Trauma Resuscitation: Management Guideline from Concept to Practice

Case Analysis

Resuscitation in hypovolemia & hemorrhagic shock

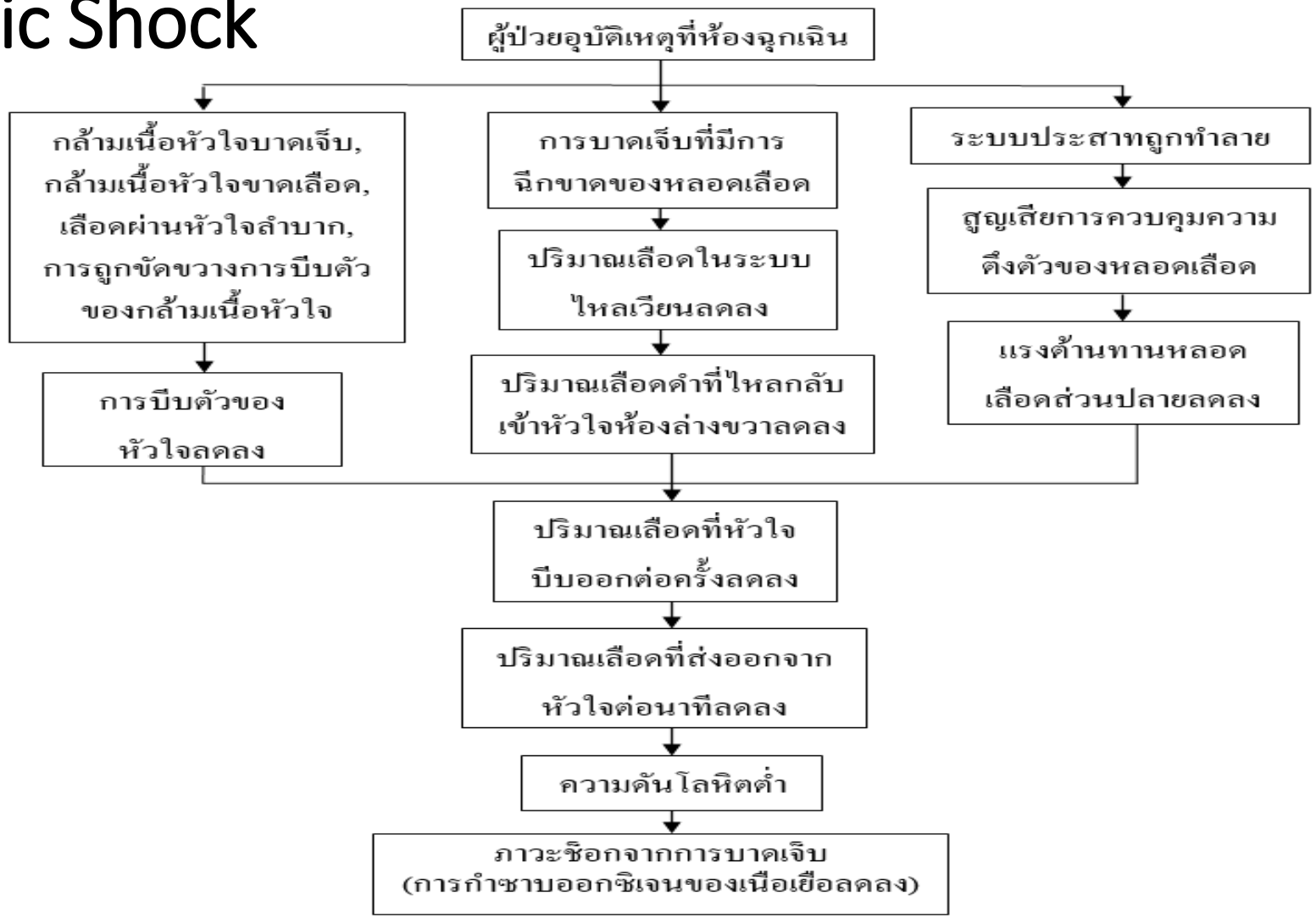
พว. พรศิริ กนกกาญจนะ
EN, B.N.S.,M.N.S , Dip. APAGN (Trauma)

Inadequate tissue perfusion

Inadequate oxygen delivery to tissue and cell

Insufficient to maintain normal aerobic metabolism

Traumatic Shock

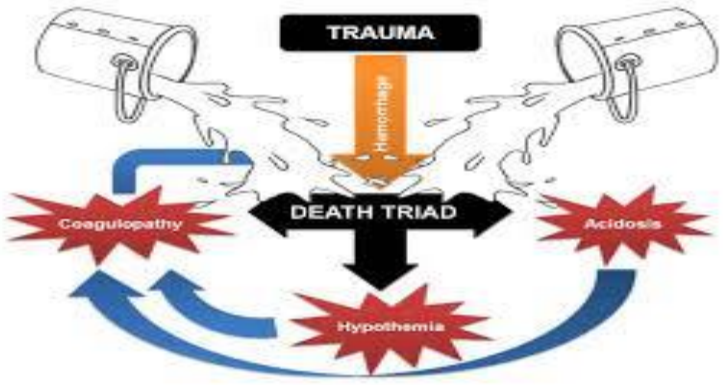


(Boswell & Scalae, 2009; Cocchi, et al., 2007; Curtis & Asha, 2010; Dutton, 2008; Guly, et al., 2008)

Management trauma patient with hemorrhagic shock

- Stop the bleeding

- Maintain oxygen delivery to limit tissue hypoxia, inflammation, and organ dysfunction
- Fluid resuscitation, vasopressors, and blood transfusion



(Bougle, Horrois & Duranteau, 2013)

