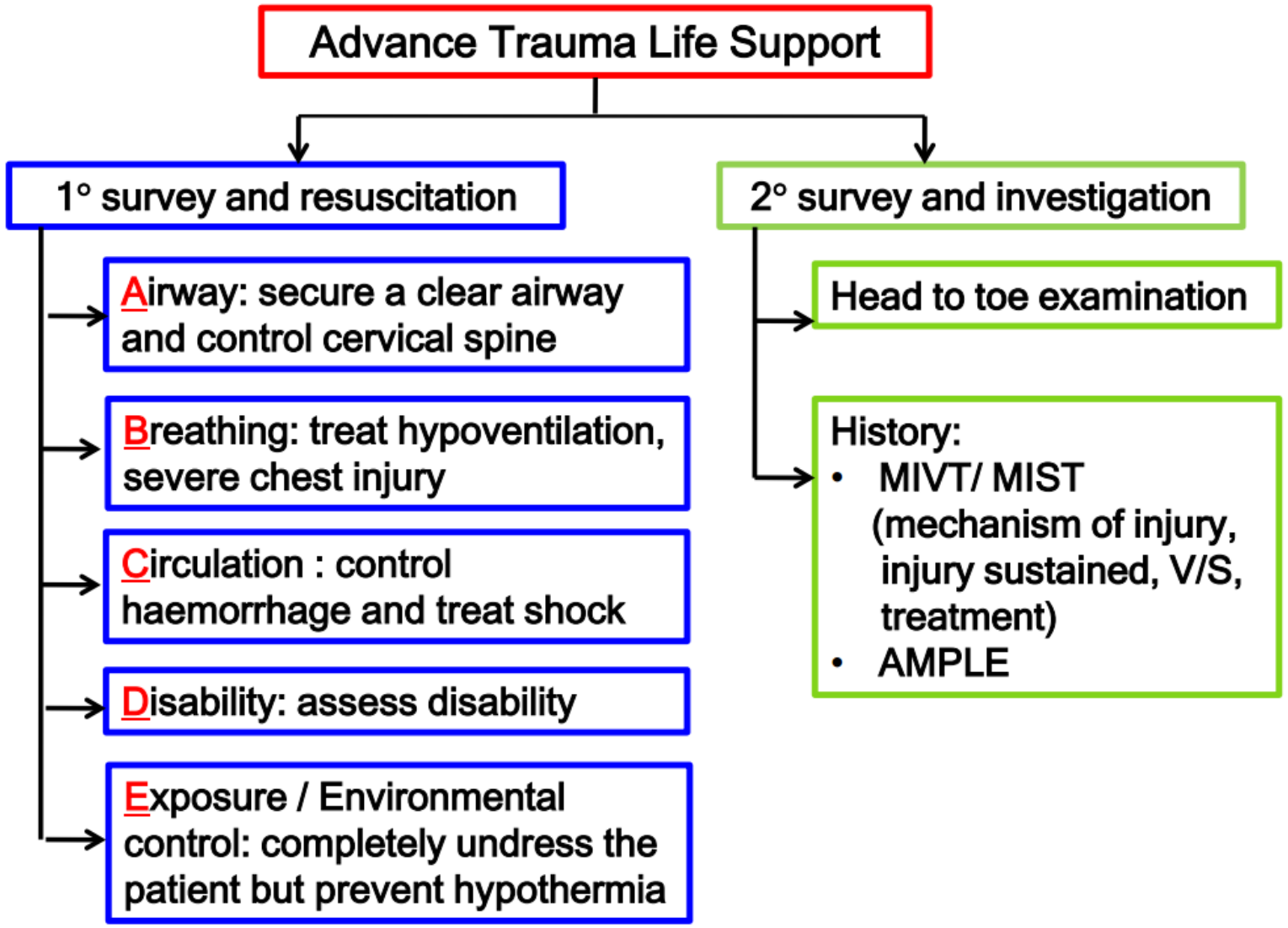
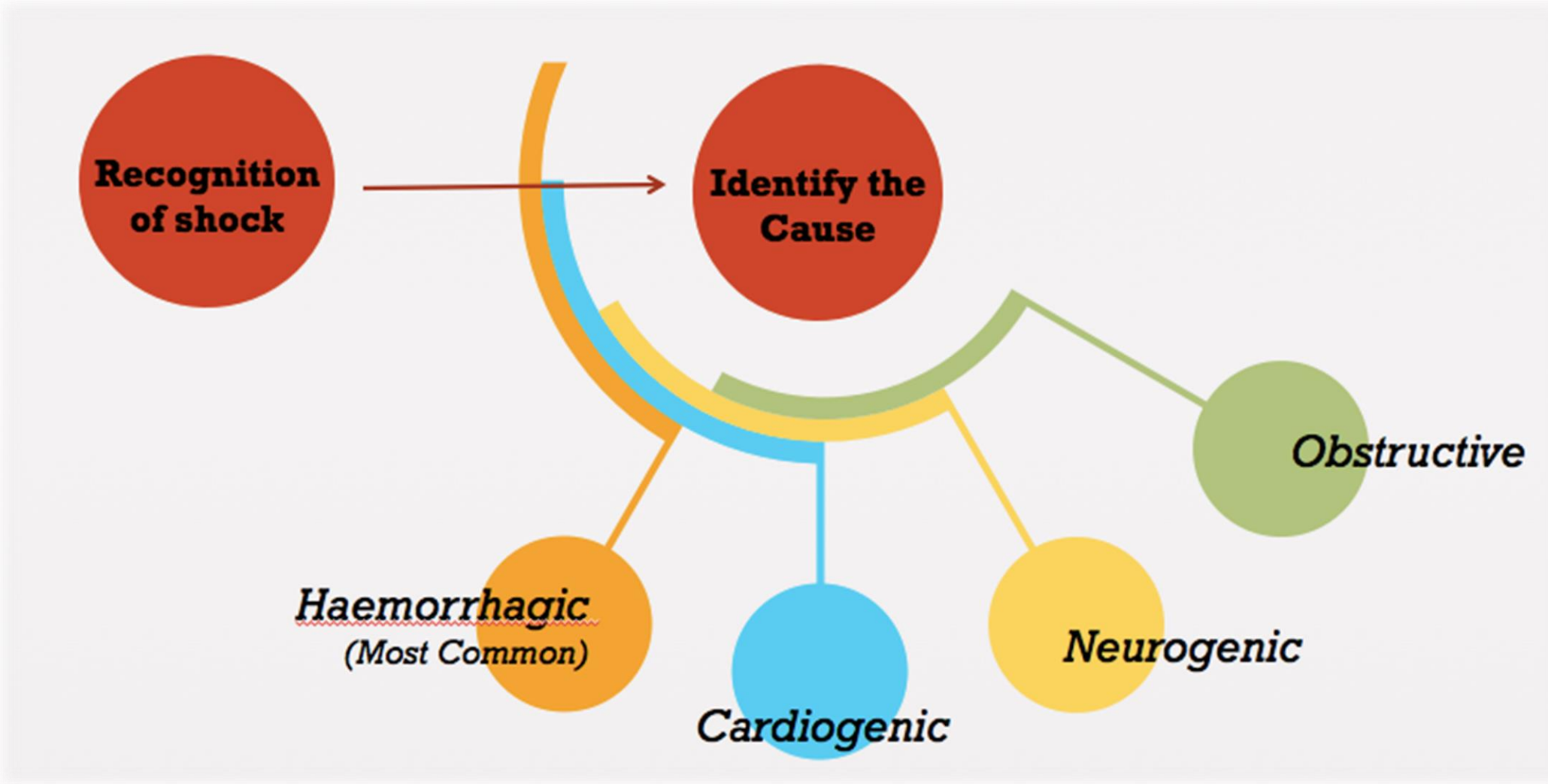


