AirWaves

Summer 2007, Volume 13, Issue 5

A Publication of West Michigan Air Care

www.aircare.org

A Note From the Editor

Welcome to our second edition of our bigger and better Air Waves! I have included a couple of our readers' comments for all to enjoy. I am always looking for exciting photos that include our crewmembers and/or helicopter. Please continue sending any comments or questions to lkriley@aircare.org, and be sure to include the SUBJECT as Air Waves. Till next issue, stay safe and have a great day.

Readers Comments

I flew with you several years ago (2004) while I was home on leave from the Air Force. I'm sure you probably don't remember me as too much time has passed. Anyway, I like the new Air Waves format! Hope all is well with everyone there … Take care! Dan

In the part about "What Makes a Helicopter Fly" you forgot to mention the most important thing … Lots of money!!!! Kevin

In This Issue …

New Air Care Associate

Please join us in welcoming our newest Air Care Pilot.

Brian is a native of the Kalamazoo area, having grown up in Portage and attended Western Michigan University. Brian earned his private pilot certificate thru the WMU Sky Broncos then obtaining his commercial pilot's certificate, instrument and multi-engine ratings, and a Bachelor of Science degree from the Aviation Technology and Operations curriculum at WMU. Brian continued on at WMU as a Presidential Intern, where he would oversee various projects that were related to the expansion of the Aviation School at the Battle Creek campus. He obviously did a great job because that school is now a College!

Brian applied to the U.S. Army flight school in 1995 and was accepted into the Warrant Officer Flight Training Program. After he graduated the flight school he was then sent to Fort Drum, NY, where he was pilot in command of the OH-58D (I), the Kiowa Warrior. Brian was then selected to teach at the Army's flight school in Fort Rucker, AL. He served there teaching Basic Combat Skills in the OH-58 A/C airframe.

Upon completion of his active duty tour with the U.S. Army, Brian was hired by St. Vincent's LifeFlight in Toledo, Ohio. Here Brian flew the AS365N2 Dauphin as a Single Pilot IFR Captain for five years, at the satellite station LifeFlight2 in Wauseon, OH. Now we are lucky enough to have Brian aboard as one of our pilots here at West Michigan Air Care

Brian and his wife Krista have two sons and are excited to be relocating back to Kalamazoo where they both have family and many friends. We at Air Care are extremely glad to have them join our family.

Current Research in Medication Assisted Intubation at Air Care, Part IV – *Kevin Franklin CFRN, EMT-P*

Welcome back to the final article on our series of Medication Assisted Intubation (MAI). In this article we will discuss the pharmacophysiology behind paralytics. In addition we will cover the current paralytics available to Air Care flight crews and the reasons behind their use.

The first paralytic class that we will cover is the Depolarizing Neuromuscular Blockers (D-NMB) of which Succinylcholine/Anectine is the only medication. Succinylcholine was first studied in 1906 in animals in relation to parasympathomimetic effects and its full effect was not realized until 1949. It was then determined that Succinylcholine could be used as a neuromuscular blocker to aid during surgery in controlling patient movements regardless of the patient's level of sedation.

To understand how Succinylcholine works it is first necessary to review the physiology related

to acetylcholine which is the structure that Succinylcholine mimics. Acetylcholine (ACh) is normally present in the body and is produced continuously by the mitochondria for a multitude of tasks. Under normal conditions ACh affects all muscarinic and nicotinic cholinergic receptors including those within the parasympathetic and sympathetic systems. In addition ACh and its receptor the Acetylcholine Receptor Complex are responsible for synaptic transmissions at neuromuscular junctions (NMJ).

At the NMJ the ACh is stored in vesicles near the pre-synaptic cleft within the neuron. When appropriately initiated the vesicle releases the ACh at the pre-synaptic cleft and the ACh travels across the NMJ synapse and lands on the acetylcholine receptor complex. When the receptor complex receives the ACh it then changes the membrane permeability to sodium and potassium leading to a change in the electro potential which causes an action potential to occur. The muscle is then stimulated along its pathway and the contraction occurs.

