



EM CASES SUMMARY

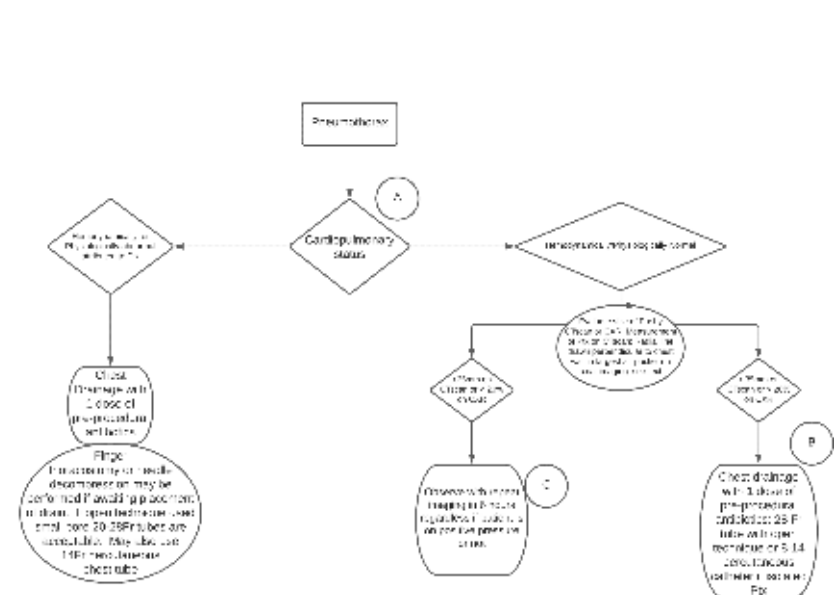
Episode 174 Traumatic Pneumothorax – Is Less More?

With Dr. Mathieu Toulouse

Prepared by Hanna Jalali September, 2022

Traumatic Pneumothorax Assessment and Management – Is Less More?

There is now very clear evidence that not all traumatic pneumothoraces require drainage. Tube thoracostomies are associated with complication rates of 10-30% and may cause significant pain to our patients which can impact rehabilitation.



Source: Western Trauma Association guidelines on management of pneumothorax

Which patients with a traumatic pneumothorax require tube thoracostomy?

The decision to place a chest tube is based on two questions:

1. What is the cardiopulmonary status? Stable vs. unstable.

If the patient is hemodynamically or physiologically abnormal as a direct result of the pneumothorax, then a chest tube should be placed. If the patient is unstable and you are not sure whether it is due to the pneumothorax, the safe approach is to place a chest tube. In the crashing patient finger thoracostomy or needle decompression should be considered while waiting for placement of the chest tube.

2. If stable, what is the pneumothorax size?

In general, the trauma literature suggests that smaller pneumothoraces have a better chance of observation success compared to larger ones.

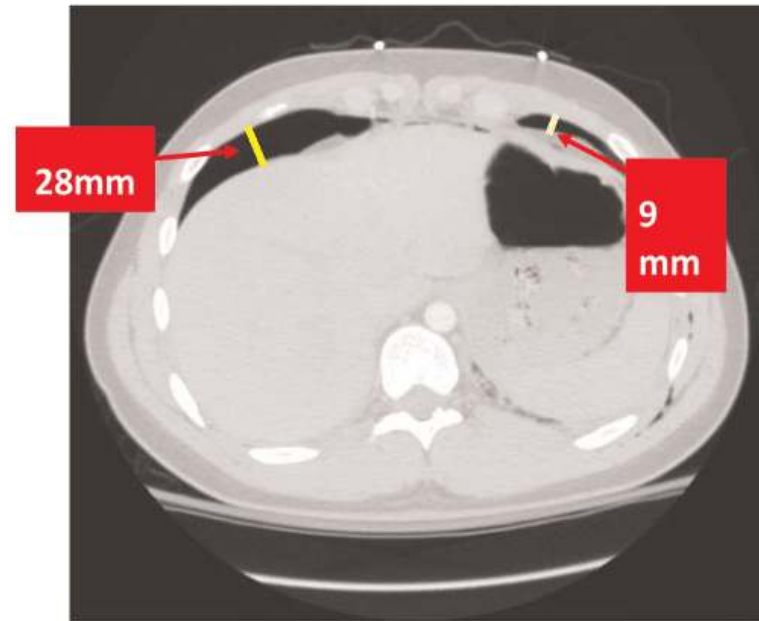
Western Trauma Association guideline suggestions for indications to place a chest tube for traumatic pneumothorax in the stable patient

On chest x-ray: >20% pneumothorax

Reminder: Percentage calculations are **not** sensitive in supine patients and upright PA chest x-rays should be used to calculate the size. If you observe a 20% pneumothorax on supine x-ray, then it is likely much larger, and a chest tube should be placed.

