What the evidence shows: Finger Thoracostomy Vs Chest Tube Insertion Vs Needle Decompression

Cynthia Griffin D.O., EMT-P
University of Wisconsin MedFlight Fellow 2014
April 21, 2015
Objectives

• Review a quick history of trauma chest decompression
• Review the procedure, pathophysiology, & complications that can occur with needle thoracostomy (NT) while reviewing the literature
• Discuss if NT mandates tube thoracostomy (TT)
• Review the prehospital literature on NT vs TT
• Review the simple thoracostomy (ST) procedure and the literature behind this
• Discussion and Questions
Pleural decompression and drainage during trauma reception and resuscitation

M. Fitzgerald a,c,* , C.F. Mackenzie b, S. Marasco d, R. Hoyle e, T. Kossmann c,f

a Emergency & Trauma Centre, The Alfred Hospital, Melbourne, Australia
b The National Study Center for Trauma and Emergency Medical Systems and Department of Anesthesiology, University of Maryland School of Medicine, Baltimore, USA
c National Trauma Research Institute, Melbourne, Australia
d Department of Cardiothoracic Surgery, The Alfred Hospital, Melbourne, Australia
e Emergency Department, Casey Hospital, Berwick, Australia
f Department of Trauma Surgery, The Alfred Hospital, Melbourne, Australia

Accepted 23 July 2007

Table 1 Key points for pleural decompression in trauma

Needle decompression should only be used a technique of last resort
Digital decompression is the essential first step
Chest tube insertion is a secondary priority
Complications will be reduced with aseptic technique, avoidance of trocars, digital exploration of the insertion site and guidance of the tube during insertion
Possible Positions of Needle Thoracocentesis

Ultrasound determination of chest wall thickness: implications for needle thoracostomy

A. Robb McLean MD⁴, Michael E. Richards MD⁴, Cameron S. Crandall MD⁴, Jonathan L. Marinaro MD⁵

⁴Department of Emergency Medicine, MSC10 5560, University of New Mexico, Albuquerque, NM 87131-0001, USA
⁵Department of Surgery, MSC10 5560, University of New Mexico, Albuquerque, NM 87131-0001

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Table 1 Comparison of male and female subjects

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.75</td>
<td>1.73-1.78</td>
<td>1.67</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>85.6</td>
<td>79.57-91.62</td>
<td>83.18</td>
</tr>
<tr>
<td>Chest circumference (cm)</td>
<td>42.61</td>
<td>41.12-44.09</td>
<td>41.63</td>
</tr>
<tr>
<td>BMI</td>
<td>27.69</td>
<td>26.14-29.25</td>
<td>30</td>
</tr>
<tr>
<td>Anterior CWT (cm)</td>
<td>2.09</td>
<td>1.91-2.26</td>
<td>2.26</td>
</tr>
<tr>
<td>Lateral CWT (cm)</td>
<td>2.36</td>
<td>2.1-2.61</td>
<td>2.47</td>
</tr>
</tbody>
</table>
Difficult needle decompression of bilateral tension pneumothoraces in an obese female patient

N=1

Needle Thoracostomy for Tension Pneumothorax:
Failure Predicted by Chest Computed Tomography

Robert L. Stevens, MD, Angel A. Rochester, MD, Jonathan Busko, MD, Thomas Blackwell, MD, Daniel Schwartz, MD, Anne Argenta, BS, Ronald F. Sing, DO

N=110

Needle Thoracostomy: Implications of Computed Tomography Chest Wall Thickness

Melissa L. Givens, MD, Karen Ayotte, MD, Craig Manifold, DO

N=111
Needle Decompression for Tension Pneumothorax in Tactical Combat Casualty Care: Do Catheters Placed in the Midaxillary Line Kink More Often Than Those in the Midclavicular Line?

Andrew Beckett, MD, Erin Savage, MD, Dylan Pannell, MD, Sanjay Acharya, MD, Andy Kirkpatrick, MD, and Homer C. Tien, MD

The Journal of TRAUMA® Injury, Infection, and Critical Care

Volume 71, Number 5, November Supplement 1, 2011
Possible Positions of Needle Thoracocentesis
The right place in the right space? Awareness of site for needle thoracocentesis

E P Ferrie, N Collum, S McGovem


Emerg Med J (2005);22:788

N=25
Prehospital Decompression for Suspected Tension Pneumothorax

Holly Herron, RN, MSN,¹ and Robert E. Falcone, MD, FACS²

Table 5
Indications for Needle Decompression

- Decreased breath sounds: 65
- Difficulty ventilating: 42
- Jugular venous distention: 2
- Tracheal shift: 2
- Isolated arrest: 2

