Sufficient Catheter Length For Pneumothorax Needle Decompression: A Meta-Analysis

Brian Clemency DO, MBA, FACEP
EMS Fellowship Director
University at Buffalo

Christopher T. Tanski, MD, MSEd
State University of New York Upstate Medical University

Michael Rosenberg, EMT-P
University at Buffalo

Paul R. May, MA
University at Buffalo

Joseph D. Consiglio, PhD
John Carroll University

Heather A. Lindstrom, PhD
University at Buffalo

Conflicts:
I will be at the trade show later looking for conflicts of interests,
But as of now I have none.
Background

- Tension PTX is a life threatening condition that requires immediate intervention
- It occurs in 0.2–1.7% of prehospital trauma cases and is a well established cause of preventable mortality in chest injury patients.
- Due to anatomic differences, the chest wall thickness that must be traversed by the catheter is variable.

Background

- The most common site for needle chest decompression is the second intercostal space, mid-clavicular line.
- A decompression needle must be long enough to transverse the chest wall at the procedural site.

Objective

- We sought to determine the minimum catheter length needed for procedural success on a percentile basis by performing a meta-analysis of existing studies.
- Specifically, what size needle is needed to decompress 95% of the population?
- A secondary goal was to get people to stop doing retrospective CT studies for this questions.
Methods

- Medline and Pubmed searches were performed using the following search terms:
  - needle decompression
  - needle thoracentesis
  - chest decompression
  - pneumothorax decompression
  - needle thoracostomy
  - tension pneumothorax

Methods

- Studies were included if they measured chest wall thicknesses at the second intercostal space midclavicular line and published:
  - a sample size (of at least 20)
  - mean chest wall thickness
  - standard deviation or confidence interval.

Methods

- Abstracts of all studies were reviewed by two reviewers
- Studies that appeared to meet the criteria were referred for full manuscript review by both reviewers.
- Conflicts among reviewers was settled over beer and arm wrestling.
The Math

- Standard deviations were calculated for all studies that did not specifically publish one
- Normal Distribution was assumed for all studies
- Cumulative data was obtained

The Data

- Standard deviations were calculated for all studies that did not specifically publish one
- Normal Distribution was assumed for all studies
- Cumulative data was obtained
The Math

\[ SD = \sqrt{\frac{n(U - L)}{2(1.96)}} \]

\[ x_{\text{pooled}} = \frac{\sum_{i=1}^{k} n_i \bar{x}_i}{\sum_{i=1}^{k} n_i} \]

\[ SD_{\text{pooled}} = \sqrt{\frac{\sum_{i=1}^{k} (n_i - 1)SD_i^2}{\sum_{i=1}^{k} n_i}} = \gamma \]

PRISMA Flow Chart

Included Studies
Included Studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owens ML et al.</td>
<td>2004</td>
<td>4.24</td>
<td>1.51</td>
</tr>
<tr>
<td>Hecce HT et al.</td>
<td>2007</td>
<td>5.36</td>
<td>1.19</td>
</tr>
<tr>
<td>Zengeski K et al.</td>
<td>2008</td>
<td>3.50</td>
<td>1.04</td>
</tr>
<tr>
<td>Stevans RL et al.</td>
<td>2009</td>
<td>4.39</td>
<td>1.45</td>
</tr>
<tr>
<td>Sanchez LB et al.</td>
<td>2011</td>
<td>4.58</td>
<td>1.26</td>
</tr>
<tr>
<td>McLain AR et al.</td>
<td>2011</td>
<td>2.17</td>
<td>0.73</td>
</tr>
<tr>
<td>Yamagishi T et al.</td>
<td>2012</td>
<td>3.06</td>
<td>1.02</td>
</tr>
<tr>
<td>Insh J et al.</td>
<td>2012</td>
<td>4.56</td>
<td>1.43</td>
</tr>
<tr>
<td>Alougu H et al.</td>
<td>2013</td>
<td>4.01</td>
<td>1.44</td>
</tr>
<tr>
<td>Schneider J et al.</td>
<td>2013</td>
<td>4.08</td>
<td>1.36</td>
</tr>
<tr>
<td>Carter TE et al.</td>
<td>2013</td>
<td>4.69</td>
<td>2.07</td>
</tr>
<tr>
<td>Powers RF et al.</td>
<td>2014</td>
<td>6.25</td>
<td>1.90</td>
</tr>
<tr>
<td>Chang Su et al.</td>
<td>2014</td>
<td>4.51</td>
<td>1.47</td>
</tr>
<tr>
<td>Summary</td>
<td></td>
<td>4.19</td>
<td>1.37</td>
</tr>
</tbody>
</table>

Results

Pooled Statistics

<table>
<thead>
<tr>
<th></th>
<th>Weighted</th>
<th>Unweighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>2,558</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.19 cm</td>
<td>4.25 cm</td>
</tr>
<tr>
<td>SD</td>
<td>1.37</td>
<td>1.38</td>
</tr>
</tbody>
</table>
Conclusion:
Friends don’t let friends decompress with standard angiocaths.