Anesthetic Considerations for Trauma Patients

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Learning objectives

1. Defining the discipline of trauma anesthesiology and the services provided by trauma anesthesiologists

2. Identifying the benefits of trauma anesthesiology

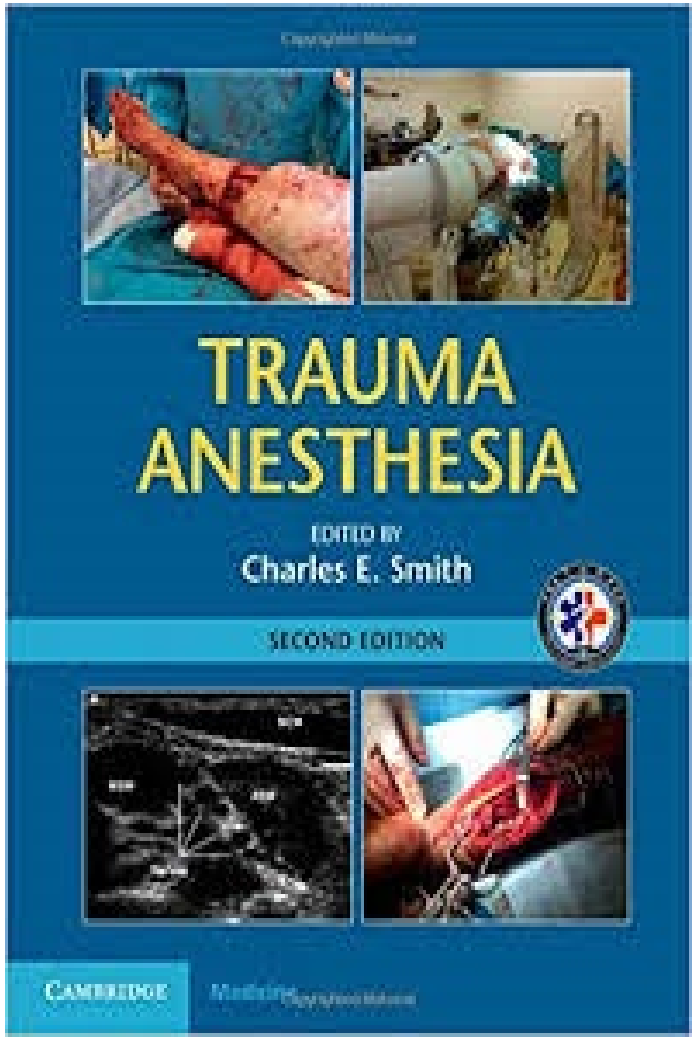
3. Identifying why trauma anesthesiology is important to the specialty of anesthesiology and medicine at large

Outline

1. Mechanisms of injury

2. Trauma assessment
   - Advanced trauma life support (ATLS)
   - KTAT in Korea
   - Primary survey: assessment steps (ABCDE)

3. Initial management: Resuscitation
   - Resuscitation goals
   - Airway managements
   - Hemostatic resuscitation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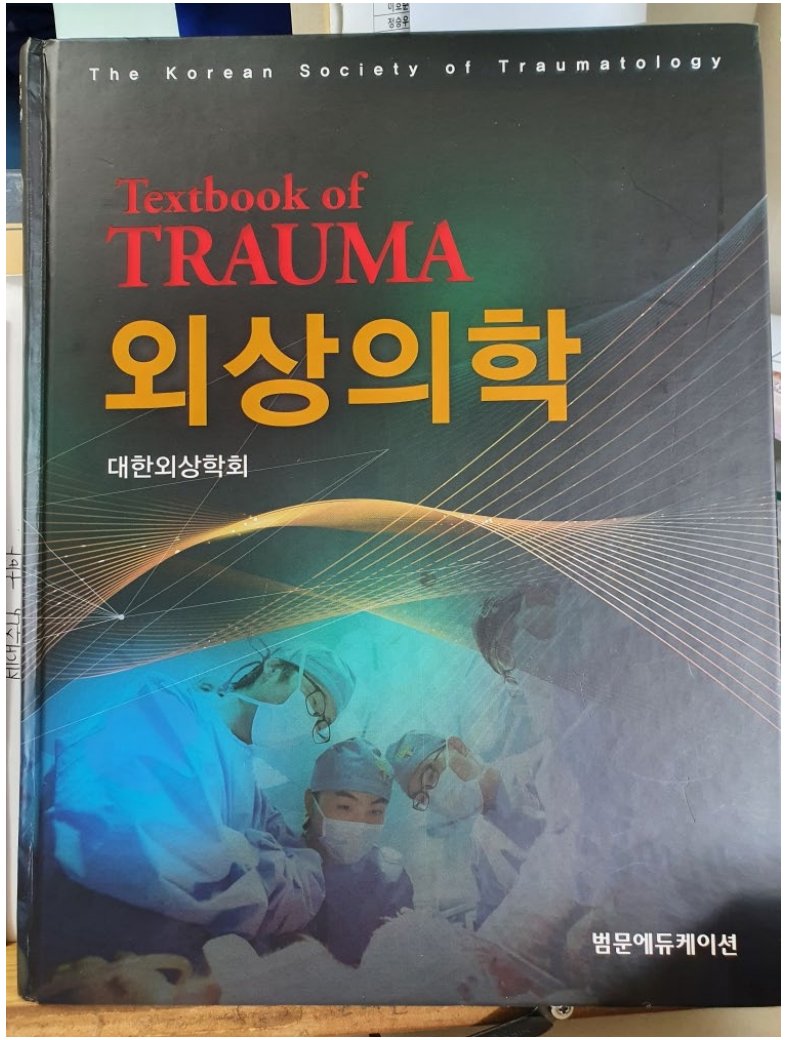
The Korean Society of Traumatology
Textbook of
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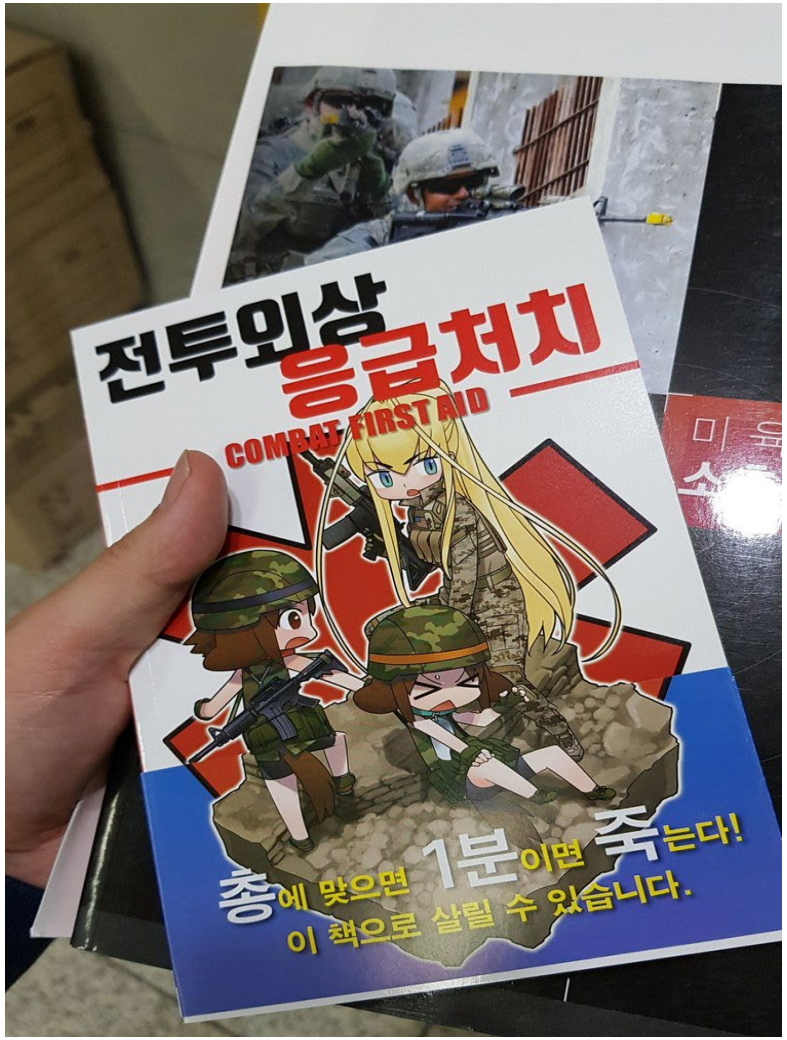
범문에듀케이션


