

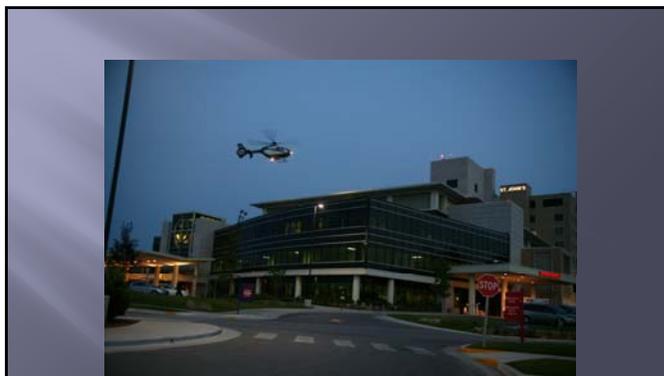
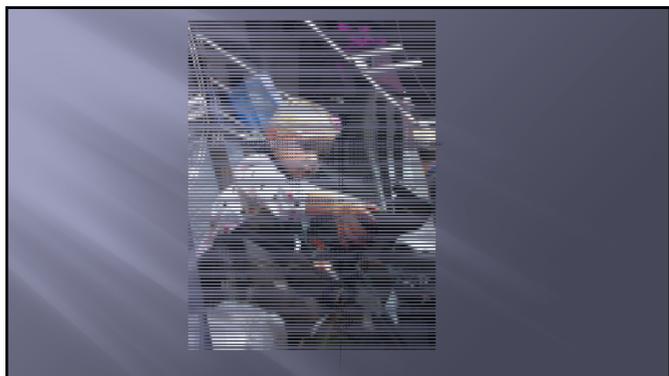
Stab, Slash, or Poke? treating tension pneumothorax



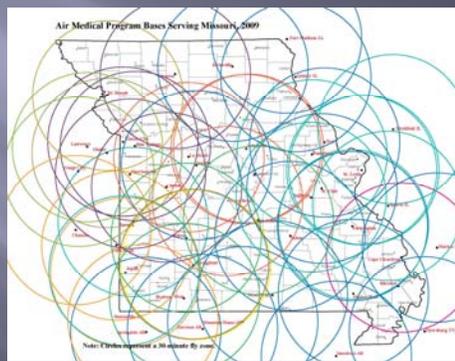
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Disclosure\$\$\$\$\$

- ▣ None,
- ▣ Nada,
- ▣ Nein
- ▣ Bribes gratefully accepted



My chief researcher



Pneumothorax

- ▣ Itard first coined the term pneumothorax in 1803
- ▣ Second only to rib fractures as the most common sign of chest injury.
- ▣ However, Bailey in 2000 reported that fewer than 10% of blunt chest injuries and 15-30% of penetrating chest injuries require thoracotomy.
- ▣ Complication rates with thoracotomy as high as 36% have been reported.

Tension Pneumothorax

- ▣ Tension pneumothorax is life-threatening and manifests clinically as hypotension, elevated jugular venous pressure, hypoxemia, chest pain, and dyspnea, and can progress rapidly to sudden cardiac arrest.

Tension pneumothorax

- ▣ Occurs when "one way valve" allows air into pleural space but not out
- ▣ Increasing volume leads to increasing pressure
- ▣ Increasing pressure leads to decreased venous return
- ▣ Shift of the mediastinum also puts pressure on vena cava
- ▣ Decreased venous return leads to decreased cardiac output
- ▣ That leads to shock and ultimately death.

Pediatric tension pneumo

- ▣ Same as adult except
- ▣ Because mediastinal structures are very mobile can actually "kink" the vena cava and cause sudden complete obstruction.

Bilateral pneumothoraces

- ▣ The other killer
- ▣ No mediastinal shift and may not have increased intrathoracic pressure.
- ▣ Ie not Tension pneumo just can't ventilate

When you put them in aircraft or intubate small pneumo's will kill them!!!

