Chris Chase, MD

Needle Thoracostomy for Tension Pneumothorax

Tension pneumothorax is a potentially deadly complication of traumas that requires emergent decompression intervention. Classically, this is primarily managed with needle thoracostomy in the mid-clavicular line (MCL) in the 2nd intercostal space (ICS), just above the 3rd rib to prevent neurovascular injury with a 14 or 16 gauge needle. Definitive management for traumatic pneumothorax is then a chest tube placement. Needle thoracostomy has shown high failure rates of up to 40% with this management, thought likely due to inadequate needle depth. Recent discussions while I was on the trauma service have prompted me to examine data on whether the site of needle thoracostomy may begin to incorporate the anterior axillary line (AAL) in the 5th ICS and determine what catheter length is adequate to enter the pleural space from each of these locations.

A tension pneumothorax occurs when there is a build-up of pressure in the pleural space secondary to air being able to leak into the pleural space (commonly due to trauma) but not return. This "one-way-valve" creates increased pressure in the pleural space causing mediastinal shift and impaired venous return to the heart. The common signs of a tension pneumothorax include **deviation of the trachea, hyper-expanded chest, distant unilateral lung sounds, tachycardia, tachypnea, hypoxia, and hypotension**. This can lead to cardiovascular collapse and traumatic arrest with PEA if not decompressed emergently.

Advanced trauma life support guidelines support needle decompression in the 2nd ICS in the MCL using a 4.5 cm catheter (5 cm needle). Many studies, however, have found high failure rates of up to 40% using this technique. **Inadequate catheter depth** is the primary reason of why needle decompression for tension pneumothorax fails so often. One retrospective review of trauma patients (average BMI of 26) that had obtained CT scans measured the chest wall thickness (CWT) at the 2nd ICS/MCL. The results of 201 patients showed that the average chest wall thickness was 4.08 cm and 29% of the cohort had a CWT greater than 4.5 cm at this space. BMI was positively associated with chest wall thickness. **As the BMI of our patient population continues to increase, this supports that a catheter with a length of 4.5 cm will often be inadequate for needle thoracostomy**. Another retrospective review of 604 male and 170 female trauma patients, done in Canada in 2008, found that the CWT averaged 3.50 cm at the 2nd intercostal space. Women were found to have a larger CWT (24.1-35.4% had >4.5 cm) than men (9.9-19.3% had >4.5 cm). These results further implicate that larger catheters may be necessary to adequately decompress tension pneumothoraces in a large amount of the trauma population that we see.

Many have proposed that the anterior axillary line in the 5th intercostal space is an alternative site for needle decompression that may provide for more successful thoracostomy. One study evaluated CWT of trauma patients in different BMI quartiles at both the 2nd ICS in MCL and 5th ICS in AAL. It was found that there was a 1.4 cm difference in thickness between the two, with the AAL being thinner. It also demonstrated that 42.5% of patients had a CWT greater than the standard 5-cm decompression needle at the second ICS in the MCL, whereas only 16.76% exceeded this at the fifth ICS in the AAL. This information may prove to be useful and improve

success rates in needle thoracostomy. I believe that this information would impact my practice and that I would think more to perform a needle thoracostomy in the **anterior axillary line in the 5th intercostal space**, especially in patients with high BMIs where mid-clavicular line thoracostomy would be difficult. It is also important to note that if this procedure is to be performed than choosing a catheter with adequate length (> 5 cm) is crucial for successful placement in many patients.

References/Further Reading

1. Inaba, Kenji, Crystal Ives, Kelsey McClure, Bernardino C. Branco, Marc Eckstein, David Shatz, Matthew J. Martin, Sravanthi Reddy, and Demetrios Demetriades. "Radiologic Evaluation of Alternative Sites for Needle Decompression of Tension Pneumothorax." Archives of Surgery, 2012. Web. 7 May 2015
2. Schroeder, Elizabeth; Valdez, Carrie; Krauthamer, Andres; Khati, Nadia; Rasmus, Jessica; Amdur, Richard; Brindle, Kathleen; Sarani, Babak, 2013: "Average chest wall thickness at two anatomic locations in trauma patients". Injury 44(9): 1183-1185
3. "Chest Trauma Pneumothorax-Tension." TRAUMA.ORG: Thoracic Trauma. N.p., Feb. 2004. Web. 07 May 2015.
4. Zengerink, I (01/2008). "Needle thoracostomy in the treatment of a tension pneumothorax in trauma patients: what size needle?". Journal of trauma: injury, infection, and critical care (0022-5282), 64 (1), 11
5. http://pubmed.org/pubmed/25857267