Needle Thoracostomy by Non-Medical Law Enforcement Personnel: Preliminary Data on Knowledge Retention

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Abbreviations:
ALS = advanced life support
EMS = emergency medical services

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Abstract

Introduction: Tension pneumothorax is the second leading cause of preventable combat death. Although relatively simple, the management of tension pneumothorax is considered an advanced life support skill set. The purpose of this study was to assess the ability of non-medical law enforcement personnel to learn this skill set and to determine long-term knowledge and skill retention.
Methods: After completing a pre-intervention questionnaire, a total of 22 tactical team operators completed a 90-minute-long training session in recognition and management of tension pneumothorax. Post-intervention testing was performed immediately post-training, and at one- and six-months post-training.
Results: Initial training resulted in a significant increase in knowledge (pre: 1.3 ±1.35, max score 7; post: 6.8 ±0.62, $p < 0.0001$). Knowledge retention persisted at one- and six-months post-training, without significant decrement.
Conclusions: Non-medical law enforcement personnel are capable of learning needle decompression, and retain this knowledge without significant deterioration for at least six months.

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Introduction

Tension pneumothorax is an emergent condition in which a communication created between the bronchoalveolar system and the pleural space forms an effective one-way valve, resulting in progressive accumulation of air into the pleural space. The resultant increase in intrapleural pressure results in compression of the vena cava, impaired right ventricular filling, obstructive shock, and if left untreated, death. Although the incidence of tension pneumothorax in non-intubated trauma patients (i.e., patients not receiving positive pressure ventilation) remains elusive, it is believed to be <6%.[1–5] Analyses of preventable combat deaths indicate that it is a cause of preventable death that is second only to extremity hemorrhage, accounting for 33% of all preventable combat deaths.[6,7]

Initial management of tension pneumothorax involves venting of the trapped intrapleural air via placement of a large gauge angiocatheter needle. Although this is a simple procedure, it is classified as an advanced life support (ALS)-level skill. As such, this procedure typically is limited to prehospital care providers operating at the emergency medical technician (EMT)-Paramedic level or higher. Recent developments in military prehospital trauma care have stressed the importance of early recognition and treatment of the tension pneumothorax.[8,9] The military has instituted an intermediate level of medical care between the first-aid skills taught to all soldiers and the medical skills of the medic or corpsman.[10] This Combat Lifesaver skill set, taught to non-medical personnel, includes training in needle decompression of a tension pneumothorax.

Although there is increased acceptance and awareness of the concept of tactical medical support for law enforcement special operations units, many such units do not yet have such a capability.[11] Further, many tactical medics

Didactic Training Session: 30 minutes
- Introduction to Chest Anatomy
- Simple Pneumothorax
- Open Pneumothorax
- Tension Pneumothorax
- Needle Decompression Overview
- Method and Location of Needle Placement
- Risks and Complications
- Troubleshooting Issues

Simulated (Homemade) Chest Wall Model: 30 Minutes
Commercial Tension Pneumothorax Chest Wall Model: 30 Minutes

Figure 1—Summary of training course

are prevented from entering the "hot-zone" due to concerns of personal safety, and thus, must wait for a degree of scene security prior to rendering medical care. As a consequence, tactical operators may find themselves injured without immediate medical support. A previous study demonstrated a lack of awareness of the symptoms, signs, and treatment of tension pneumothorax among law enforcement personnel.[12]

The purpose of this study was to determine whether non-medical tactical operators were capable of learning the skill of needle thoracostomy, and to characterize the degree of knowledge retention over time.

Methods

Study Setting

This study was conducted with members of a combined city/county tactical team. The study was reviewed by the Mayo Foundation Institutional Review Board and determined to be exempt.

Study Design

This was a prospective, longitudinal study that evaluated knowledge retention over a six-month study period. A convenience sample of law enforcement personnel serving on a regional tactical team received an initial seven-question test (Appendix). Given their non-medical background, the questionnaire was designed to be pertinent to rapid recognition and to assess the ability to correctly locate necessary landmarks and perform the required procedure. Then, they received a 30-minute didactic presentation on chest trauma, with emphasis on recognition and management of tension pneumothorax (Figure 1). Specific indications for needle decompression were emphasized: penetrating chest trauma and worsening trouble breathing. This was followed by a 60-minute, hands-on, skills session using a commercial needle decompression skills mannequin [Tension Pneumothorax Simulator, Simulaids, Inc., Saugerties, NY] and individual simulated chest wall models (Figure 2). All training was performed under the guidance of the team medical director, with individual tutelage and confirmation of correct skill performance. After completing the training session, an evaluation form was provided as a post-test assessment. Repeat testing occurred in an unannounced manner at one and six months after the initial training. No formal review was performed prior to the completion of the study protocol. At the completion of the six-month testing, all personnel received an additional 30-minute didactic review of tension pneumothorax identification and management.

