The Trauma Professional's Blog

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Welcome Back!

I've taken several months off to catch up on some other projects. Now, it's time to get back to work! I thought I would resume with a miscellaneous collection of interesting material.

Here we go!

Who's Better At Invasive Procedures: Residents or ACPs?

With the implementation of resident work hour restrictions nearly 20 years ago, resident participation in clinical care has declined. In order to make up for this loss of clinical manpower and expertise, many hospitals have added advanced clinical providers (**ACPs**, nurse practitioners and physician assistants). These ACPs are being given more and more advanced responsibilities, in all clinical settings. This includes performing invasive procedures on critically ill patients.

A study from Carolinas Medical Center in Charlotte NC compared complication rates for invasive procedures performed by ACPs vs residents in a Level I trauma center setting.

A one-year retrospective study was carried out. Here are the factoids:

- Residents were either surgery or emergency medicine PGY2s, ACPs and surgical residents underwent an orientation and animal- or simulation-based training in various procedures
- All procedures were supervised by an attending physician
- Arterial lines, central venous lines, chest tubes, percutaneous endoscopic gastrostomy, tracheostomy, and broncho-alveolar lavage performances were studied
- Residents performed 1020 procedures and had 21 complications (2%)
- ACPs performed 555 procedures and had 11 complications (2%)
- ICU and hospital length of stay and mortality rates were no different between the groups

Bottom line: Resident and ACP performance of invasive procedures is comparable. As residents become less available for these procedures, ACPs can (and will) be hired to take their place. Although this is great news for hospitals that need manpower to assist their surgeons and emergency physicians, it should be another wakeup call for training programs and educators to show that resident education will continue to degrade.

Reference: Comparison of procedural complications between resident physicians and advanced clinical providers. J Trauma 77(1):143-147, 2014.

Trauma Conferences

The vast majority of live trauma meetings, symposia, and conferences have been cancelled. I am excited to say that a few are moving forward with their plans, providing valuable conferences in an electronic format. Here are some conferences I will be speaking at in the near future:

Texas Health 22nd Annual Trauma Conference

Aspirus Wausau Hospital Trauma Conference

If you are in need of a speaker for your trauma conference, Grand Rounds, or other CME/CEU activity, please reach out!

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How Many Salt Tabs In A Liter Of Saline?

Seems like a simple, silly question, right? Well then, I dare you to figure it out without reading the rest of this article!

On occasion, our brain injured trauma patients have sodium issues. You know, cerebral salt wasting. Trying to maintain or regain the normal range, without making any sudden moves can be challenging. There are a lot of tools available to the trauma professional, including:

- Saline
- Hypertonic saline
- Salt tablets
- Fluid restriction
- Some combination thereof

Fun times are had trying to figure out how much extra sodium we are giving with any of the first three items. This is important as you begin to transition from the big guns (hypertonic), to regular saline, and then to oral salt tabs.

Below is a quick and dirty conversion list. I won't make your heads explode by trying to explain the math involved changing between meq, mg, moles, sodium and sodium chloride.

- The "normal saline" bags we use are actually 0.9% saline (9 gm NaCl per liter)
- Hypertonic saline can be 3% or 5% (30 gm or 50 gm per liter)
- Salt tabs are usually 1 gm each (and oh so yummy)

Therefore, a liter of 0.9% normal saline is the same as 9 salt tabs.

A liter of 3% hypertonic saline is the same as 30 salt tabs. The usual 500cc bag contains 15.

A liter of 5% hypertonic saline is the same as 50 salt tabs. The usual 500cc bag contains 30.

To figure out how many tablets you need to give to match their IV input, calculate the number of liters infused, then do the math! **And have fun doing it!**

Mainstem Intubation In Pediatric Patients: How Common?

Mainstem intubation in the pediatric patient is a common problem. **There are two major issues:** the **trachea is shorter** than in an adult, and the **angles are different** making intubation of the left mainstem bronchus much easier. Frequently, the intubator watches the balloon slide between the cords, then pushes the tube in "just a little further."

Unfortunately, that "little bit" can vary significantly. An abstract from my hospital was presented at the Pediatric Trauma Society in 2016. Subjectively, we noticed that mainstem intubation was occurring with some regularity in our pediatric trauma patients. It seemed as though insufficient attention was being paid to the depth of the tube.

