AirWaves

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Continuing Education at West Michigan Air Care

West Michigan Air Care (WMAC) has sustained a robust educational program over the years, both internally as well as extensions to our community in the way of training and outreach. The framework for the training standard was developed at inception of the program, but it has evolved over the years. Driving this education at WMAC is the Clinical Educator, which is a role that has always been paramount in setting the standard for training and developing the medical crew to be prepared for all types of patients.

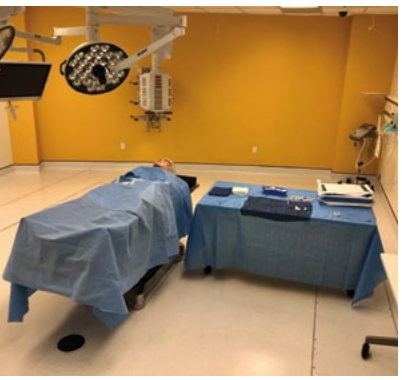

Photo by Sara Sturgeon

Flight nurse, Paul Rigby, has been the Clinical Educator since December, 2017 and oversees the planning and implementation of the medical crew education that focuses on four main areas: Adult Critical Care, High Risk Obstetrics, Pediatric Critical Care and Trauma and Emergency Care. The topic rotates every three months and includes hands-on practical application of skills from ventilator management to surgical skills, such as chest tubes and cricothyrotomy; case reviews in collaboration with physicians from Bronson Methodist Hospital and Ascension Borgess Health; pertinent lectures on applicable topics; and simulation lab training at Western Michigan University Homer Stryker M.D. School of Medicine's state of the art facility located in downtown Kalamazoo.

The crew undergoes extensive didactic instruction pertaining to outlined quarterly educational objectives. Once this information is given to the medical crew, cases pertaining to the objectives are reviewed. Protocols that guide our treatment, as well as current literature, is compared to make certain that the care we are bringing the communities is best practice and evidence based. To complete each quarter every crewmember completes several high-fidelity simulations to evaluate the retention of the training and also practice the newly developed protocols before signing them into practice.

WMAC welcomes opportunities to partner with crews from neighboring programs. Pictured above are Joetta Vamos and David Saddler, flight nurses from University of Michigan Survival Flight participating in a recent pediatric simulation day with WMAC flight nurses Jennifer Kennedy (left) and Nick Wright (right). Also pictured assisting is Joi Presberry. Photos by Sara Sturgeon.

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History of the Pilot Watch Part II

With the Wright Brothers and Alberto Santos ushering in the golden age of aviation as well as the Pilot Watch (see Part 1), newly minted pilots assumed the mantle, raised the goals and attempted to do the impossible, like flying across the English Channel.

The English set prize to fly across the Channel at 1,000 pounds, fully expecting one of their own, French National Hubert Latham, to win and all odds were on him. The French newspaper Le Matin disparaged the contest by declaring that there was no chance of a pilot winning the prize; the attempt was unreasonable.

Enter Louis Charles Joseph Blériot, French aviator, inventor, and engineer. Having earned the nickname of "Crash King" in his quest to perfect his own-designed monoplane prototypes (at this time, monoplanes lacked the popularity of bi-planes, and some doubted their suitability for flight.)

In 1909, Blériot, in a monoplane of his own design, crossed 31 miles of open water from Calais to Dover in approximately 40 minutes at an altitude of 150-300 feet. The "Crash King", with the Channel crossing became "the Father of Aviation".

The watch worn for the Channel crossing (Zenith Montre d'Aeronef Type 20) boasted a host of features that distinguished it as an aviation tool. This watch possesses the DNA shared with all future pilot watches. The watch offered features conducive to flying; luminous dial and hands for readability, oversized Arabic numerals, a large crown for turning when wearing gloves, a bi-metallic anti-magnetic hairspring and a case that could be attached to the instrument panel. This last feature is a bit anachronistic, but the pilot 'cool factor' is here at the start. "I am very satisfied with the Zenith watch, which I usually use, and I cannot recommend it too highly

(continued on page 4)

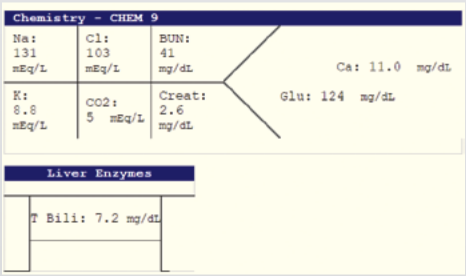
"You Flew A Kid ..."