- ▣ As we go up will expand right?
 - 2000 ft climb will increase size about 10%
- ▣ This study:
 - Darren Braude Air Med J 2014 Air Transport of Patients with Pneumothorax: Is Tube Thoracostomy Required Before Flight?
 - 66 Pts w pneumo transported 21% PPV
 - 6% required needle

Simple physics problem right?

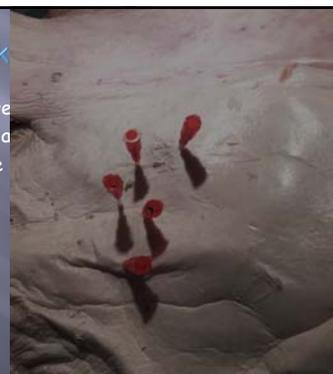
- ▣ Too much air in closed space what to do?
- ▣ Duh
- ▣ Remove the air right?
- ▣ But how is the question.

We all learned 14 g angio mid-clavicular line second ICS. 3.2 or 5 cm length



We all know the problem is not the catheter

- ▣ Often got no re
- ▣ Kinked immedi
- ▣ Leading to the



What else?

- ▣ Use wrong catheter?
- ▣ Maybe wrong location
- ▣ Loud environment maybe can't hear "rush of air"

The real problem today



Wrong catheter?

- ▣ Ball et al 2010 Can J Surg: Thoracic needle decompression for tension pneumothorax: clinical correlation with catheter length
 - Looked at prehospital needle decompression over 48 months at trauma center
 - Conclusion: Tension pneumothorax decompression using a 3.2-cm catheter was unsuccessful in up to 65% of cases because too short.

Wrong Catheter

- ▣ Clemency et al Prehosp Disast Med 2015 Sufficient Catheter Length for pneumothorax needle decompression: a metanalysis.
 - 13 Studies 2558 patients
 - Conclusion: A catheter length of at least 6.44 Cm would be necessary to assure 95% success in reaching pleural cavity

Wrong catheter?

- ▣ Schroeder et al Injury 2013 Average chest wall thickness at two anatomic locations in trauma patients
 - Conclusion 2nd ICS Number with CWT >4.5 cm (angiocath) 29.4%
 - If BMI >30 62.5%

Wrong catheter 2

- ▣ Designed for IV access hence thin wall and flexible
- ▣ Designed for fluid to go through catheter INTO patient
- ▣ Once needle out often collapses or kinks.

So just use a 30 cm catheter right?

- ▣ Oops a lot of important structures in there
 - Heart
 - Great vessels
 - Etc.

Table 2 Predicted Rates for Injuring Critical Structures by Needle Length

Needle Length, mm	I, SICS MAL Perpendicular, % (n/No.)	I, SICS MAL Closest, % (n/No.)	Overall Injury to Critical Structures, %
50	0 (0/63)	0 (0/63)	0
55	2 (1/63)	2 (1/63)	0.3
60	3 (2/63)	5 (3/63)	4
70	5 (3/63)	10 (6/63)	7
80	14 (9/63)	29 (18/63)	21

Notes: SICS, fifth intercostal space; I, left; MAL, midaxillary line.

What about different location?

- ▣ Typically put chest tubes in 4-5 ICS mid axillary line.
- ▣ Inaba et al Arch Surg 2012 Radiologic Evaluation of Alternative Sites for Needle Decompression of Tension Pneumothorax
 - Conclusion CW 1.4 cm narrower at 5 ICS AAL

Location Location Location

- ▣ Schroeder et al Inj 2013 Average chest wall thickness at two anatomic locations in trauma patients.
 - 201 trauma patients
 - 2 ICS MCL 3.93-5.25 cm depending on BMI and Gender
 - 5 ICS AAL 4.55-6.0 cm
 - so says higher in AAL opposite of prior study???