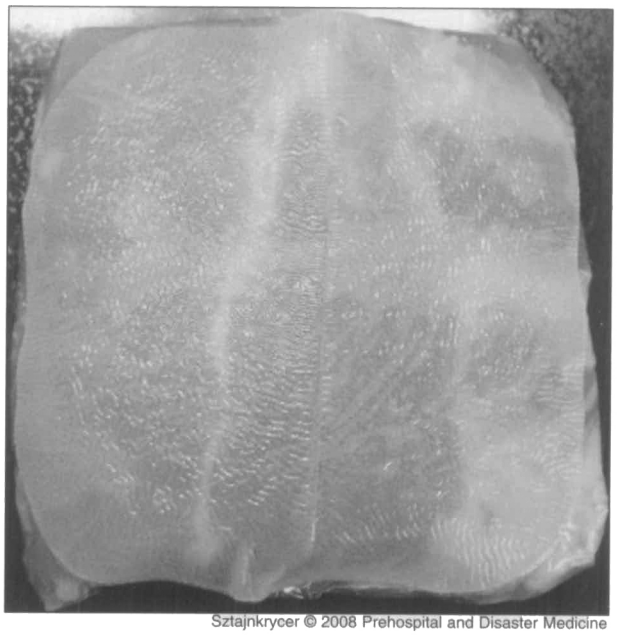

Figure 2—Homemade chest wall model: In order to provide a more realistic tactile experience to the officers, a homemade chest wall model was developed, using pork ribs wrapped in multiple layers of Saran Wrap©, and covered in DuoDerm© to simulate skin. A dark layer of biohazard bag (not shown) can be used to hide the actual bony landmarks from view.

Statistics

Descriptive statistics and Student's *t*-tests were used to analyze results [Microsoft Excel, Microsoft Inc., Redmond, WA], with an alpha level of ≤0.05 defining statistical significance.

Results

A total of 22 officers participated in the initial training. Given the non-medical background of the participants, the initial pre-test score was understandably low at 1.3 ±1.35 (maximum possible score 7, range 0–5, Figure 3). After completing the training curriculum, immediate post-test score rose to 6.8 ±0.62 (range 5–7, p <0.0001). One-month follow up score was 6.4 ±1.16 (range 3–7). At the six-month follow-up, the score was 6.3 ±1.20 (range 3–7). No statistically significant difference was noted between the immediate and one-month (p = 0.34) or six month (p = 0.19) post-tests.

Discussion

Although relatively rare in civilian trauma, tension pneumothorax is the second leading cause of preventable combat death.[6,7] No similar data exist for the civilian tactical environment, although the current view is that tactical medical care is more analogous to military medicine (in terms of austere settings, nature of injuries, limited equipment and personnel, potential for active threat, and potential for delayed evacuation) than the conventional EMS setting.