= 71 patients, some patients had more than one indication for decompression

Table 8
Accuracy of Diagnostic Signs in Patients with Vital Signs*

<table>
<thead>
<tr>
<th></th>
<th>Decreased Breath Sounds</th>
<th>Hard to Vent</th>
<th>JVD</th>
<th>Tracheal Shift</th>
<th>Decreased BS Hard to Vent</th>
<th>Decreased BS Tracheal Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>95.1%</td>
<td>67.5%</td>
<td>5%</td>
<td>2.4%</td>
<td>70.3%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Specificity</td>
<td>12.9%</td>
<td>57.1%</td>
<td>96%</td>
<td>100.0%</td>
<td>44.4%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>59.1%</td>
<td>64.2%</td>
<td>66.6%</td>
<td>100.0%</td>
<td>63.4%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Accuracy</td>
<td>59.7%</td>
<td>60.6%</td>
<td>45.1%</td>
<td>43.7%</td>
<td>59.7%</td>
<td>43.7%</td>
</tr>
</tbody>
</table>

*n = 41 patients; VENT = ventilates; JVD = jugular venous distention; BS = breath sounds

Table 6
Improvement Post Decompression

- Ventilated more easily: 38
- Improved breath sounds: 24
- Improved blood pressure: 13
- Improved oxygen saturation: 2

= 71 patients, some patients improved in more than one parameter

Table 9
Accuracy of Diagnostic Signs in Patients in Cardiorespiratory Arrest*

<table>
<thead>
<tr>
<th></th>
<th>Decreased Breath Sounds</th>
<th>Hard to Vent</th>
<th>Decreased BS with Hard to Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>94.7%</td>
<td>63.2%</td>
<td>63.2%</td>
</tr>
<tr>
<td>Specificity</td>
<td>15.0%</td>
<td>50.0%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>51.4%</td>
<td>54.5%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Accuracy</td>
<td>53.8%</td>
<td>☀ 56.4%</td>
<td>54.1%</td>
</tr>
</tbody>
</table>

*n = 40 patients; BS = breath sounds

Table 7
Mortality

- Dead on arrival: 49
- Head injury: 6
- Exsanguination: 1
- Arrested in emergency department: 2

N=75
Needle Thoracostomy in the Prehospital Setting
Marc Eckstein, MD, Deborah Suyehara, RN, MSN

“Generally safe and rapid procedure”

PREHOSPITAL EMERGENCY CARE 1998;2:132–135

Table 1. Frequency of Clinical Findings among Patients Who Received Prehospital Needle Thoracostomy*

<table>
<thead>
<tr>
<th></th>
<th>Dec/Abs BS</th>
<th>BP&lt;90</th>
<th>ALOC</th>
<th>JVD</th>
<th>SQ Air</th>
<th>Dev Trach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>108 (100%)</td>
<td>93 (86%)</td>
<td>69 (64%)</td>
<td>7 (6%)</td>
<td>5 (5%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

*Dec/Abs BS = decreased or absent breath sounds; BP<90 = systolic blood pressure < 90 mm Hg; ALOC = altered level of consciousness; JVD = jugular venous distention; SQ Air = subcutaneous air; Dev Trach = deviated trachea.
“Judicious decompression prior to definitive care in the ED is a potentially life saving maneuver in the paramedics armamentarium”
Now, let's take a look at Chest Tubes...

Bilateral False-Positive Tube Thoracostomy in Helicopter Emergency Medical Service

To the Editors:

Procedural checks to confirm chest tube positions are performed to provide safety and functionality of tube thoracostomy (TT). This may particularly be important in emergency situations when time-sensitive patient conditions and environmental circumstances may impede intervention success.

We report a 32-year-old man who was trapped by a leading snap sustaining blunt thoracic trauma. He presented with venous congestion and dyspnea suspect of a pneumothorax. The physician-staffed helicopter emergency medical service team performed tracheal intubation and bilateral TT, each by the lateral approach using blunt dissection. Mechanical ventilation, oxygenation, and circulation appeared normal. After admission to the emergency department, a computed tomographic scan revealed pneumothorax and both chest tubes in extrapleural positions (Fig. 1A and B). Consequently, misplaced tubes were removed, and another TT was performed. Further course was uneventful, and written informed consent to publish the computed tomographic scans was obtained from the patient.

As an emergency procedure, TT requires training and experience. It contains the risk of severe complications including trauma to the intercostal neurovascular bundle; extrapleural, intrathoracic, and intrapulmonary placement; mediastinal impingement or penetration; transdiaphragmatic placement; and infection. However, in the literature, reports of extrapleural misplacements of TT are rare. Although our case was not associated with an adverse outcome, it should be kept in mind that any misplacement of TT has the potential for fatal consequences. A false-positive TT position should be considered if there is deterioration in a patient’s condition during emergency medical service transport, general anesthesia, and intensive care treatment.

References

2. Salamone MR, Marshfield FJ, Children's Hospital Boston, Massachusetts, USA.

Manuel Florian Struck, MD, Nadine Leclair, MD, and Hermann Wrigge, MD, PhD, Leipzig, Germany

1067-991X/$36.00
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http://dx.doi.org/10.1016/j.amj.2014.09.006
Is routine tube thoracostomy necessary after prehospital needle decompression for tension pneumothorax?