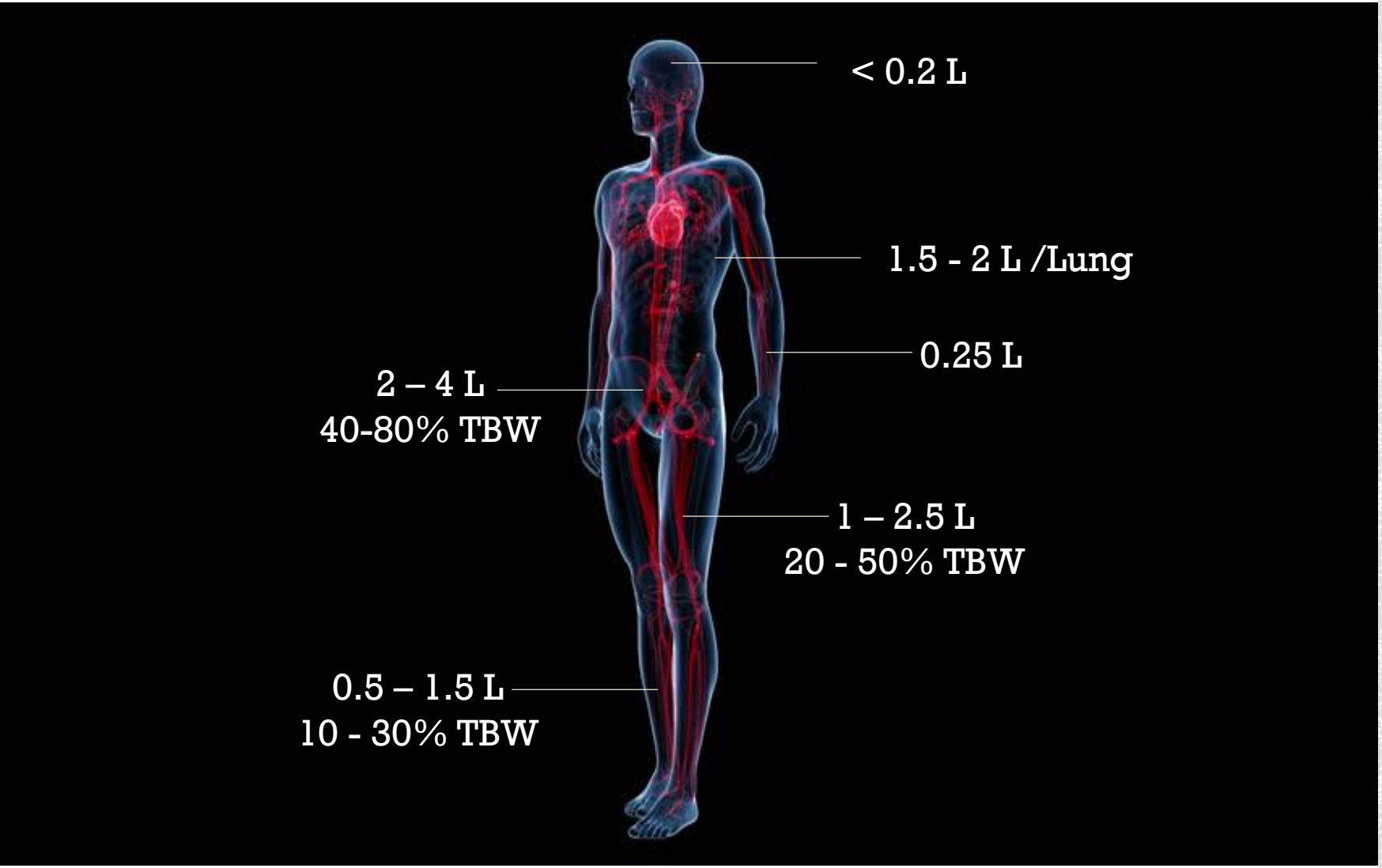
ATLS APPROACH

Don't Forget to Complete The Secondary Survey

2 CRITICAL STEPS



Any injured patient who is cool and tachycardia is in "SHOCK" until proven otherwise!

