

ThinkAskLearn  
Health Professional Education

### Hypovolaemic Shock – A momentary pause in the act of death

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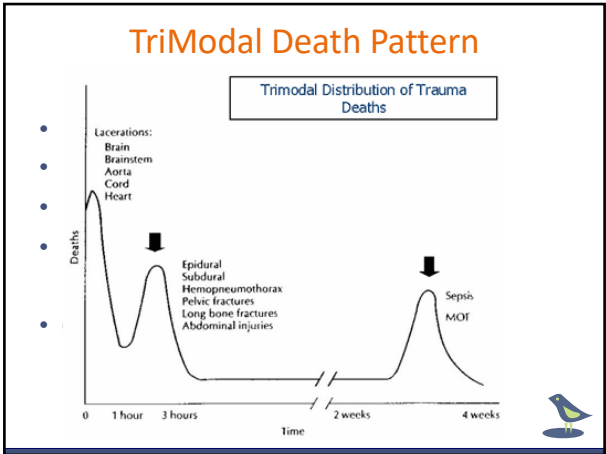
www.thinkasklearn.com.au

1

### Stephen Hales (1677–1761)



2



3

### A Changing Pattern

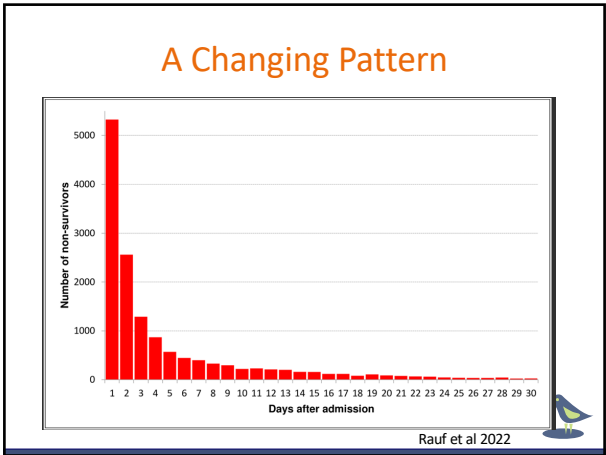
- Does the trimodal death pattern still exist?
- Prehospital 80.6%
- <48hrs 11.3%
- <1 week 4.3%
- >1 week 3.8%

Is the trimodal pattern of death after trauma a dated concept in the 21st century? Trauma deaths in Auckland 2004

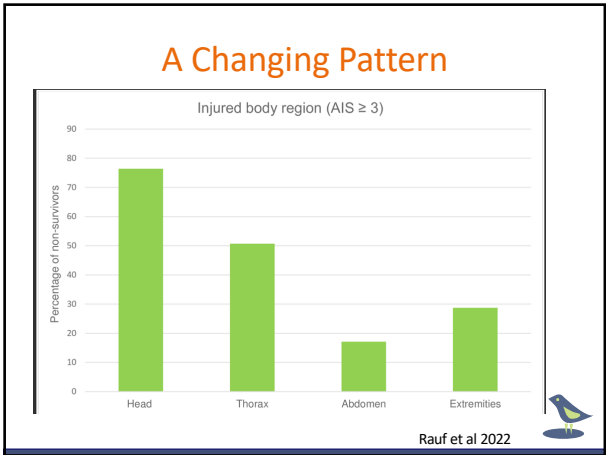
Jia-Min Pang<sup>a,\*</sup>, Ian Civi<sup>a</sup>, Alexander Ng<sup>a</sup>, Dave Adams<sup>b</sup>, Tim Koelmeyer<sup>a</sup>

INJURY  
www.elsevier.com/locate/injury

4



5



6

## Definition of Shock

- 'manifestation of the rude unhooking of the machinery of life.' Samuel Goss 1876
- Hypoxaemia at the cellular level
- Every 3 minutes of haemodynamic instability increases mortality by 1%