On CT scan: >35mm

Measurement: A line in the largest air pocket on axial imaging drawn perpendicular or radial to the chest wall.



Measurement of size of pneumothorax on CT scan – line in the largest air pocket on axial imaging drawn perpendicular or radial to the chest wall; source: Western Trauma Association pneumothorax guidelines

≤ 35mm traumatic pneumothorax on CT predicts a success rate of 90% with observation; >35mm predicts a failure rate of 40%.

Considerations in patients with pneumothorax who require positive pressure ventilation (PPV)

The OPTICC trial looked at *occult* pneumothorax to chest x-ray in ventilated patients with a composite outcome of respiratory distress and concluded that those patients who require short term PPV (ie. for OR) have no significant difference in outcomes. Patients who require prolonged PPV for greater than 4 days (ie. ICU with PPV) have a 40% failure rate and chest tube placement is recommended for these patients.

The decision to place a chest tube in a patient on PVV with a traumatic pneumothorax should ultimately be made in concordance with your team and the accepting service, as close observation to detect early progression to tension pneumothorax is necessary for patients with pneumothorax on PPV who do not have a chest tube in place.

Factors to take into consideration in the decision to place a chest tube in ventilated patients with traumatic pneumothorax include:

- Prolonged transport times
- Situations where close observation for progression to tension pneumothorax is not possible
- Mechanism of injury – *penetrating* trauma patients who are ventilated tend to have higher rates of observation failure compared to non-ventilated patients in the setting of occult pneumothorax

Chest tube size for traumatic pneumothorax – bigger is not better

In the past, larger chest tubes (28-36Fr) were generally used for traumatic pneumothoraces due to concern of occlusion with blood. Recently, however there has been a shift to using smaller catheters including 14Fr pigtail catheters based on small RCTs and observational studies.

The average distance between ribs is 9mm; larger chest tubes (28-Fr and up) have diameters >9mm. This may cause the chest tube to compress the neurovascular bundle and cause significant pain to the patient.

Although there are no large RCTs, most evidence suggests that small conventional chest tubes (ie. 20-Fr) and even 14-Fr pigtail catheters are equally as effective for drainage of traumatic pneumothorax when compared to larger chest tubes. Many centers are now using pigtail catheters which tend to impart less pain and allow for quicker rehabilitation compared to larger chest tubes. The Eastern Association for the Surgery of Trauma (EAST) has a conditional recommendation in favour of using a pigtail catheter and a survey completed by them suggested that in *stable* patients the majority of surgeons would choose 14-Fr pigtail catheter and another 20% would use conventional 20-Fr chest tube.

Does the presence of hemothorax necessitate placement of a chest tube?

A 2021 multicenter prospective RCT totalling 119 patients comparing 14Fr Pigtail catheters to 28-32Fr chest tubes for management of traumatic hemothorax (excluded patients who were in extremis and required emergent tube placement) looking at the failure rate, defined as a retained hemothorax requiring a second intervention, found that failure rate, was similar between the two groups (11% pigtail catheters vs. 13% large chest tubes).

Bottom line: as per the WTA algorithm use the smallest bore chest tube available, even when hemothorax is present, unless the patient with a hemothorax/hemopneumothorax is unstable

Clinical pearl: The average distance between ribs is 9mm; larger chest tubes (28-Fr and up) have diameters >9mm. This may cause the chest tube to compress the neurovascular bundle and cause significant pain to the patient.

Peri-procedural antibiotic use for traumatic pneumothorax – should antibiotics be given routinely when placing a chest tube?

There is currently largely heterogenous evidence with no clear conclusion as to whether or not antibiotics are indicated for peri-procedure chest tube placement. The main complications that antibiotics are meant to prevent are empyema and pneumonia that may result after chest tube insertion.

- An RCT from 2014 comparing 24 hours of cefazolin vs placebo in blunt trauma showed no difference in complication rates
- EAST states that there is insufficient evidence, and this will continue to be the case until there is a large multi-center RCT available
- AAST observational study: no significant difference in complications or ICU LOS in those that received antibiotics or not
- WTA recommends one dose of pre-procedural antibiotics based on a meta-analysis that concluded a significant difference, but the papers used within the meta-analysis were heterogenous
- The most recent meta-analysis (2021) showed a significant difference in complication rates for *penetrating* trauma but *not* blunt trauma; in the context of a dirty open wound, antibiotics are likely to have more benefit.

Bottom line: Prioritize other lifesaving and proven outcome-changing interventions over administration of antibiotics, as currently no clear evidence for benefit exists. In the setting of penetrating trauma, consider that antibiotics may be more likely to be beneficial. Further evidence is required to determine the effect on antimicrobial stewardship and number needed to treat.

