Round Table Discussion 25th Annual SPA Meeting  
Topic: PICU/NICU  
Title: Critical Care Management of a Pediatric Near-Drowning Victim, s/p Cardiac Arrest, with Acute Lung Injury and Ischemic Encephalopathy  
Presenters: Todd Kilbaugh, George Politis, Alvin Hackel  

Goals:  
1. Discuss initial management of the near-drowning patient.  
2. Discuss issues regarding transport of critically ill pediatric patients.  
3. Discuss ventilation in patients with acute lung injury and avoidance of VILI.  
4. Understand factors that contribute to secondary brain injury  
5. Understand the history and current role of hypothermia after cardiac arrest in children.  
6. Discuss the role of surfactant in ARDS, and near drowning.  
7. Understand the role of extracorporeal membrane oxygenation as rescue therapy for ARDS in pediatric patients  

Case Presentation of Near Drowning-Initial Resuscitation/Stabilization & Transport:  
A 5-year-old girl was found at the bottom of a public pool after being seen by her parents 10 minutes before. She was pulled from the water by a lifeguard, was apneic & pulseless, and rescue breaths and chest compressions were initiated and continued with a cycle of 15:2 until EMS arrived. EMS techs placed a tracheal tube and hand ventilated at a rate of 10-12 breaths per minute and gave 100 chest compressions per minute. An AED did not advise shocking. The EMS providers placed a C-collar, and an intraosseous needle in her proximal right tibia. The patient’s weight was estimated to be 20 kg and an intraosseous bolus of 2 ml of epinephrine 1:10,000 was given every 3 minutes x 3, with return of spontaneous circulation. The child was brought to the closest community hospital ED, and while moving from the stretcher to the bed was accidentally extubated. The ED physician was unable to re-intubate, but bag-mask ventilation was accomplished with ease.[1-3]  

Questions for Initial Resuscitation/Stabilization & Transport:  
Is it reasonable to keep this patient at the community hospital if they have an ICU? Are outcomes improved for critically ill children in pediatric centers versus community hospitals? Would it be appropriate to transport this patient without a tracheal tube? What steps should be taken to secure the airway? What resources should be available to the transport team in terms of equipment and personnel? What resources should be available at the receiving hospital? Should this child be transferred directly to the PICU or seen first in a level-one trauma center? What instructions should be given to the transport team in terms of medical care for a child with post-cardiac arrest, near-drowning?  

Case Progression in ED:  
Following transport, her VS were rectal T 36°C, HR 170 bpm, BP 120/60 and SpO2 was 100%, and end-tidal CO2 was 65 mm Hg with hand ventilation using 100% FiO2. Her pupils were 4 mm bilaterally and reactive and she had intermittent extensor posturing with stimulation, but no purposeful movement. Two peripheral IV lines were placed. Her initial VBG revealed a pH 6.9, PCO2 65, PaO2 25, bicarbonate of 12, base deficit of -22 and ionized calcium of 1.02. A CXR showed an ETT in the mid trachea, and bilateral hazy infiltrates. She was taken to the CT scan for intracranial evaluation, which was unremarkable, and she was then transferred to the PICU for further management.  

Questions for Case Progression in ED:
What is the diagnostic utility of a head CT in this patient?[4, 5]

**Case Progression in PICU 1:**
On arrival in the ICU, she had a rectal temperature of 35.5°C, HR of 150 bpm, BP of 90/40, an O2 saturation of 100%, and an end tidal CO2 of 50 mm Hg, during manual ventilation with 100% FiO2. She was placed on a ventilator in SIMV Volume Control with initial settings of 160 ml TV, 10 cm of PEEP, a rate of 22, and 100% oxygen, with oxygen subsequently weaned to maintain saturation > 94%, and ventilator rate titrated to maintain normocarbia. A 5 French, 12 cm, triple lumen, subclavian catheter and a radial arterial line were placed, as were esophageal and bladder temperature probes.

**Questions for Progression in PICU 1:** What ventilation parameters are important to consider in patients with respiratory failure to avoid ventilator induced lung injury (VILI), while optimizing oxygen delivery?

**Case Progression in PICU 2:**
Despite fluid boluses, the BP remained 80/40, and vasopressor therapy was commenced to improve cerebral perfusion pressure. Dobutamine was infused at 10 mcg/kg/min, resulting in a BP of 102/55 mmHg and urine output of 1.5 ml/kg/hr. She remained comatose with a GCS of 7T (E1, V-T, M5). A cooling blanket was utilized with a goal of maintaining her temperature between 36 and 37 degrees to avoid hyperthermia. Maintenance fluids without dextrose were initiated as here serum glucose was 327 mg/dl. Intermittent posturing and tachycardia resolved after IV midazolam treatment, and a continuous electroencephalogram was performed to monitor for post cardiac arrest seizure activity. The neurologist noted non-convulsive seizure activity on the electroencephalogram, and the patient was loaded with 20 mg/kg of intravenous fosphenytoin. The patient’s family was approached for inclusion into Therapeutic Hypothermia After Pediatric Cardiac Arrest (THAPCA) trial, however declined.

**Questions for Case Progression in PICU 2:**
Do pediatric patients have post-cardiac arrest myocardial depression? Is there goal directed therapy after cardiac arrest in children: cardiac function, secondary brain injury, and glucose control? What are the catalysts for development of secondary brain injury? Is there a role for avoiding hyperoxia after brain injury? What is the role of hypothermia after cardiac arrest in children? What is the incidence of seizures following cardiac arrests? [6-15]

**Case Progression in PICU 3:**
Pulmonary function worsened and multiple ventilation modes were attempted, including pressure-regulated volume control, pressure control, and airway pressure release ventilation (APRV). A repeat chest radiograph revealed worsening bilateral infiltrates. Utilization of the APRV mode with settings of Phigh 40, Thigh 2.6, Tlow 0.3, and with inhaled nitric oxide at 20ppm, resulted in a mean airway pressure of 35, and calculated PaO2/FiO2 ratio and oxygenation index (OI) of 61 and 57, respectively. The patient received 2 therapeutic bronchoscopies on hospital days 2 and 4 for removal of mucus-laden debris and directed instillation of calfactant (80ml/m2). Due to ongoing refractory hypoxemia, she was transported to the operating room for placement of a dual lumen bi-caval cannula for veno-venous extracorporeal bypass.

**Questions for Progression in PICU 3:**
What is the efficacy of surfactant therapy in pediatric ARDS, and near drowning patients? What is the role of ECMO as a treatment modality in pediatric ARDS? Why was venovenous ECMO chosen for this particular patient? [16, 17]