7

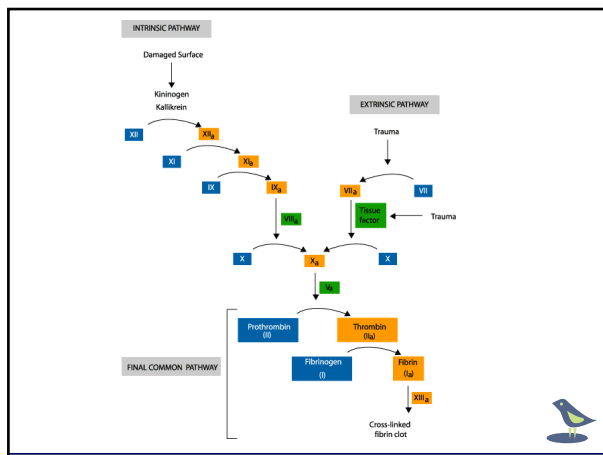
## Pathophysiology of Shock

- Haematologic system
  - activating the coagulation cascade and contracting the bleeding vessels
  - platelets are activated and form an immature clot
  - the damaged vessel exposes collagen, which causes fibrin deposition and stabilization of the clot.
  - Approximately 24 hours are needed for complete clot fibrination and mature formation.

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8



9

## Pathophysiology of Shock

- Cardiovascular system
  - increasing the heart rate, increasing myocardial contractility, and constricting peripheral blood vessels.
  - occurs secondary to an increased release of norepinephrine and decreased baseline vagal tone (regulated by the baroreceptors in the carotid arch, aortic arch, left atrium, and pulmonary vessels)
  - redistributing blood to the brain, heart, and kidneys and away from skin, muscle, and GI tract.

Kolecki 2012



10

## Pathophysiology of Shock

- Renal system
  - stimulating an increase in renin secretion from the juxtaglomerular apparatus. Renin – angiotensinogen – angiotensin I – angiotensin II
  - Angiotensin II has 2 main effects
    - vasoconstriction of arteriolar smooth muscle, and stimulation of aldosterone secretion by the adrenal cortex. Aldosterone is responsible for active sodium reabsorption and subsequent water conservation.

Kolecki 2012



11

## Pathophysiology of Shock

- Neuroendocrine system
  - Increases circulating antidiuretic hormone (ADH). ADH is released from the posterior pituitary gland in response to a decrease in BP (as detected by baroreceptors) and a decrease in the sodium concentration (as detected by osmoreceptors)
  - ADH indirectly leads to an increased reabsorption of water and salt (NaCl) by the distal tubule, the collecting ducts, and the loop of Henle.

Kolecki 2012



12

### Causes of Hypovolaemic Shock

- Trauma
- Non traumatic
  - Ruptured thoracic/AAA
  - Ruptured ectopic pregnancy
  - Severe gastroenteritis
  - Haematemesis/Melena/NSAID



13

### Classification of Shock

- 4 Stages of Shock
- Described by percentage, volume lost, clinical signs
- Not clear or discrete stages
- Theoretical knowledge not supported by evidence
- Blood pressure and heart rate will not identify all trauma patients who are in shock NSW ITIM



14

### Anyone for tennis?

- Stage 1 0-15%
- Stage 2 15-30%
- Stage 3 30-40%
- Stage 4 >40%



15

### How about some wine?

- Stage 1 0-750mls
- Stage 2 750mls-1.5L
- Stage 3 1.5L-2.2L
- Stage 4 >2.2L



16

### Class I haemorrhage

- In the absence of complications, only minimal tachycardia is seen.
- Usually, no changes in BP, pulse pressure, or respiratory rate occur.
- A delay in capillary refill of longer than 3 seconds corresponds to a volume loss of approximately 10%.



17

### Class II haemorrhage

- Clinical symptoms
  - tachycardia (rate >100 beats per minute), tachypnea, decrease in pulse pressure, cool clammy skin, delayed capillary refill, and slight anxiety.
  - The decrease in pulse pressure is a result of increased catecholamine levels, which causes an increase in peripheral vascular resistance and a subsequent increase in the diastolic BP.



18

### Class III haemorrhage

- By this point, patients usually have marked tachypnea and tachycardia, decreased systolic BP, oliguria, and significant changes in mental status, such as confusion or agitation.
- Most of these patients require blood transfusions



19

### Class IV haemorrhage

- Symptoms include:
  - marked tachycardia, decreased systolic BP, narrowed pulse pressure (or immeasurable diastolic pressure), markedly decreased (or no) urinary output, depressed mental status (or loss of consciousness), and cold and pale skin.
- This amount of hemorrhage is immediately life threatening.



20

### What bloods should be undertaken?

- Assessment of the trauma patient should include:
  - arterial blood gases and assessment of base deficit
  - Haemoglobin
  - Lactate
  - Haematocrit.
- These tests are only of value when interpreted in a series, therefore should be repeated.