The length of time that this stimulation can occur is directly related to an enzyme named aceytlcholinesterase that is responsible for hydrolyzing ACh. This enzyme is normally present right at the NMJ and thus breaks up ACh as soon as it releases from the acetylcholine receptor complex.

The neuromuscular blocker Succinylcholine works similarly by mimicking the normally present ACh. Succinylcholines advantage occurs because it is not hydrolyzed by the enzyme acetylcholinesterase like ACh would be. Instead a different enzyme is responsible for this and it is called plasma cholinesterase and it is only present in the intravascular system. This separation of medication from enzyme prevents the Succinylcholine from being deactivated until it diffuses out of the NMJ and back into the intravascular circulation. The result is that the excitation at the NMJ occurs for three to five minutes with Succinylcholine compared to milliseconds with ACh.

This prolonged excitation at the NMJ causes the muscles to contract and produce muscle twitching called clonus. As clonus progresses the muscles become exhausted and are unable to maintain tension and hence relax producing the desired muscle relaxation. This relaxation phase will last until the Succinylcholine has been deactivated by the plasma cholinesterase as noted prior which usually occurs in 3 – 5 minutes. During this time, procedures such as endotracheal intubation (ETI) can occur with all skeletal muscles, including those in the mouth and jaw.

At Air Care all intubations are performed using Succinylcholine except those with contraindications to its use. Contraindications include hypersensitivity (allergy) to the drug, hyperkalemia > 6.0 mEq/L, history of malignant hyperthermia, history of muscular dystrophy and recent massive cell death (e.g., burns, crush injuries, significant muscle trauma). To maintain blockade of neuromuscular transmission after ETI has been performed, often a longer acting neuromuscular blocker is utilized by Air Care medical crew.

Currently the longer acting neuromuscular blocker utilized is Rocuronium/Zemuron. Rocuronium falls into a different class of neuromuscular blockers known as the non-depolarizing neuromuscular blockers (ND-NMB). ND-NMB's work through a slightly different mechanism then the D-NMB Succinylcholine.

Non-depolarizes work instead by being an antagonist at the acetylcholine receptor complex. This results in cessation of the sodium/potassium exchange and the prevention of an electro potential from being created. The result is muscle relaxation without the clonic activity that occurs with Succinylcholine.

At this time there are a variety of ND-NMB's on the market with the main variances being the onset of action and the duration of action. At Air Care Rocuronium is the primary ND-NMB. Rocuronium has 2 distinct advantages that make it an optimal NMB for air transport. The first is that the onset of action is 60 seconds so in those patients whom Succinylcholine is contraindicated, Rocuronium provides a good alternative for NMB and ETI. The second advantage is that Rocuronium has a duration of activity of approximately 20-60 minutes allowing neuro/physical re-evaluation by receiving staff shortly after the transport is concluded.

Neuromuscular blockers make up the final part of the Medication Assisted Intubation Matrix at Air Care. Readers are encouraged to review the previous AirWaves issues that addressed the pre-medications and sedative/hypnotics. Through continued research and education it is hoped that in the near future this information will be introduced to a broader national audience and continue to promote the best utilization of medications for assistance in intubation (MAI).

On behalf of the entire MAI research team, we thank you for your interest in this subject matter. For questions or comments related to this or any of the previous related articles, or for a list of references, please feel free to email myself directly at kmfranklin@aircare.org.

Air Care: Behind the Scene

So … Who Are Those People?

So … Who does handle the patient accounting activities; coordinate purchasing, invoicing and payables; who is responsible for marketing supplies and facilitating a plethora of administrative functions for Air Care? It's the ladies behind the curtain – the Business Office.

So … Where Are They?

