The Trauma Professional's Blog

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Why I Didn't Like Finger Thoracostomy

I continue to see interest in using finger thoracostomy in place of needling the chest for the management of real or presumed tension pneumothorax. **As noted in the title, I didn't really used to care much for this procedure.** I know that there's a lot of opinion on this topic out there, especially in blogs. My colleague, Scott Weingart (EMCrit) has a very nice podcast on the topic (link below). But the actual scientific literature supporting or condemning its use is sparse.

The procedure consists of doing a limited prep of the chest in the same location for regular chest tube placement, incision, rapid puncture of the parietal pleura, followed by placement of a finger into the pleural space to release tension. Sounds well and good! So what's my beef? **The arguments for it emphasize speed, certainty, and reversibility.**

Let's talk about speed first. This procedure is supposed to be fast. An incision, a few quick sweeps with a clamp, and voila! Finger inserted. And it can be this fast. But in reality, especially in training centers, people who don't insert chest tubes very often take too long (1-2 minutes).

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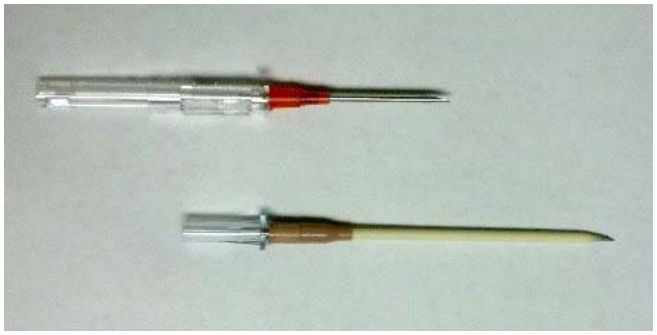
Trauma Calendar of Events

Orthopedic Trauma Association
Location: Tampa, Florida
Date: October 15-18, 2014

American College of Surgeons Clinical Congress
Location: San Francisco, California
Date: October 26-30, 2014

The next argument is certainty. There are a number of papers showing that needle thoracostomies often miss the mark, especially when using standard through the catheter needles. This is more likely to occur when the needle is inserted in the standard location (2nd intercostal space, midclavicular line) and in obese patients. My response is, use a longer needle!



The angio-catheter on top is a standard 14Ga 1.25 inch model, and won't get you anywhere. It's only good for thin people, and will kink as soon as the needle is withdrawn. The bottom model is 10Ga 3 inch, and is effective in everyone save the very morbidly obese. It's thick and will not kink until it gets good and warm.

The final issue is reversibility. The argument goes, stick a needle in the lung and you'll get a pneumothorax, but stick a finger in the chest and no

harm done. I don't completely buy this, but at least it's plausible. Puncturing the lung with a needle does not guarantee a pneumothorax. But it will require a subsequent chest xray to see if one develops. Finger thoracostomy doesn't guarantee that a pneumothorax won't occur, either. It also requires a chest xray later to check.

Bottom line: As you can tell, I'm more tolerant of finger thoracostomy now. Stock some big fat needle catheters in your trauma bay. But if you really, really want to use the finger technique, make sure that the person doing it is very experienced. This is not a learner's procedure. It should take no more than 15 seconds, or the wrong person is doing it.

Scott Weingart podcast on needle thoracostomy. http://emcrit.org/podcasts/needle-finger-thoracostomy/

Advanced Needle Thoracostomy

Let me expand a bit on the previous article on the merits of needle vs finger thoracostomy. One of the arguments against needle thoracostomy is that it may not reach into the chest cavity in obese patients. As I mentioned above, use the right needle!

Refer again to the picture on Page 1. Obviously, the needle on top isn't going to get you very far. The bottom one (10 gauge 3 inch) should get into most pleural spaces.

But what if you don't have the right needle? Or what if the patient is massively obese and the longer needle won't even reach? Pushing harder may seem logical, but it doesn't work. You might be able to get the needle to reach to the pleural space, but the catheter won't stay in it.

