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A Statewide Evaluation of Signs and Symptoms of Tension Pneumothorax Among Patients Receiving Prehospital Needle Decompression

AUTHORS

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INTRODUCTION

Needle decompression is a crucial intervention in the prehospital setting for patients presenting with tension pneumothorax. There is ongoing national discussion regarding the possible overutilization of the procedure in prehospital patients presenting with mild clinical signs, with some research supporting its safety and benefits, while other studies highlight limited advantages that may not outweigh the risks (Osterman, 2022; Muchnok, 2022; Axtman, 2019).

Virginia EMS agencies follow varying protocols for needle decompression, with no statewide guideline in place. The current state of needle decompression utilization and factors associated with its potential overuse among prehospital clinicians in Virginia are not well understood.

OBJECTIVE

The objective of this study was to evaluate documented signs and symptoms of tension pneumothorax in the prehospital setting in Virginia, assessing the proportion of potentially unnecessary needle decompression procedures and factors contributing to their overuse.

METHODS

STUDY DESIGN

This was a retrospective observational study.

POPULATION & DATA SOURCE

All EMS events occurring between January 1, 2018 and December 31, 2024 submitted to the Virginia EMS State Data Repository, provided by ESO (Austin, TX), were evaluated.

Inclusion criteria were:

1) 9-1-1 response,
2) successful passage of state data validation,
3) unit and patient dispositions indicating the patient was evaluated, and
4) documentation of a needle decompression procedure performed by an EMS clinician.

Non-traumatic causes of cardiac arrest were excluded (n=167).

SIGNS & SYMPTOMS

Criteria evaluating potential clinical presentation of a tension pneumothorax were identified based on cardiac arrest data, vital signs, trauma triage criteria, exam assessment results, and primary and secondary impressions of the EMS clinician.

ANALYSIS

The Python package *RegEx* was used to analyze electronic patient care narratives for quality assurance. The Python data linkage package *Splink* was utilized to identify duplicate patient incidents.

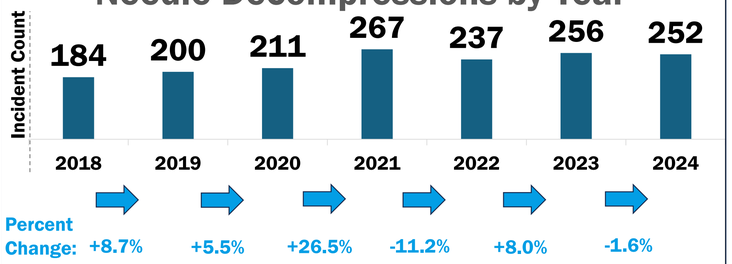
Descriptive statistics, univariate odds ratios (ORs), 95% confidence intervals (95% CI), and chi-square tests of independence were calculated.

RESULTS

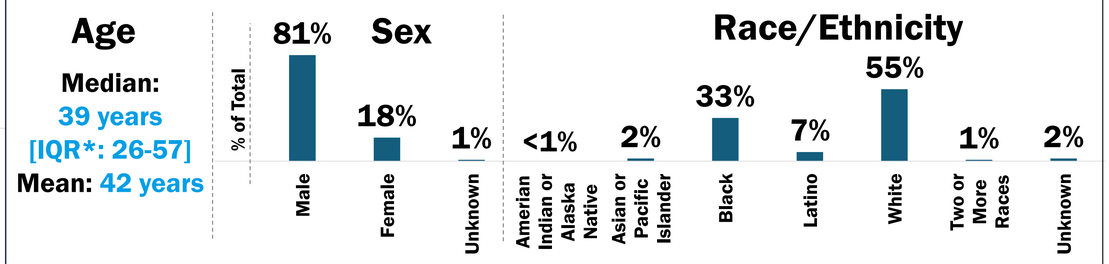
There were 1,607 EMS incidents involving needle decompression in Virginia from 2018 through 2024 that met all inclusion criteria and no exclusion criteria.

*Interquartile Range

Needle Decompressions by Year



Patient Demographics



Signs and Symptoms Criteria

Among the 1,607 EMS incidents involving needle decompression, the following percent of incidents met each of the established criteria:

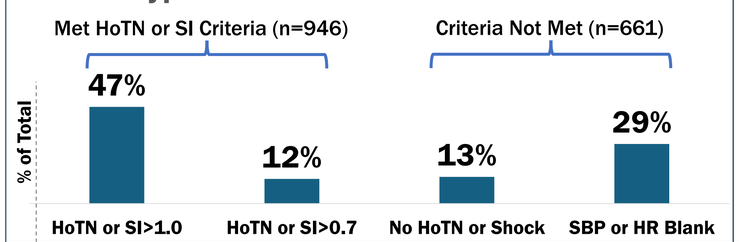
Hypotension or Shock Index

- Hypotension [HoTN] (SBP<90 mmHg in adults ≥15YO or <80 in children<15YO or Trauma Triage Criteria Indicates SBP <90): 38%
- High Risk Shock Index [SI] (HR/SBP>1.0): 24%
- Shock Index Above Normal (SI>0.7): 40%