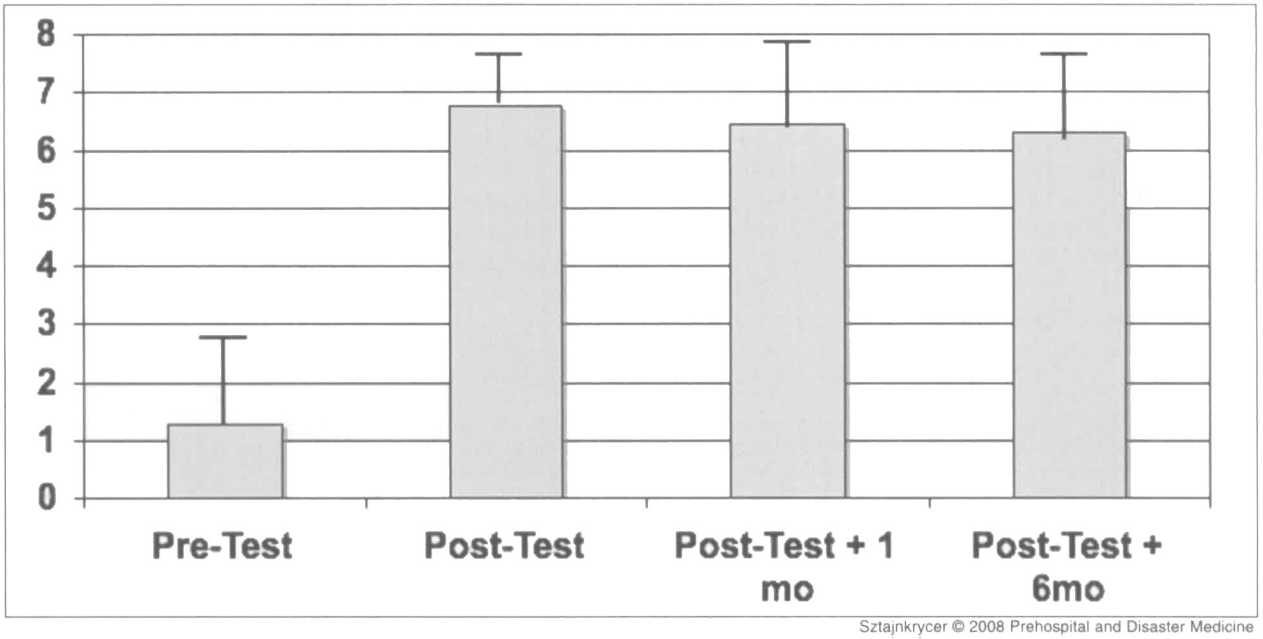

Figure 3—Needle decompression scores over time: Pre- and post-intervention scores (max = 7), and follow-up scores at 1 and 6 months post-training. Lines represent standard deviation. Statistically significant differences occurred pre- and post-intervention. Decrement over time was non-significant.

Shifts in modern tactical combat casualty care have shifted toward the early recognition and management of this condition, even by non-medically trained personnel.[8–10] This training is so important that the entire Iraqi police force currently is receiving medical training to the Combat Lifesaver level.[13]

The military already has decided that non-medical personnel are capable of learning advanced medical skill sets and applying them in combat. The purpose of this study was to determine whether civilian law enforcement operators were similarly capable of learning and retaining the skill set for management of needle decompression. Based on the current results, officers are capable of learning the skill and retaining the knowledge for up to six months without significant decrement in knowledge (Figure 3). The decision was made to limit the study period in this study to six months, rather than a full year, in order to allow for further training on the subject, and to require biannual retraining and recertification in the skill set. However, it may be that these officers have longer knowledge retention periods.

It must be stressed that the objective of this training was not to replace emergency medical services (EMS) personnel, but rather to allow officers to render selected life-saving interventions while awaiting EMS arrival. Although in most instances, transition to ALS-capable personnel (whether conventional or tactical) would be anticipated to occur in an expeditious manner, this is not guaranteed. Despite increased awareness, many tactical teams lack tactical EMS capability, and rely on conventional EMS assets.[11] Many rural areas have limited access to ALS capabilities, with potential for extended delays in ALS on-scene arrival. These delays are compounded further in the tactical setting by issues of scene safety, which preclude EMS providers from entering the inner perimeter during ongoing threats. Similarly, although stabilizing treatment may be initiated at the point of wounding, an ongoing threat may prevent casualty evacuation to EMS units staged in the outer perimeter.

Members of the tactical team are selected through a rigorous process that tests physical stamina and mental fortitude. All are experienced law enforcement officers, and presumably are highly motivated given the inherent risks of their assignment to learn life-saving survival skills with direct implications for their well-being. It may be that these results are not generalizable to all law enforcement personnel. However, all law enforcement officers in Minnesota require some form of post-graduate higher education, and all must be certified to at least the first responder level. As such, their pre-existing medical knowledge base may well exceed those of military personnel currently being trained as Combat Lifesavers. Moreover, in a study of tactical medical decision-making by law enforcement personnel, members assigned to the tactical team actually scored lower than non-assigned officers.[12] As such, it is likely that this skill set can be taught to all personnel with good retention.