A major difference between adult and pediatric intubations is that in adults, optimal tube depth is locked into a relatively narrow range. In children, the depth varies considerably based upon child age and size. And small variations in depth can have major implications for tube position.

We decided to implement a PI project to change our intubation policy. In order to focus the entire team on tube depth, a color coded card was attached to each size of endotracheal tube. This card listed the optimal depth for insertion. Once the provider inserted the tube, the final depth was called out for the team and documentation scribe to hear. This had the added advantage of allowing multiple team members confirm the appropriateness of tube depth. A chest x-ray was immediately obtained to confirm position.

We retrospectively reviewed our seven year experience with pediatric intubations, from 2009-2015. Here are the factoids:

- Nearly 2,000 pediatric trauma patients were admitted during the study period
- 94 patients (5%) required intubation in the ED
- **Prior to implementation** of the new protocol, 6 of 68 patients **(8.8%) had confirmed right mainstem intubation**
- **After the change, only one further mainstem intubation occurred** in 26 procedures (3.8%)

Bottom line: Unfortunately, this series is too small to determine statistical significance. There is a definite trend toward fewer mainstem intubations. It appears that by calling more attention to the proper tube depth, fewer deep placements occur. Our numbers have remained low since this change.

Are there other methods to ensure proper ET tube placement in small patients? In my next article, I'll review a paper that compares three additional different techniques that can be used.

Reference: Eliminating the Preventable Occurrence of Right Mainstem Intubation in the Pediatric Trauma Patient: A Quality Performance Improvement (PI) Initiative. Pediatric Trauma Society Poster Abstract #1, 2016.

More Ways To Avoid Mainstem Intubation In Kids

I just described a simple technique utilizing a reminder card and provider feedback loops to reduce deep intubations in pediatric patients. Now, I'll review three other techniques and discuss a paper that compared their efficacy.

A variety of techniques for determining and/or confirming endotracheal tube position exist. Use of one or more of them is important in children due to their short trachea and increased likelihood of deep intubation. Some, like the confirmatory chest x-ray, are obvious. However, **it's more desirable to apply techniques during the intubation in order to avoid deep intubation in the first place.** Hyperinflation of one lung, especially in very small children, can cause a host of impairments and complications that may compound their other injuries.

A paper from the University Hospital Basel in Switzerland evaluated three techniques: bronchoscopic insertion to a specific depth, cuff palpation in the sternal notch, and intentional right mainstem intubation followed by slow withdrawal during auscultation. Each of 68 children ranging in age from 0 to 4 years were studied using all three techniques.

Each endotracheal tube was marked at the ideal insertion point that would ideally be placed just beyond the vocal cords. The distance from this mark to the mouth end of the tube was measured so actual intubation depths could be compared.

Bronchoscopic insertion was always performed first to obtain a baseline depth measurement, essentially the gold standard. The other two techniques were performed in random order. For the **cuff palpation technique**, the trachea was palpated while the balloon was intermittently partially inflated until it could be felt at the suprasternal notch. For the **mainstem intubation technique**, the uninflated tube was advanced until breath sounds in the left axilla disappeared. It was then slowly withdrawn until sounds reappeared.

Distances from the tip of the tube to the carina were calculated using the insertion depth at the incisors and the initial ideal intubation depth mark. Here are the factoids:

- Insertion to a depth mark on the tube via **bronchoscope technique resulted in the highest tube tip with respect to the carina, and also with the greatest depth variability**
- The **cuff palpation technique resulted in less distance to the carina** (about 19mm vs 36 for the mark technique) and less variability
- Use of the **mainstem intubation with pull-back technique resulted in the tube tip resting within just a few mm of the carina**, but tube depth was very consistent

Bottom line: What to make of all this? Which technique is "best?" First, it's not practical or advisable to use a bronchoscope for every pediatric intubation. It's invasive and adds complexity and time to a critical procedure. The cuff palpation technique also takes additional time due to the repeated cuff inflation/deflation that is required. However, the tube position is fairly accurate and safe.

The intentional right mainstem intubation with pull-back seems a bit sketchy. It requires some type of ongoing ventilation while the tube is being inserted, as well as someone who can listen to the left chest. Additionally, it results in a tube position that is so low that neck positioning may move it into the mainstem bronchus again.