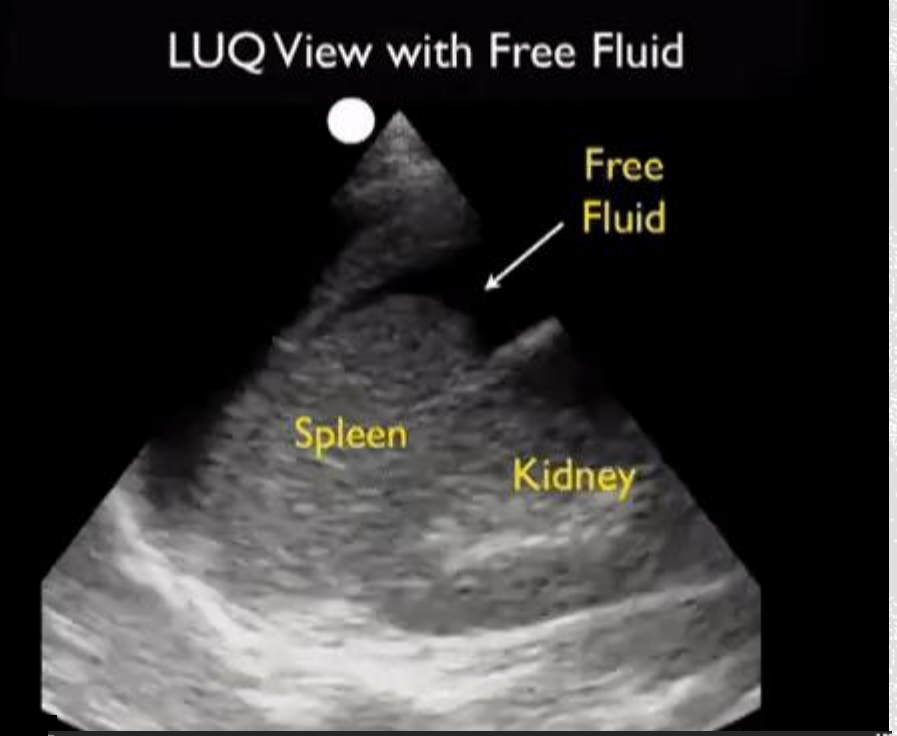


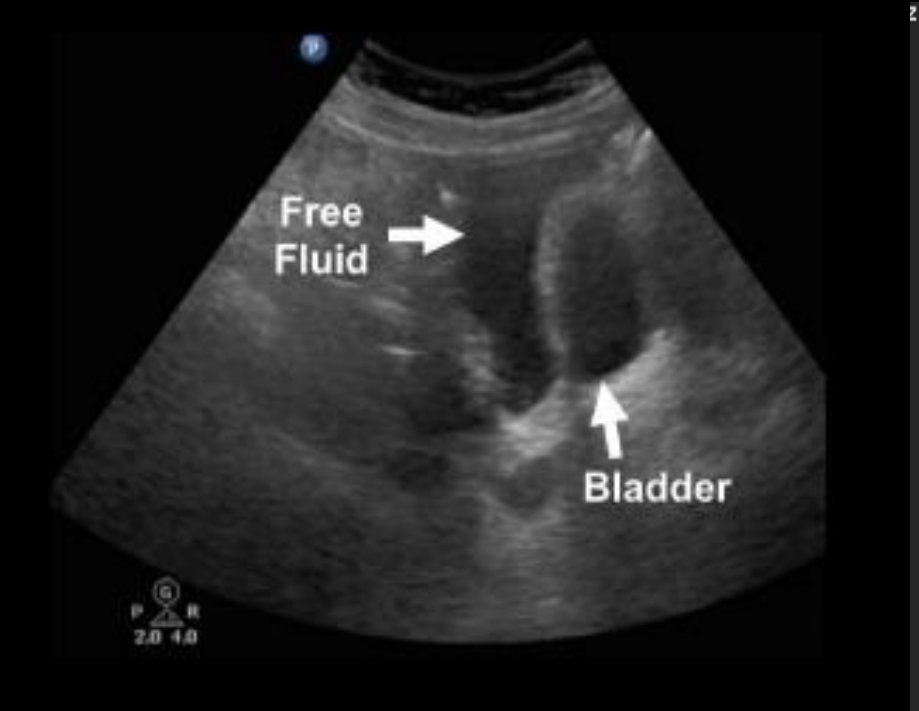
SOURCE OF BLEEDING 1+4 SCALPR

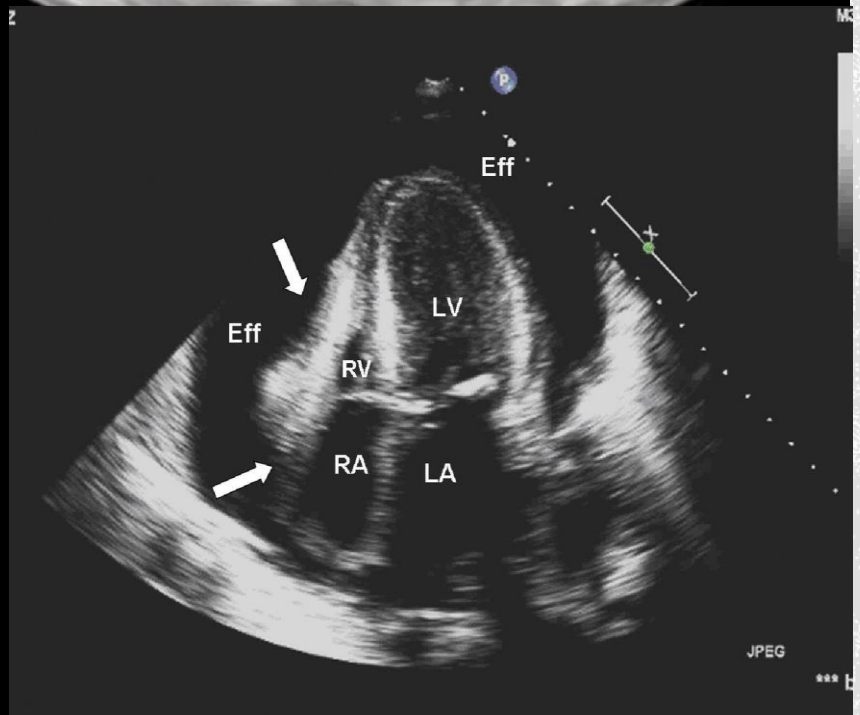
- Scalp, Skin & Street

&

- Chest
- Abdomen
- Long Bones
- Pelvic + Retroperitoneal







EFAST

Remember -

Rule in ! Not to rule out.

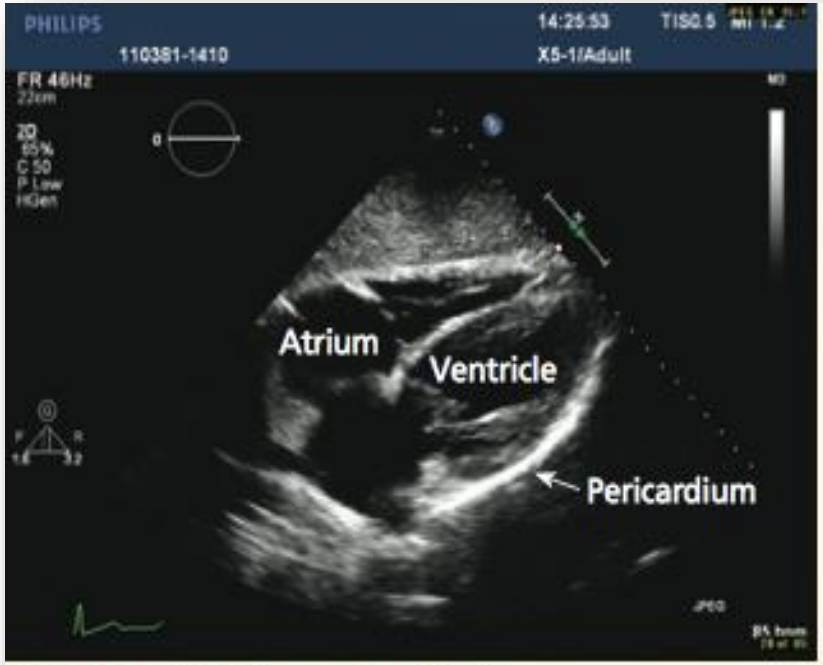


FIGURE VIII-2 The pericardial view.

FIGURE VIII-3 The right upper quadrant view.

FIGURE VIII-4 The left upper quadrant view.

FIGURE VIII-5 The suprapubic view.

EFAST

Normal?

Bleed?

Intraperitoneal or Retroperitoneal?

Intra – SALTD SPRSS	Retro – SAD PUCKER
Stomach	**S**uprarenal glands
Appendix	**A**orta & IVC
Liver	**D**uodenum (parts 2, 3 and 4)
Transverse Colon	**P**ancreas (all but the tail)
Duodenum (1st part)	**U**reter & Bladder
Small intestine	**C**olon (Ascending and Descending)
Pancreas (tail only)	**K**idneys
Sigmoid colon	**E**sophagus
Spleen	**R**ectum (lower 2/3rds)

Secondary Retro – Pussy Cat Dolls

Pancreas, **C**olon (Ascending and Descending), **D**uodenum (parts 2, 3 and 4).

PERITONEAL BLEEDING

ESTIMATE THE LOSSES!

By patient's initial presentation

TABLE 3.1 Estimated Blood Loss[1] Based on Patient's Initial Presentation

	CLASS I	CLASS II	CLASS III	CLASS IV
Blood loss (mL)	Up to 750	750–1500	1500–2000	>2000
Blood loss (% blood volume)	Up to 15%	15%–30%	30%–40%	>40%
Pulse rate (BPM)	<100	100-120	120-140	>140
Systolic b pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mm Hg)	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate	14–20	20–30	30–40	>35
Urine output (mL/hr)	>30	20–30	5–15	Negligible
CNS/mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic
Initial fluid replacement	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

[1] For a 70-kg man.

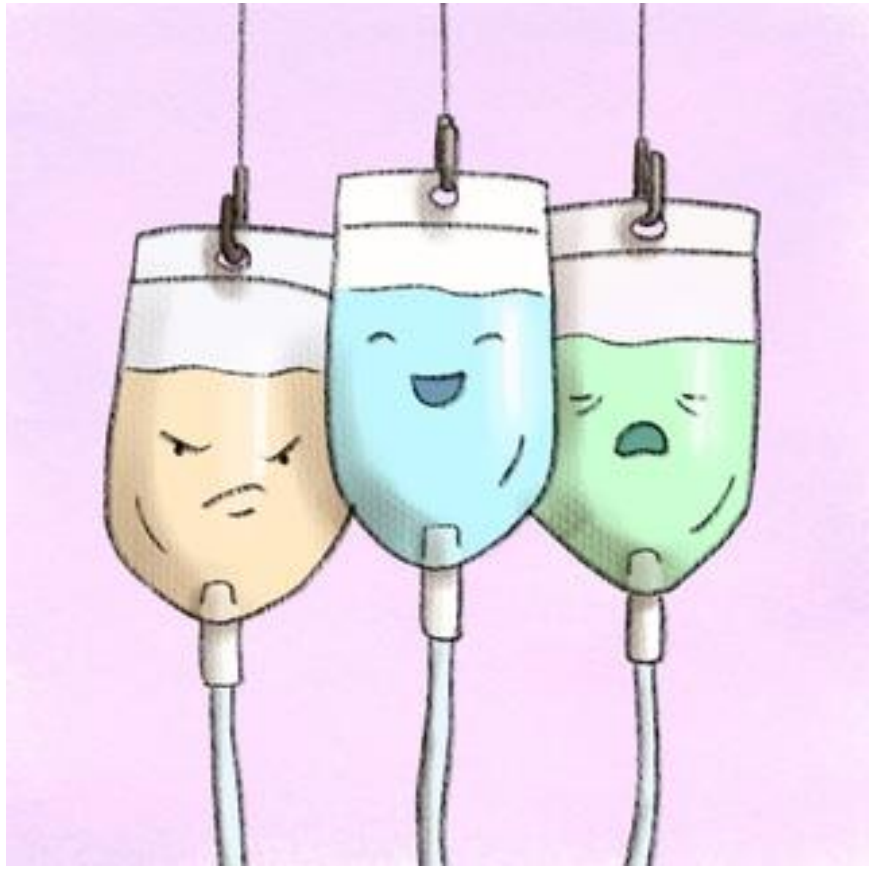
(ATLS 9th &10th Edition)