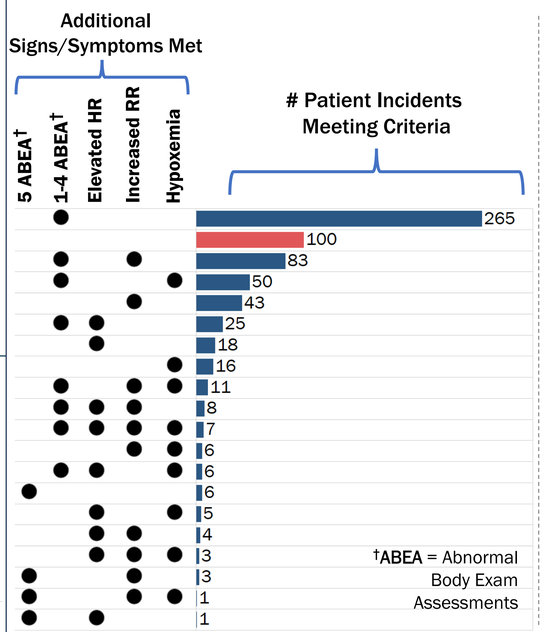
Additional Signs or Symptoms

- Elevated Heart Rate (HR>120 beats/min or HR>SBP): 38%
- Increased Respiratory Rate (RR>30 breaths/min or Trauma Triage Criteria indicates RR>29 breaths/min): 36%
- Hypoxemia (Pulse Oximetry<90% not respondent to oxygen therapy): 26%
- At Least One Abnormal EMS Body Exam Assessment [ABEA †] (of 5 potential exams: lung, neck, skin, chest, mental status): 71%

Hypotension or Shock Index Criteria



Among the 661 patient incidents not involving hypotension or shock:



Primary Impression Category

Primary Impression Category	No Additional Signs or Symptoms Met	At Least One Additional Criterion Met	Grand Total
Injury	20 (9.4)	193 (90.6)	213 (100.0)
Cardiac arrest	34 (20.0)	136 (80.0)	170 (100.0)
Collapsed lung	14 (16.9)	69 (83.1)	83 (100.0)
Brain injury/death	6 (13.0)	40 (87.0)	46 (100.0)
Fluid in/around the lungs	5 (12.2)	36 (87.8)	41 (100.0)
Awareness/consciousness problem	6 (33.3)	12 (66.7)	18 (100.0)
Pain	1 (5.9)	16 (94.1)	17 (100.0)
Other	2 (15.4)	11 (84.6)	13 (100.0)
General problem/unspecified	5 (41.7)	7 (58.3)	12 (100.0)
Shock	0 (0.0)	6 (100.0)	6 (100.0)
Brain hemorrhage	1 (20.0)	4 (80.0)	5 (100.0)
Breathing abnormalities	0 (0.0)	5 (100.0)	5 (100.0)
Psychiatric/behavioral	1 (20.0)	4 (80.0)	5 (100.0)
Blood/bleeding condition	0 (0.0)	4 (100.0)	4 (100.0)
Chest pain	0 (0.0)	3 (100.0)	3 (100.0)
Traumatic arthropathy	0 (0.0)	3 (100.0)	3 (100.0)
Abnormal heartbeat	0 (0.0)	2 (100.0)	2 (100.0)
Malaise/fatigue	1 (50.0)	1 (50.0)	2 (100.0)
Respiratory arrest	1 (50.0)	1 (50.0)	2 (100.0)
Bleeding	0 (0.0)	1 (100.0)	1 (100.0)
Circulation disorder	0 (0.0)	1 (100.0)	1 (100.0)
Fluid or electrolyte imbalance	0 (0.0)	1 (100.0)	1 (100.0)
Nausea, vomiting, diarrhea	1 (100.0)	0 (0.0)	1 (100.0)
Respiratory failure	0 (0.0)	1 (100.0)	1 (100.0)
Seizure/convulsions	0 (0.0)	1 (100.0)	1 (100.0)
Stroke/TIA	1 (100.0)	0 (0.0)	1 (100.0)
Substance use/effects of drug	1 (100.0)	0 (0.0)	1 (100.0)
Blank	0 (0.0)	3 (100.0)	3 (100.0)
Grand Total	100 (15.1%)	561 (84.9%)	661 (100.0%)

CONCLUSION

These analyses identified that for approximately two in every five (661 of 1,607; 41.1%) needle decompression procedures performed between 2018 and 2024 in Virginia, the patient's SBP and HR vital signs were missing or inconsistent with hypotension or shock. For one in every 16 (100 of 1,607; 6.2%) needle decompression procedures, there were also no additional documented signs or symptoms indicating the need for needle decompression, even though many of the documented primary impressions suggested tension pneumothorax. These analyses contribute a statewide perspective to the national discussion on whether needle decompression is overperformed and the factors that may contribute to its overuse. These results support the need for enhanced education, programming, and policy on chest decompression patient care in Virginia, including on sufficient record documentation. Next steps should involve linking these EMS patient records with hospital outcomes to assess potential harms, including injuries from improper needle decompression placement in patients with mild clinical illness.

References

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