Case Analysis

General History

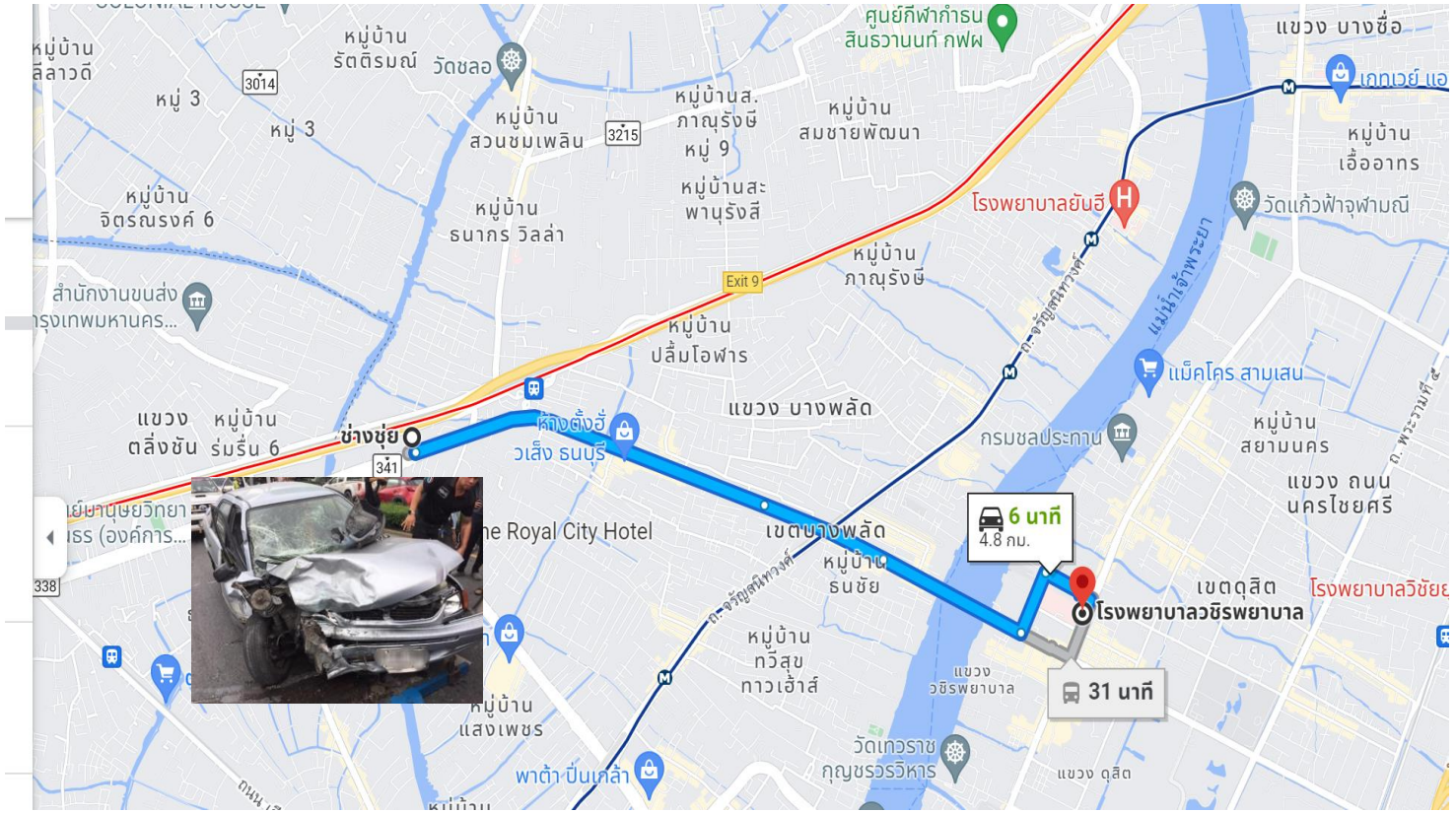
Thai Male 67-year-old

present with car accident, amnesia, restrain in car, sweating and cold 40 minutes prior to admission.

Assess special patient or system considerations

Old adults

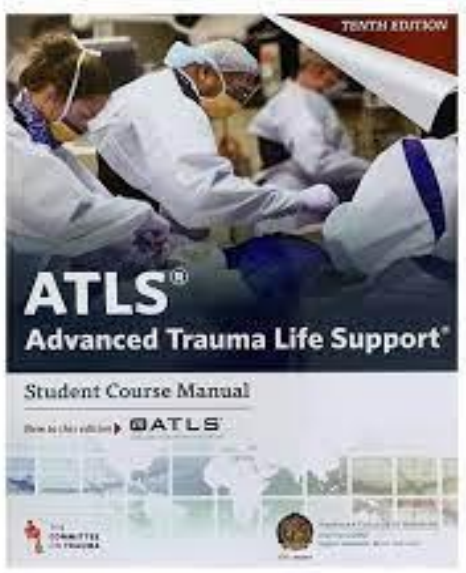
- Risk of injury/death increases after age 55
- Systolic BP <110 may represent shock after age 65
- Low-impact mechanism (e.g. ground-level fall)
- Can result in severe injury



Map Changchui – Hospital 4.8 Km.

Initial assessment follow ATLS

- Preparation
- Triage
- Primary survey (ABCDEs) with immediate resuscitation of patients with life-threatening injuries
- Adjuncts to the primary survey and resuscitation
- Consideration of the need for patient transfer
- Secondary survey (head-to-toe evaluation and patient history)
- Adjuncts to the secondary survey
- Continued post-resuscitation monitoring and reevaluation
- Definitive care