Here's the trick. First, make the angiocatheter longer by hooking it up to a small (5 or 10cc) syringe. Now prep the chest over your location of choice (2nd intercostal space, mid-clavicular line or 5th intercostal space, anterior axillary line) and make a skin incision slightly larger than the diameter of the syringe. Now place the syringe and attached needle into the chest via your incision. It is guaranteed to reach the pleura, because you can now get the hub of the catheter down to the level of the ribs. Just don't forget to pull out the catheter once you've placed the chest tube!

Trochar vs Needle (vs Finger) for Tension Pneumothorax

I've been involved in a number of debates regarding the best way to decompress the chest if there is a suspected tension pneumothorax. Some are proponents of the needle. Some believe that finger thoracostomy is better because it does not necessarily create a simple pneumothorax if you were wrong.

Surgeons at Madigan Army Medical Center in Washington State tried something a little different. They experimented with placing a 5mm laparoscopy port for treatment of induced tension pneumothorax in a large animal model (swine) to see how safe it was.

Here are the factoids:

- Tension pneumo (TPTX) and/or pulseless electrical activity (PEA) was induced about 30 times each in 5 adult swine. TPTX was defined as a measured 50% decrease in cardiac output.
- Placement of a 5mm laparoscopy trochar immediately relieved the abnormal physiology in 100% of TPTX cases
- Trochar placement restored perfusion within 30 seconds in all PEA cases
- No trochar induced injury to heart or lung was identified in any animal at necropsy
- The authors compared these results to older needle decompression literature which showed only 40-70% success rates

Bottom line: Using a laparoscopy port to quickly relieve tension pneumo or PEA from TPTX looks like an option. It's fast, reliable, and safe. Surgeons place these all the time in the OR, and they are designed to safely push skin and subq layers aside, not harming the viscera. However, it does suffer the same drawback as the needle: it will create a simple pneumothorax. And it will probably do so 100% of the time due to its size, guaranteeing the need for a chest tube. Furthermore, these are expensive toys to stock in an ED for only occasional use. Interesting, but I would not recommend.

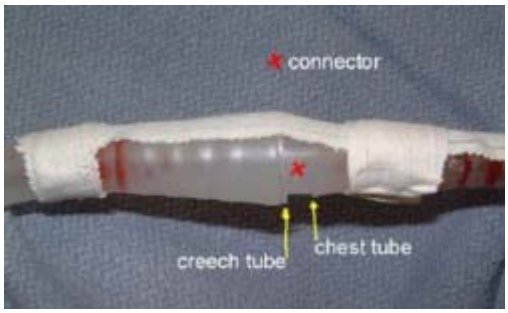
Reference: 5mm trochars for the treatment of tension pneumothorax: a superior alternative to needle decompression. EAST 2014, poster abstract #1.

Troubleshooting Chest Tube Air Leaks

An air leak is a sure-fire reason to keep a chest tube in place. Fortunately, many air leaks are not from the patient's chest, but from a plumbing problem. Here's how to locate the leak.

To quickly localize the problem, **take a sizable clamp** (no mosquito clamps, please) and **place it on the chest tube between the patient's chest and the plastic connector that leads to the collection system**. Watch the water seal chamber of the system as you do this. If the leak stops, it is coming from the patient or leaking in from the chest wall.

If the leak persists, **clamp the soft Creech tubing between the plastic connector and the collection system itself**. If the leak stops now, the connector is loose.



If it is still leaking, then the collection system is bad or has been knocked over.

Here are the remedies for each problem area:

Patient - Take the dressing down and look at the skin entry site. Does it gape, or is their obvious air hissing and entering the chest? If so, plug it with petrolatum gauze. If not, the air is actually coming out of your patient and you must wait it out.

Connector - Secure it with Ty-Rap fasteners or tape (see picture). This is a common problem area.

Collection system - The one-way valve system is not functioning, or the system has been knocked over. See the next article regarding this problem.

Note: If you are using a "dry seal" system (click here for more on this) you will not be able to tell if you have a leak until you fill the seal chamber with some water.

