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FOR: JONATHAN WOODSON, M.D., ASSISTANT SECRETARY OF DEFENSE (HEALTH AFFAIRS)

SUBJECT: Needle Decompression of Tension Pneumothorax Tactical Combat Casualty Care Guideline Recommendations 2012-05

EXECUTIVE SUMMARY

The Defense Health Board (DHB) submitted a report to the Assistant Secretary of Defense (Health Affairs) (ASD(HA)) on October 11, 2011 recommending changes to the TCCC Guidelines pertaining to tension pneumothorax (TP). The Board recommended that the Department of Defense (DoD) amend the TCCC Guidelines to include performing bilateral needle decompression (ND) at the second intercostal space (ICS) along the midclavicular line (MCL) for any casualty in cardiorespiratory arrest with known or suspected torso trauma.

Case report findings and feedback from the field highlight a lack of consensus surrounding ND techniques, including reported failure rates for ND. Inadequate needle length, improper technique, and muscle mass of casualties may be contributing to high ND failure rates, emphasizing the need to consider alternative ND techniques. As such, the Board is issuing this updated report, which includes utilizing the fourth or fifth ICS along the anterior axillary line (AAL) as an additional site for ND.

BACKGROUND

Unrelieved TPs contribute to preventable deaths in U.S. combat casualties. [1, 2] Historical data available from the Vietnam Wound Data and Munitions Effectiveness Team show that TPs caused three to four percent of combat fatalities. [3] Despite existing need, a lack of consensus exists on the optimal technique for performing ND. [4] TCCC Guidelines currently recommend performing ND at the second ICS along the MCL; however, civilian studies report a wide range of ND failure rates ranging from four to 65 percent. [4, 5, 6] Alternate sites and longer needles may increase the likelihood of success. Anatomic and chest wall thickness (CWT) analyses suggest that a preferable site may be an ICS located more laterally and away from the heart. The American College of Surgeons Advanced Trauma Life Support (ATLS) Program recommends the fourth or fifth ICS along the AAL as primary site for chest tube insertion. [7, 5, 8, 6] Based upon these recommendations, the Prehospital Trauma Life Support (PHTLS) Manual/TCCC Curriculum has historically recommended the fourth or fifth ICS AAL as potential alternative sites for ND. [9] However, this recommendation has not been part of the TCCC Guideline section.

The TCCC Guidelines are a set of trauma care guidelines customized for use in the pre-hospital combat setting. TCCC is currently used in training for medics by all Services in the DoD and by many U.S. coalition partners. [1] The CoTCCC performs a quarterly review of current evidence

demonstrating the successes and shortcomings of the TCCC Guidelines, and considers proposed updates and revisions. [10]

METHODOLOGY

CoTCCC member Dr. David Callaway conducted an extensive literature review to determine the optimal site for conducting needle decompression. At the May 1, 2012 CoTCCC meeting, he proposed that the TCCC Guidelines offer an additional site for ND. The members deliberated and amended the proposed changes on May 1-2, 2012. The CoTCCC agreed by unanimous vote on May 2, 2012 to forward its recommendations to the Trauma and Injury Subcommittee for review. The Trauma and Injury Subcommittee subsequently passed the proposed amendments. On June 25, 2012, the DHB deliberated the proposed recommendations and approved they be forwarded to the ASD(HA). This report includes the findings of the review as well as an evaluation of levels of evidence in accordance with the Oxford Centre for Evidence-Based Medicine (OCEBM) method. [11].

FINDINGS

Thoracic injuries are one of the leading causes of death in trauma casualties. Accumulation of extrapleural air compresses intrathoracic blood vessels promoting hypoxemia and the collapse of cardiovascular activity. [1, 12] Failure of an attempted ND can have life threatening complications. [13]

The level of evidence supporting ND research is primarily level four, consisting of case reports based on predominantly prehospital ND performed both in theater and in the civilian sector. Evidence supporting alternative ND sites is generally between levels three and four according to OCEBM and focuses on anatomical analysis.

Location of Needle Decompression Site

The current TCCC Guidelines specify performing ND at the second ICS along the MCL. Despite this, multiple studies have shown that in practice, medics frequently place the ND more medially, putting internal organs at risk. [13, 14] In a small study of civilian paramedics (n=18), 44 percent (n=8) placed ND medial to the MCL. [13] As such, ATLS advises alternative placement in the fourth or fifth ICS along the AAL has been suggested to reduce the risk of complications. [6] By using a more lateral ND placement, it is less likely that any internal organs may be punctured, as these organs are located more medially within the thoracic cavity.