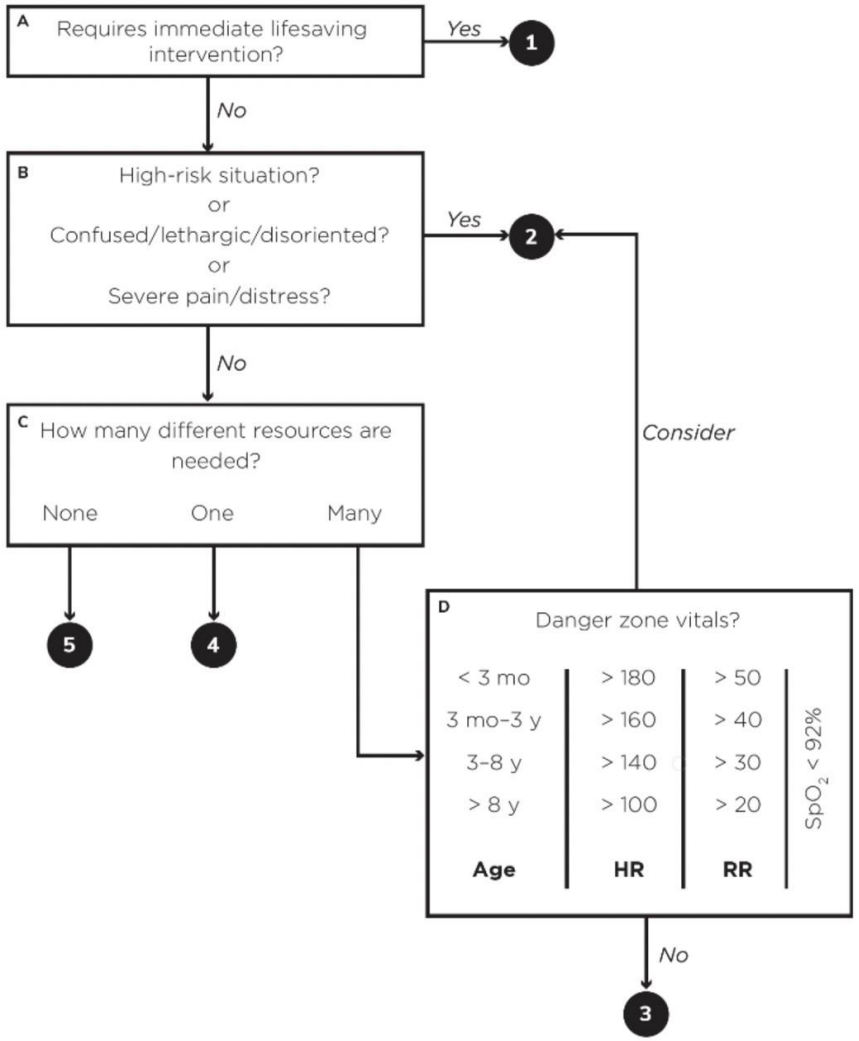
(Advance Trauma life support ed. 10, 2018)

Preparation

Pre-hospital report & MOI	Resuscitation Room
1. Trauma team 2. MOI – predict injury pattern	1. PPE 2. Equipment 3. Optimize room temperature to prevent hypothermia

(Advance Trauma life support ed. 10, 2018)

Figure 2-2. ESI Triage Algorithm, v4



ESI Triage

- **Level 1**

Thai Male 67-year-old present with car accident, amnesia, restrain in car, sweating and cold 40 minutes prior to admission

- **V/S at ER**

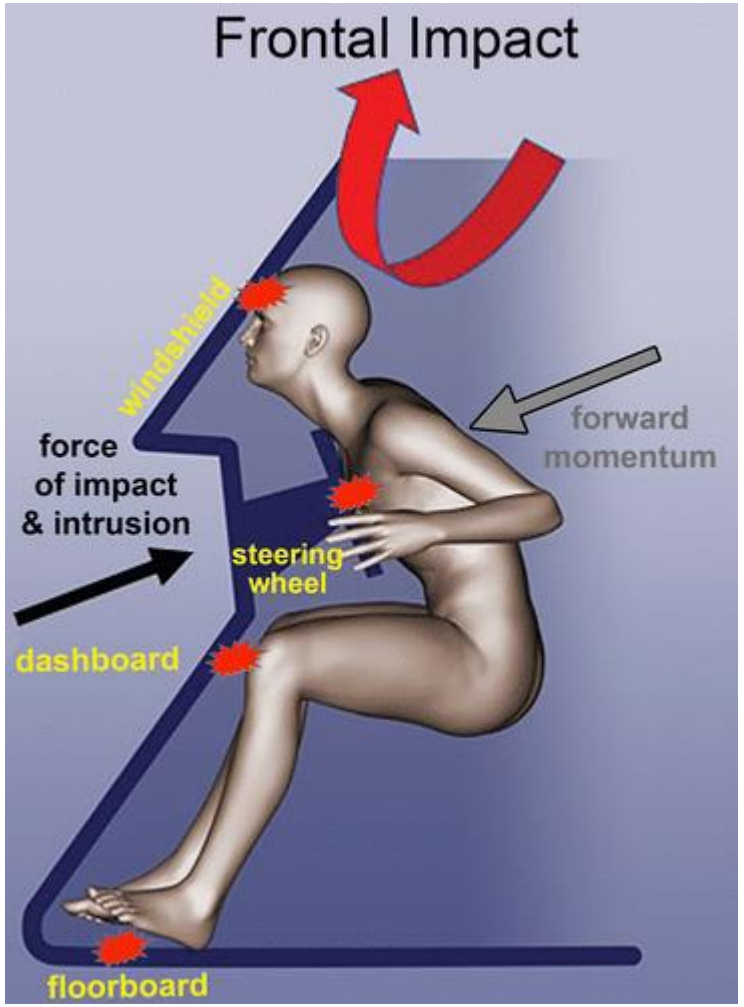
T = 36 c BP = 70/40 mmHg. (MAP 50 mmHg.)P = 127/min RR = 26/minSpO2 = 86 %RA.
E4V4M5 pupil 3 mm RTLBE

POCT glucose = 223 mg/dL.

FAST TRACK TRAUMA, Trauma Level I

(ESI Emergency Severity Index Version 4,2020)