Kathleen M. Dominguez, M.D., A. Peter Ekeh, M.D., M.P.H., Kathryn M. Tchorz, M.D., Randy J. Woods, M.D., Mbaga S. Walusimbi, M.D., Jonathan M. Saxe, M.D., Mary C. McCarthy, M.D.*

Department of Surgery, Wright State University Boonshoft School of Medicine and the Miami Valley Hospital Trauma Service, One Wyoming Street, Suite 7800, Dayton, OH 45409, USA

“78% w neg CXR initially s/p NT developed PTX of which 2 were tPTX”
“The laws of physics dictate that the clinician should consider PTX expansion as a risk assoc. w intratransport ascent and decreasing ambient pressure”
“With proper technique we consider pre-hospital TT to be a safe technique for the Rx of suspected tPTX w/out increased risk of iatrogenic injury.”
“There was no significant difference in the rate of malposition in the on scene vs in hospital placed chest tubes”
“NT generally safe and rapid rx for tPTX in field TT should be adjunctive if NT fails & can be performed w out complications or worsening outcomes”

“TT was associated with less DOA, than NT”

N=106 TT, 169 NT
Aeromedical crews appear to appropriately select MTVs to undergo field NT or TT.
“Swine model of thoracic insufflation showed NT w High failure rate for relief of tension physiology & for Rx of the tPTX induced PEA which was due to both mechanical failure & inadequate evacuation.”
“Prehospital use of TT by qualified professionals does not introduce additional risks of complications compared w/in Hosp therefore is a lifesaving & valuable addition to prehospital care.”
• TT on scene vs ED

• “There appeared to be no differences between chest tubes inserted in the emergency room or at the scene”

• Beware of the complications with TT ~13
Simple Thoracostomy Avoids Chest Drain Insertion in Prehospital Trauma

Deakin, C. D. MA, MRCP, FRCA; Davies, G. MRCP; Wilson, A. FRCS

Author Information
Address for reprints: Dr. C. D. Deakin, MA, MRCP, FRCA, Shackleton Department of Anaesthetics, Tremona Road, Southampton S016 6YD, England.
Simple thoracostomy in prehospital trauma management is safe and effective: a 2-year experience by helicopter emergency medical crews

Daniele Massarutti a, Giulio Trillon a, Giorgio Berlot a, Ariella Tomasini a, Barbara Bacer b, Loris D’Orlando a, Marino Viviani a, Adriano Rinaldi a, Alberto Babuin a, Lorenzo Burato a and Elio Carchietti a

“Demonstrated ST to be a safe & effective method of chest drainage without major complications or infections related to field thoracostomy. Moreover, no recurrent tension PNX occurred”
Simple Thoracostomy: Moving Beyond Needle Decompression in Traumatic Cardiac Arrest

Andrew Karrer, LP | Brett J. Monroe, MD | Guy R. Gleisberg, MBA, BSEE, NREMT-B, EMS-I | Jared Cosper, BS, LP | Kasia Kimmel, MD | Mark E.A. Escott, MD, MPH, FACEP | From the April 2014 Issue | Friday, March 28, 2014
"Finger Thoracostomy" 10-30-2013

Scott Weingart MD, FACEP

blog.emcrit.org

MAKING THINGS HAPPEN
Summary of Recommendations

• Not all rushes of air means NT is successful.
• NT has limitations although may be used as a temporizing measure.
• Decompression with breaching the pleural space is definitive treatment for tPTX.
• Giving them the finger with ST has data supporting this as effective and safe.
References


Fuld H. Simple device for control of tension pneumothorax. BMJ. 1944;2:503.3


download.springer.com/static/pdf/222/art%253A10.1007%252Fs00134-014-3434-1.pdf?auth66=1425310437_db07b031374ad1de2ee348ad76bab12e&ext=.pdf

Waydhas C, Sauerland S. Prehospital Decompression for Suspected Tension Pneumothorax, Resuscitation 2007, Jan;72 (1) 11-25 Epub 2006 Nov 22. PMID: 17118508


Martin M., Satterly S., Inaba K., Blair K. Does Needle Thoracostomy provide adequate and effective decompression of tension pneumothorax? Journal of Trauma Acute Care Surgery 2012


Waydhas C, Sauerland S. Pre-Hospital pleural decompression and chest tube placement after blunt trauma: a systematic review. Resuscitation 2006


Weingart S. "Finger Thoracostomy Podcast" emcrit.org 10-30-2013
For latest revision...

@CMGrffn

Dr. Cynthia M. Griffin DO
Mobile: (919) 417-3452

CMGriffin@Medicine.wisc.edu
CynthiaMGriffin@gmail.com
UW MedFlight Fellow 2014

Flight Physician
VCU-MCV, VCOM, VT EM Residency Trained
Emergency Physician
NREMT-Paramedic
NVG Current

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