Comparison of Cadaveric Warming Rates in Accidental Hypothermia between Continuous and Dwell Thoracic Lavage

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Introduction

- Accidental hypothermia is the unintentional decrease in core body temperature below 35°C due to environmental exposure.[1]
- In the United States, there are approximately 1,300 deaths attributable to accidental hypothermia annually with rural populations most likely to be affected.[2]
- Severe hypothermia, defined as a core body temperature less than 28°C, is of particular concern as patients can experience hemodynamic instability, cardiac arrest, and death.[3]
- Extracorporeal membrane oxygenation (ECMO) is the gold-standard rewarming treatment; however, many rural hospital systems lack access to this resource.[4]
- In these rural emergency departments, continuous infusion and dwell thoracic lavage methods are utilized clinically at the physician's discretion, but there remains no evidence as to which method is more efficacious for rewarming.

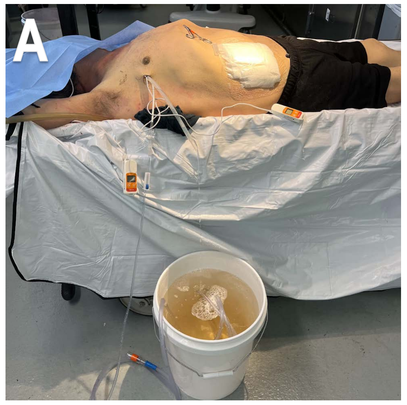
Study Objective

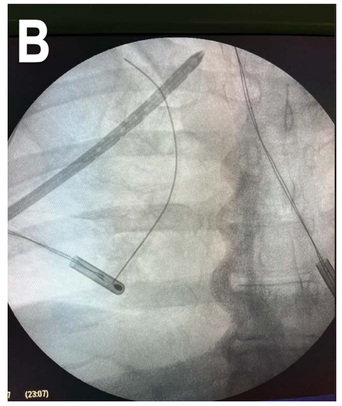
- Our overarching research goal is to identify the optimal rewarming technique for patients with severe hypothermia in a limited-resource emergency department.
- In this study, we aimed to provide experimental data suggesting which currently utilized thoracic lavage method is faster at increasing core body temperature.

Materials and Methods

- Five fresh cadavers (3 male, 2 female) were passively warmed at room temperature (19°C).
- A 28 Fr chest thoracostomy tube and a pigtail catheter were placed in the right anterior axillary fifth intercostal space for warm fluid drainage and infusion, respectively.
- An Elitech RC-5+ temperature probe was placed in the distal third of the esophagus to measure core body temperature and a second probe was placed in the thoracic cavity to measure warmed input fluid temperature.
- Proper temperature probe and chest tube placement were confirmed via fluoroscopy.
- Thoracic lavage was performed utilizing a Belmont Rapid infuser RI-2 at a rate of 200 mL/min for continuous lavage and a 500 mL dwell of at least seven minutes.
- Both methods were utilized for at least one trial per cadaver.
- The study was repeated with the sequence of thoracic lavage method randomized via block randomization.
- Data analyses were performed using descriptive statistics, a Wilcoxon signed-rank test, and a two-tailed T-test ($p \leq 05$).

Novel Thoracic Lavage Chest Thoracostomy Method

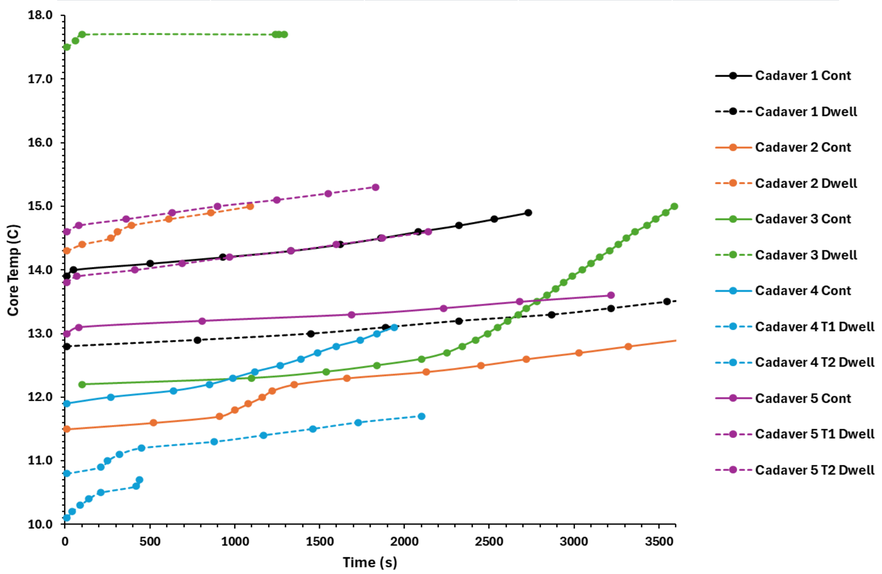




- This novel thoracic lavage chest thoracostomy method involves a single incision in the right anterior axillary line fifth intercostal space. A 28 Fr thoracostomy tube is inserted and directed posterior-inferior while a pigtail catheter is inserted through the same incision and directed anterior-superior.

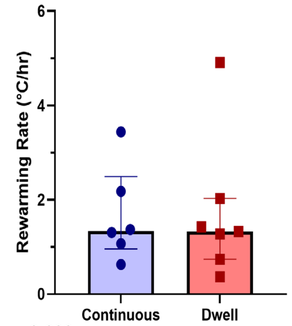
Cohort Details and Core Temperature Rewarming Measurements

Cadaver	Height (cm)	Weight (kg)	Sex	Trial Order
1	157	47	Female	Dwell, Continuous
2	163	62	Male	Continuous, