AMERICAN COLLEGE OF SURGEONS CRITICAL CARE REVIEW COURSE 2012

HOT TOPICS IN PEDIATRIC CRITICAL CARE

Karyn L. Butler, MD, FACS, FCCM
Chief, Surgical Critical Care
Hartford Hospital / University of Connecticut
Hartford, CT
TIGHT GLUCOSE CONTROL
Which one of the following is true regarding glycemic control in critically ill children?

A. Permissive glycemic target is associated with decreased mortality
B. Hyperglycemia increases nosocomial infection rates in children
C. Glycemic control in children does not impact ICU outcome
D. None of the above
Background

- Critically ill patients with alterations in glucose may have adverse outcomes
- What is the appropriate threshold?
- Are glycemic control protocols safe in critically ill children?
- Do permissive glycemic targets increase adverse outcomes?
Strict glycemic targets need not be so strict: a more permissive glycemic range for critically ill children

Ulate KP, Lima Falcao GC, Bielefeld MR, Morales JM, Rotta AT.

Driscoll Children’s Hospital

Pediatrics 2008 Oct
**Methods**

- Retrospective review
- 177 patients undergoing 211 cardiac surgical procedures
- Stratified into 4 groups:
  - Euglycemia: 60-125 mg/dl
  - Mild hyperglycemia: 126-139 mg/dl
  - Moderate hyperglycemia: 140-179 mg/dl
  - Severe hyperglycemia: > 180 mg/dl
- Permissive target: 90-140 mg/dl
- Primary outcome: survival
Results

- Peak / mean glucose and duration of hyperglycemia not different for survivors
- Non-survivors
  - First 5 post-op days
  - Longer duration of hyperglycemia
  - Higher peak glucose levels
- Mortality:
  - Euglycemia 6%
  - Permissive target 5%
  - Moderate: 39%
  - Severe: 58%
Conclusions

- Post-op hyperglycemia was associated with increased morbidity and mortality

- Permissive glycemic target (90-140 mg/dl) associated with lower incidence of hypoglycemia

- No increased mortality with permissive glycemic target
Alterations in glucose homeostasis in the pediatric intensive care unit: hyperglycemia and glucose variability are associated with increased mortality and morbidity

Hirshberg E, Larsen G, VanDuker H.

University of Utah

Pediatric Critical Care Medicine 2008
Methods

- Retrospective cohort analysis
- All PICU admissions > 24 hours < 18 years
- No insulin administered during PICU stay
- Admitting diagnosis of DM or hypoglycemia excluded
Results

- Hyperglycemia 56%
- Hypoglycemia 10%
- Glucose variability 7%
- Increased mortality
  - Glucose variability  OR 64, 95% CI, 7.8-512
  - Hyperglycemia  OR 11.1, 95% CI, 1.5-85.6
- Increased morbidity
  - Increased nosocomial infections
  - Increased hospital LOS
- No deaths in patients with isolated hypoglycemia
Conclusions

- Relationship between blood glucose level and PICU outcomes

- Similar to outcomes in adults

- Will control of blood glucose in critically ill children improve outcomes?
Hypoglycemia in critically ill children

Faustino EV, Hirshberg EL, Bogue CW.
Yale University of School of Medicine

J Diabetes Sci Technol 2012 Jan
**Methods**

- Systematic literature review to August 2011
- Search terms: hypoglycemia, critical care, critical illness
- Articles limited to all child 0-18 years old
Results

- 513 articles identified, 132 included for review
- Defined hypoglycemia based on outcomes
  - Neonates: < 40-45 mg/dl
  - Children: < 60-65 mg/dl
- Below threshold
  - Worse neurological outcomes
  - Increased ICU LOS
  - Increased mortality
Conclusions

- Accurate measuring techniques
- Frequent or continuous glucose monitoring
- Computerized insulin titration protocols
- Research on risk factors and outcomes associated with insulin-induce hypoglycemia in children needed
THERAPEUTIC HYPOTHERMIA
Which of the following are true regarding therapeutic hypothermia (TH) in children?