전투외상
응급처치
COMBAT FIRST AID
총에 맞으면 1분이면 죽는다!
이 책으로 살릴 수 있습니다.


STOP THE BLEED
SAVE A LIFE
BLEEDINGCONTROL.ORG
1 APPLY PRESSURE WITH HANDS
2 APPLY DRESSING AND PRESS
3 APPLY TOURNIQUET
WRAP
WIND
SECURE
TIME
CALL 911


경추의 손상 - 목의 안정화
최근의 전투차량은 IED나 지뢰에 대한 방어력을 높이고 있으나 그래도 폭발의 충격으로 승무원이 천정에 머리를 부딪혀 목(경추)를 다치는 사례가 많다. 이런 경우에 실시되는 경추의 고정(안정화) 방법을 해설한다.
◆X칼라(경추보호기)에 의한 고정
1 부상자 본인이 가장 편한 상태로 목 위치를 둘 수 있도록 보조자가 머리를 든다.
X칼라 (경추보호기)
◆SAM부목에 의한 고정
COMBAT FIRST AID
112
버디에이드에 의한 지혈
(예 : 왼쪽 다리에 부상)
지혈대를 감아 조이는데는 상당한 힘이 필요하다. 부상자 자신이 의식이 희미해져가는 와중에 그 만큼의 힘을 발휘할 가능성은 매우 낮다. 대부분의 경우 지혈대 장착은 버디 에이드(동료에 의한 응급처치)에 의해 이뤄지게 된다.
1 구호자는 부상자의 지혈대를 꺼낸다. 자신의 지혈대는 쓰지 않는 편이 좋다.

Mechanisms of injury

- Transfer of energy occurs d/t blunt or penetrating trauma

- According to Sir Isaac Newton's first law of motion

제 1법칙=관성(inertia) 의 법칙

: 외부에서 물체의 상태에 변화를 일으킬 수 있는 힘이 적용되지 않는 한, 물체는 가만히 있거나 일정한 선형속도를 유지하려는 것

Severity of injury is related to

1. Kinetic energy absorbed by the body ($KE=mass * velocity^2/2$)

2. Direction the energy travels through the body

3. Body structure density:
   - -solid organs more likely to rupture than hollow organs
   - -bone and cartilage are more rigid and dense

Mechanisms of injury

1. 추락 Fall
  Unintentional falls,
  Falls from a height, such as ladder, more common
  Working age population
  widespread use of anticoagulants in the elderly

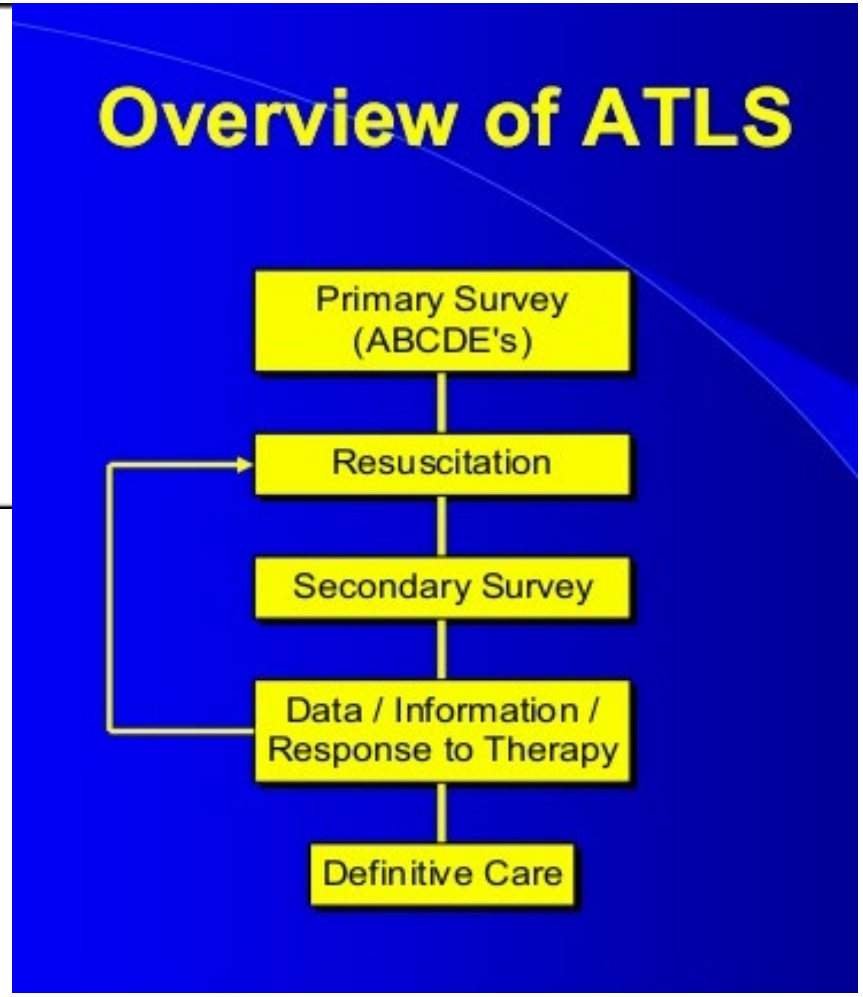
2. 교통사고
  Transportation-related injuries
    : motor vehicle collisions,
      motorcycle, bike, pedestrian
      rollover crashes with ejection
  Prevention: seat belt, booster seat

3. 관통상 Penetrating Trauma
  Gun-shot
  - tissue damage from a bullet
  - entry and exit wounds
  Stab wounds

4. 폭발 Blasts or explosions
  Direct effect of high-pressure, blunt trauma, fall or ejection

ATLS

A
Airway and C-Spine Protection
B
Breathing
C
Circulation
D
Disability
E
Exposure and Environment