Frontal Impact



Related Injuries Based on the Injury Mechanism

Injury Mechanism	Related Injuries
Seat belt–related injuries (increased suspicion with clinical or CT seat belt sign)	Superficial soft tissues: abdominal wall musculature Neck: laryngotracheal injury Spine: flexion-distraction injuries, C7 and T1 transverse process fractures Thoracic: rib and costal cartilage fractures (coronal images with soft-tissue window), sternum, anterior mediastinum, lungs Abdominal: duodenum, bowel and mesentery, pancreas Pelvic: pelvic ring injury, bladder rupture Vascular: subclavian, vertebral, and carotid arteries, thoracoabdominal aorta
Steering wheel– and windshield-related injuries (increased suspicion with forehead contusion or knowledge of steering wheel deformity found at crash site)	Head and neck injuries: facial and skull base fractures, blunt cerebrovascular injury, laryngotracheal crush injuries Spine injuries: cervicothoracic hyperextension injuries; craniocervical dissociation; occipital condyle, C1, and C2 fractures; cervical flexion-distraction injuries Thoracic: rib and sternal fractures, aortic injuries Abdominal injuries: solid organ injuries Extremities: axial load on outstretched hands
Dashboard-related injuries	Hip dislocation Direction of dislocation (posterior, anteroinferior, anterosuperior) Acetabular fracture Femoral head or neck fracture Postreduction CT: location of bone fragments, new fracture Knee injuries Patellar fracture Tibial plateau fracture Posterior cruciate ligament injury or posterior knee dislocation, popliteal vascular injury Femoral condyle (Hoffa) or shaft fracture
Floorboard-related injuries	Metatarsal and tarsal fractures (including talar dome or body, talar neck, lateral talar process, and calcaneus) Lisfranc, Chopart, and subtalar joint malalignment (consider stress views) Tibial or fibular fractures (pilon, shaft, and tibial plateau)
Side-impact injuries	Head and neck: coup and countercoup brain injury, skull fracture, blunt cerebrovascular injury Spine: lateral flexion injuries, facet joint subluxation or dislocation, with particular attention to the C7-T1 level Thoracic: rib fractures, aorta, diaphragm Abdominal: solid organ injuries Pelvis: lateral pelvic compression injuries (unilateral or bilateral)

(Fadl & Sandstrom, 2019)

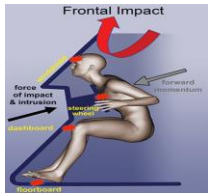
Case Analysis

67 year old patient

Car accident 40 min PTA
- Amnesia
- Restrain in car
- Sweating & cold

Basic

Frontal impact → BLUNT



Old Adult
- Dead increase after age 55 (67 y)
- SBP < 110 HR > 90 may be shock after age 65 (SBP 70, HR 127)
- AASI 127
- UD = HT, DM, DLP

ISS = 50
TRISS = 22.9

Unpreventable death

BLUNT
- CHEST
  - Lung contusion → Rupture pulmonary artery → Gas exchange → Hypoxia
    - From CXR
  - Rib fracture → Pneumothorax → Gas exchange
    - Fx rib 2-8 Rt
    - Fx rib 2 – 9 Lt
  - Rib fracture → Hemothorax → bleeding → hypovolemia & hemorrhagic shock
- ABDOMINAL → Organ injury → bleeding → hypovolemia & hemorrhagic shock
  - FAST +

- Paradoxical abdominal movement
- contusion at chest wall
- subcutaneous emphysema
- chest crepitus, crepitation Both Lung
- decrease breath sound Lt lung
- RR 26 O2sat 86% RA

มีภาวะพร่องออกซิเจน

OR: laparotomy
liver injury grade IV
spleen injury grade V

hypovolemia & hemorrhagic shock → Vasoconstriction Plt. aggregation → Hypoperfusion → Anaerobic metabolism

- Radial pulse weak both side fast , Polar, Pallor, Capillary refill >2 sec.
- E-FAST : positive at cul de sac
- HR 127 bpm.
- BP 70/40 mmHg

มีภาวะช็อค

prevent

Blood lost
Transfusion further exacerbates

Shock: cellular metabolism
Unwarm fluids and blood component

Lost/ consumption/
Dilutional/ clot instability
Crystalloid infusions

เตรียมผู้ป่วยก่อนผ่าตัด

ผู้ป่วยและญาติวิตกกังวล

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.

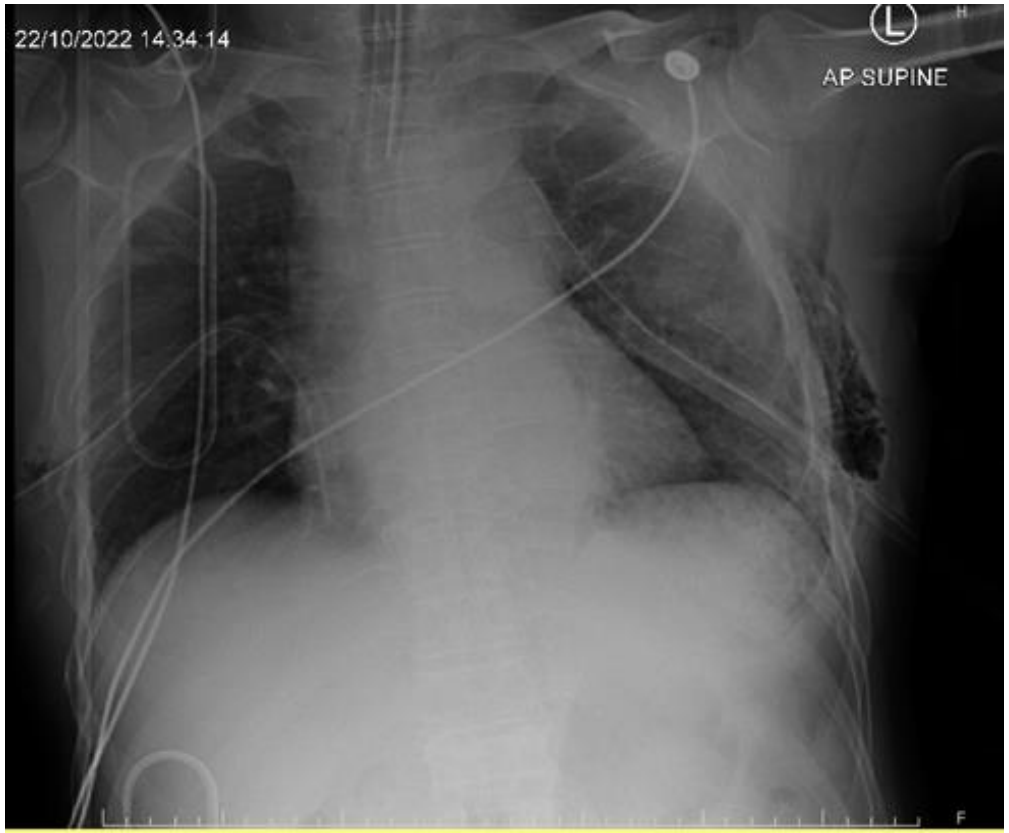
TABLE 3-2 RESPONSES TO INITIAL FLUID RESUSCITATION[a]