A. Increases free radical production

B. TH decreases the need for inotropic support

C. Increases NSE release into the serum

D. Reduces morbidity in newborns with HIE
Background

- Therapeutic hypothermia (TH) improves neurologic outcome in adult patients with ROSR following cardiac arrest

- Brain injury is the leading cause of death in the PICU

- Does therapeutic hypothermia improve outcomes in children with brain injury?
Cooling for newborns with hypoxic ischaemic encephalopathy

Jacobs S, Hunt R, Tarnow-Mordi W, Inder T, Davis P.
Royal Women’s Hospital, Australia

Cochrane Database Systemic Review 2007
Methods

- Cochrane Library searched for randomized controlled trials
- Therapeutic hypothermia in term newborns with hypoxic ischemic encephalopathy (HIE)
- 1966 to June 2007
- Studies randomizing TH with standard care without major congenital anomalies included
- Primary outcome: Death or long-term major neurodevelopmental disability
Results

- Eight randomized controlled trials, 638 term infants

- TH vs. standard care:
  - Combined mortality and disability: RR 0.76, 95% CI
  - Reduced mortality: RR 0.74, 95% CI
  - Decreased disability: RR 0.68

- Adverse effects
  - Need for inotrope support
  - Thrombocytopenia
Conclusions

- TH is beneficial to term newborns with HIE
- Cooling reduces mortality
- No increased major disability in survivors
- Benefits on survival outweigh short-term adverse effects
- Ongoing trials needed
  - Whole body vs. selective head cooling
  - Mild vs. therapeutic hypothermia
Advantages of hypothermia

- Neuroprotection from reduced:
  - Excitotoxicity
  - Neuroinflammation
  - Apoptosis
  - Free radical production
  - Blood-brain barrier disruption
  - Blood vessel leakage
  - Rescue therapy for increased intra-cranial pressure

- Reduced serum biomarkers (S100B, NSE)
RADIATION EXPOSURE AND THE PEDIATRIC PATIENT
Which of the following are correct regarding imaging in pediatric patients?

A. ALARA refers to limiting the number of CT scans over a patient's hospital course
B. CT imaging of the abdomen is necessary in all pediatric trauma patients
C. ALARA refers to limiting the dose of CT scans over a patient's hospital course
D. What the heck is ALARA?
Background

- Increased risk of cancer in children exposed to low-dose radiation during CT
- ALARA concept (As Low As Reasonably Achievable)
- Wide acceptance in children’s hospitals
- Compliance in adult centers?
Dose reduction and compliance with pediatric CT protocols adapted to patient size, clinical indication, and number of prior studies

Singh S, Kalra MK, Moore MA, Shailam R, Liu B, Toth TL, Grant E, Westra SJ.
Massachusetts General Hospital

Radiology 2009
Methods

- Retrospective review of pediatric CT protocols
- Scanning parameters adjusted for patient weight
- Three phases of incremental stepwise dose reduction during a 17 month period
- Two radiologists reviewed CT images for image quality
Results

- Early compliance lower than later compliance
  - Chest: 59% vs. 88%
  - Abdomen: 65% vs. 82%

- Significant (P<0.01) dose reduction in early and late vs. non-compliant examinations
  - Chest: 53% - 85%
  - Abdomen: 34% - 84%

- No loss of clinically relevant image quality
Image Gently: progress and challenges in CT education and advocacy

Goske MJ, Applegate KE, Treves ST et. al.
Alliance for Radiation Safety in Pediatric Imaging
Cincinnati Children’s Hospital

Pediatric Radiology 2011
Overview

- Goal: radiation protection for children
- Increase awareness of the need for radiation protection
- International partnerships through the Alliance
- Areas of progress:
  - Development of an adult radiation protection campaign Image Wisely™
  - Increased collaboration with government agencies, societies and vendors
  - National guidelines in pediatric nuclear medicine
  - Size-based patient dose correction factor by the American Association of Physicists in Medicine
Challenges

- Continued education
- Change of practice at adult-focused hospitals
- Emphasis on appropriateness of pediatric imaging
- Outcomes research to validate performance of CT studies
- Establish ranges of optimal CT technique for specific scan indications