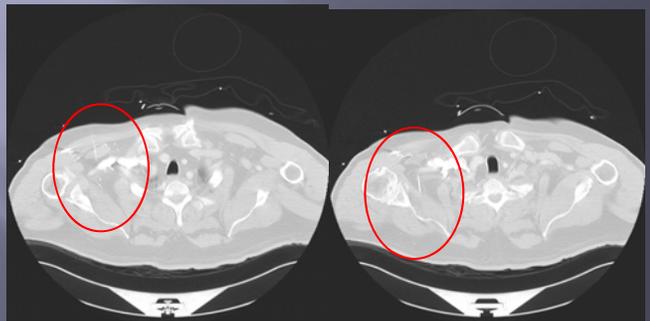
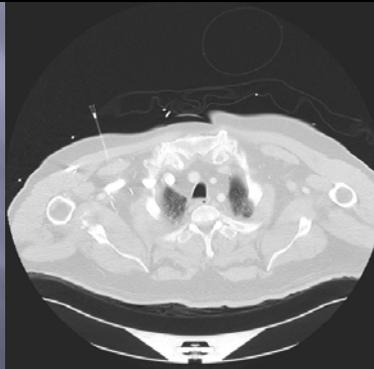
Can you even pick the spot?

- ▣ Carter et al *Emergency Medicine Australasia* (2014)
- ▣ Asked ED docs to put a marker on the 4-5th ICS
- ▣ Then took CXR Guess what happened?
 - Picked right spot 36.2% of the time
 - Slightly better in females?
- ▣ Ferrie et al *Em Med J* 2005.
 - 25 EM Docs asked to identify
 - 60% could identify 2 ICS mid clavicular site
- ▣ So What?
 - Spleen
 - Liver
 - Diaphragm

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Other options?

- ▣ Special needles
 - Turkel
 - Unfortunately I have no stock in company
 - 8.9 cm needle with indicator



1. Lubin J Trauma & acute care surg 2013
Modified Veress needle decompression
of tension pneumothorax: A randomized
crossover animal study

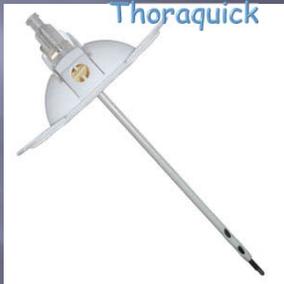
A. Veress needle: used for insufflation of
peritoneum for laparoscopy
B. compared needle thoracotomy with Veress
needle
C. Conclusion Modified Veress was way more
effective



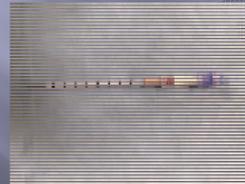
Indicators??

- ▣ Upside: Should be able to tell if in
- ▣ Downside: can be fooled by air pockets (think subQ air)
- ▣ If going to use MUST be sure you hit rib and then as you slide over look for green not before

Thoraquick



- ▣ Scotty Bolleter has new catheter that should be available soon that corrects some of the faults of the Turkel



- ▣ Larger catheter
- ▣ No indicator
- ▣ Has one way valve attachable to top.
- ▣ Supposed to be on market

Other options?

- ▣ Open thoracotomy
 - With or Without chest tube insertion?
 - Advantages
 - ▣ Definitely should know in
 - ▣ No other "organs" there
 - ▣ Open
 - ▣ Going to get chest tube anyway (although that is controversial)
 - ▣ So why not just go ahead and make an incision

Downside?