STRATEGY

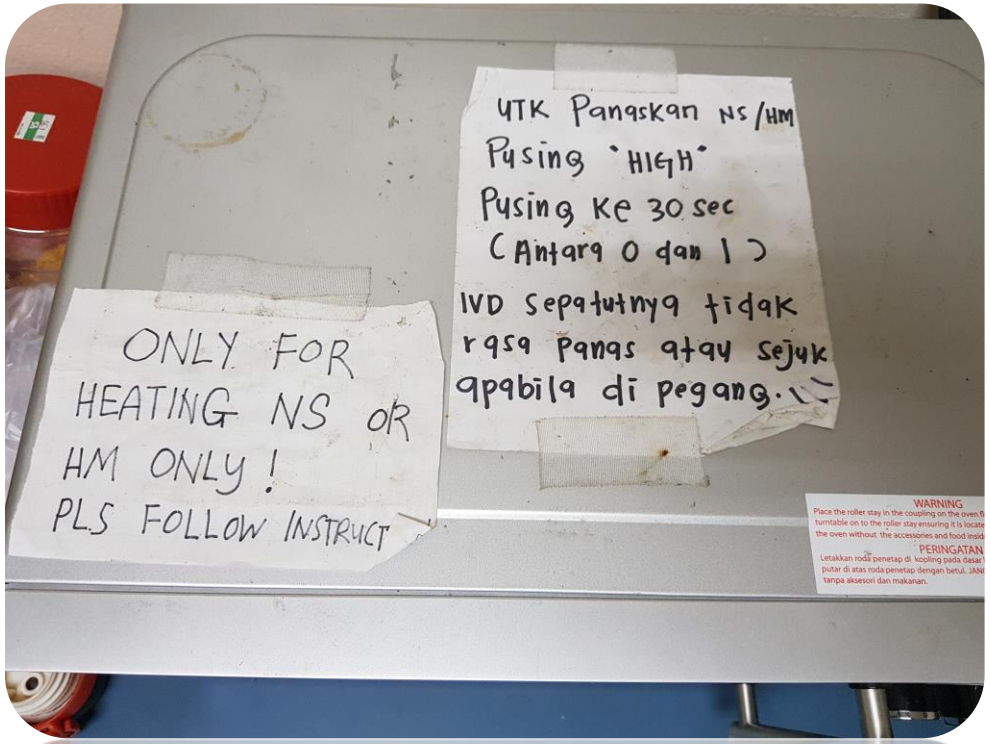
- Assess and manage "ABC".
- Establish "IV -Oxygen –Monitors".
- Insert "2 large bore" cannulae in peripheral Veins/ CVL/ IO
- Infuse "1 - 2 L" of warm crystalloids rapidly.
- ECG heart rate monitoring,
- Continuous pulse oximetry, ET CO2 monitorii
- Monitor arterial blood pressure, GCS, and peripheral perfusion.
- IV Tranexemic Acid 1g Stat
- Insert NG tube and bladder catheter.

FLUIDS

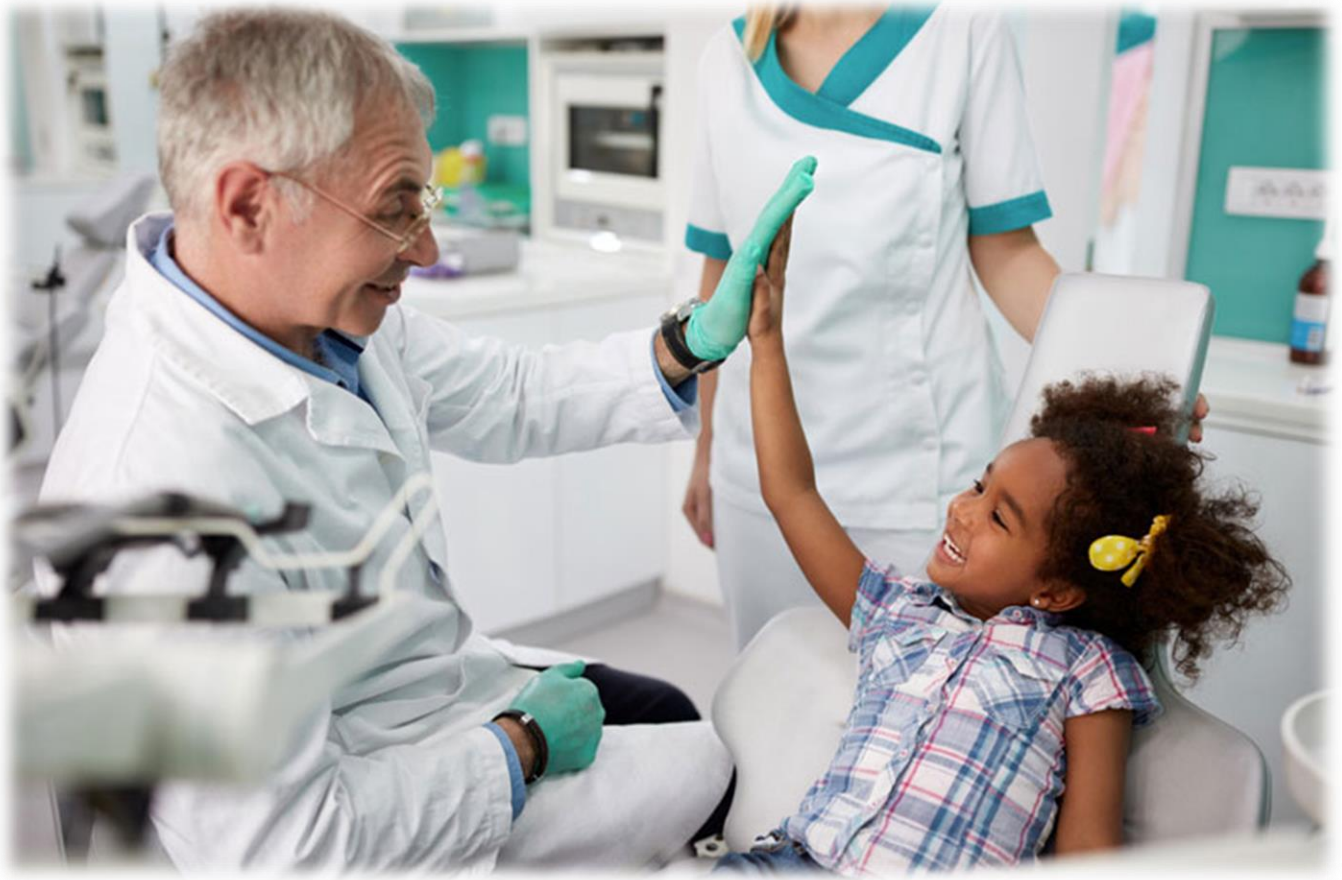
- Bolus therapy
  - Children : 20 cc/kg
  - Adults : 1- 2 liters
- Monitor response
- Repeat if necessary
- After 2nd bolus: need blood txn
  - 10cc/kg



BEWARE OF HYPOTHERMIA



ETD HWKKS



Assess the "RESPONSE" to initial volume therapy!

RESPONSE TO INITIAL FLUID RESUS!

TABLE 3-2 RESPONSES TO INITIAL FLUID RESUSCITATION[a]

	RAPID RESPONSE	TRANSIENT RESPONSE	MINIMAL OR NO RESPONSE
Vital signs	Return to normal	Transient improvement, recurrence of decreased blood pressure and increased heart rate	Remain abnormal
Estimated blood loss	Minimal (<15 %)	Moderate and ongoing (15%–40%)	Severe (>40%)
Need for blood	Low	Moderate to high	Immediate
Blood preparation	Type and crossmatch	Type-specific	Emergency blood release
Need for operative intervention	Possibly	Likely	Highly likely
Early presence of surgeon	Yes	Yes	Yes

[a] Isotonic crystalloid solution, up to 1000 mL in adults; 20 mL/kg in children

(ATLS 10th Edition)

FAILURE TO RESPOND? LOOK HARD!