ACLS	ATLS
• High-quality CPR (100/min; >2 inches) • Minimize interruptions in chest compressions • Compressions, airway, breathing (CAB)	• Primary ABCDE/Secondary ABCDE • Airway maintenance with cervical spine protection • Breathing and "normal" ventilation (avoid hypoventilation)

Objectives of ATLS

- Assess the patient's condition rapidly and accurately
- Resuscitate and stabilize the patient according to priority
- Determine if the patient's needs exceed a facility's capabilities
- Arrange appropriately for the patient's definitive care
- Ensure that optimum care is provided

Trauma Assessment (primary survey< 5min) ABCDE

- Airway maintenance with restriction of cervical spine motion
- Breathing and ventilation
- Circulation with hemorrhage control
  :tourniquet/FAST/CXR for intrathoracic injuries/Pelvis XR
- Disability : GCS/motor-sensory assessment
- Exposure / Environmental control: Completely undress the patient, but prevent hypothermia

The final step in the primary survey

- is complete Exposure of the patient (by cutting off the garments) and a **head-to-toe** search for visible injuries or deformities, including deformities of bones or joints, soft tissue bruising, and any breaks in the skin.

- The anesthesiologist can assist by support of the

head and neck, airway, and care in manipulating the spine.

→ When the primary survey is completed, resuscitation efforts are well established, and the vital signs are normalizing,

→ the secondary survey can begin.

Primary goals in the T-bay and the OR

- Airway management
- Management of hemodynamic instability
  - Include management of hemorrhagic shock and its sequel
  - Coagulopathy, hemodilution, hypothermia, electrolyte and acid-base derangements
- Lung-protective ventilation
- Maintenance of normothermia
- Avoid secondary brain injury

대한마취통증의학회

- 대한통증학회
- 대한산과마취학회
- 대한소아마취학회
- 대한노인마취통증학회
- 대한심폐혈관마취학회
- 대한이식마취학회
- 대한뇌신경마취학회
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- 대한마취약리학회
- 중환자의학회

외상마취

Speacialty를 갖는가..?

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TAS

- Trauma anesthesiologists must be prepared to emergently care for a patient with any form & severity of injury

- Patients may have an unknown or suboptimally managed pre-existing conditions, and who may require any kind of operation regardless of the time of day, even when resources are not readily available

- The services required of specially trained trauma anesthesiologists

- Resuscitation from the pre-hospital setting → trauma bay → the operating room → interventional radiology suite → intensive care unit

- Airway mx, establishing breathing & ventilation.

- Circulatory resuscitation, including establishment of an adequate iv access, administration of blood components in optimal ratio to enhance oxygen delivery and to ensure adequate coagulation.

- Massive transfusion in effective ratios of component therapy – with coagulation adjuncts – to the patient in hemorrhagic shock.

- Lines and invasive monitors including arterial line, central venous or pulmonary artery catheter (when indicated).

- Providing data of intraoperative diagnostic studies such as transesophageal echocardiography(TEE) and laboratory data such as arterial blood gases, thromboelastogram/thromboelastometry, platelet function assay, etc.

- Fluid and electrolyte administration to optimize end organ perfusion, at the same time avoiding over-and under-hydration; precise titration of inotropic agents and vasoactive drugs.

- Optimization of cerebral and spinal cord perfusion in order to minimize adverse neurologic outcome associated with traumatic brain (secondary TBI) and spinal cord injury.

- Comprehensive perioperative pain management including intravenous, neuraxial and regional anesthesia

- Leadership in data management, outcomes appraisal, quality improvement, and clinical research trials.

Optimal requirements for anesthesiology services specifically at a Level I Trauma Center

- Anesthesiology services should be promptly available for emergency operations and for airway problems. Anesthesia services in Level I trauma centers must be available 24 hours a day 7 days a week.

- When anesthesiology chief residents are used to fulfill availability requirements, the staff anesthesiologist on call should always be advised and promptly available at all times

- - A designated anesthesiologist should participate in both a Trauma Program Operational Process Performance Improvement Committee and a Multidisciplinary Peer Review Committee. The liaison should be involved in continuously evaluating the trauma program processes and outcomes to ensure optimal and timely care.

이상적 마취과의사의 역할

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- Anesthesiologist as a member of the first responder team
  - Benefits
    - Airway management
    - Precise resuscitation during shock
    - Invasive iv, a-line, TEE, ABGA, Transfusion, Ventilator
    - Provide effective analgesia and sedation
    - Brain and spinal cord protection
    - Allow seamless transfer of the patients to the OR w/o delay with ongoing resuscitation

- Airway managements

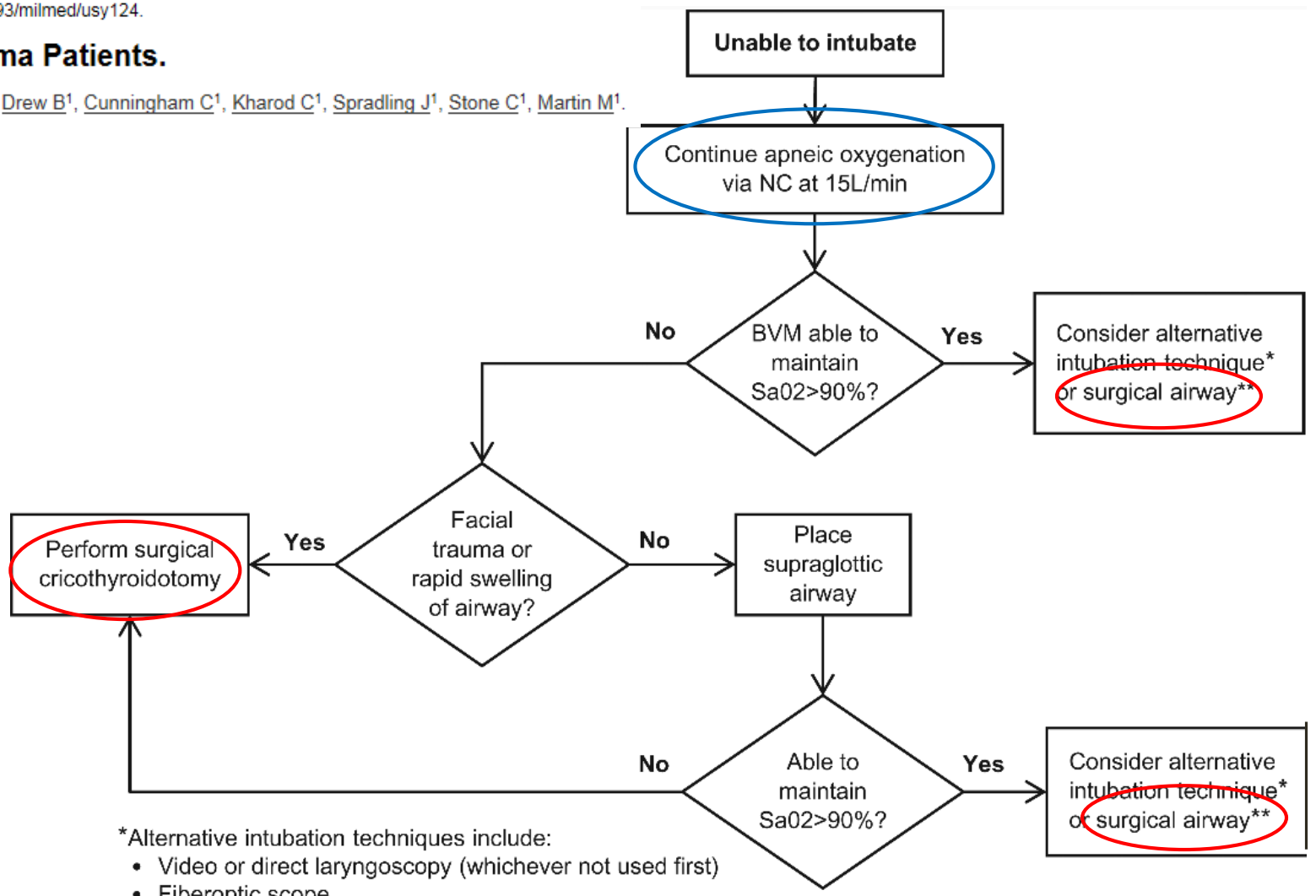
- Waking up the patient → X
- Canceling the procedure → X
- Cooperative patient → rare
- Awake intubation → rare

