



Accuracy of Needle Decompression Site Selection in Simulated High Stress Environments Among Air Force Healthcare Professionals

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Introduction

- Tension pneumothorax (tPTX) is a life-threatening condition that occurs most predominantly in the prehospital setting
- Studies show tPTX is a prominent cause of potentially survivable injuries on the battlefield
- Management for a patient with tension physiology should immediately be treated with a needle chest decompression (NCD)
- The Joint Trauma System's Committee on Tactical Combat Casualty Care (CoTCCC), governing body for military medicine, recommends performing NCD at the second intercostal, mid-clavicular line (2ICS, MCL) or the fifth intercostal space, anterior axillary line (5ICS, AAL) on the respective side of concern

Hypothesis / Purpose

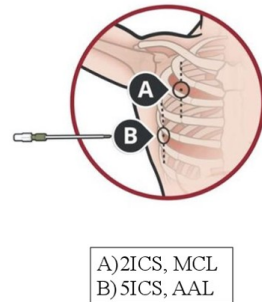
- Active-duty military medical professionals (ADMP) will successfully identify the correct NCD site location at higher rates in a controlled setting compared to a simulated high stress environment
- Evaluate overall accuracy of NCD site selection amongst active-duty military medical professionals in a simulated high stress combat environment

Materials & Methods

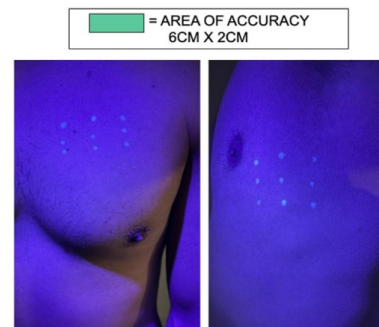
- Study population: active-duty military medical professionals of varying levels of education and experience within the medical hierarchy
- Six male volunteers served as study models
- Study investigators and a Board-Certified Emergency Medicine Physician pre-identified the targeted site and area of accuracy under ultrasound guidance and marked all four sites on each model with a black light pen
- Area of accuracy: three centimeters (cm) medial and lateral and one cm superior and inferior to the targeted site was measured and marked at all four sites on each model (see pictures above)
- Participants were randomized into the control or high stress group and given a study packet including pre-survey, study protocol, informed consent, data collection sheet, and post-survey
- Participants were asked to identify the CoTCCC sites for NCD (2ICS, MCL and 5ICS, AAL) bilaterally on all six models by marking the skin with a surgical marker
- The high stress group performed the task in a dark room with a red-light head lamp and warfare sounds playing in the background and the control group performed task in a well-lit room with no added distractions
- Once the participant marked all four sites on a model, a study investigator assessed for accuracy with use of a black light
- If the participants mark was within the pre-identified area of accuracy, it was considered accurate (data recorded as YES or NO)
- An alcohol swab was used to remove surgical marker prior to rotation to the next model, but did not remove UV pen markings
- This was repeated until each participant had completed site selection on all six models



CONTROL (B) GROUP PERFORMING NCD SITE SELECTION



Methods



HIGH STRESS (A) GROUP PERFORMING NCD SITE SELECTION

Results

Accuracy	Overall, N = 75 ¹	A, N = 37 ¹	B, N = 38 ¹	p-value ²
Total Accuracy	0.31 (0.16)	0.30 (0.14)	0.32 (0.17)	0.7
2ICS	0.41 (0.24)	0.40 (0.21)	0.41 (0.27)	0.7
5ICS	0.21 (0.20)	0.21 (0.19)	0.22 (0.20)	0.8

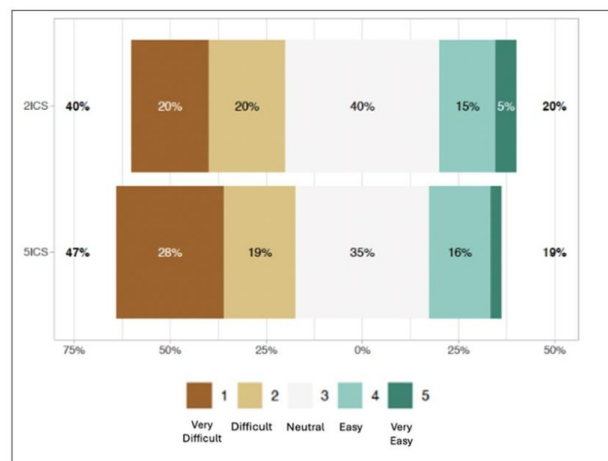
¹Mean (SD)
²Welch Two Sample t-test

This table shows the difference in accuracy rates between the control (B) and high stress (A) groups