- Blunt myocardial injury
- Cardiac tamponade
- Tension pneumothorax
- Neurogenic shock
- Ongoing haemorrhage
  - Retroperitoneal bleed
  - Internal organ injury

TABLE IV.3 TRANSIENT RESPONDER

ETIOLOGY	PHYSICAL EXAM	ADDITIONAL DIAGNOSTIC STEPS	INTERVENTION
Underestimation of blood loss or continuing blood loss	• Abdominal distention • Pelvic fracture • Extremity fracture • Obvious external bleeding	• DPL or ultrasonography	• Surgical consultation • Volume infusion • Blood transfusion • Apply appropriate splints
Nonhemorrhagic • Cardiac tamponade	• Distended neck veins • Decreased heart sounds • Normal breath sounds	• Echocardiogram • FAST	• Thoracotomy • Transfer
• Recurrent/persistent tension pneumothorax	• Distended neck veins • Tracheal shift • Absent breath sounds • Hyperresonant chest percussion	• Clinical diagnosis	• Reevaluate chest • Needle decompression • Tube thoracostomy

(ATLS 9th Edition)

TABLE IV.4 NONRESPONDER

ETIOLOGY	PHYSICAL EXAM	ADDITIONAL DIAGNOSTIC STEPS	INTERVENTION
Massive blood loss (Class III or IV) • Intraabdominal bleeding	• Abdominal distention	• DPL or ultrasonography	• Immediate intervention by surgeon • Volume restoration
Nonhemorrhagic • Tension pneumothorax	• Distended neck veins • Tracheal shift • Absent breath sounds • Hyperresonant chest percussion	• Clinical diagnosis	• Reevaluate chest • Needle decompression • Tube thoracotomy
• Cardiac tamponade	• Distended neck veins • Decreased heart sounds • Normal breath sounds	• FAST • Pericardiocentesis	• Thoracotomy
• Blunt cardiac injury	• Irregular heart rate • Inadequate perfusion	• Ischemic ECG changes • ECG	• Ensure no source of hemorrhage missed • Inotropic support • Invasive monitoring

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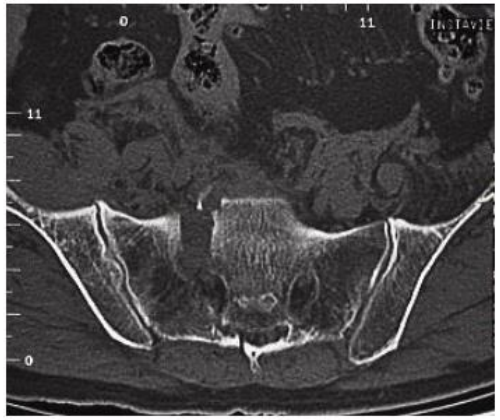
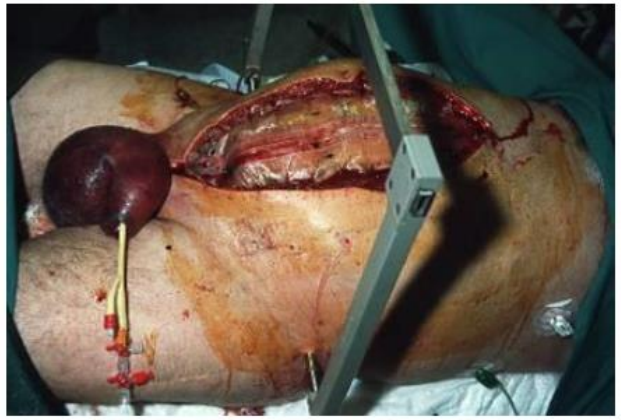
PELVIC TRAUMA

- Hemorrhage control by closed reduction (Pelvic trauma: vertical shear)





- Pelvic clamp and pelvic packing
- Pelvic binder

PELVIC CLAMPING

Where do we tie / Clamp?

Anatomy marker?

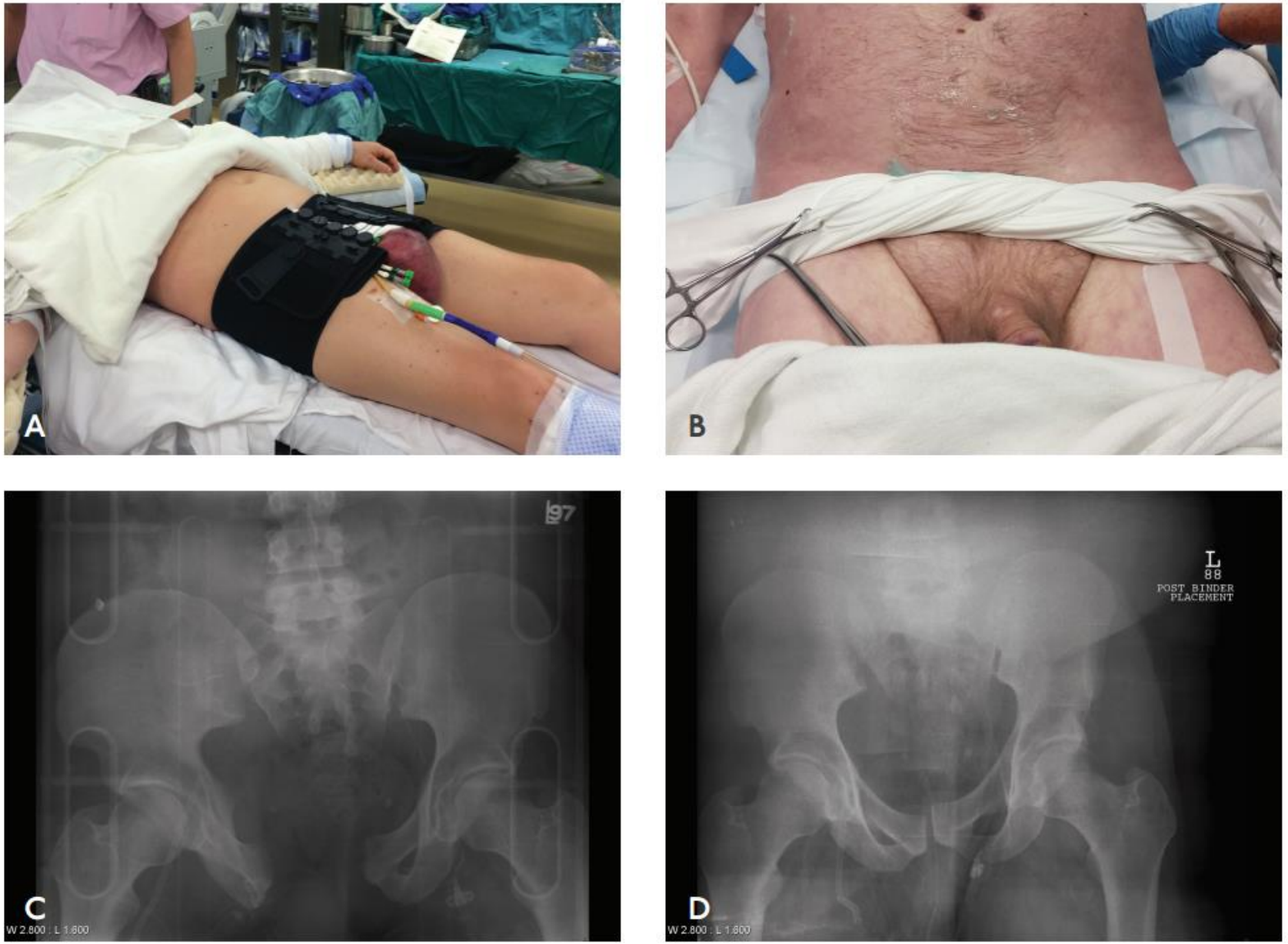


FIGURE 5-9 Pelvic Stabilization. A. Pelvic binder. **B.** Pelvic stabilization using a sheet. **C.** Before application of pelvic binder. **D.** After application of pelvic binder.