Modified Difficult Airway Guideline in Trauma

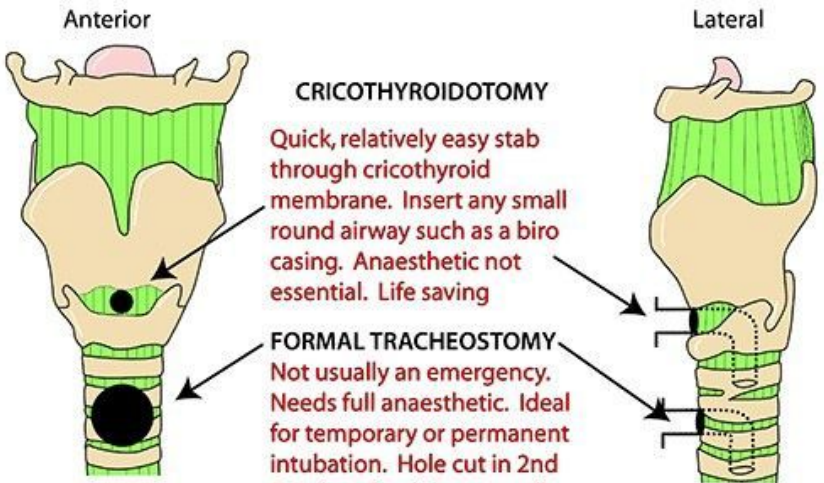
Mil Med. 2018 Sep 1;183(suppl_2):29-31. doi: 10.1093/milmed/usy124.

Airway Management for Trauma Patients.

Walrath BD[1], Harper S[1], Barnard E[1], Tobin JM[1], Drew B[1], Cunningham C[1], Kharod C[1], Spradling J[1], Stone C[1], Martin M[1].



EMERGENCY ACCESS TO TRACHEA



CRICOTHYROIDOTOMY

Quick, relatively easy stab through cricothyroid membrane. Insert any small round airway such as a biro casing. Anaesthetic not essential. Life saving

FORMAL TRACHEOSTOMY

Not usually an emergency. Needs full anaesthetic. Ideal for temporary or permanent intubation. Hole cut in 2nd & 3rd tracheal rings, usually after dividing thyroid isthmus. Inferior thyroid veins can be troublesome

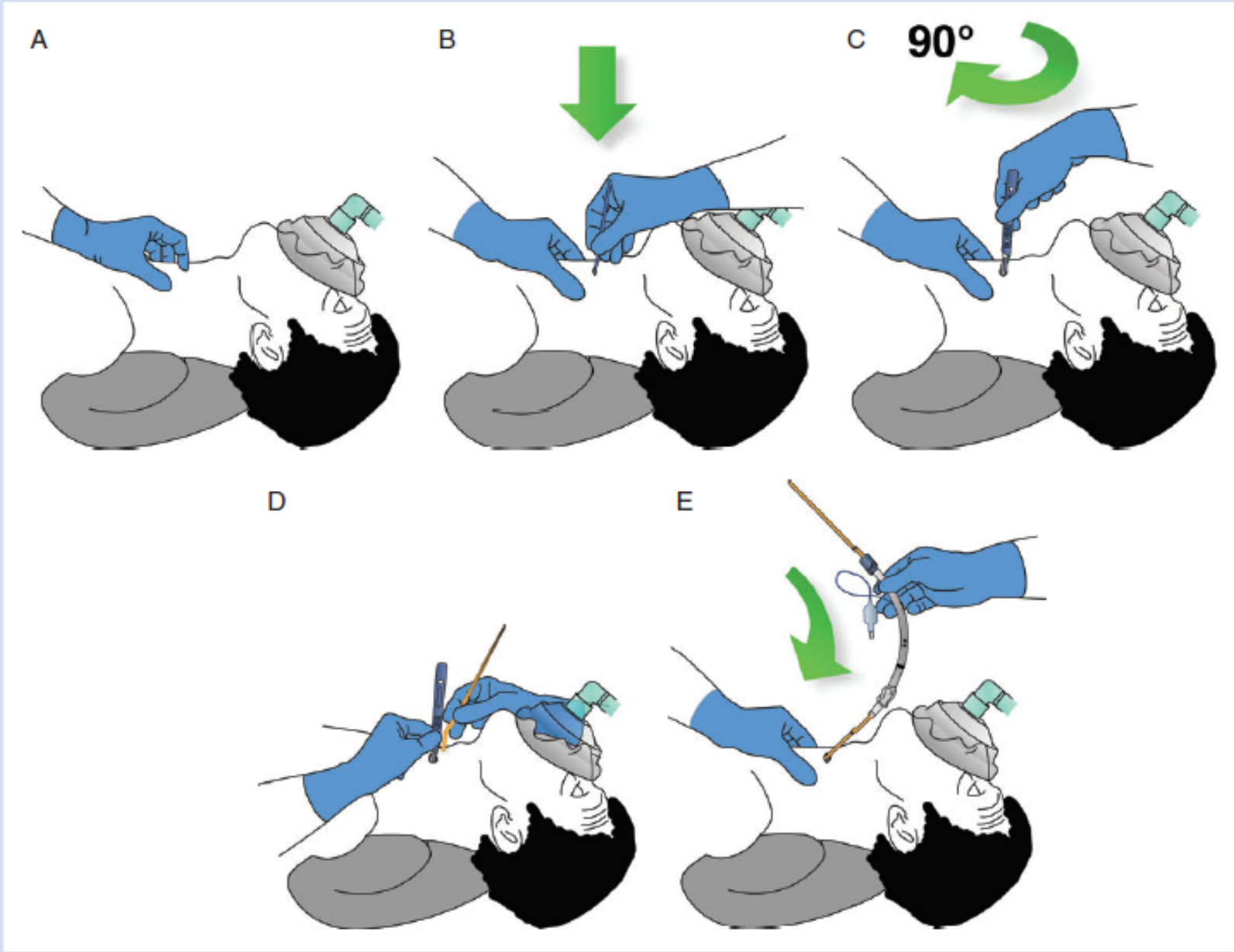
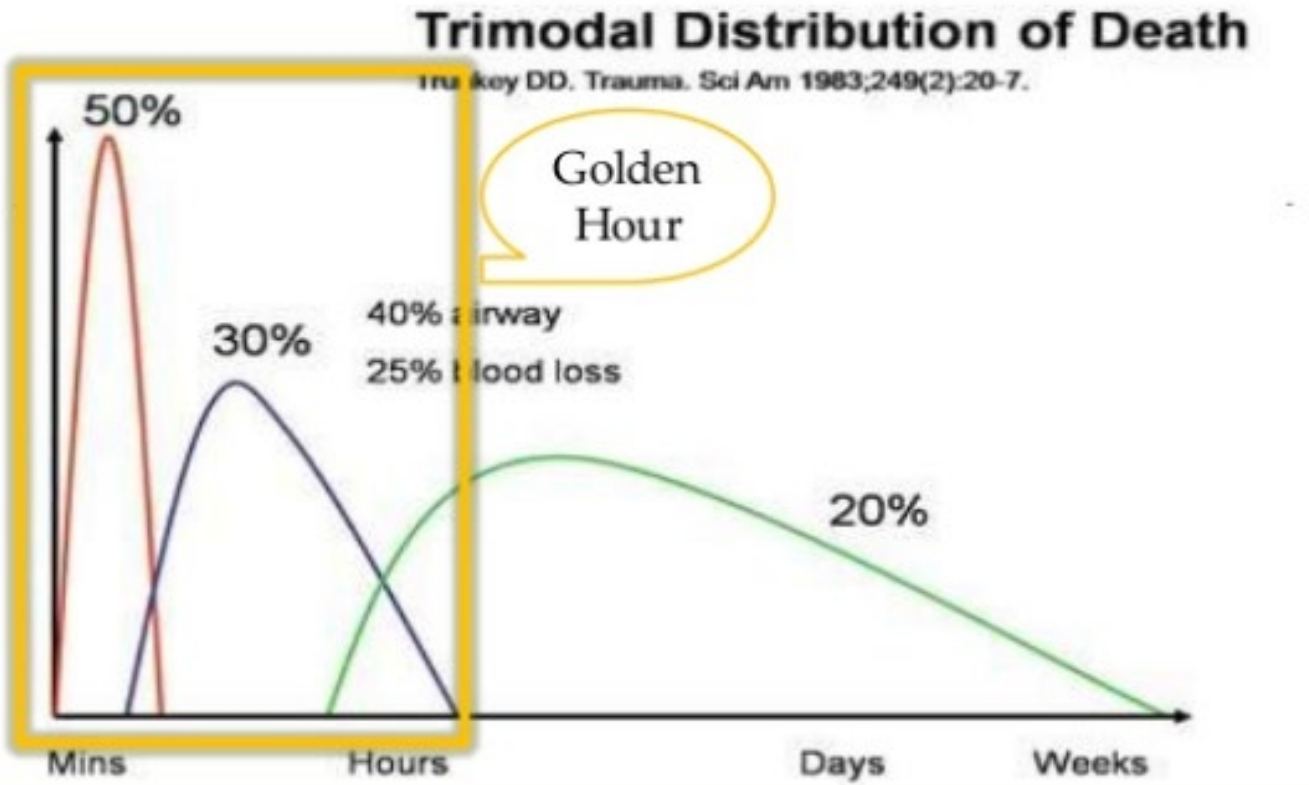