A more lateral site for ND may be easier for medics to find on casualties. The fifth ICS is located at the level of the nipple in young, fit males. The AAL is located at approximately the lateral aspect of the pectoralis major muscle, making this location easy to identify in a field or Tactical Evacuation (TACEVAC) environment. A lateral location may also be faster and safer given body armor configuration and ability to reassess the status of the TP.

Catheter Length

Catheter length remains a highly variable component in the successful execution of ND. In the literature, catheter length ranges from 4-8cm. Multiple CWT studies advise that a 5 cm long

needle may be too short to reliably reach the pleural space at *either the second ICS at the MCL or the fourth or fifth ICS AAL* and is not suitable for optimal use in ND. [1, 4] The majority of these studies used civilian volunteers, retrospective trauma database analysis and cadavers to measure the mean chest wall thickness. This population of cadavers and civilians may have thinner chest walls than Service members due to the physical training of Service members and the degradation of tissue in cadavers. However, Harcke's 2007 study of military males also supported the need for longer catheters. [1] Current TCCC Guidelines recommend the use of an 8 cm needle for ND. Though several CT- based CWT thickness studies showed increased CWT laterally, this difference was not found to be statically significant and would not be operationally relevant if an 8cm needle was utilized. [6] Therefore, the CoTCCC recommends continued utilization of the 14g, 3.25 inch (8cm) catheter at the second ICS MCL or the fourth or fifth ICS at the AAL.

Needle Decompression Complications

Although rare and unusual, life threatening complications may be associated with ND. Multiple studies demonstrate difficulty with proper site identification and catheter placement utilizing the anterior approach. [5, 15, 16] Due to the proximity of the second ICS along the MCL, artery injury has been observed as a complication of ND. One case report noted laceration of the subclavian artery from an attempted ND. Additional case reports note the development of hemopneumothoraces following ND. [8, 15] Possible explanations for the failure of ND to relieve TP include:

- Inadequate training and improper technique
- Needle length
- Catheter kinking
- Muscle mass of casualty

The tactical environment further complicates the use of ND. Challenges result in exposing the ND site, as medics must remove any equipment or body armor covering the chest. Removal of these protective layers puts the casualty at risk for exposure. Using a more easily identifiable lateral location may be faster than attempting to locate a medial ND site.

CONCLUSIONS

Currently, needle decompression is recommended as a Combat Lifesaver (CLS), Combat Medic (CM), and Combat Paramedic (CPM) Level Skill. Two major practice guidelines, Prehospital Trauma Life Support (PHTLS) and Special Operations Forces Tactics, Techniques and Procedures (SOF TTP), recommend fourth or fifth ICS AAL as acceptable alternative site for needle decompression of tension pneumothoraces.

Non- inferiority: No definitive literature was found that establishes the superiority of the second intercostal space at the MCL over the fourth or fifth intercostal site at the AAL as the preferred site for needle decompression of a presumed tension pneumothorax. Further, studies evaluating chest wall thickness are mixed when evaluating the difference in chest wall thickness at the second ICS anteriorly vs the fourth or fifth ICS at the AAL. Most current data suggests that the 8cm catheter placed at the fourth or fifth ICS at the AAL will be effective for the majority of casualties.

Potential Superiority: The fourth or fifth ICS at the AAL is more remote from the heart and great vessels and may reduce the incidence of complications from needle decompression. In addition, it may offer distinct tactical advantages that improve successful execution of the procedure.

Conclusion: The fourth or fifth intercostal space at the AAL is an acceptable alternate site for needle decompression.

RECOMMENDATIONS

The Board recommends DoD incorporate the following text allowing the fourth or fifth ICS at the AAL as alternative sites for needle decompression, into the TCCC Tactical Field Care and TACEVAC Guidelines (proposed additions are underlined):

Tactical Field Care:

3. Breathing

a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch (8cm) needle/catheter unit inserted in the second intercostal space at the midclavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart. <u>An acceptable alternate site is the 4th or 5th intercostal space at the anterior axillary line (AAL).</u>

b. All open and/or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.

