Tension Pneumothorax

Finding a safer, more effective way forward

Tension Pneumothorax is a known life-threatening condition that requires prompt treatment. Needle decompression is an established, life-saving procedure supported by evidence. With this in mind, we suggest you read this brief introductory review, consider procedural modifications, and carefully look at an entirely redesigned needle set.

Signs and Symptoms

There are multiple reasons to suspect a tension pneumothorax. Published and anecdotal evidence suggests that we should simplify and improve our list of suspicions.

These now include:

- Severe or progressive respiratory distress.
- Severe or progressive tachypnea.
- Absent or markedly decreased breath sounds.
- Oxygen saturation that is less than 90%.
- Shock.
- Traumatic cardiac arrest without obvious fatal wounds (at which point, you should consider placement of bilateral decompression needles with consideration for ALL other possible causes).

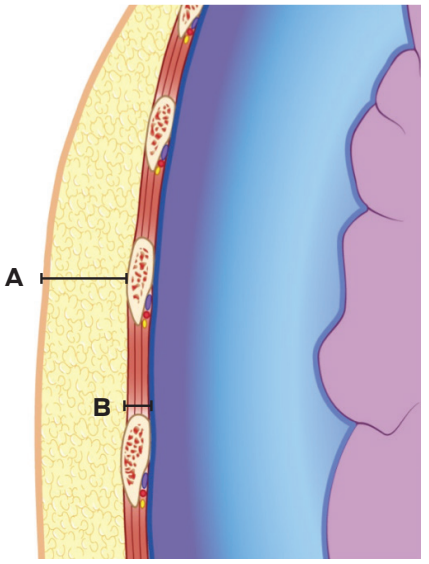


Fig. 1

Tension pneumothorax realities

(fig.1) It's about depth

A = Skin to rib depth (a highly variable distance)
Averages 5.36 cm (2.11")

B = Rib to Parietal Pleura depth (a relatively variable distance)
Averages 0.5 cm (0.2")

On average A + B = 5.86 cm (2.31")

How does this add up?

Needle sets come in various lengths. So, let's consider how length affects thoracic decompression.

Having a 3.25" (8.26 cm) catheter means that the system only has 0.94" or 2.4 cm of usable catheter in the thoracic cavity.

Having a 3.75" (9.52 cm) catheter means the system has 1.44" or (3.66 cm) of usable catheter in the chest.

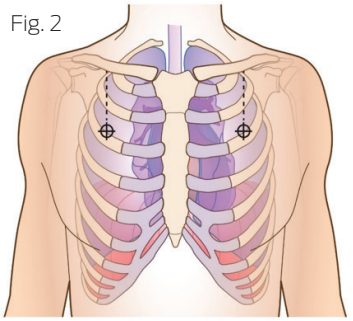
This 0.5" (1.26 cm) difference is critical when trying to prevent the redevelopment of intrathoracic pressure.

The numbers and illustration above equate to a serious set of questions that require an answer. 1. Do you have the needle set length to reach the patient's problem? 2. If you can reach the problem, do you have the catheter length to sustain decompression during patient care? Remember, we are simply illustrating "averages." More specifically stated, these averages might not represent your next patient.

Location. Location. Location.

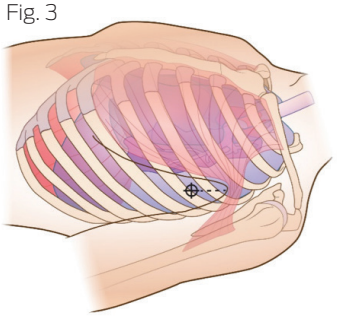
There are four sites for thoracic needle decompression with reasonable anatomic justification. However, you must be aware that this procedure is not without risk of injury to underlying structures.

Fig. 2



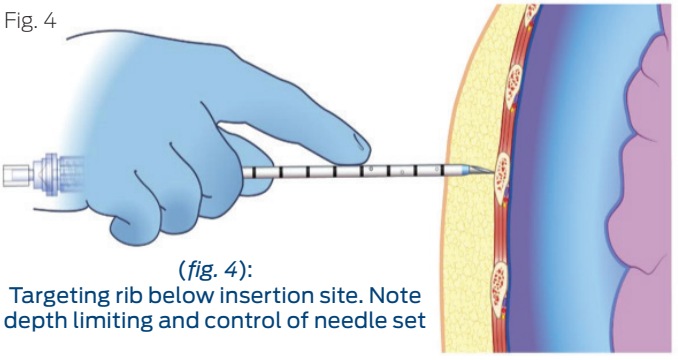
Two anterior sites
(*fig. 2*):
2nd intercostal space,
mid-clavicular line

Fig. 3



Two lateral sites
(*fig. 3*):
4th or 5th intercostal space,
anterior axillary line

Fig. 4



(*fig. 4*):
Targeting rib below insertion site. Note depth limiting and control of needle set

Procedural points

After appropriately cleansing insertion site, you should insert the needle set through the various tissues (which can be challenging, depending on skin thickness and depth of adipose tissue). The needle set should be advanced by initially targeting the rib BELOW the intended intercostal space (fig.4). By targeting the rib, you can control depth and avoid secondary (or explosive) thoracic injuries. Once