Chest Tube Collection Systems Gone Wild!

This unit has been knocked over. Note the blood in both collection columns on the right. In this case, the water seal and pressure chambers have also been compromised (area on the left).

Collection systems that have been knocked over frequently malfunction and should be changed immediately! (It's also impossible to accurately measure tube output after this happens)

Managing Chest Tube Air Leaks

There are a lot of opinions and not so much literature on how to manage chest tube air leaks. Here is some practical advice on how to deal with this occasional problem.

Most air leaks are an **alveolar-pleural fistula**, representing a connection between a very small airspace and the pleura. This should not be confused with a bronchopleural fistula, which involves larger airways and is much more challenging to manage.

First, identify what kind of leak it is. Remember, dry seal chest tube systems will not show an air leak unless it has a fluid chamber that can be filled with water (see related post below).

- **Expiratory** - occurs during normal expiration only
- **Forced expiratory** - occurs only with coughing
- **Inspiratory** - occurs during inspiration in ventilated patients
- **Continuous**

Inspiratory leaks are rare and should be managed conservatively with maneuvers to minimize airway pressures. Continuous air leaks can be monitored, but may indicate a bronchopleural fistula.

Expiratory and forced expiratory types account for about 98% of all air leaks. Small air leaks should be managed with water seal, not with increased suction. The main concept is to reduce air flow through the fistula so it can heal. A prospective study has shown that this technique stops small to moderate size leaks sooner than leaving on suction.

Larger air leaks will probably not seal on their own and are probably not safe to place on water seal. They will likely require pleurodesis, either chemical or mechanical via a VATS procedure. Blood and fibrin patches have also been tried.

Any air leak that extends hospital stay should be evaluated for appropriateness of discharge with a Heimlich valve or VATS pleurodesis.

References:

- *A prospective algorithm for the management of air leaks after pulmonary resection. Ann Thoracic Surg 66:1726-1731, 1998.*
- *Prospective randomized trial compares suction versus water seal for air leaks. Ann Thoracic Surg 71:1613-1617, 2001.*

Pneumothorax In Children

This condition is **far more mysterious** than in adults.

Sports related pneumothorax rarely occurs without rib fractures, which are themselves uncommon in children. The usual mechanism is barotrauma, most likely from an impact while the glottis is closed. The typical presentation is that of pleuritic chest pain, which may be followed by dyspnea. Focal chest wall tenderness is typically absent. Teenagers tend to engage in more strenuous activity and are more likely to actually sustain a rib fracture, so they may have focal tenderness over the fracture site.

Spontaneous pneumothorax in children is also uncommon. However, it is a very different entity. It may be related to blebs in the lungs, and may be more common in children who were born prematurely. The recurrence rate after successful treatment is approximately 50% (in small series). Recurrence is not predictable by looking for blebs on chest CT. The recurrence rate is significantly lower after VATS.

Bottom line: A child who complains of pleuritic chest pain, and especially dyspnea, should undergo a simple PA chest xray. If a pneumothorax is present, consider the following:

- Insert a small chest tube or catheter if needed, the smaller the better. (I'm stilling looking for the answer to the question of how big of a pneumothorax is big enough)
- Don't use high inspired oxygen; it doesn't work. (Read my older blogs from 2010)
- Don't get a chest CT for either the initial pneumothorax or any recurrences (too much radiation, too little utility)
- If this is a spontaneous pneumothorax, caution the parents on the possibility of recurrence
- If a spontaneous pneumothorax does recur, consult a pediatric surgeon to consider VATS pleurodesis
- When can the child return to sports? There is absolutely no good literature. I recommend the usual time it takes most soft tissues to return to full tensile strength after injury (6 weeks).

References:

- *Management of primary spontaneous pneumothorax in children. Clin Pediatr (Phila),50(9):797-802, 2011.*
- *Sports-related pneumothorax in children. Pediatric Emergency Care 21(4): 259-260, 2005*.

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