	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

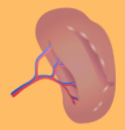
[a] Isotonic crystalloid solution, up to 1000 mL in adults; 20 mL/kg in children

(Advance Trauma life support ed. 10, 2018)

Fail chest , Fracture rib right 2nd-8th, Fracture rib left 2nd-9th, Pulmonary contusion right Pulmonary contusion left, Hemopneumothorax right, Hemopneumothorax left



COMPARISON OF SPLEEN, LIVER AND KIDNEY INJURY GRADES

GRADE	SPLEEN INJURY 	LIVER INJURY 	KIDNEY INJURY 
1	• Subcapsular Hematoma < 10% • Laceration < 1 cm	• Subcapsular Hematoma < 10% • Laceration < 1 cm	• Subcapsular Hematoma
2	• Subcapsular Hematoma - 10-50% • Laceration 1-3 cm	• Subcapsular Hematoma - 10-50% • Laceration 1-3 cm	• Subcapsular Hematoma • Laceration < 1 cm
3	• Subcapsular Hematoma > 50% • Laceration > 3cm	• Subcapsular Hematoma > 50% • Laceration > 3cm	• Laceration > 1 cm
4	• > 25% Vascular Loss (Hilum Injury)	• Laceration: 25-75% hepatic lobe or involves 1-3 Couinaud segments. • Ruptured intraparenchymal hematoma with active bleeding	• Partial Vascular Loss (Injury to Medulla) WWW.OPENMED.CO.IN
5	• Complete Vascular Loss • Shattered Spleen	• Laceration: >75% hepatic lobe or involves > 3 Couinaud segments • Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins)	• Complete Vascular Loss • Shattered Kidney

Timeline of patient

13.00
22/10/65
At Scene

13.42
At ER

13.43
Activated trauma level 1

13.45
Trauma surgeon visit case at ER , Activated Massive blood transfusion

15.00
Go on surgery Dx Blunt trauma with R/O intraabdominal bleeding with fail chest with hemopneumothorax

23.00
Post-operation at SICU Dx Blunt trauma with liver injury grade IV with spleen injury grade V with fail chest with hemopneumothorax

14.34
23/10/65
Dead at ICU

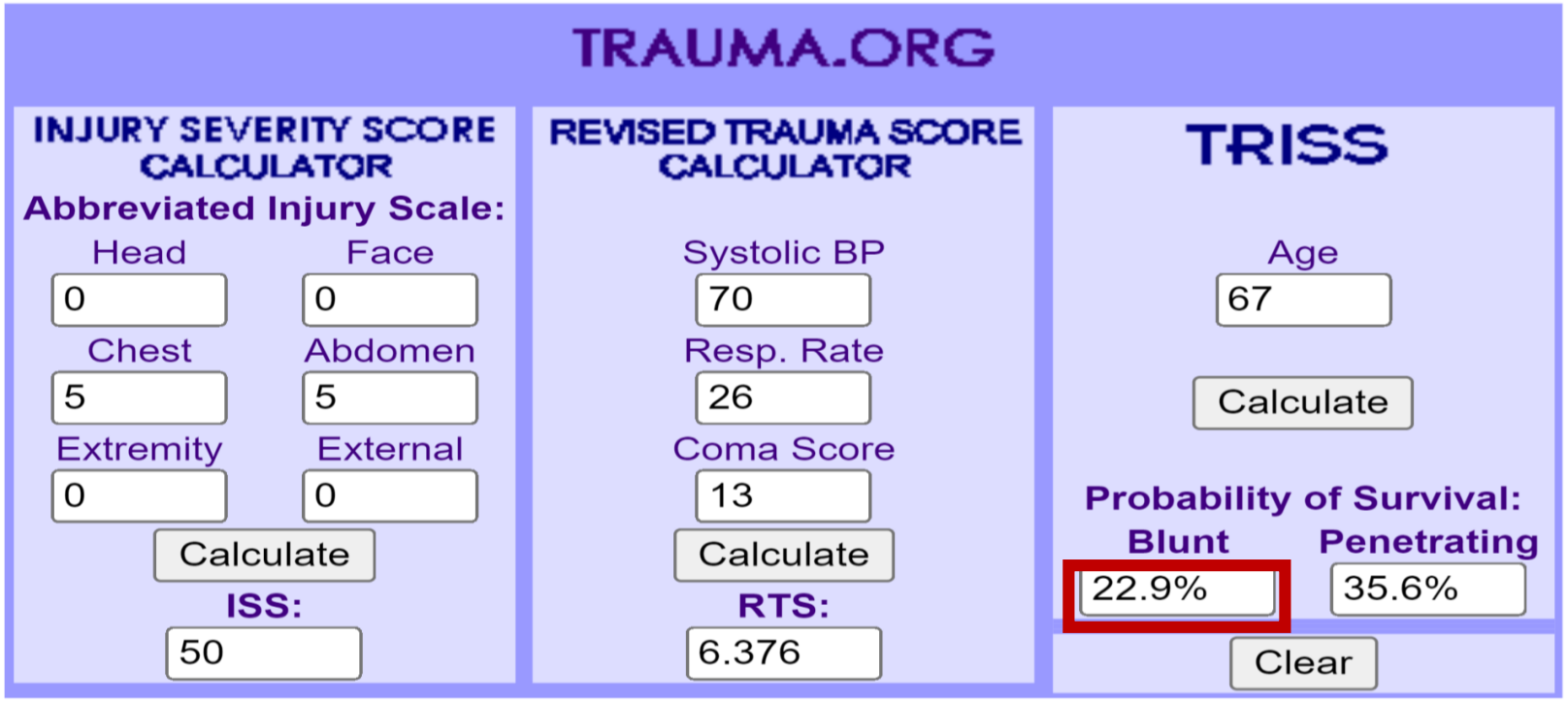
Injury Severity Score (ISS)

Region	Injury Description	AIS	Square Top Three
Head & Neck	No Injury	**0**	
Face	No Injury	**0**	
Chest	Fracture rib right 2nd-8th, Fracture rib left 2nd-9th, Fail chest Pulmonary contusion right Pulmonary contusion left Hemopneumothorax right Hemopneumothorax left	**4** **4** **5** **3** **3** **3** **3**	**25**
Abdomen	Spleen injury Liver injury	**5** **4**	**25**
Extremity	No Injury	**0**	
External	No Injury	**0**	
ISS =(The 3 most AIS score)2 and added together			**50**