If you have ever stopped in at Air Care on the Bronson Campus you may have noticed the activities of the maintenance crew, medical crew, dispatchers, or pilots but where is the administrative branch of Air Care? Where are the people who answer the non-emergency phone calls, send the bills out, and handle all the day to day administrative responsibilities?

Where are they? They are the Air Care Business Office which is located on the Borgess campus in the Medical Specialties Building.

And … Just What Do They Do?

To maintain operations as a stand-alone air ambulance company sponsored by Borgess Medical Center and Bronson Methodist Hospital, the Business Office is comprised of the Assistant Program Director, Business Assistant and Reimbursement Specialist.

The Assistant Program Director orchestrates the show. The Assistant Program Director has a multitude of responsibilities ranging from administration, billing, accounting, budget, network functions and anything else that needs to be done or accomplished to keep the company working like a well oiled machine.

It is the Business Assistant that is tasked with a variety of administrative functions to maintain business operations. Purchasing, accounts payable, marketing assistance, IT support and internal phone system maintenance are just a few that make up her position description.

Air Care is extremely fortunate to have the resources to facilitate, handle and maintain its patient accounting activities in-house. These activities ranging from billing of accounts to collections are all completed with strict adherence to the regulations set forth under HIPAA (The Health Insurance Portability and Accountability Act of 1996 (Public Law 104-191). These position responsibilities are fulfilled by the Reimbursement Specialist.

BETH, *Assistant Program Director*

If you have heard the term, "been around longer than dirt", you could reference the length of time Beth has been an associate at Air Care. Beth has been with Air Care since it's inception in 1993. A previous associate with Borgess Inflight, Beth affords 22+ years of air ambulance industry knowledge.

Have a question about the past, present or future of Air Care? Contact the "company glue" – Beth. This term best describes the gambit of responsibilities Beth affords Air Care, ranging from administrative, marketing, strategic planning, financial responsibilities, network administrator, IT problem solver, mail carrier, wearable designer, delivery service, conference coordinator; and, in conjunction with the Business Assistant and Reimbursement Specialist facilitates the daily business operational functions required at Air Care.

When not working at the Business Office located on the Borgess campus, Beth is traveling to visit her grandchildren in Minneapolis, MN and Reno, NV or arranging summer visits for them to spend time in Michigan. In the summer, she enjoys fishing for blue gills with her husband at their summer lake trailer; family fish fries; or riding together on their Harley. In the winter, she enjoys hibernating with a good book and traveling to visit family for the holidays.

KATHY, *Reimbursement Specialist*

Kathy came to Air Care with experience in insurance as well as previous knowledge of the EMS community.

Kathy has been Air Care's Reimbursement Specialist since October 2002. As the reimbursement specialist she is able to be 'polite' or 'not so polite' when dealing with insurance companies BUT always 'polite' when dealing with the patients and their families.

She is considered the "keeper of the charts," so when a patient wants to inquire about the status of their bill, invoice, or just wonders 'what is happening' with their account – Kathy is the person to contact.

Kathy has 2 daughters living in Florida, so that is cause for at least 2 road trips a year to sunny Florida. She also enjoys playing **at** golf, bowling and working around her home.

MELANIE, *Business Assistant*

Melanie is Air Care's Business Assistant. She came to work at Air Care in April 2003. Melanie brought to Air Care over 30 years of experience in service oriented environments with extensive experience in the health insurance industry, and specialized software applications.

As the Business Assistant, Melanie handles a myriad of duties which include processing purchase orders and invoices, assisting with marketing functions, reconciling marketing sales and marketing inventory, posting various items to the Air Care website, maintaining internal phone system set up/troubleshooting, and assisting with IT issues.

She enjoys reading, gardening, cooking, and working around the family farm. Summers Melanie and her husband spend weekends on their sailboat on Lake Michigan or riding their Harley.

The Landing Zone

When it comes to providing assistance to accident victims in our service area, West Michigan Air Care (Air Care) would like to say thank you to everyone in the region who prepare and manage the Landing Zone. The Landing Zone (LZ) is an area of potential hazard to our crew members and yours. Thank you for being an indispensable part of the team when it comes to conducting a safe and effective operation.