- ▣ Requires more training
- ▣ Requires sharp/slicing instruments
- ▣ Increased risk of bleeding
- ▣ Increased risk of infection
- ▣ Way more painful

Two different options

- ▣ Do a chest tube and be done
 - Takes longer
 - More equipment
 - More chance for error
 - What do you do with the tube??
- ▣ Just do a thoracostomy and skip tube
 - Less time
 - Less equipment
 - Less chance for error
 - Requires intubated patient

Barton et al. J Emerg Med 1995 PREHOSPITAL NEEDLE ASPIRATION AND TUBE THORACOSTOMY IN TRAUMA VICTIMS: A SIX-YEAR EXPERIENCE WITH AEROMEDICAL CREWS

- ▣ San Diego Life flight had option for either.
 - Needle aspiration (NA) using angiocath
 - Tube thoracotomy (TT)
- ▣ 207 patients 275 procedures
- ▣ 169 NA (39 bilateral)
- ▣ 84 pts (106 Chest tubes)

Table 2. Procedure-Related Complications

Complication	# Cases	
	NA	TT
No chest wall penetration	5	1
Wrong site	1	0
Dislodged	3	0
Valve malfunction	3	0
Excess blood	1	5
Tube clamped	2	1
Placement in fissure	0	2
Organ perforation (abdomen)	0	1
Difficult insertion	5	12
Total	20	22

Barton et al 1995

Number of procedure-related complications reported by flight nurses for prehospital NA and TT procedures.

Florian Air Medical
Journal 2015 Letter to
Ed



Massarutti et al. Euro J Em Med 2006 Simple thoracostomy in prehospital trauma management is safe and effective: a 2-year experience by helicopter emergency medical crews

- ▣ Med crew is anesthesiologist and 2 RNs
- ▣ Intubated patients not in cardiac arrest.
- ▣ 55 patients 51 unilateral 4 bilateral
- ▣ Pneumothorax or hemopneumothorax in 54
- ▣ No complications

Simple Thoracostomy: Moving Beyond Needle Decompression in Traumatic Cardiac Arrest

- ▣ Escott JEMS 2014
- ▣ Protocol for traumatic arrest patients.
- ▣ Description of how to introduce this
- ▣ No data reported.

So how do you do it?

- ▣ **If not unresponsive/dead need pain med (ketamine)**
- ▣ **And maybe rethink?**
- ▣ **Mid Axillary line 4-5th ICS**
- ▣ **Skin incision with scalpel 2-3 cm cut over rib**
- ▣ **Dissect down to pleura with hemostat of Kelly**
- ▣ **Two choices at this point**

Choices

- ▣ **A. Dissect through with finger**
 - Zero chance of injuring lung
 - Harder (impossible in some patients)
- ▣ **B. Dissect through with hemostat**
 - Easier
 - Small chance of lung injury
- ▣ **In both cases need to put finger in and "sweep"**

Outcomes?

- ▣ **Rush of air Problem solved**
- ▣ **Rush of blood New problem answered**
- ▣ **Normal palpable lung Not the problem**
- ▣ **Liver or spleen too low or ruptured diaphragm**

Gottlieb et al. Bougie assisted thoracostomy American Journal of Emergency Medicine (2016)

- ▣ 2010 Beer described in sheep
- ▣ This study in fresh cadavers
 - 8 tubes 4 with bougie
 - 100% in chest cavity
 - Faster with bougie
 - Smaller incision

Conclusions

- ▣ **Angiocath is too short and not durable**
 - Not really designed for this job
 - Has very high failure rate
 - Failure rate goes up with BMI
 - Often get reoccurrence of Tension Pneumothorax
 - ▣ Kinks (again not designed for this)
 - ▣ Comes out (too short)
 - On the other hand chances if causing additional injury are very low.
 - May be should use different location Anterior or mid axillary line 4-5 ICS (but increases chance of injury)

Conclusions

- ▣ Other tube options are much better if going to stick to needle aspiration.
 - Designed for this job
 - Length is more appropriate
 - They are an Actual tube less kinking stay in better
 - Better connectors (3 way valve)
 - Best with indicator of entry into chest cavity
 - Don't push all the way in

Conclusion

- ▣ Thoracotomy for intubated or dead patients probably the highest success rate.
- ▣ If don't put in a tube appears almost as fast as needle
 - Requires training and extra equipment
 - Don't really know risks yet
 - Criteria are all important
 - Seems little reason in this group to put in the tube prehospital
 - Is important that you tell the receiving hospital you did this.