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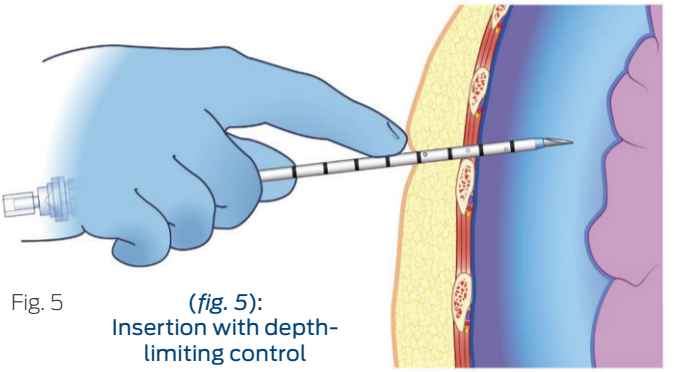


Fig. 5 (*fig. 5*): Insertion with depth-limiting control

the needle tip is on the rib, you should stabilize the needle set in such a way that insertion depth is controlled (and over-penetration is unlikely). Initial placement depth should be approximately 3 cm beyond exterior of targeted rib (fig.5, but more realistically, should not extend much beyond the pleural "pop or give," which can often be appreciated upon entry into the thoracic cavity). **There are published papers and case reports suggesting that thoracic decompression SHOULD NOT be achieved by blindly inserting the entire needle set into the chest cavity** (*regardless of length or site selected*).

Once performed correctly (fig. 6), thoracic decompression should improve one or more of the following:

- Reduced respiratory distress.
- Relief of restrictive pressure between the parietal and visceral pleura (*which was secondary to injury or a significant medical complication*).
- Increase in oxygen saturation ≥ 90% (*which may be dependent on use of supplemental oxygen*).
- Return of radial pulse or vital signs.

(*fig. 6*): 10-gauge catheter with one-way valve in thoracic cavity

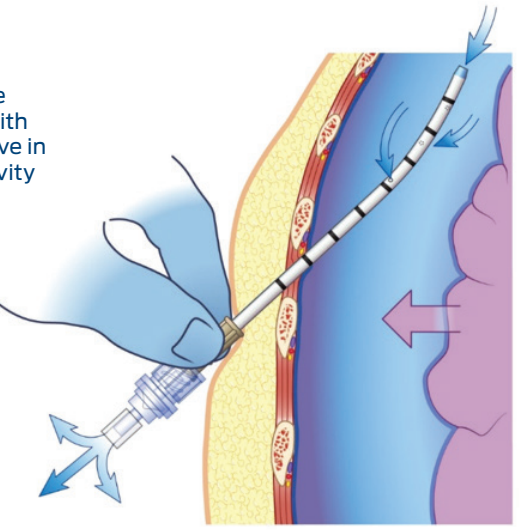


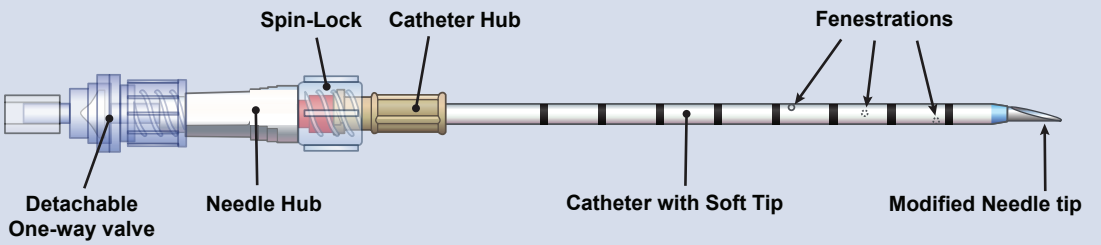
Fig. 6

While this is a life-saving procedure, it does present risk. Following decompression, you should assess the patient for complications. These would include:

- Hemodynamic instability
- Respiratory distress
- Unilateral chest expansion
- Decreased oxygen saturation
- Bleeding
- Catheter occlusion
- Hematoma

New evidence suggests that if two needle decompression attempts fail to relieve the suspected problem, you should consider other causes and treatments. This is a critical understanding that mandates your reliable skill set and properly designed decompression needle system.

With continuous skills refinement and scientifically based considerations, risk can be mitigated. ■



A modern thoracic decompression system should meet (*and where evidence supports, exceed*) clinical suggestions for tension pneumothorax management. Today's needle set should have several important attributes (*or you should have methods to mitigate your systems short-falls*). **1.** It should be supplied in a robust package (*or secured in such a way that it maintains sterility in difficult environments*). **2.** It should have an enhanced needle tip that specifically aids insertion through various types of tissue (*or you should have a scalpel to assist in placement*). **3.** Supportive evidence suggests that the catheter should be centimeter-marked (*for placement control*), 10-gauge with fenestrations (*which is less likely to become obstructed, and can improve air-release by as much as 300% when compared to a standard 14-gauge catheter*), it should be flexible (*to resist kinking*), and soft tipped (*to avoid secondary pleural injury*), **4.** It should have a slip-lock (*or you need a procedural mechanism*) to prevent the needle and catheter from prematurely separating during insertion (*a documented problem*). **5.** The catheter should have a one-way valve (*for prolonged management*), and (*importantly*) it should be long enough to remain in the thoracic cavity during all phases of care.

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