TABLE IV.2 PELVIC FRACTURES

CONDITION	IMAGE FINDINGS	SIGNIFICANCE	INTERVENTION
Pelvic fracture	**Pelvic x-ray** • Pubic ramus fracture	• Less blood loss than other types • Lateral compression mechanism	• Volume replacement • Probable transfusion • Decreased pelvic volume • Pelvic binder • External fixator • Angiography • Skeletal traction • Orthopedic consultation
	• Open book	• Pelvic volume increased • Major source of blood loss	
	• Vertical shear	• Major source of blood loss	
Visceral organ injury	**CT scan** • Intraabdominal hemorrhage	• Potential for continuing blood loss • Performed only in hemodynamically normal patients	• Volume replacement • Possible transfusion • Surgical consultation

(ATLS 9th Edition)

When to Use | Pearls/Pitfalls | Why Use

Early initiation of massive transfusion has been shown to improve survival in critical trauma patients. The ABC Score reduces delay in determining need for massive transfusion in a trauma patient, while also providing consistency in appropriateness of transfusion by reducing practice variations among providers.

Penetrating mechanism	No 0	Yes +1
Systolic BP ≤90 in ED	No 0	Yes +1
HR ≥120 in ED	No 0	Yes +1
Positive FAST	No 0	Yes +1

0 points

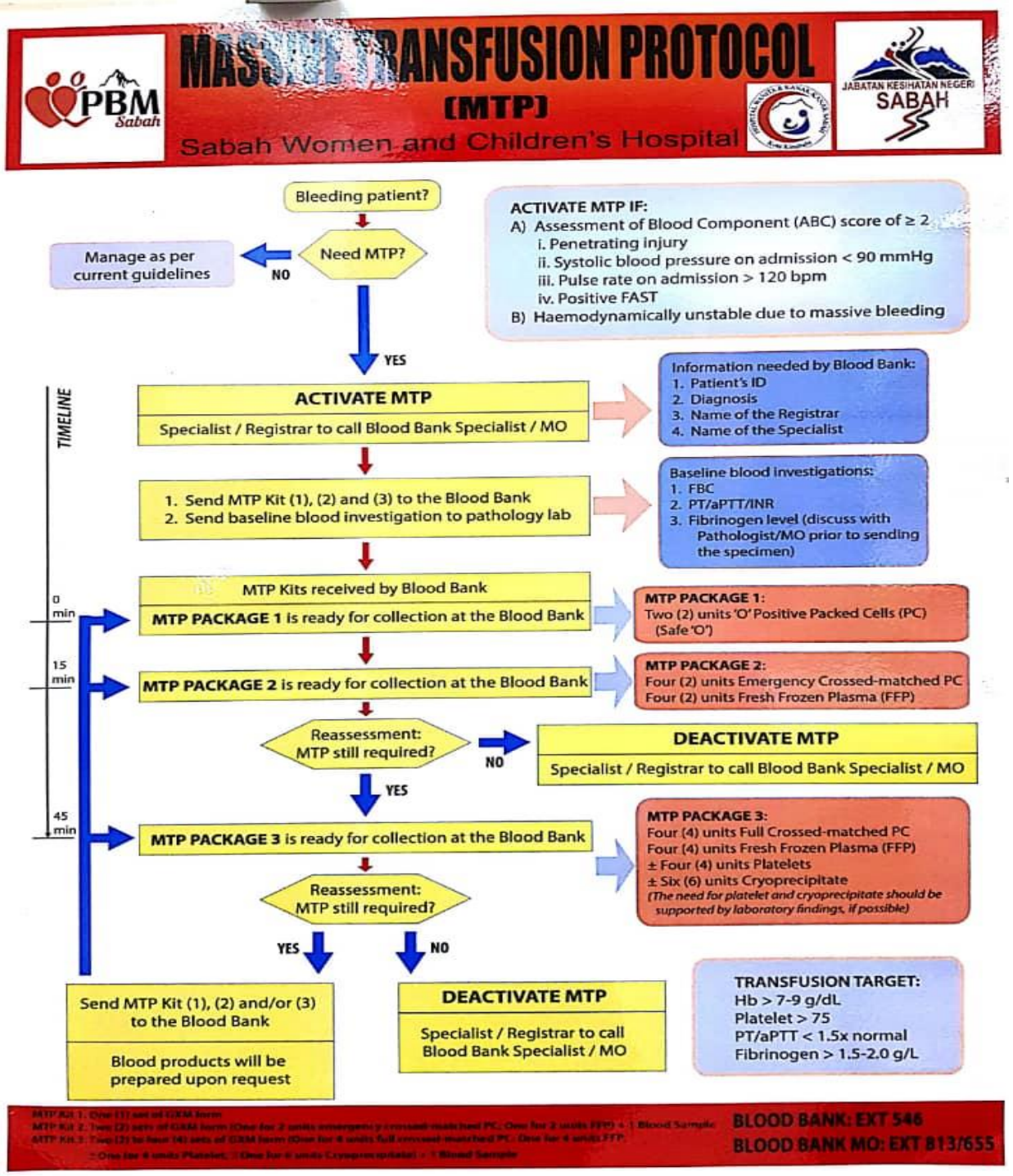
Less likely to require massive transfusion (≥10 units pRBCs).

In the ABC Score studies, scores <2 were unlikely to require massive transfusion, with sensitivity and specificity ranging from 75% to 90% and 67% to 88%, respectively, at multiple trauma centers.

Copy Results | Next Steps

NUNEZ – ABC SCORING

- 2 out of 4 criteria
- Criteria
  - Tachycardia > 120 b/min
  - SBP < 90 mmHg
  - Positive eFAST
  - Penetrating injury



MASSIVE TRANSFUSION PROTOCOL

Alert Blood Bank MO

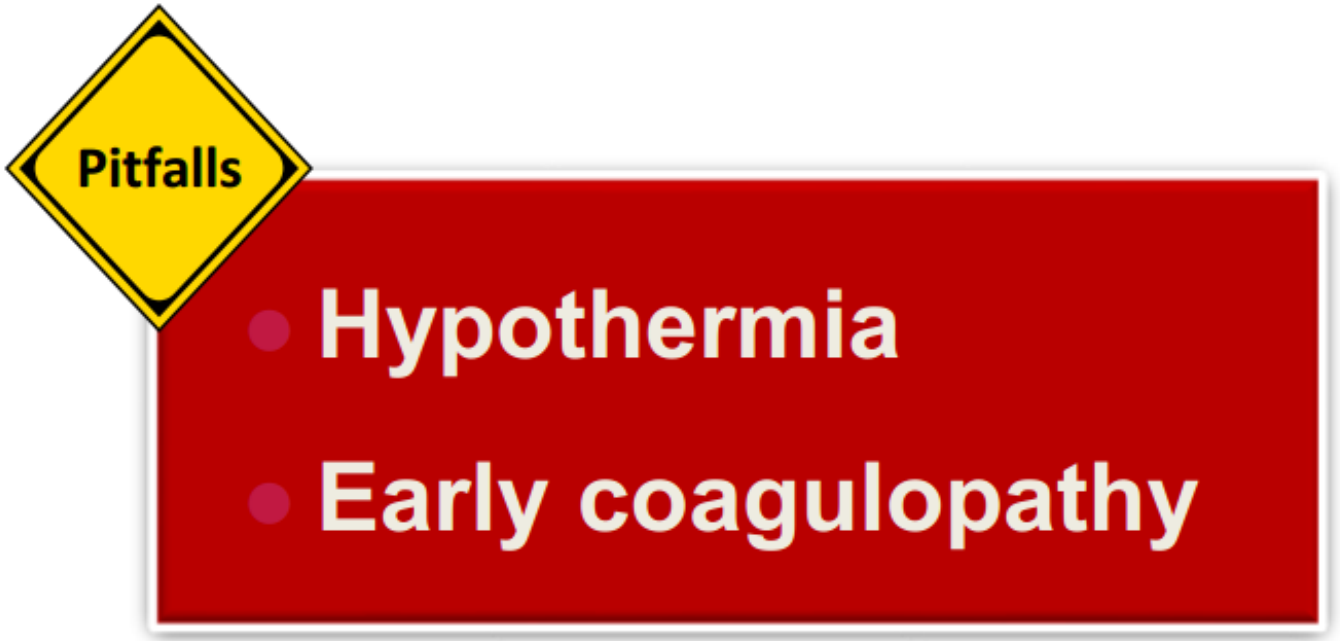
Blood Bank EXT : 546

END POINT OF RESUSCITATION

- Stop the bleeding
- Restore volume
- Adequate Urine output
  - 0.5 - 1.0 cc/kg/hr
- Tissue Oxygenation measurement
  - *Normalization of Oxygen delivery DO_2*
  - *Normal Serum Lactate levels*