The short answer to this question is an emphatic "YES;" here is why …

A 3-day old, 2.5 kg term female presents to a local emergency department (ED) with poor feeding, loose, runny stools and respiratory distress since being discharged home the previous day. Lethargy and "breathing problems" worried the mother enough to bring her newborn daughter back to the hospital for evaluation. The ED physician took one look at this tiny patient and activated a transport team before she even began the physical examination and work-up.

Upon initial examination, the baby was ill-looking in appearance with jaundiced skin, poor turgor and an obviously sunken anterior fontanelle. She was tachypneic with intercostal retractions, and poor peripheral and central pulse quality. Per the mother's report, the baby had no wet diapers within the past 12 hours and the last diaper change revealed copious amounts of milky white stool.

Prior to the transport team arrival, a peripheral intravenous line had been obtained in the right antecubital fossa and two (2), 10 ml/kg fluid boluses were initiated. The baby was placed under a radiant warmer. Laboratory studies were obtained with the following results:



Vital signs obtained just prior to the transport team's arrival included a heart rate of 180-200 bpm, a respiratory rate of 60 – 70 breaths/min, a room air oxygen saturation between 95 and 98%, a blood pressure of 68/38 (MAP 48) and a rectal temperature of 35.3oC. The bedside monitor showed the following lead II rhythm:

Clinical Question

Even for neonatal experts (which I am not even close to), the primary question may be "where do you start?" You have a critically ill newborn, in shock, who is displaying dysfunction in several organ systems at 3 days of life. The answer to this question is to identify the most serious threat to this baby's life and address it. Your role as a critical care transport provider is to stabilize and deliver this patient to expert care (in this case, a level IV nursery 20 minutes away by helicopter).

Keeping this tiny patient alive relies upon how you establish your priorities and the patient's response to your intervention for the short period of time that she is in you care.

Review of Pertinent Neonatal Electrolyte and Acid-Base Balance, and Management Principles

Total body water (TBW) changes significantly during the first year of life. In the newborn, TBW is approximately 75-80% of total body weight. This can be even higher in the newborn that is small for gestational age (SGA) (recall that the newborn in this case weighed 2.5 kg). This can explain why even the smallest loss in circulating blood volume or extracellular fluid (ECF) loss can have profound effects on a newborn's tissue perfusion and cellular respiration. Additionally, a comparatively high metabolic and fluid turnover rate have important implications on glucose requirements and electrolyte balances. Illness can greatly exacerbate this.

Renal function and Glomerular Filtration Rate (GFR) in the developing newborn are naturally much lower compared to that of an older child or adult. This decreases the ability to regulate sodium and water. As their renal compensatory mechanisms are immature, the ability to regulate acid-base balance is also impaired. This makes the bicarbonate loss from diarrhea and gastrointestinal (GI) disturbance particularly concerning.

Diarrhea and GI loss remain as one of the primary causes of morbidity and mortality in the very young (in both developed and developing countries) with dehydration, shock and electrolyte imbalance as the primary cause of death and permanent disability. Hyponatremia, hypochloremia and hyperkalemia are primary electrolyte disturbances as a result of GI loss. Moreover, a GI disturbance can exacerbate existing issues in glucose regulation. This can make matters worse since the ability of the developing neonate to control glucose stores is naturally reduced during this developmental stage.

Potassium disorders (hyper- and hypokalemia) are common in the newborn with dehydration. This electrolyte plays a key role in electrical conduction to skeletal, smooth and cardiac muscle. If gone unregulated or untreated, this can result in cardiac arrhythmias, cardiac arrest, respiratory failure, muscle weakness and an exacerbation in GI disturbances. Hyperkalemia is common in the severely dehydrated newborn as metabolic acidosis from absolute bicarbonate loss causes a shift in potassium from intracellular to extracellular fluid.