21

### Lactate and Trauma

- Anaerobic metabolism when shock progress
  - lactate production and subsequent metabolic acidosis
  - metabolic acidosis further exacerbates the shock state,
  - results in decreased myocardial contractility and worsening shock
- Serum lactate produced from Lactic acidosis
  - lactate produced correlates with total oxygen debt, signifying the magnitude of hypoperfusion, the severity of shock, and also adequacy of resuscitation.



22

### Lactate and Trauma

- Serum lactate and the occult
  - Serum lactate is considered a sensitive indicator of occult shock and may be useful in patients with a significant mechanism of injury yet demonstrating vital signs within normal limits.



23

### Where is the bleeding from?

- Five Potential sites of bleeding
- Externally
- Long Bones
- Chest
- Pelvis
- Abdomen



24

### External Blood Loss



25

### Long Bones



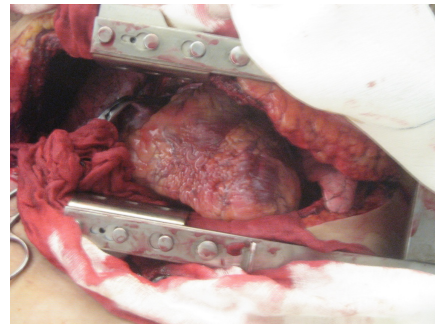
26

### The Chest

- 4-29% of Trauma cases
- Chest xray essential
- Should be performed within 10 mins of arrival
- Small haemothorax - 5% of surviving patients
- Looking for massive haemothorax

27

### The Chest



28

### The Abdomen

- Most difficult to assess
- Access to CT improves diagnosis
- FAST scan helpful
- Still needs formal scan
- Diagnostic Peritoneal Aspiration (DPA), (DPL)

29

### The Abdomen



30

### The Pelvis



31

### Sam Sling Applied



32

### Prometheus vs TPod



33

### Sheet Wrapping????



34

### Management of Hypovolaemia

- Establish patent airway
- Ensure adequate ventilation and oxygenation
- Secure venous access – large bore cannula x 2
- Control any external bleeding by applying direct pressure
- Rapidly identify patients requiring operative haemostasis
- Establish prompt contact with the major referral hospital and retrieval service.

35

### Not every patient should have a CT

Over Reliance on Computed Tomography Imaging in Patients With Severe Abdominal Injury: Is the Delay Worth the Risk?

*Matthew D. Neal, MD, Andrew B. Peitzman, MD, Raquel M. Forsythe, MD, Gary T. Marshall, MD, Matthew R. Rosengart, MD, MPH, Louis H. Alarcon, MD, Timothy R. Billiar, MD, and Jason L. Sperry, MD, MPH*

*The Journal of TRAUMA® Injury, Infection, and Critical Care • Volume 70, Number 2, February 2011*

- Severe abdo trauma
- Compared Laparotomy within 30min vs CT and laparotomy within 90 min
- CT and Laparotomy associated with more than a seven- fold higher risk of mortality (odds ratios, 7.6;  $p < 0.038$ )

36



## Low Volume Resuscitation

- Lots of Animal Models
- Works well for non traumatic events – AAA
- Demonstrated benefit on penetrating trauma
- High volume resuscitation
  - Soft clot dissolution
  - Hydraulic acceleration of bleeding
  - Dilution of clotting factors



37

## Institute of Trauma and Injury Management

- In the presence of uncontrolled haemorrhage and a delay of greater than 30 minutes to operative haemostasis, infuse small aliquots of fluid (100-200mls) to maintain systolic blood pressure between 80-90mmHg.
- Use caution in the elderly.
- Contraindicated in unconscious patients without a palpable blood pressure and those with traumatic brain injury



38

## What Fluids

- Early use of blood remains optimal
- Hartmanns or Normal Saline
- Many complications of Blood
  - Impaired oxygen release
  - Dilutional coagulopathy
  - Thrombocytopenia
  - Hypothermia
  - Citrate toxicity
  - Hyperkalaemia
  - Acid base disturbance
  - Haemolytic transfusion reactions



39

If continuing uncontrolled bleeding a senior clinician should notify blood bank (8314) to  
**ACTIVATE MASSIVE TRANSFUSION PROTOCOL**