Fig 4 Cricothyroidotomy technique. Cricothyroid membrane palpable: scalpel technique; 'stab, twist, bougie, tube'. (A) Identify cricothyroid membrane. (B) Make transverse stab incision through cricothyroid membrane. (C) Rotate scalpel so that sharp edge points caudally. (D) Pulling scalpel towards you to open up the incision, slide coude tip of bougie down scalpel blade into trachea. (E) Railroad tube into trachea.

Hemorrahgic Resuscitation

Trimodal distribution of trauma deaths



- 1st: Great vessel injury, CNS (central nervous system)
- 2nd: Hemorrhage
- 3rd: Multi-organ failure

ATLS classification of hemorrhagic shock

Classification of Shock				
	Class I	Class II	Class III	Class IV
Blood loss (mL)	< 750	750-1500	1500-2000	> 2000
Blood loss (%body vol)	< 15%	15-30%	30-40%	> 40%
HR	< 100	**> 100**	> 120	> 140
BP	Normal	Normal	**Decreased**	**Decreased**
Pulse pressure	**Normal/ Increased**	Decreased	Decreased	Decreased
RR	14-20	20-30	30-40	> 35
Urine output (mL/ hr)	> 30	20-30	5-15	Negligible
CNS	Slightly anxious	Mildly anxious	Anxious and confused	**Confused and lethargic**
Fluid replacement	Crystalloid	Crystalloid	**Crystalloid and Blood**	**Crystalloid and Blood**