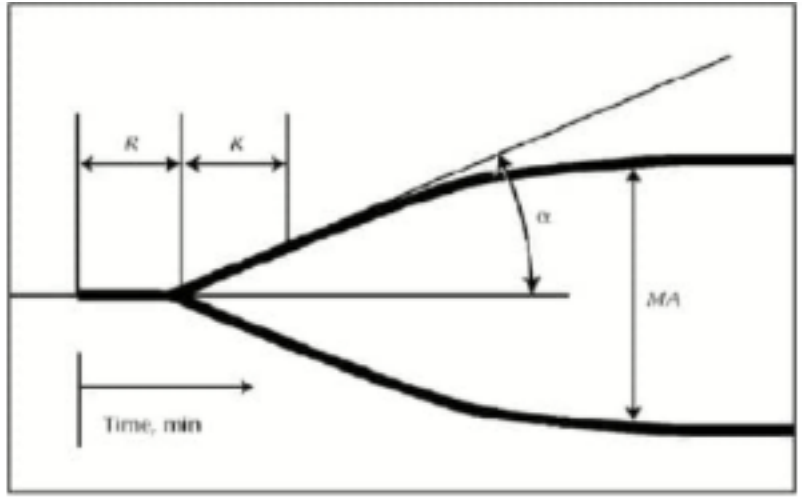
PITFALLS

Complications of Shock and Shock Management



DAMAGE CONTROL RESUSCITATION

1. Permissive Hypotension
2. Haemostatic Resuscitation
3. Prevent Acidosis, Hypothermia, Hypocalcemia
4. Damage Control Surgery



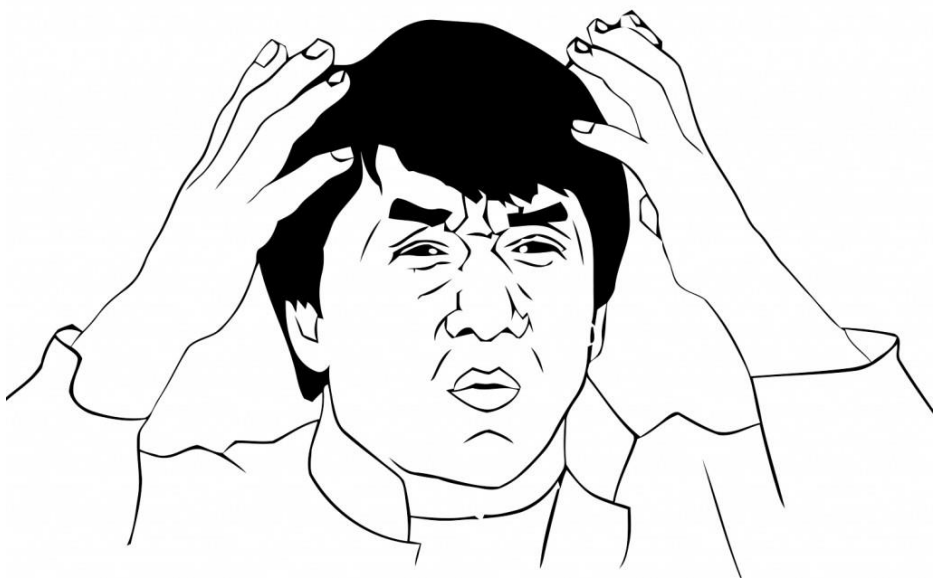
Some of the components involved in the interpretation of a typical TEG tracing include:

- **R-time** (minutes); designated as "R" in the image above: The period from the start of sample placement in the cup to the initial fibrin formation. This component reflects the level of clotting factors. A prolonged R-time may suggest the need for plasma transfusion.
- **Angle** (degrees); designated by the "alpha" symbol in the image above: Formed by the slope of the TEG tracing from the horizontal line. This component reflects the presence or absence of fibrinogen. A decreased Angle may suggest the need for fibrinogen supplementation (in the U.S., that need would typically be supplied by a cryoprecipitate transfusion).
- **Maximum amplitude** (millimeters); designated as "MA" in the image above: The height of the TEG tracing from the horizontal line. This component reflects the strength of the developed clot contributed mainly by platelets but also fibrin. A low MA may suggest the need for platelet transfusion).
- While not shown on the tracing above, TEG will also typically analyze the amount of clot lysis at 30 and 60 minutes ("LY30" and "LY60," respectively). This measurement helps detect fibrinolysis.

VISCOELASTIC HAEMOSTATIC ASSAY THROMBOELASTROGRAPHY (TEG)

PERMISSIVE HYPOTENSION IN TRAUMA

"One of the most controversial issues in trauma care today is restricting intravenous fluid resuscitation in hypotensive trauma patients who have uncontrolled haemorrhage"



PERMISSIVE HYPOTENSION

- SBP 80 to 90 mm Hg (trauma),
  - If severe TBI (GCS≤8), keep SBP ≥ 100 mmHg (50 to 69 years)
  - ≥ 110 mm Hg (15 to 49 years / > 70 years) *(ATLS 10th Edition)*
- Not applicable in
  - Myocardial disease,
  - Cerebral ischemia, or
  - Traumatic brain injury.
  - Pregnancy
  - Children <12 YO

Curr Anesthesiol Rep. Author manuscript; available in PMC 2015 Sep 1.
Published in final edited form as:
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Published online 2014 May 9. doi: 10.1007/s40140-014-0064-7

PMCID: PMC4185194
NIHMSID: NIHMS594016
PMID: 25294973

Hypotensive Resuscitation

Jeremy B. Smith, M.D.,✉ Jean-Francois Pittet, M.D., and Albert Pierce, M.D.

hypotensive resuscitation in severely injured patients. Of the three prospective studies dealing with permissive hypotension, two showed increased survival but none showed harm. Currently, this is a very

HYPOTENSIVE RESUSCITATION

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4185194/

The Journal of
Trauma and
Acute Care Surgery

Hypotensive Resuscitation during Active Hemorrhage: Impact on In-Hospital Mortality

Dutton, Richard P. MD, MBA; Mackenzie, Colin F. MD; Scalea, Thomas M. MD

The Journal of Trauma: Injury, Infection, and Critical Care: June 2002 - Volume 52 - Issue 6 - p 1141-1146
Original Articles

FREE

Background Traditional fluid resuscitation strategy in the actively hemorrhaging trauma patient emphasizes maintenance of a normal systolic blood pressure (SBP). One human trial has demonstrated improved survival when fluid resuscitation is restricted, whereas numerous laboratory studies have reported improved survival when resuscitation is directed to a lower than normal pressure. We hypothesized that fluid resuscitation titrated to a

HYPOTENSIVE RESUSCITATION

https://journals.lww.com/jtrauma/Fulltext/2002/06000/Airbag_induced_Lethal_Cervical_Trauma.20.aspx

HAEMOSTATIC RESUSCITATION

- Early transfusion to maintain circulating volume
- Minimisation of crystalloid use – dilutional effect, dislodges clot, induces hypothermia
- Reduce coagulopathy
- Keep warm
- Prevent acidemia