In my mind, estimation of the proper depth pre-intubation is probably the best. Strict attention must be paid to the final depth of the tube once it is inserted, as measured by the distance marker at the incisors. This number must match the one decided upon at the start of the procedure. A good exam of the chest should be carried out to quickly identify an inadvertent mainstem intubation. And finally, a quick

confirmatory chest x-ray should always be obtained for objective information on tube position.

The fancy techniques described in this paper add too much time and complexity for intubation in a trauma situation. They may very well have a place in the OR where the situation is more controlled and there is more advanced equipment and support. But stick to the basics when intubating children in your trauma bay!

Reference: Assessment of three placement techniques for individualized positioning of the tip of the tracheal tube in children under the age of 4 years. Ped Anesthesia 25:379-285, 2014.

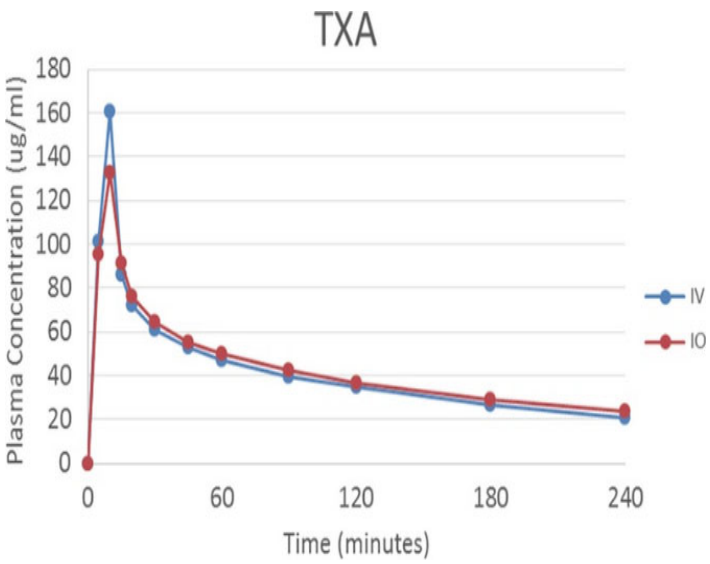
Giving TXA Via An Intraosseous Line?

Seriously injured patients frequently develop coagulopathy, which makes resuscitation (and survival) more challenging. A few years ago, the CRASH-2 study lent support for using tranexamic acid (TXA) in select trauma patients to improve survival. This drug is cheap and has antifibrinolytic properties that may be beneficial if given for life-threatening bleeding within 3 hours of initial injury. It's typically given as a rapid IV infusion, followed by a slower followup infusion. The US military has adopted its routine use at forward combat hospitals.

But what if you don't have IV access? This can and does occur with military type injuries. Surgeons at Madigan Army Medical Center in Washington state tried using a common alternative access device, the intraosseous needle, to see if the results were equivalent. This study used an adult swine model with hemorrhage and aortic crossclamping to simulate military injury and resuscitation. Half of the animals then received IV TXA, the other half had it administered via IO. Only the bolus dose was given. Serum TXA levels were monitored, and serial ROTEM determinations were performed to evaluate coagulopathy.

Here are the factoids:

- The serum TXA peak and taper curves were similar. The IV peak was higher than IO and approached statistical significance (0.053)



- ROTEM showed that the animals were significantly hyperfibrinolytic after injury, but rapidly corrected after administration of TXA. Results were the same for both IV and IO groups.

Bottom line: This was a very simple and elegant study. The usual animal study issues come into play (small numbers, pigs are not people). But it would be nearly impossible to have such a study approved in humans. Even though the peak TXA concentration via IO is (nearly significantly) lower, this doesn't appear to matter. The anti-fibrinolytic effect was very similar according to ROTEM analysis.

From a practical standpoint, I'm not recommending that we start giving TXA via IO in civilian practice. We don't typically see military style injuries, and are usually able to establish some type of IV access within a reasonably short period of time. But for our military colleagues, this could be a very valuable tool!

Reference: No intravenous access, no problem: Intraosseous administration of tranexamic acid is as effective as intravenous in a porcine hemorrhage model. J Trauma 84(2):379-385, 2018.