The successful Landing Zone operation can be reduced to two basic functions: selection of the site, and management of the area beginning prior to the arrival of the helicopter until after departure.

Let's look at the selection of an appropriate site. One approach to the selection process is to use the "Four S's". These are Size, Surface, Slope and Surroundings. (You may encounter a fifth S, Shape, however in our experience, if the size is right, the shape isn't a concern.)

West Michigan Air Care requests a minimum size of 100'x 100'. This provides adequate main rotor and tail rotor clearance, and allows the pilot a good view of the Landing Zone from the air. The first thing that the pilot will do on arrival at the scene is perform an aerial reconnaissance to evaluate the site. As long as a clear area of 100' in two directions is available, rectangular, round or odd shaped areas should be acceptable. Modern rotor technology is far too expensive for pilots to knowingly risk trying to squeeze their aircraft into an area less than the minimum requirement, not to mention the safety of crewmembers and individuals on the ground.

Weighing roughly 8500 pounds, our aircraft requires a firm surface upon which to land. Paved roads and mowed fields typically provide the best support. Fields with crops such as soybeans and alfalfa are usually acceptable (provided that the landowner is agreeable). Standing or cut corn fields may or may not be suitable depending on the height of the corn and the nature of the material left standing after the crop has been harvested. In the spring or during particularly wet conditions the ground may be sufficiently soft that the helicopter tires will tend to sink excessively. In these situations the extra effort required to find a suitable surface such as a road or parking lot will be worthwhile. The area also needs to be relatively even and clear of trees, bushes, fences and poles that would pose a hazard to the helicopter. The best practice is to walk the LZ to ensure a consistent surface. If one of the landing gear is positioned in a ditch or hole that is hidden by tall grass, it would pose a hazard to the aircraft and off loading crewmembers. It may make transporting the patient more difficult as well. The surface should be clear of loose debris. Plastic, cardboard, trash cans or plywood may become lethal projectiles in the aircraft's downwash.

Equally important is the Slope. Air Care's helicopters are restricted to a slope of no more than 10 degrees. This is a limitation imposed by the Rotorcraft Flight Manual and is dictated by rotor system construction and control authority. Pilots will know from flight instrumentation as well as gut feel when this limitation is about to be exceeded.

We must also consider the Surroundings of the proposed LZ. Wires, tall towers, trees, and structures are the most common obstructions found in the vicinity of the Landing Zone. Wires are difficult to detect from the air, especially at night or when looking into the sun. This is another reason to walk the proposed LZ and look up as well as at the surface, using lights at night to discover wires. Poles are the pilot's clue to the presence of wires, however the poles may be hidden in a tree line, and wires may take a route that the pilot may not have expected. The victim or wreckage must be considered and care should be taken not to

jeopardize the security of the patient and responders by rotor downwash in excess of 50 mph. When planning an approach into the LZ, pilots will as much as possible, line the helicopter up to approach and depart into the wind. Another consideration will be the proximity of high obstructions, approach and departure over the lowest obstacles being preferable.