Trauma Score and Injury Severity Score (TRISS)

ISS	
1-8	Minor
9-15	Moderate
16-24	Serious
25-49	Severe
50-74	Critical
75	Maximum

Injury Severity Score = 50
"Critical"



PS score 0.75 – 1 = Preventable death
PS score < 0.50 = Unpreventable death

Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma

Jeremy W. Cannon, MD, SM, Mansoor A. Khan, MBBS (Lond), PhD, Ali S. Raja, MD, Mitchell J. Cohen, MD, John J. Como, MD, MPH, Bryan A. Cotton, MD, Joseph J. Dubose, MD, Erin E. Fox, PhD, Kenji Inaba, MD, Carlos J. Rodriguez, DO, John B. Holcomb, MD, *and* **Juan C. Duchesne, MD**, *Philadelphia, Pennsylvania*

BACKGROUND: The resuscitation of severely injured bleeding patients has evolved into a multi-modal strategy termed damage control resuscitation (DCR). This guideline evaluates several aspects of DCR including the role of massive transfusion (MT) protocols, the optimal target ratio of plasma (PLAS) and platelets (PLT) to red blood cells (RBC) during DCR, and the role of recombinant activated factor VII (rVIIa) and tranexamic acid (TXA).

METHODS: Using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology, a subcommittee of the Practice Management Guidelines (PMG) Section of EAST conducted a systematic review using MEDLINE and EMBASE. Articles in English from1985 through 2015 were considered in evaluating four PICO questions relevant to DCR.

RESULT: A total of 37 studies were identified for analysis, of which 31 met criteria for quantitative meta-analysis. In these studies, mortality decreased with use of an MT/DCR protocol vs. no protocol (OR 0.61, 95% CI 0.43–0.87, $p = 0.006$) and with a high ratio of PLAS:RBC and PLT:RBC (relatively more PLAS and PLT) vs. a low ratio (OR 0.60, 95% CI 0.46–0.77, $p < 0.0001$; OR 0.44, 95% CI 0.28–0.71, $p = 0.0003$). Mortality and blood product use were no different with either rVIIa vs. no rVIIa or with TXA vs. no TXA.

CONCLUSION: DCR can significantly improve outcomes in severely injured bleeding patients. After a review of the best available evidence, we recommend the use of a MT/DCR protocol in hospitals that manage such patients and recommend that the protocol target a high ratio of PLAS and PLT to RBC. This is best achieved by transfusing equal amounts of RBC, PLAS, and PLT during the early, empiric phase of resuscitation. We cannot recommend for or against the use of rVIIa based on the available evidence. Finally, we conditionally recommend the in-hospital use of TXA early in the management of severely injured bleeding patients. (*J Trauma Acute Care Surg.* 2017;82: 605–617.

KEY WORDS: Damage control resuscitation; massive transfusion protocol; coagulopathy of trauma; recombinant factor VIIa; tranexamic acid.

(Cannon, Jeremy W., et al., 2017)

TABLE 1. Principles of Damage Control Resuscitation (DCR)

Principle	References
Avoid/reverse hypothermia	Gentilello,[1] Shafi[2]
Minimize blood loss with early hemorrhage control measures during transport and initial evaluation	Kragh,[3] Schroll,[4] Inaba,[5] Leonard,[6] Yong,[7] Dubose[8]
Delay resuscitation/target low-normal blood pressure before definitive hemostasis	Bickell,[9] Dutton[10]
Minimize crystalloid administration	Duchesne,[11] Schreiber[12]
Use MT protocol to ensure sufficient blood products are available in a prespecified ratio	O'Keeffe,[13] Cotton[14]
Avoid delays in surgical or angiographic hemostasis	Meizoso,[15] Schwartz,[16] Tesoriero[17]
Transfuse blood components that optimize hemostasis	Borgman,[18] Holcomb,[19] Holcomb[20]
Obtain functional laboratory measures of coagulation (e.g., TEG or TEM) to guide ongoing resuscitation	Gonzalez,[21] Tapia[22]
Give pharmacologic adjuncts to safely promote hemostasis	CRASH-2,[23] Morrison,[24] Hauser[25]

TEG, thromboelastography; TEM, thromboelastometry.

(Cannon, Jeremy W., et al., 2017)