18. Cardiopulmonary resuscitation (CPR)

Resuscitation on the battlefield for victims of blast or penetrating trauma who have no pulse, no ventilations, and no other signs of life will not be successful and should not be attempted. However, casualties with torso trauma or polytrauma who have no pulse or respirations during TFC should have bilateral needle decompression performed to ensure they do not have a tension pneumothorax prior to discontinuation of care. The procedure is the same as described in section 3 above.

Tactical Evacuation Care:

2. Breathing

a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch (8cm) needle/catheter unit inserted in the second intercostal space at the midclavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart. <u>An acceptable alternate site is the 4th or 5th intercostal space at the anterior axillary line (AAL).</u>

b. Consider chest tube insertion if no improvement and/or long transport is anticipated.

c. Most combat casualties do not require supplemental oxygen, but administration of oxygen may be of benefit for the following types of casualties:

- Low oxygen saturation by pulse oximetry
- Injuries associated with impaired oxygenation
- Unconscious casualty
- Casualty with TBI (maintain oxygen saturation > 90%)
- Casualty in shock
- Casualty at altitude

d. All open and/or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.

17. CPR in TACEVAC Care

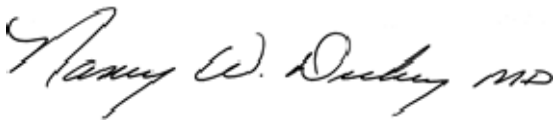
a. Casualties with torso trauma or polytrauma who have no pulse or respirations during TACEVAC should have bilateral needle decompression performed to ensure they do not have a tension pneumothorax. The procedure is the same as described in section 2 above.

b. CPR may be attempted during this phase of care if the casualty does not have obviously fatal wounds and will be arriving at a facility with a surgical capability within a short period of time. CPR should not be done at the expense of compromising the mission or denying lifesaving care to other casualties.

Because definitive evidence does not exist regarding the superiority of either the second ICS at the MCL or the fourth or fifth ICS at the AAL, every effort should be made to collect evidence regarding comparative effectiveness of the two sites in order for inform future guidelines.

The above recommendations were unanimously approved.

FOR THE DEFENSE HEALTH BOARD:



Nancy Dickey, M.D.
DHB President

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TABLE

Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Question	Step 1 (Level 1*)	Step 2 (Level 2*)	Step 3 (Level 3*)	Step 4 (Level 4*)	Step 5 (Level 5)
How common is the problem?	Local and current random sample surveys (or censuses)	Systematic review of surveys that allow matching to local circumstances**	Local non-random sample**	Case-series**	n/a
Is this diagnostic or monitoring test accurate? (Diagnosis)	Systematic review of cross sectional studies with consistently applied reference standard and blinding	Individual cross sectional studies with consistently applied reference standard and blinding	Non-consecutive studies, or studies without consistently applied reference standards**	Case-control studies, or "poor or non-independent reference standard**	Mechanism-based reasoning
What will happen if we do not add a therapy? (Prognosis)	Systematic review of inception cohort studies	Inception cohort studies	Cohort study or control arm of randomized trial*	Case-series or case-control studies, or poor quality prognostic cohort study**	n/a
Does this intervention help? (Treatment Benefits)	Systematic review of randomized trials or *n*-of-1 trials	Randomized trial or observational study with dramatic effect	Non-randomized controlled cohort/follow-up study**	Case-series, case-control studies, or historically controlled studies**	Mechanism-based reasoning
What are the COMMON harms? (Treatment Harms)	Systematic review of randomized trials, systematic review of nested case-control studies, *n*-of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Non-randomized controlled cohort/follow-up study (post-marketing surveillance) provided there are sufficient numbers to rule out a common harm. (For long-term harms the duration of follow-up must be sufficient.)**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning
What are the RARE harms? (Treatment Harms)	Systematic review of randomized trials or *n*-of-1 trial	Randomized trial or (exceptionally) observational study with dramatic effect			
Is this (early detection) test worthwhile? (Screening)	Systematic review of randomized trials	Randomized trial	Non -randomized controlled cohort/follow-up study**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning

*** Level may be graded down on the basis of study quality, imprecision, indirectness (study PICO does not match questions PICO), because of inconsistency between studies, or because the absolute effect size is very small; Level may be graded up if there is a large or very large effect size.**

**** As always, a systematic review is generally better than an individual study.**

How to cite the Levels of Evidence Table

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