As early as is practical, the Air Care crew will attempt to make radio contact with ground personnel. We will provide an estimated time of arrival (ETA), and request LZ information including location, type of surface, wind direction and obstacles. Once the site has been selected and you have an estimated time of arrival, it is essential that personnel be delegated to secure the area. Due to rotorwash and high noise levels, hearing and eye protection are important for the safety of those guarding the LZ. When the aircraft is directly overhead on the final approach, the crewmembers have a blind spot below. Many helicopter crews have been surprised by vehicles trying to get through the LZ at the last second; this potentially catastrophic situation must not be allowed at any cost. If a dangerous situation is observed while on approach, it is imperative to make radio contact immediately! Radio communication of the word ***ABORT*** will cause the pilot to pull up and resolve the situation before attempting a landing. There is a natural tendency to watch the helicopter as it touches down, however, it is important for those securing the area to be alert for onlookers who may try to come too close. At the scene of an accident, it is common for Air Care medical crews to exit the helicopter while the rotors are still turning. No assistance is required at this point and all ground personnel must remain clear until rotor blades have stopped. When the patient has been packaged and is ready to be transported to the aircraft, we will direct you while loading the patient into the cabin. Please clear the LZ of vehicles immediately after patient loading has been completed to allow for departure preparations. After engines have been started the crew cannot see directly behind and cannot hear, thus it is critical that those guarding the tail area not allow any intrusions into the secure area until the helicopter has departed. Contact the crew by radio if a hazardous situation develops prior to liftoff.

Thank you again for being a vital part of the team during scene operations. It wouldn't be possible without your support.

Air Care is available to come to your location to present a Landing Zone Class. There is no charge for this service and the increased safety factor benefits all of us. Please contact Richard Morley at (269) 337-2504 or call our Communication Center at 1 (800) 922-1234 to schedule a class.

Intraosseous Access for All Ages – *Kathy Nichols, RN, BSN, EMT-P & Kevin Franklin, CFRN, EMT-P*

Establishing a means of delivering intravenous (IV) fluids and medications is vital for optimal patient care and essential for successful resuscitation. Critically ill and injured patients require immediate vascular access but often have compromised vascular access due to poor peripheral perfusion or decompensated shock, making peripheral venous access difficult and even impossible.

Experimentation with IV fluids using animals began after Harvey's description of circulation was published in 1616. O'Shaughnessy and Latta reported use of IV water and saline to successfully treat humans with cholera in 1831. Use of needles to gain access to bone marrow for therapeutic purposes was first documented in the 1930s and Arbeiter-Greengard reported successful intraosseous (IO) infusion into the tibias of infants and children in 1944 (Dudrick, 2006). The development and widespread use of IV catheters in the 1960s reduced the use of IO access to diagnostic procedures and emergent use in children and infants until this procedure began to regain popularity in the 1980s, particularly in the pre-hospital arena (Fowler, R. 2007). As of 2005, the American Heart Association now also recommends IO access as a Class IIa, a reasonable procedure to perform in both adults and children (AHA, 2005).

There are several sites recommended for insertion of an IO needle. The most common site for emergency access is the proximal tibia. This site is easily located approximately 2-3 cm below the tibial tuberosity, an easily located flattened area that lies very close to the skin. Other advantages of this site include lack of muscle and nerves, distance from CPR procedures, and proven effectiveness.

Other potential sites in older children and adults include distal tibia, distal femur, proximal humerus, iliac crest, and sternum. A hollow bore needle with a trocar or stilette is inserted through the bone cortex directly into the marrow of the bone. Inside the cortex of the bone lies a noncollapsible, spongy network of blood vessels held in place by stroma or supporting tissue. The illustration on page six demonstrates the marrow venous plexus that connect directly to the central circulation.

Once in place, correct placement of the needle may be confirmed by aspiration of bone marrow, injection of saline with little or no resistance, and the needle should stand in place without support. Any medications that are approved for IV use and all fluids including blood may be given. It is recommended that a pressure bag or infuser pump be used to augment flow.