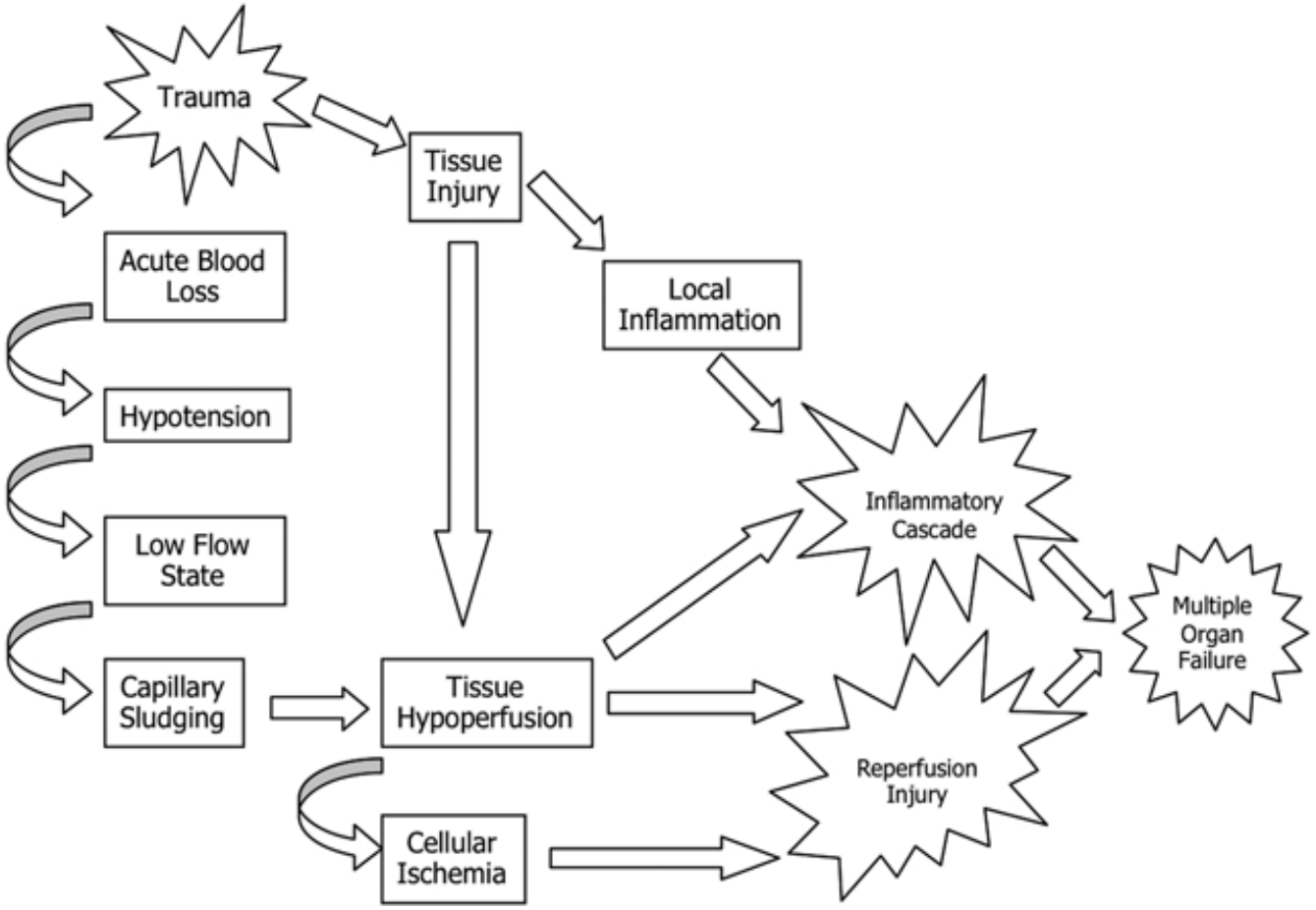
CLASSIFICATION OF STAGES OF HAEMORRHAGIC SHOCK

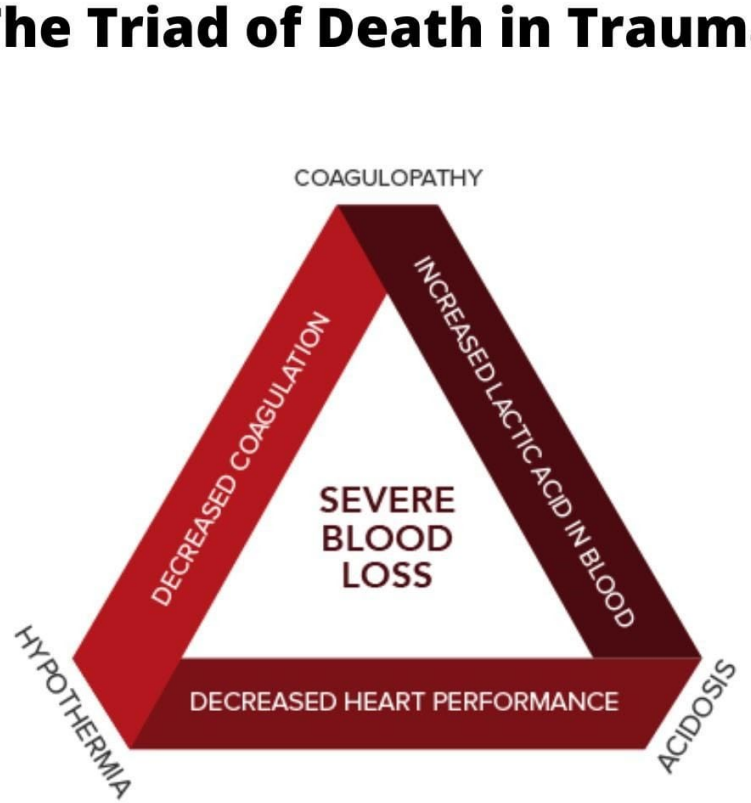
- Tennis scores: **Love – 15 – 30 – 40 — game over (>40)**

- Unfortunately, the classic stages of hemorrhagic shock are of limited clinical relevance in the real world, because of:

- Differences in compensation for different types of injuries (e.g. blunt *vs*. penetrating trauma)
- Age (e.g. blunted physiological responses in the elderly)
- Comorbidities
- Medications (e.g. beta-blockade may conceal shock by preventing tachycardia)

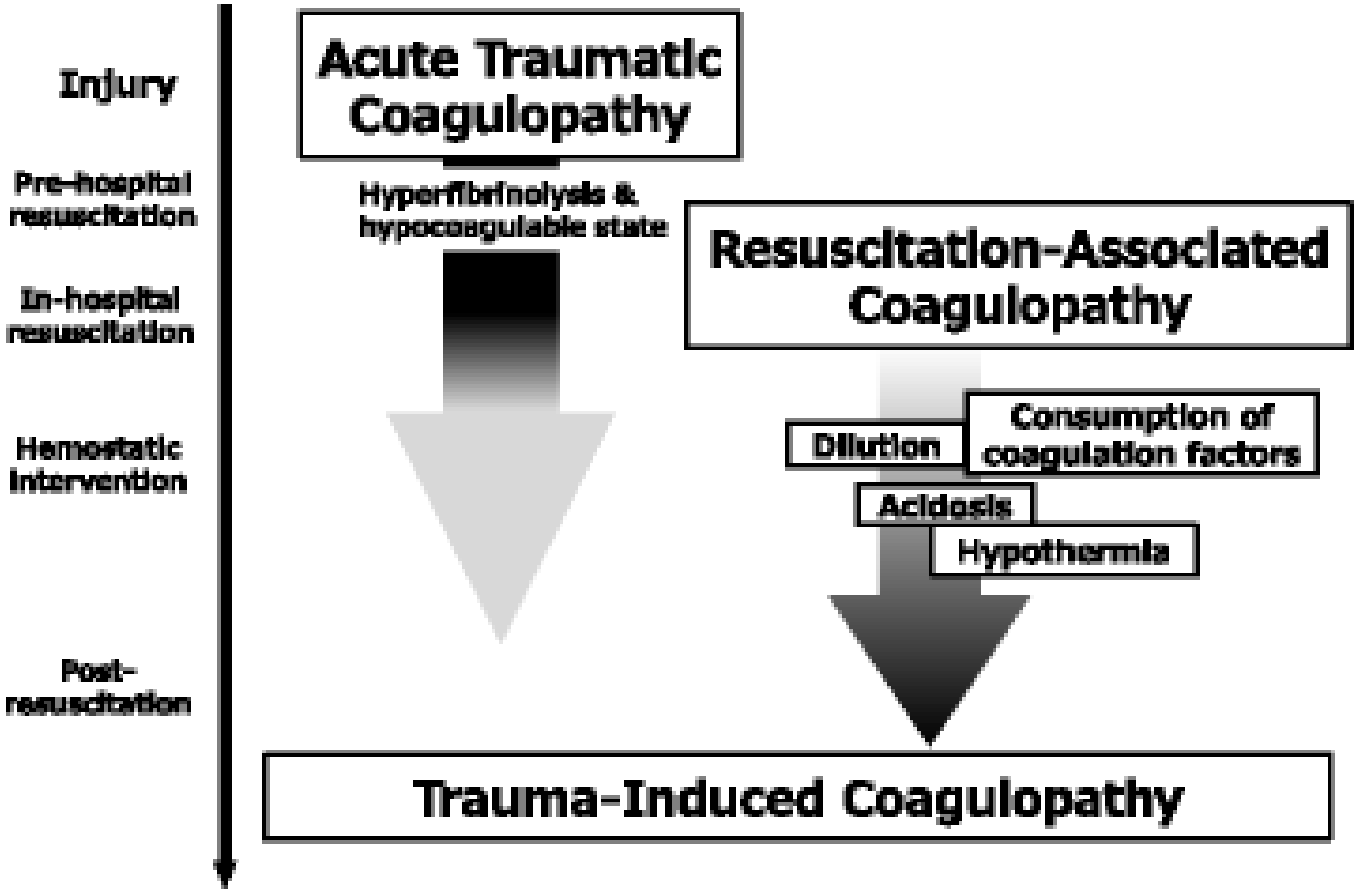
LETHAL TRIAD (치사 세징후)
AND ACUTE COAGULOPATHY OF TRAUMA/ SHOCK





