

Goal Directed Therapy in Pediatric Trauma Care

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Disclosures

- *I have no financial interests that conflict, contribute, or confound this presentation.*
- *I will not be discussing any off-label therapy during this presentation.*
- *I am honored to be asked to lead our discussion on this topic today.*

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Best Recent Reference:

- Carcillo, et al; Goal Directed Management of Pediatric Shock in the Emergency Department, Clinical Pediatric Emergency Medicine, 8: 165-175, 2007.

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Trauma

- Injury is the leading cause of death among children older than 1 year
- For children, injury exceeds all other causes of death combined.
- Death from unintentional injury accounts for 65% of all injury deaths in children younger than 19 years.
- From 1972-1992, motor vehicle accidents were the leading cause of death in children aged 1-19 years, followed by homicide or suicide (predominantly with firearms) and drowning

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Injury Patterns

- Blunt Trauma: Penetrating Trauma follows the 80/20 rule
- CNS injury is the most common isolated injury with Non-accidental trauma the most common cause of serious head injury in children under 2.

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70-98% Mortality with head injury.

- A presenting GCS score of less than 8,
- unilateral dilated pupil, or
- transcranial gun shot wound

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Shock can cause secondary brain injury

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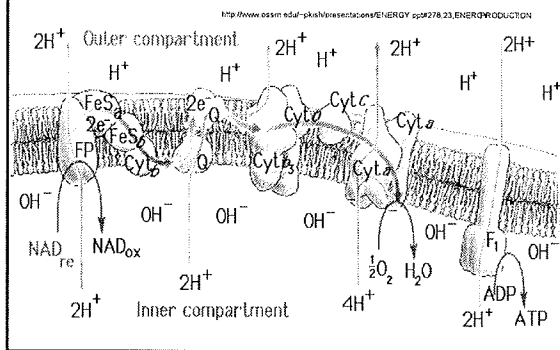
A Brief Review of Shock

- Shock is the cellular condition characterized by an insufficient quantity of energy substrate available at the cellular level to support cellular metabolism.
- Of course we all remember biochemistry with fondness especially the pathways detailing the production and availability of ATP.
- The key substrates are oxygen and glucose that influence cellular utilization of ATP.

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ENERGY PRODUCTION



Sensical Definitions of Shock in Trauma

- Hypoxic Shock: Oxygen saturations are too low.
- Anemic Shock: Oxygen carrying capacity is impaired from low hemoglobin.
- Ischemic Shock: Perfusion is inadequate (Low flow states)
- Glycopenic shock: Hypoglycemia or insulin resistance - rare in trauma, but a definite consideration in prolonged / sustained insults.

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While Dandy – How does this translate to the bedside?

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Clinical Indicators – Hypoxia

- Compensatory tachypnea
- PaO₂ < 60 mm Hg

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Clinical Indicators – Anemia

- Pallor
- Compensatory tachycardia
- Low hemoglobin levels (< 6 or 8)

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Clinical Indicators - Ischemia

- Compensatory tachycardia
- Prolonged capillary refill

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Clinical Indicators - Glycopenia

- Either mild hypoglycemia or hyperglycemia
- Increased anion gap acidosis

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Measure Goal Directed Therapy in Children:

- Mortality and neuromorbidity increase in ascending order based upon the following:
 - Tachycardia alone
 - Hypotension with normal capillary refill
 - Prolonged capillary refill without hypotension
 - Prolonged capillary refill with hypotension

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Does it work?

- Reversal of these signs in the ED reduced mortality and neuromorbidity by 50%
- Each passing hour of hypotension or prolonged capillary refill time was associated with a 2 fold increased odds ratio of mortality from multiple organ failure.

Parr et al. cardiac surgery model. Circulation 1975

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End Points – Resuscitation to clinical goals

- Normal mental status
- Normal pulse quality (centrally and peripherally)
- Capillary refill of < 2 seconds
- Urine Output of > 1 ml/kg/hour
- Normal toe temperature (with normal cap refill indicate sufficient cardiac index)

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Goal Directed Therapy – hypoxia

- Oxygen to keep sats at 100%

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Goal Directed Therapy – Anemia / Ischemia

- Fluid and Blood administration

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How is fluid resuscitation monitored?

- Reduction of tachycardia
- Palpation of liver edge
- Listening for rales and a wet cough
- Increasing tachypnea

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What is fluid resuscitation?

- 20 ml / kg aliquots rapidly of normal saline
- If a second bolus is required prepare for blood administration.
- Prepare to infuse 10 ml / kg PRBC when third bolus started. (raise Hgb by about 2 g/dL)

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Oxygen extraction

- Normally mitochondria extract about 25% of bound oxygen. (reflected by normal mixed venous O₂ sat of 75%)
- Mitochondria unable to extract the last 20% of bound O₂
- Mortality increases if Hgb drops below 6 g/dL
- Beware trauma insult on chronic anemia

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Goal Directed Therapy – Glycopenia

- Normalize glucose and provide sufficient insulin
- hydrocortisone succinate for persistent shock 50 mg/kg (achieves stress doses of 150 µg/dL of cortisol)

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Controversies

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Family Centered Care

- Families report increased satisfaction with resuscitation and procedural care when included in decision making and have the option of family presence.
- Brown K, Mace SE, Dietrich AM, Knazik S, Schamban NE Patient and family-centred care for pediatric patients in the emergency department. *CJEM*. 2008 Jan;10(1):38-43
- Staff (especially junior house officers) report dissatisfaction with family presence.
- Fernandez, Rosemarie MD; Compton, Scott PhD; Jones, Kerin A, MD; Veililla, Marc Anthony MD The presence of a family witness impacts physician performance during simulated medical codes. *Critical Care Medicine: June 2009 - Volume 37 - Issue 6 - pp 1956-1960*

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Steroids in spinal cord injury

- no evidence of benefit in pediatric patients

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Are operations good for people?

- Well, no. Non-operative management failure was only 5% (Holmes JH 4th, Wriebe DJ, Tataria M, Mattix KD, Mooney DP, Scaife ER. The failure of nonoperative management in pediatric solid organ injury: a multi-institutional experience. *J Trauma*. Dec 2005;59(6):1309-13.)

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Does hematuria predict the severity of renal injury?

- No - Rogers CG, Knight V, MacUra KJ, Ziegfeld S, Paldas CN, Mathews RI. High-grade renal injuries in children--is conservative management possible?. *Urology*. Sep 2004;64(3):574-9.

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Do pediatric trauma centers matter?

- Yes – Survival 10 X greater in pediatric trauma centers
- Cooper A. *J Pediatr Surg*. 1993 Mar;28(3):299-303; discussion 304-5

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Thanks for your attention
and your time
????Questions????

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