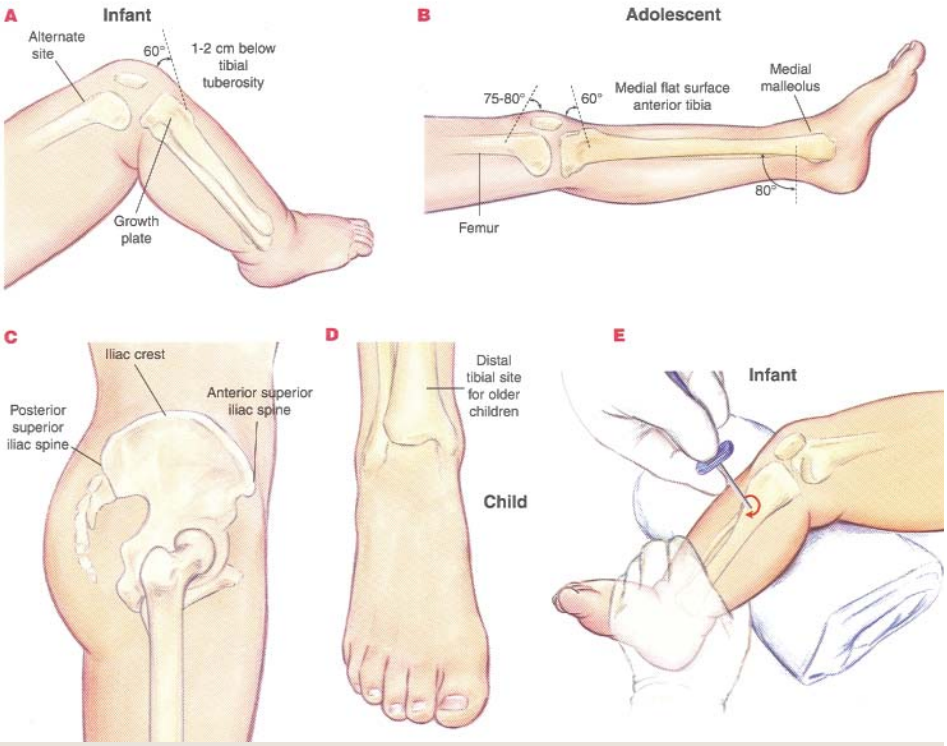
Contraindications to IO access include fractures and crush injuries near the access site, previous attempts in the same extremity, and fragile bone disease such as osteogenesis imperfecta. It is also recommended to avoid areas of cellulitis and infection.

Complications include displacement of the needle and subsequent extravasation of fluids and/or medications into the tissues. The site should be examined frequently and if swelling or leaking around the site is noted, further fluid administration should be stopped to prevent compartment syndrome and/or tissue necrosis from vasoactive medications (LaRocco and Wang, 2003).

Several commercial varieties of devices are available for IO access. West Michigan Air Care medical crew now uses the EZ-IO™ device, an FDA-approved unit with a battery powered driver that drives the needle quickly into the bone. Adult and pediatric size needles are both available. A 250 patient prospective multi-center trial of the EZ-IO™ indicated a 97% success rate of insertion and function (Davidoff, et al, 2005).

The advantage of gaining vascular access for emergent medications and fluids cannot be understated. **The following case reports demonstrate both the ease of use and the benefits our patients have received from this technique.**

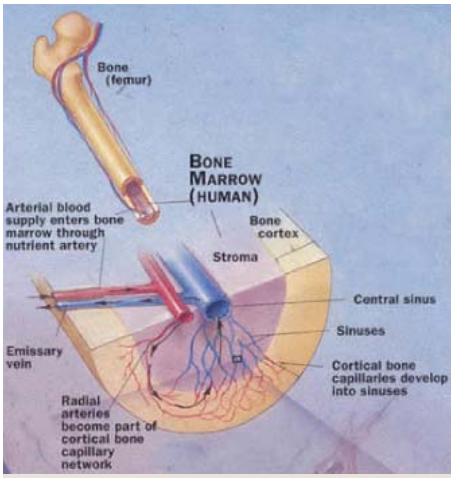
FIGURE 1. **A,** Locations for intraosseous infusion (IOI) in an infant. **B,** Locations for IOI in the distal tibia and the femur in older children. **C,** Location for IOI in the iliac crest. **D,** Location for IOI in the distal tibia. **E,** Technique for IOI infusion needle.



(Adapted from PALS Provider Manual, AHA 2002)

Case review #1

Our first case review utilizing the new EZ-IO occurred in the late winter of this year, while both authors were on duty together.