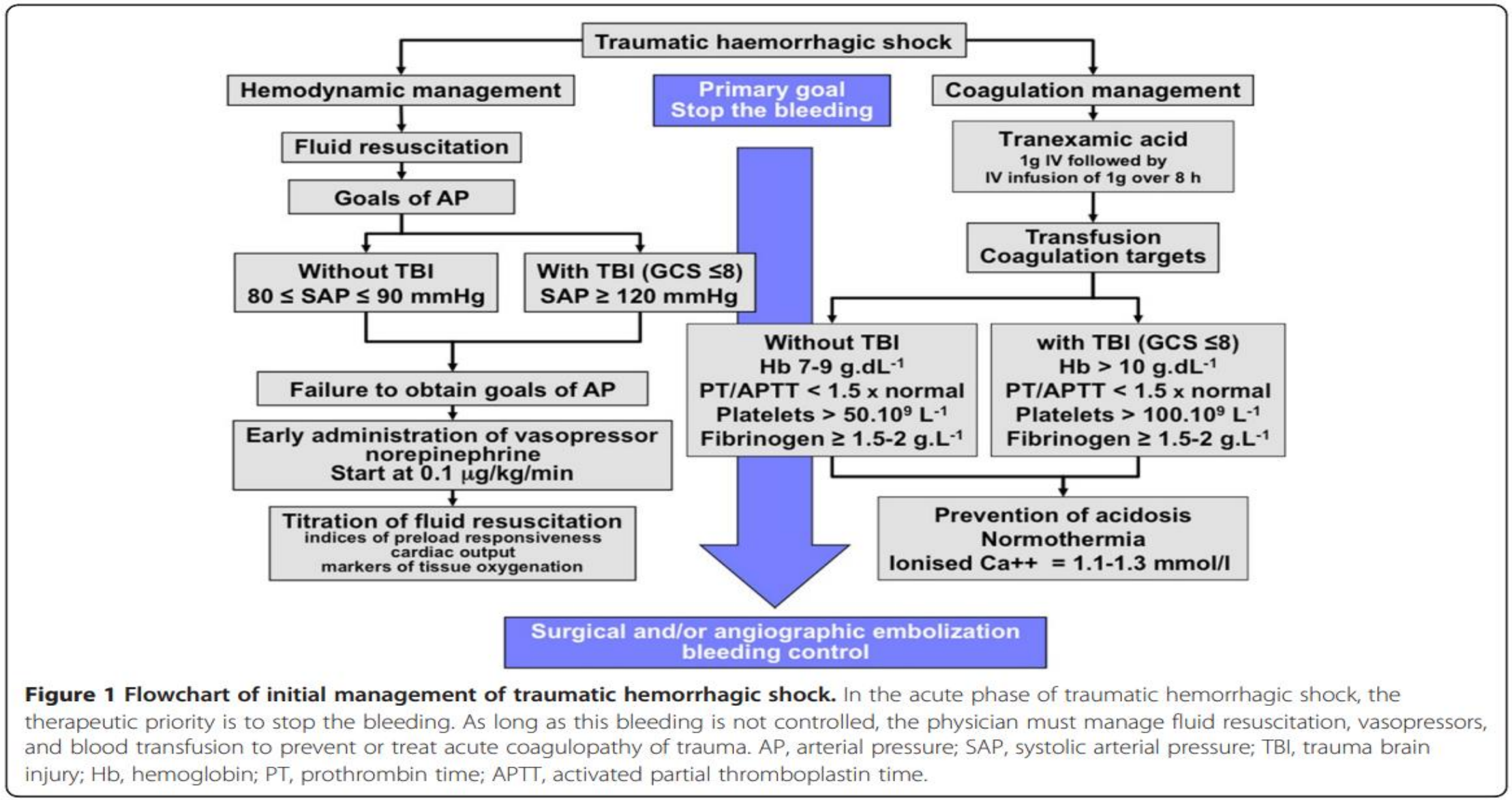


Figure 1 Flowchart of initial management of traumatic hemorrhagic shock. In the acute phase of traumatic hemorrhagic shock, the therapeutic priority is to stop the bleeding. As long as this bleeding is not controlled, the physician must manage fluid resuscitation, vasopressors, and blood transfusion to prevent or treat acute coagulopathy of trauma. AP, arterial pressure; SAP, systolic arterial pressure; TBI, trauma brain injury; Hb, hemoglobin; PT, prothrombin time; APTT, activated partial thromboplastin time.

(Bougle, Horrois & Duranteau, 2013)

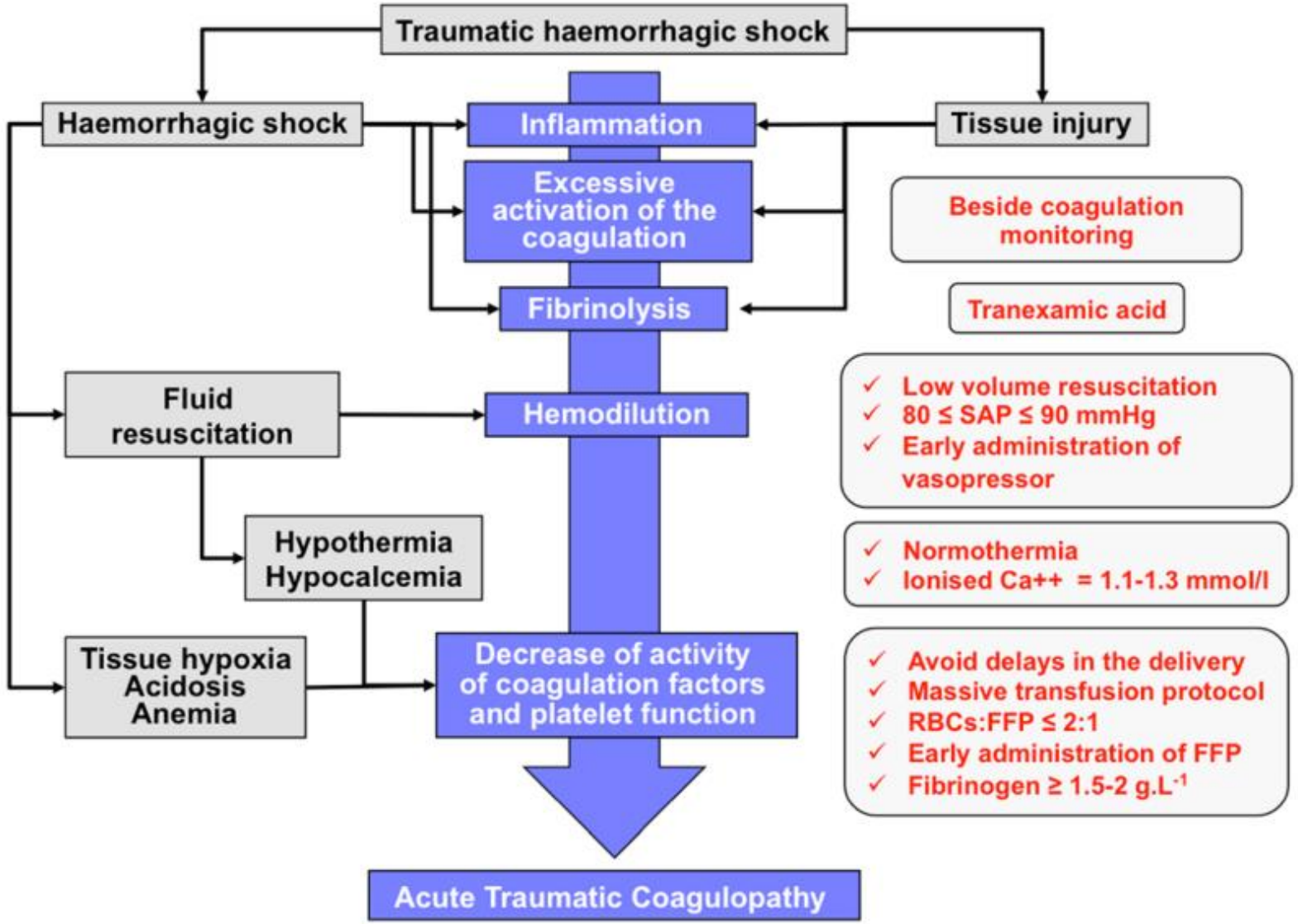


Figure 2 The main pathophysiological mechanisms involved in acute traumatic coagulopathy and transfusion strategy. SAP, systolic arterial pressure; RBC, red blood cells; FFP, fresh-frozen plasma.