Pathophysiology of traumatic shock, *Shere-Wolfe, R., & Fouche, Y. (2012). Shock, resuscitation, and Fluid Therapy*

Acute traumatic coagulopathy (ATC) & trauma-induced coagulopathy



S. Kushimoto. Acute traumatic coagulopathy and trauma-induced coagulopathy: an overview Journal of Intensive Care vol 5, 6 (2017)

Resuscitation Goals

- Speed!
- Identify injury early and develop tx plan (multidisciplinary)
- Facilitate non-elective intervention
  : patient is not NPO, incomplete background information, unknown extend of the injury
- Avoid hypotension (Goal is SBP>90mmHg, MBP> 65mmHg)
- Provide adequate oxygenation and ventilation
- Treat hypotermia

Resuscitation Goals

- Maintaining adequate perfusion pressure to the brain and other vital organ
- Avoiding irreversible shock
- Preventing clot disruption and worsening hemorrhage
- Restoring circulating volume
- Restoring the microcirculation

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Original Contribution

Efficacy of a massive transfusion protocol for hemorrhagic trauma resuscitation☆

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ABSTRACT

Objectives: New paradigm shifts in trauma resuscitation recommend that early reconstitution of whole blood ratios with massive transfusion protocols (MTP) may be associated with improved survival. We performed a preliminary study on the efficacy of MTP at an urban, Level 1 trauma center and its impact on resuscitation goals.
Methods: A case-control study was performed on consecutive critically-ill trauma patients over the course of 1 year. The trauma captain designated patients as either MTP activation (cases) or routine care without MTP (controls) in matched, non-randomized fashion. Primary outcomes were: time to initial transfusion; number of total units of packed red blood cells (pRBC) and fresh frozen plasma (FFP) transfused; and ratio of pRBC to fresh frozen plasma (pRBC:FFP). Secondary outcomes were in-hospital mortality, and length of stay.
Results: Out of 226 patients screened, we analyzed 58 patients meeting study criteria (32 MTP, 26 non-MTP). Study characteristics for the MTP and non-MTP groups were similar except age (34.0 vs. 45.85 years, $p = 0.015$). MTP patients received blood products more expeditiously (41.7 minutes vs. 62.1 minutes, $p = 0.10$), with more pRBC (5.19 vs 3.08 units, $p = 0.05$), more FFP (0.19 vs 0.08 units, $p < 0.01$), and had larger pRBC:FFP ratios (1.90 vs 0.52, $p < 0.01$). Secondary outcomes did not differ significantly but the MTP group was associated with a trend for decreased hospital length of stay ($p = 0.08$).
Conclusions: MTP resulted in clinically significant improvements in transfusion times and volumes. Further larger and randomized studies are warranted to validate these findings to optimize MTP protocols.

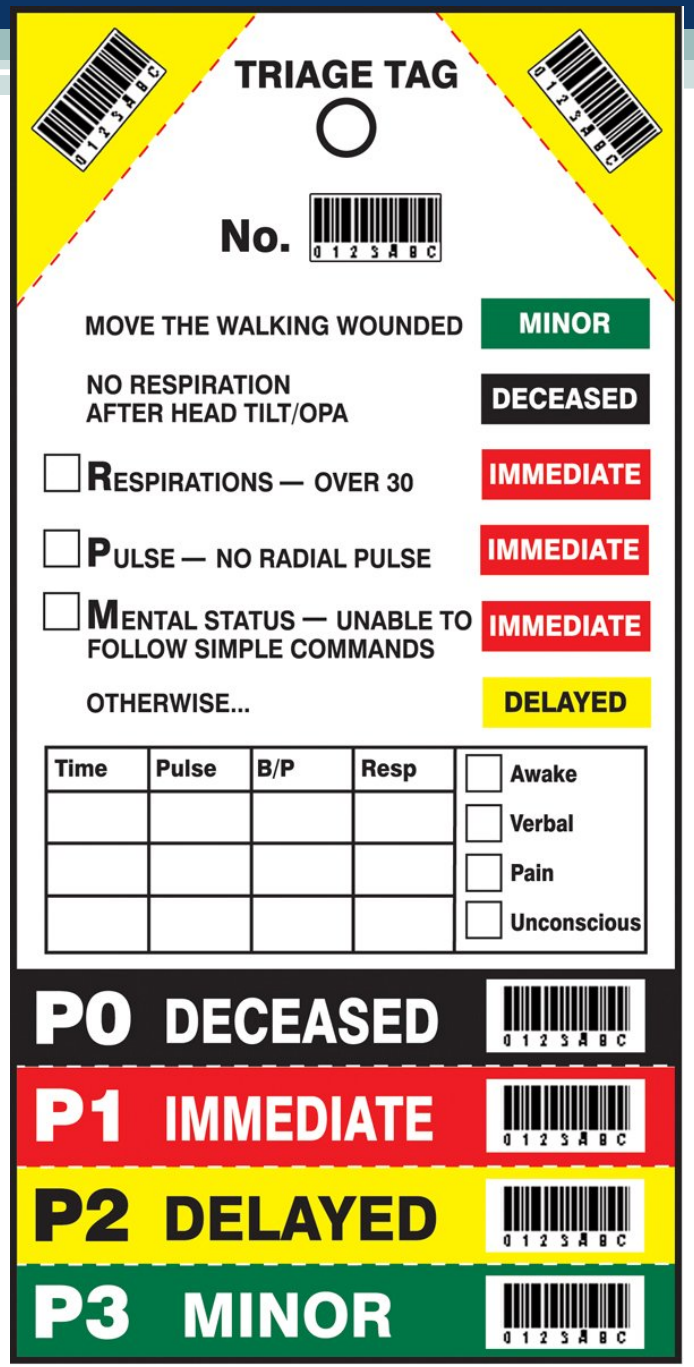
Mass Casualty approach

- Designate a team/unit leader to Triage incoming patients
- Needs to be knowledgeable in trauma care
- Needs to be able to function in the system (communication with ED/hospital/surgeons etc)
- Needs to know resources(OR space/staff/staff ability)