Bicarbonate is important in the body's buffering system and is a key component to acid-base balance. Neonates have a lower serum bicarbonate level as compared to adults and as previously noted, have immature renal compensatory mechanisms. Because of this, a natural source of bicarbonate replenishment is the base equivalents contained in mother's milk or regulated formula. As this source of nutrition is not an option for the newborn with a feeding intolerance they are deprived of this base source.

In critical illness and acidosis, the bicarbonate level may become low because the cells are inadequately perfused and must revert to anaerobic metabolism for energy production. Logic would state that in this situation, management needs to focus on correcting the cause of the hypoperfusion rather than replacing bicarbonate. In fact, aggressive administration of bicarbonate in the neonate has been associated with deterioration in cardiac function, increases in intracellular acidosis, reduced tissue oxygenation and intraventricular hemorrhage.

In the case of severe dehydration due to diarrhea and / or absolute GI loss, the use of bicarbonate is most sincerely warranted. The typical dose is 0.5 mEq/kg of a 4.2% solution as an intermittent or continuous infusion.

Because of these key differences in anatomy and physiology, it is essential to monitor newborns for any indication of abnormalities in fluid and electrolyte balance. If oral hydration and nutrition strategies are ineffective or impractical, the newborn should receive parenteral therapy without delay. Establishing normal blood volume / TBW, tissue perfusion, electrolyte and acid-base balance is paramount. This should consist of at minimum, an isotonic crystalloid (Normal Saline or Ringers Lactate). In the above case, 5% Albumin could be considered in order to maintain the newborn's colloid oncotic pressure (arguably, with signs of hepatic dysfunction, this would have been a reasonable choice). Bolus dosing should be 10 ml/kg per hour. Parameters to assess efficacy of therapy should be mean arterial pressure, heart rate, capillary refill time, core temperature, base deficit and blood glucose values.

Differential Diagnoses for this type of presentation may include:

- Sepsis
- Ductal-Dependent Cardiac Defect
- Biliary Atresia
- Inborn Error in Metabolism
- Congenital Adrenal Hyperplasia

Sequence of Events

Upon arrival of the transport team, the newborn's glucose was reassessed and was found to be 89 mg/dl. Labs were reviewed and clinical examination was relatively unchanged from initial assessment. Volume resuscitation with an isotonic crystalloid was continued and a second peripheral intravenous line was established. A sodium bicarbonate infusion was ordered (this was mixed in a 10% dextrose containing solution and administered a "maintenance fluid" rate). The hyperkalemia was determined to be a priority as it was changing the morphology of the ECG tracing. Calcium Chloride (20 mg/kg) was slowly administered in order to stabilize cardiac cell membranes. The baby was then transferred to the pre-warmed transport isolette and skin temperature monitoring was initiated.

A couple of issues concerning to the referring staff that were not immediately addressed was:

» The baby's tachypnea. The transport team recognized this as a compensatory mechanism for hypoperfusion and profound acidosis. Aggressively managing this could have made the disparity in acid-base balance worse. While tachypneic, the baby was exchanging gasses appropriately.
» The "milky white" stool in the baby's diaper. This is typically a warning sign that the newborn is not properly digesting food. A white color can indicate a lack of bile from the liver to digest food. This was more than likely due to the acute liver dysfunction that the baby was experiencing and should be self-resolving once normal liver function / perfusion is re-established. While an abnormal finding, not a priority management goal for transport.

Take Home Points

» Especially in the newborn population, it is important to understand the cause of acidosis.
» Prioritize. Think about how your priority intervention will affect other issues (these issues do not exist in "silos").
» Do not underestimate the simplicity of intravascular volume restoration, glucose and temperature regulation. These interventions alone can be life saving to the newborn.
» A critically ill patient does NOT automatically = aggressive airway management. Think about WHY a tachypneic newborn is tachypneic. However, since newborns have little reserve so be prepared for a rapid deterioration.