Take home points for traumatic pneumothorax assessment and management

- **Unstable** due to pneumothorax? Place **chest tube** for drainage of pneumothorax.
 - Finger thoracostomy or needle decompression can be performed while waiting for chest tube placement.
 - Consider 1 dose of pre-procedural antibiotics, especially in penetrating trauma, but this is low priority.
 - Place the smallest bore chest tube available unless there is a significant hemothorax present
- **Stable?** Consider the **size** of the pneumothorax:
 - If a radial line perpendicular to chest wall on axial imaging is $\leq 35\text{mm}$ on CT or $\leq 20\%$ on upright CXR, observe with repeat imaging in 6 hours regardless of need for PPV. Otherwise, place a small chest tube, 20Fr or 14Fr Pigtail catheter, even if a hemothorax is present.

References

1. de Moya, M., Brasel, K., Brown, C., Hartwell, J., Inaba, K., Ley, E., Moore, E., Peck, K., Rizzo, A., Rosen, N., Sperry, J., Weinberg, J. & Martin, M. (2022). Evaluation and management of traumatic pneumothorax: A Western Trauma Association critical decisions algorithm. *Journal of Trauma and Acute Care Surgery*, 92(1), 103-107.
2. Bou Zein Eddine, S., Boyle, K. A., Dodgion, C. M., Davis, C. S., Webb, T. P., Juern, J. S., Milia, D. J., Carver, T. W., Beckman, M. A., Codner, P. A., Trevino, C., & de Moya, M. A. (2019). Observing pneumothoraces: The 35-millimeter rule is safe for both

- blunt and penetrating chest trauma. *The journal of trauma and acute care surgery*, 86(4), 557-564.
3. Clements, T. W., Sirois, M., Parry, N., Roberts, D. J., Trotter, V., Rizoli, S., Ball, C. G., Xiao, Z. J., & Kirkpatrick, A. W. (2021). OPTICC: A multicentre trial of Occult Pneumothoraces subjected to mechanical ventilation: The final report. *American journal of surgery*, 221(6), 1252-1258.
 4. Kulvatunyou N, Bauman ZM, Zein Edine SB, de Moya M, Krause C, Mukherjee K, Gries L, Tang AL, Joseph B, Rhee P. The small (14 Fr) percutaneous catheter (P-CAT) versus large (28-32 Fr) open chest tube for traumatic hemothorax: A multicenter randomized clinical trial. *J Trauma Acute Care Surg*. 2021 Nov 1;91(5):809-813.
 5. Kulvatunyou, N., Erickson, L., Vijayasekaran, A., Gries, L., Joseph, B., Friese, R. F., O'Keeffe, T., Tang, A. L., Wynne, J. L., & Rhee, P. (2014). Randomized clinical trial of pigtail catheter versus chest tube in injured patients with uncomplicated traumatic pneumothorax. *The British journal of surgery*, 101(2), 17-22.
 6. Beattie, Genna MD; Cohan, Caitlin M. MD; Tang, Annie MD; Chen, Joshua Y. BS; Victorino, Gregory P. MD, FACS. Observational management of penetrating occult pneumothoraces: Outcomes and risk factors for interval tube thoracostomy placement. *Journal of Trauma and Acute Care Surgery*: January 2022 - Volume 92 - Issue 1 - p 177-184 doi: 10.1097/TA.0000000000003415
 7. Parker, M. H., Newcomb, A. B., Liu, C., & Michetti, C. P. (2019). Chest Tube Management Practices by Trauma Surgeons. *The Journal of surgical research*, 244, 225-230.
 8. Heydari, M. B., Hessami, M. A., Setayeshi, K., & Sajadifar, F. (2014). Use of prophylactic antibiotics following tube thoracostomy for blunt chest trauma in the prevention of empyema and pneumonia. *Journal of injury & violence research*, 6(2), 91-92.
 9. Cook, A., Hu, C., Ward, J., Schultz, S., Moore Iii, F. O., Funk, G., Juern, J., Turay, D., Ahmad, S., Pieri, P., Allen, S., Berne, J., & AAST Antibiotics in Tube Thoracostomy Study Group (2019). Presumptive antibiotics in tube thoracostomy for traumatic hemopneumothorax: a prospective, Multicenter American Association for the Surgery of Trauma Study. *Trauma surgery & acute care open*, 4(1), e000356.
 10. Ayoub, F., Quirke, M., & Frith, D. (2019). Use of prophylactic antibiotic in preventing complications for blunt and penetrating chest trauma requiring chest drain insertion: a systematic review and meta-analysis. *Trauma surgery & acute care open*, 4(1), e000246.
 11. Elnahla, A., Iuliucci, K. R., Toraih, E., Duchesne, J. C., Nichols, R. L., & Kandil, E. (2021). The efficacy of the use of presumptive antibiotics in tube thoracostomy in thoracic trauma-results of a meta-analysis. *American journal of surgery*, 222(5), 1017-1022.