### MTP pack 1

- 4 units RBC
- 4 units FFP

### MTP pack 2

- 4 units RBC
- 4 units FFP
- 1 Adult dose Platelets



40

## ROTEM – Potential Game Changer



41



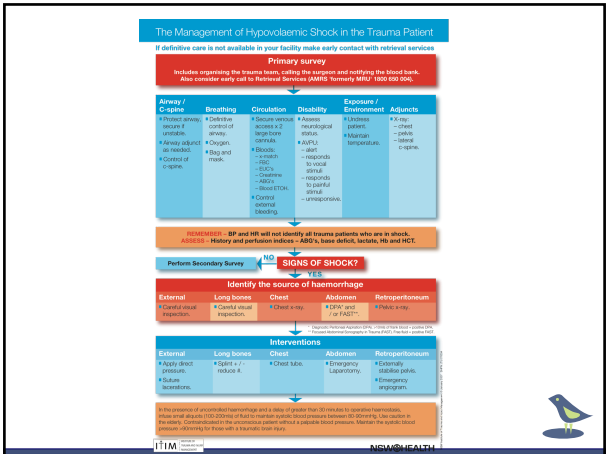
*Better Complexions*

**Tranexamic Acid**  
**For Skin Bleaching**

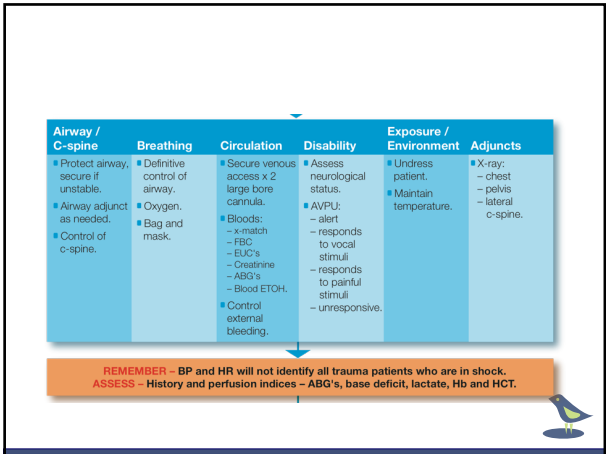
- Also stops bleeding and reduces mortality
- Give within 3 hours
- Increased risk of PE/DVT



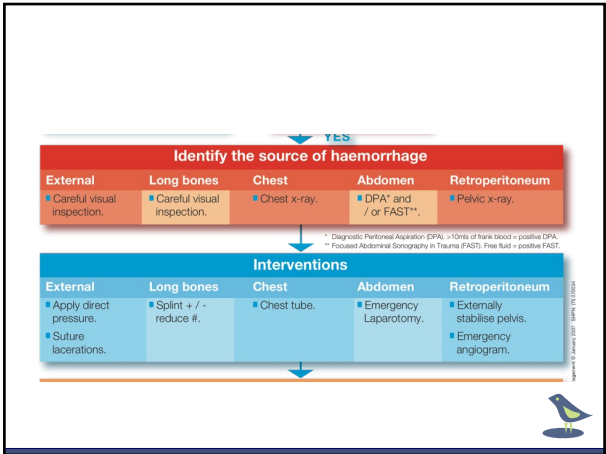
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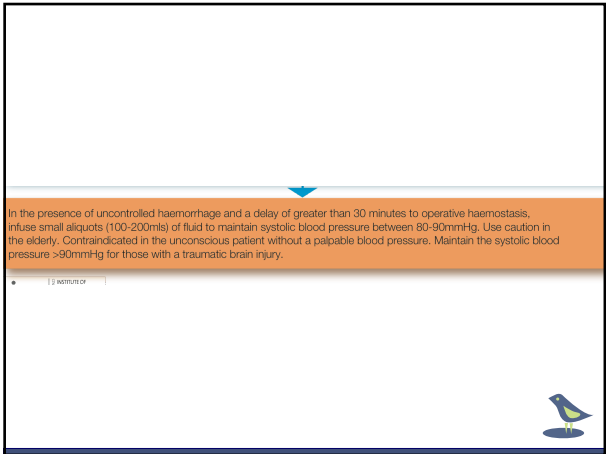
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44



45



46

**Summary**

- BP and Pulse not perfect assessment tools
- Blood is primary response fluids is shock
- Minimal Fluid Resuscitation
- Contraindicated in HI and unconscious pts

47