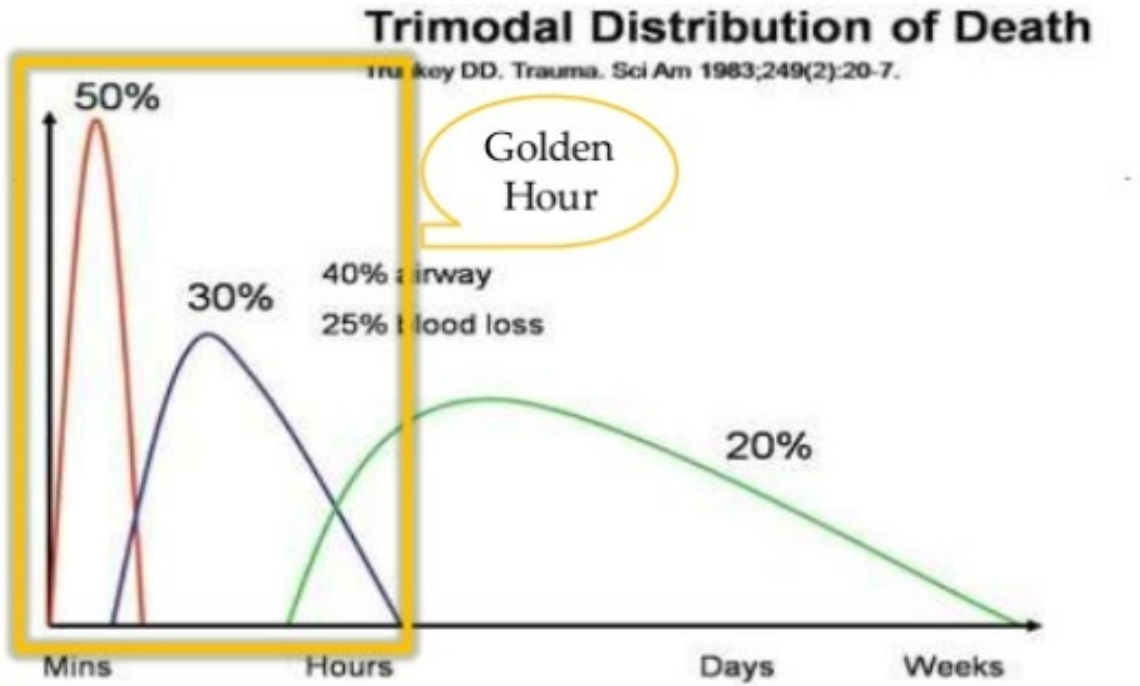
Disaster preparedness for Mass Casualty approach

- Triage in ED into
- Non rescueable
- Requires imnmediate intervention
- Requires intervention soon
- Requires intervention but can be delayed
- Non surgical injury but needs resources (Burn, TBI etc)

- Coordiate space/resources with other areas
- Communication with blood bank, ICU, other hospitals, transport services



The Golden Hour



- There is a golden hour **between life and death**.

- Dr. R Adams Cowley, a military surgeon

- Something happes in the body irreparable

- Resuscitation should be initiated simultaneously with the primary assessment.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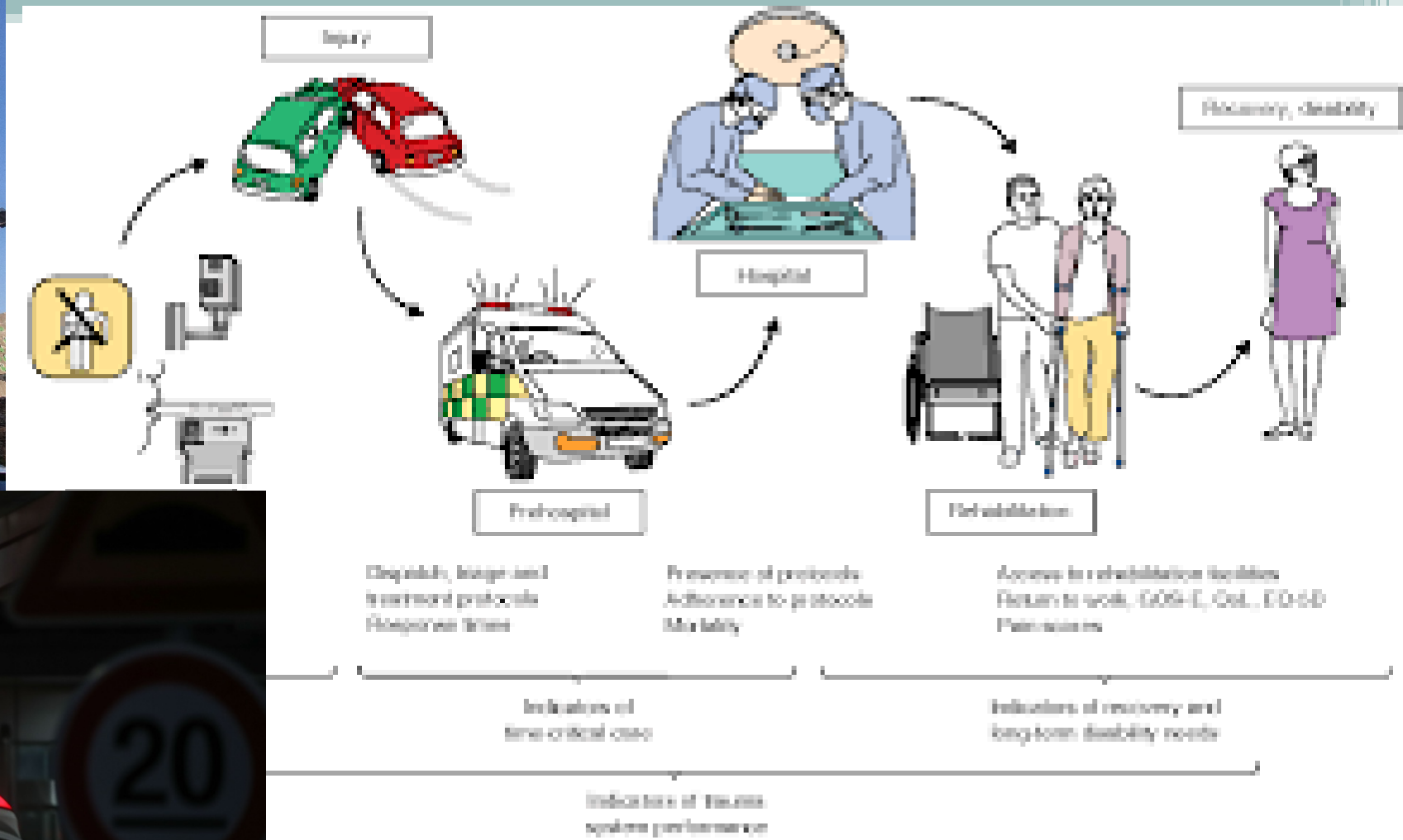
AMBULANCE
ONLY
20


Injury
Hospital
Recovery, disability
Pre-hospital
Rehabilitation
Indicators of
time-critical care
Indicators of recovery and
long-term disability needs

“The first sign of civilization” : Femur fracture

Margaret Mead
: Cultural anthropologist

Thank you for kind attention.

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