R.E.B.E.L.Em

The PROPPR Randomized Clinical Trial

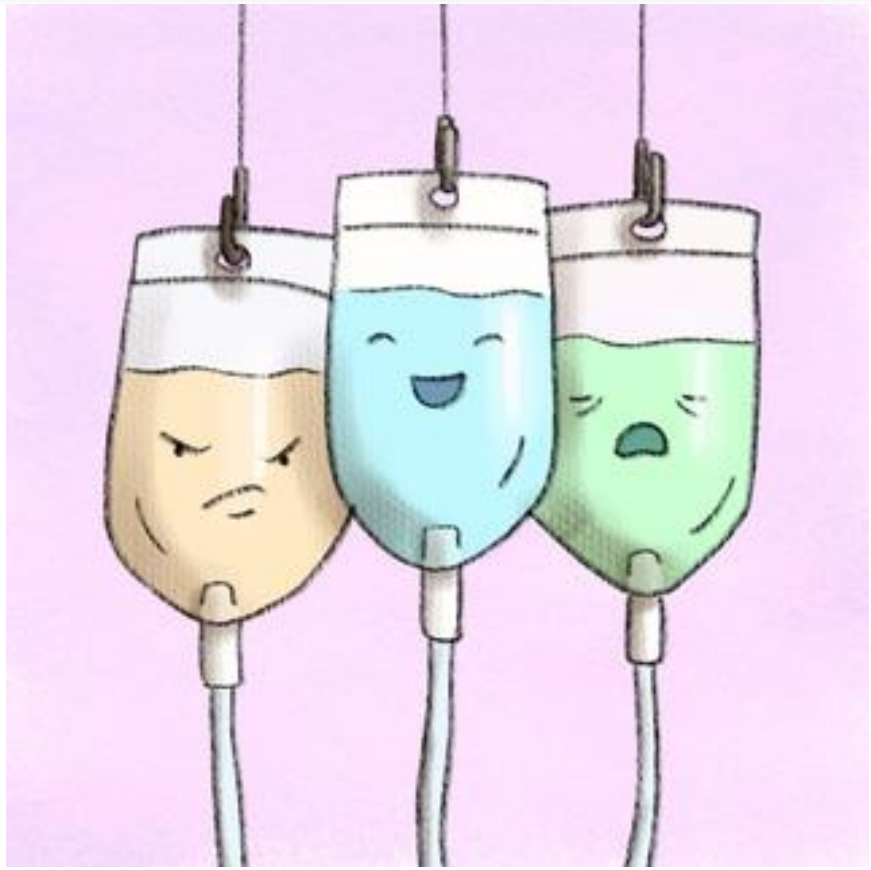
Results:

- No statistically significant difference in mortality at 24 hours or at 30 days
- Exsanguination in first 24 hours (secondary outcome) significantly decreased in the 1:1:1 group vs 1:1:2 group (9.2% vs 14.6%; p = 0.03)
- More patients achieved hemostasis in the 1:1:1 group vs 1:1:2 group (86% vs 78%; p = 0.006)
- More plasma (Median 7 Units vs 5 Units) and platelets (Median 12 Units vs 6 Units) were used in the 1:1:1 ratio vs 1:1:2 ratio
- No difference in complications between the two strategies

FLUIDS

- Bolus therapy
  - Children(<40kg) : 20 cc/kg
  - Adults : 1- 2 liters
- Monitor Effect
- Repeat if necessary
- After 2nd bolus: need blood txn
  - 10cc/kg

(ATLS 10th Edition)



ROLE OF BLOOD GAS

- Base deficit - new criteria for the hemorrhage classification.

Conclusions

Go to:

Pre-hospital arterial blood gas measurements during trauma patient's fluid resuscitation by emergency physician based helicopter emergency medical system (HEMS) provided useful information about patients' acid-base values. Comparing the values after either conventional fluid therapy or small-volume

REWARMING

- Maintain normo-thermia (36-37 Celsius)
  - Remove wet clothes,
  - Use warmed fluids (e.g. Level 1 Fluid Warmer),
  - Bair Hugger or warm blankets,
  - Insulating foils
- Fluids warmth to 39 Celsius prior transfusion

TABLE B-2 REWARMING TECHNIQUES	
REWARMING TECHNIQUE	**LEVEL OF HYPOTHERMIA**
PASSIVE REWARMING	
• Dry patient • Warm environment • Shivering • Blankets or clothing • Cover head	Mild (HTI) hypothermia 35°C to 32° C (95-89.6 F)

(ATLS 10th Edition)

ACTIVE REWARMING	
External • Heating pad • Warm water, blankets, and warm water bottles • Warm water immersion • External convection heaters (lamps and radiant warmers)	Mild (HT I) (35°C to 32° C [95-89.6 F]) and moderate (HT II) hypothermia < 32°C to 28° C (< 89.6-82.4 F)
Internal • Heated intravenous fluids • Gastric or colonic lavage • Peritoneal lavage • Mediastinal lavage • Warmed inhalational air or oxygen	Moderate (HT II) < 32°C to 28° C (< 89.6-82.4 F) and severe hypothermia (HT III and IV) < 28°C to < 24°C (<82.4-<75.2 F)
Extracorporeal Rewarming • Hemodialysis • Continuous arteriove-nous rewarming (CAVR) • Continuous venovenous rewarming (CVVR) • Cardiopulmonary bypass	Severe hypothermia (HT III and IV) < 28°C to < 24°C (<82.4-<75.2 F)

(ATLS 10th Edition)

TXA

- Anti-fibrinolytic: Tranexamic acid (TXA) – CRASH-2 trial.
  - TXA 1g/10m, then 1g/8h .
  - Within 3h of injury , best within 1h.
- Suggest to give even in pre-hospital setting .

Cochrane Database Syst Rev. 2015 May 9;(5):CD004896. doi: 10.1002/14651858.CD004896.pub4.

Antifibrinolytic drugs for acute traumatic injury.

Ker K[1], Roberts I, Shakur H, Coats TJ.

⊕ Author information

Abstract

AUTHORS' CONCLUSIONS: TXA safely reduces mortality in trauma patients with bleeding without increasing the risk of adverse events. TXA should be given as early as possible and within three hours of injury, as further analysis of the CRASH-2 trial showed that treatment later than this is unlikely to be effective and may be harmful. Although there is some promising evidence for the

Journal of Blood Transfusion

J Blood Transfus. 2015; 2015: 874920.
Published online 2015 Sep 7. doi: 10.1155/2015/874920

PMCID: PMC4576020
PMID: 26448897

CRASH-2 Study of Tranexamic Acid to Treat Bleeding in Trauma Patients: A Controversy Fueled by Science and Social Media

Sophia Binz, [1,*] Jonathon McCollester, [2] Scott Thomas, [3] Joseph Miller, [1] Timothy Pohlman, [4] Dan Waxman, [5] Faisal Shariff, [3,6] Rebecca Tracy, [3] and Mark Walsh [3,7]

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Abstract

Go to:

This paper reviews the application of tranexamic acid, an antifibrinolytic, to trauma. CRASH-2, a large

8. Summary

Go to:

(1) In summary, TXA has been described in the CRASH-2 trial as a successful treatment for the reduction of mortality in hemorrhaging trauma patients. The reduction in mortality was subtle, and the mechanistic rationale was elusive because of the absence of reduced blood transfusion products in patients who benefited from the administration of the drug. This large RCT, which was based on a reasonable

CRASH-2 TXA

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576020/

CALCIUM

- Calcium:
  - Acute hypocalcaemia due to massive transfusion (citrate binds to Ca).
  - Monitor and maintain ionized Ca level in normal range (1.1-1.3 mmol/L).

DAMAGE CONTROL RESUSCITATION

- Recognition
- Haemostatic Resuscitation
- Rapid movement to OT without waiting for normal vitals
- Initial Surgery to only secure bleeding
- Post-operative care in ICU settings
- Re-operation in 24-36 H

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thank
you!