The treatment of tension pneumothorax involves penetration of the chest cavity with a sharp needle, and as such, poses some risk if performed inappropriately or incorrectly. However, studies examining complications and risks of needle decompression have demonstrated this procedure to be well-tolerated, safe, and effective.[14–17] Moreover, as a gross motor skill (rather than a fine motor skill), the performance of this technique would be less likely to deteriorate under critical incident stress. Guidelines followed in the current study do not permit the use of needle decompression in all circumstances, but rather only those that involve the specified indications of penetrating chest trauma and worsening breathing problems. This conditional

use, termed "limited needle decompression", provides a further safety margin against inappropriate use. Precedent exists for this in the civilian (albeit federal) setting.[18]

The current study examined knowledge retention over an extended time period. It did not assess actual performance issues, including recognition and management during critical incidents. But, the need to perform these techniques on a downed officer is a relatively rare event. To address these limitations, this skill set currently is being applied to scenario-based training, in which the officers must recognize and treat a tension pneumothorax while operating tactically and maintaining situational awareness.

Conclusions

The current study demonstrates the ability of non-medical law enforcement personnel to learn an ALS skill typically deemed well above their level of medical competence and to retain skill knowledge for six months post-initial training.

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Appendix—Needle decompression questionnaire: The questionnaire is composed of both simple didactic questions assessing signs and symptoms of tension pneumothorax and indications for limited needle decompression, as well as chest wall schematics assessing needle placement location (gross chest wall placement, placement above versus below the costal margin).

Name:
POST Number:
Date of Examination:
Circle One: Pre Post Follow-Up

Certification Test – Needle Decompression

What is a tension pneumothorax?
1.

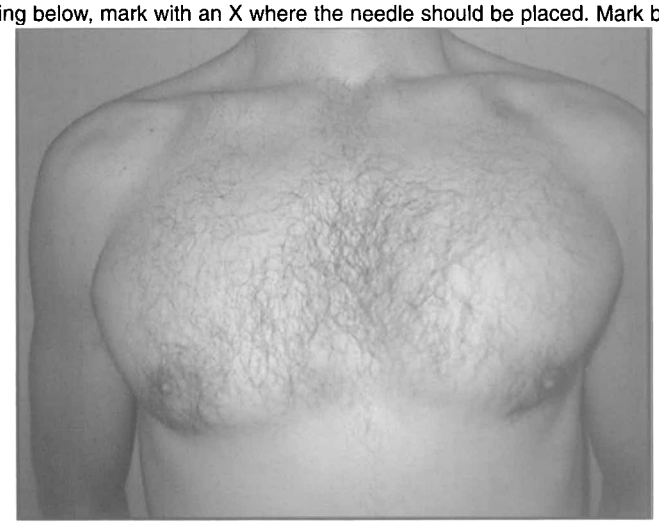
After calling for casualty evacuation, what is the treatment for tension pneumothorax?
1.

What are the 2 indications for limited needle decompression?
1.
2.

What side of the chest should the needle be placed in?
1.

What if the needle decompression works for a while, and then stops working?
1.

On the drawing below, mark with an X where the needle should be placed. Mark both sides of the chest.



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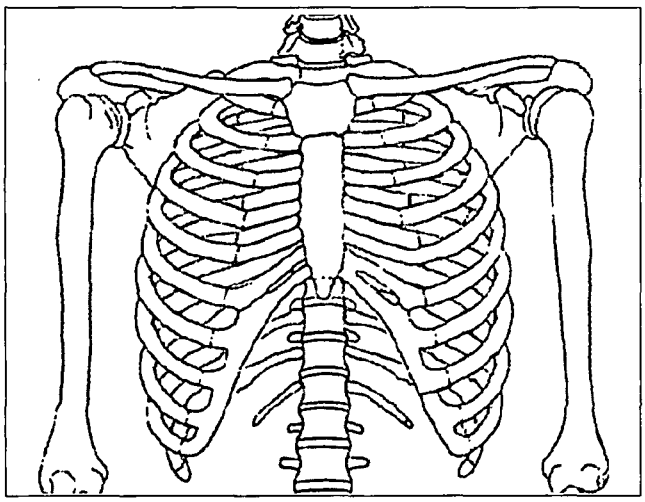

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