By Paul Mazurek
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Medical Director's Corner

Localization of the subglottic, cricoid, and tracheal regions using three-dimensional computed tomography images. Lateral (bottom left) and anteroposterior (bottom right) view of the airway column (bottom right). The volume of each segment was calculated using 3 mm slices, and comparisons made between the subglottis, cricoid and trachea. There was an increase in the airway volume from the subglottis to the cricoid to the tracheal levels.[11] (Reproduced with permission from John Wiley and Sons, Pediatr Anesth 2017; 27:604–608)

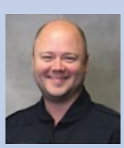
This quarter's education has focused on pediatrics. Coincidentally, there have been a couple recent papers published looking at pediatric resuscitation. Let's take a closer look and at the end we'll dispel one of the biggest dogmas in pediatric resuscitation/airway management.

At this point, most of you have probably heard about or read the PARAMEDIC2 study that was published last year which showed increased Return of Spontaneous Circulation (ROSC) with epinephrine in adult prehospital cardiac arrest[1]. This, however, did not translate to improved 30-day mortality with good neurologic outcome. A recent study in the Journal of the American College of Cardiology in January looks at the same question in the pediatric population[2]. This was a large meta-analysis from a Japanese database which has data from every cardiac arrest in the country (think CARES Network on steroids). In the 10 years of data, 1.2 million patients were recorded with just under 4,000 children 8-17 years old. In this population, epinephrine again showed significant improvement in ROSC, but no significant improvement in 30-day survival with or without good neurologic outcome. Interestingly, there was a sub-group analysis that showed marked improvement in ROSC and 30-day mortality when epinephrine was given within 15 min of cardiac arrest with a trend towards improvement in good neurologic outcome which did not reach significance. This is similar to previous studies in the adult population[3,4,5], and one of the limitations to the PARAMEDIC2 trial. In PARAMEDIC2, the average time to epinephrine was over 20 minutes. Bottom line, epinephrine appears to have benefits in both adults and pediatrics when given early (<10-15 min), but detrimental effects when given late (> 20 min).

Although pediatric cardiac arrest from a shockable rhythm is actually quite rare, what anti-dysrhythmic should we use when we do happen to encounter this? This was looked at in a recently published study in Resuscitation[6]. This was an analysis of in-hospital cardiac arrest patients listed in the Get With The Guidelines – Resuscitation Registry over an 18 year period. They matched 180 pediatric patients, 90 receiving lidocaine and 90 receiving amiodarone. They found no statistical difference in ROSC, survival at 24 hours, survival to hospital discharge, or in a good neurologic outcome.

What about pediatric airway? We all know that kids get uncuffed tubes because their anatomy is different right? This dogma has been challenged more in recent years[7,8,9,10]. Contrary to popular belief, the pediatric airway is not conical/funnel shaped, but is more elliptical shaped which transitions to the typical cylindrical adult airway over time[11]. Multiple studies have shown that cuffed tubes allowed for better control of ventilation and tidal volumes with no difference in complications including need for treatment of post-extubation stridor. One study even showed fewer complications in the transport environment when using cuffed ET tubes[10]. When selecting the appropriate cuffed tube size, it is recommended to use ½ size smaller tube than you would for an uncuffed tube.

That will do it for this quarter's Medical Director Corner. Next quarter we will be going over adult critical care. If you have any topics you would like to see covered, please send me a message. Until next time, keep yourself and our communities safe.



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History of the Pilot Watch Part II (continued from page 1)

to people who are looking for precision", said Louis Blériot on March 19, 1912.

Blériot's use of a Zenith watch cemented the brand in French consciousness. Beginning in 1939, the Zenith Montre d'Aeronef Type 20 was the chronometric instrument for French aircraft. It resided on the instrument panel where its large, luminous numerals were visible day or night.

Zenith, a Swiss watch company, has been making watches in the town of Le Locle since 1865. Zenith's aeronautical prowess, then and now, is about quality timepieces that can withstand the rigors of flight.

This company stands as a giant over time. Zenith's cal.5011 K movement, which debuted in 1960, received recognition as the most accurate chronometer ever tested by the Neuchâtel Observatory in 1967 (for mechanical watches, of course).

Adapted from *History of the Pilot Watch Part II – Zenith Montre d'Aéronef Type 20* by By Max E. Reddick.

By Brian Vanderberg
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