In this instance, we were dispatched to an Motor Vehicle Crash (MVC) with entrapment for a patient with chest injuries and difficulty in breathing. Upon arrival we were met near the landing zone with a middle aged female in acute respiratory distress post chest trauma.

EMS on scene had attempted intravenous access (IVA) multiple times during their encounter with the patient and was involved in a 4th attempt. The patient assessment showed paradoxical chest movement, chest pain, respiratory distress and significant agitation. Due to the high probability of closed chest trauma as well as possible decompensation requiring Medication Assisted Intubation (MAI), the decision was made to establish vascular access through the EZ-IO system.

The lower left extremity was prepped with alcohol/betadine and the EZ-IO gun with attached 19 gauge needle was applied to the tibial site as per protocol. Within 5-6 seconds the needle had penetrated the medullary cavity of the tibial bone and became secured. Once the stylet was removed, 40mg of Lidocaine was infused through the IO site and no resistance or swelling was encountered. Initially the patient complained of pain during the infusion but this was quickly abated within 1 minute of Lidocaine administration, and the patient did not complain of any further pain during her care and transport.

During the transport this site was utilized for fluid resuscitation as well as analgesic administration. Upon arrival to the nearest trauma center the EZ-IO site was maintained and utilized until large bore central catheters had been established. This case exemplifies the ease of utilization, as well as the beneficial effects the EZ-IO can provide patients whom have significant potential for decompensation and in whom peripheral vascular access is not possible.

Case review #2

Our second case review utilizing the new EZ-IO occurred this past spring while this author was on duty. In this instance, we were once again dispatched for an MVC with entrapment and an unresponsive patient. Upon arrival we found a middle aged woman that was still being extricated from a rollover MVC with significant damage to the vehicle.

EMS on scene was in the process of managing the patient's airway as well as attempting to gain IVA. The patients current Glasgow Coma Scale was 8 and the patient had suffered significant trauma to the scalp and head suggestive of a closed head injury. Due to the patient's level of consciousness and potential for further deterioration, the decision was made to intubate the patient with an endotracheal tube utilizing MAI prior to aircrew departure. Several rapid attempts were made by EMS on scene as well as the aircrew in establishing IVA to aid in MAI of this patient. After several failed attempts in less then 1 minute it was determined that the patient met criteria for vascular access utilizing the EZ-IO.

The left lower extremity was cleansed and prepped in the standard fashion as had been done in the prior case review. Due to the patients alteration in level of consciousness, manual stabilization of the extremity occurred since the patient was not able to follow commands. A 19 gauge needle set with the EZ-IO driver was able to gain access to the tibial medullary cavity within 5-6 seconds. Bone marrow was successfully withdrawn and a normal saline flush solution was administered as per standing protocol. During infusion the patient responded with movement and verbal acknowledgement but was not able to follow commands.

The site was immediately utilized for the standard MAI prep for endotracheal intubation which includes Lidocaine initially at 1.5mg/kg. After administration of the pre-intubation Lidocaine through the EZ-IO site the patient returned to their previous GCS of 8 and no longer responded to the infusion stimulus. The remainder of the medication administration for intubation proceeded and the airway was secured by the flight team.

The EZ-IO site remained in use during the transport and was again utilized within the receiving trauma facilities emergency department until further intravascular access could be obtained. This case again exemplifies the types of patients whom benefit from immediate vascular access without the higher risk that would be present if central venous access sites were utilized. In addition the EZ-IO has improved on-scene times when vascular compromise and access have become issues.

As Air Care moves forward in the coming years most EMS agencies and sending facilities will most likely encounter the utilization of this product in patient care. We encourage questions regarding the EZ-IO as well as any other Air Care protocol or procedure. From those of us here at Air Care we would like to thank you in advance for your continued support of helicopter EMS transport and look forward to our continued collective effort in improving patient care and outcomes.

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