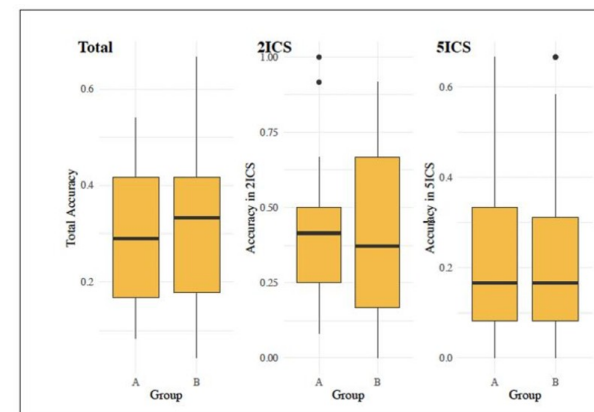
Accuracy	accuracy_2ICS, N = 75 ¹	accuracy_5ICS, N = 75 ¹	p-value ²
Accuracy	0.41 (0.24)	0.21 (0.20)	<0.001

¹Mean (SD)
²Welch Two Sample t-test

This table shows the overall site selection accuracy rates between the two sites



This plot shows how participants rated the ease of selecting a site (on a scale from 1 very difficult to 5 very easy) for the two sites: The x-axis represents the percentage of participants who chose each rating, and the y-axis represents the two intercostal spaces being compared



This box plot shows compares total accuracy, accuracy at the 2ICS and accuracy at the 5ICS between the control (B) and high stress groups (A)

Characteristic	A, N = 37 ¹	B, N = 38 ¹
Military Experience (yrs)		
< 1	13 (35%)	7 (18%)
1-3	8 (22%)	13 (34%)
3-5	3 (8.1%)	7 (18%)
> 5	6 (16%)	8 (21%)
> 10	7 (19%)	3 (7.9%)
Have been deployed	6 (16%)	10 (26%)
Have performed real-life NCD	1 (2.7%)	1 (2.6%)

¹n (%)

This table shows study population demographics between the high stress (A) and control (B) groups. Participants with real life NCD experience overall performed with higher accuracy at all sites compared to participants with no experience. No other study demographic had impact on site selection accuracy

Discussion

- ADMP demonstrated no difference in site selection accuracy between the control and high stress groups
- Overall site selection accuracy in both groups was 31%, consistent with accuracy rates of previous studies
- ADMP are more accurate at NCD site selection at the 2ICS, MCL(41%) compared to the 5ICS, AAL (21%)
- Participants with real life NCD experience had overall higher accuracy rates than those without
- Despite higher accuracy rates at the 2ICS, MCL compared to 5ICS, AAL, participants demonstrated no statistically significant difference between perceived ease of access of the two sites
- Limitations: single site study and may not be generalizable to the greater military population; female models were not used and play an equally important role in the military requiring treatment with NCD in the setting of a tPTX; realistic creation of high stress deployed environment
- Recommendation for future studies: focus on evaluating different training methods such as cadaver or live model versus current TCCC methods prior to skill assessment in a high stress environment, heightening high stress environment to more closely replicate the stress experienced on the battlefield with yelling, low crawling to the victim, wearing battle gear, and time pressure, and lastly, focused evaluation of BMI and body habitus on NCD site selection accuracy

Conclusion

- ADMP demonstrated a high stress environment had no impact on accuracy rates for NCD site selection, proving our null hypothesis
- ADMP are better at identifying the 2ICS, MCL compared to the 5ICS, AAL
- ADMP misplaced 69% of NCD attempts, suggesting that current training methods may be poorly translating to proficient hands-on skills
- Results highlight the importance and critical need for improved training methods to ensure patient safety and successful NCD outcomes in deployed settings
- ADMP are expected to be knowledgeable and perform lifesaving procedures under extreme stress on the battlefield, and therefore comprehensive and in-depth training methods are critical to ensure successful NCD and improved patient outcomes in deployed settings

Disclaimer:

- The views expressed are those of the authors and do not reflect the official policy or position of the US Air Force Medical Department, Department of the Air Force, Department of Defence, or the US Government. The investigators have adhered to the policies for protection of human subjects as prescribed in 45 CFR 46

- All references will be available upon request