MTP activation

- Scoring System:
  - Assessment of Blood Consumption (ABC) Score:
    - ✓ SBP ≤ 90 mmHg
    - ✓ HR ≥ 120 bpm
    - Penetrating
    - ✓ Positive FAST

    Score 2 = 38%, 3 = 45%, 4 = 100%

TASH Score (Trauma Associated Severe Hemorrhage)

Predicts the need for massive transfusion based on clinical and laboratory data.

When to Use | Why Use

Sex	Female 0	Male +1
Hemoglobin	< 7 g/dL	+8
	< 9 g/dL	+6
	< 10 g/dL	+4
	< 11 g/dL	+3
	< 12 g/dL	+2
	≥ 12 g/dL	0
Base Excess	< -10 mmol/L	+4
	< -6 mmol/L	+3
	< -2 mmol/L	+1
	≥ -2 mmol/L	0

Systolic Blood Pressure	< 100 mm Hg	+4
	< 120 mm Hg	+1
	≥ 120 mm Hg	0
Heart Rate	>120 bpm	+2
	≤ 120 bpm	0
Positive FAST for Intra-Abdominal Fluid	No 0	Yes +3
Clinically Unstable Pelvic Fracture	No 0	Yes +6
Open or Dislocated Femur Fracture	No 0	Yes +3

Result:

Please fill out required fields.

Next Steps | Evidence | Creator Insights

TASH> 16 → MT > 50%

TASH> 27 → MT 100%

คะแนนเต็ม 31

Maegele M. Transfusion Medicine and Hemotherapy 2012; 39:85-97.

Maegele M. Vox Sanguinis 2011; 100:231-238.

Shock index (SI = HR / SBP)

0.5 – 0.6 = normal

0.8 = 10 – 20% (Shock class I)

1.0 = 20 – 30% (Shock class II)

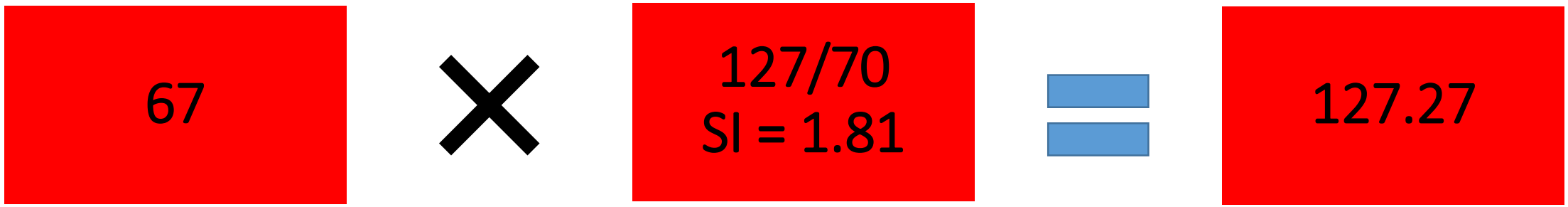
1.1 = 30 – 40% (Shock class III)

1.5 – 2.0 = 40 – 50% (Shock class IV)

127/70
SI = 1.81

Age – Adjusted Shock Index (AASI)

- Age × (HR/SBP) if ≥ 50 concern for shock



Trauma Damage Control

Prehospital

Who?
Multisystem injuries with
- hemodynamic instability
- lethal triads

Key
As ATLS primary survey
keep permissive hypotension
Massive transfusion protocal
Keep warm
Early operation

Indication
BT < 35C
Acidosis
- pH < 7.2
- BD <-5,-15(<55yo)mmol/L
- Lactate>5mmol/L

INR,PTT > 50%normal

Goals
Control of hemorrhage
& contamination

Initial operation

By
Packing of bleeding space & organ
Repair or shunting vessel
Closure GI perforation
Abdominal toilet
Temporary closure

ICU Resuscitation

Correct hypovolumia
Blood component or RLS
Monitor pH & lactate

Lethal Triad
- Acidosis
- Hypothermia
- Coagulopathy

TEG,ROTEM(Goal-directed)

Keep warm
Balnket
Warm IV
Irrigate

When?
After corrected metbolic failure
(~12-72hr. after 1st DCS)
Early if uncontrol bleeding

Reoperation

Key
Correct metabolic failure
Organ support

When?
No bowel swelling
No ACS
No need for re-operation

Goals
Removal of packs
Comprehensive examination
Reestablish bowel or create stomas
Insertion darins & feeding tube

Closure of abdominal wall

FB: Surgeonvivor

https://www.facebook.com/surgeonvivor/posts/840722953433044/, 18 มกราคม 2021

Resuscitation in special group

Elderly

- ให้ระวังภาวะ shock เมื่อ HR > 90 mmHg, SBP < 110 mmHg
- Medication, Comorbidities
- Age – Adjusted Shock Index (AASI) = Age × (HR/SBP)
  if ≥ 50 concern for shock

(Koch et al., 2019, Ramesh, Uma & Farhath, 2019)

Resuscitation in special group

Elderly

- Clear fluid administration should initially be limited to 20 ml/kg with early consideration given to the administration of blood and blood products
- Careful re-evaluation and monitoring should to performed to determine if further fluid administration is required; particularly if underlying heart disease is suspected.
- Maintaining hemoglobin levels above 9 g/dl and mean arterial pressure above 70 mmHg, particularly if the patients comorbidities are unknown

(Koch et al., 2019, Ramesh, Uma & Farhath, 2019)


ศาลาชีรพยาบาล
Thank You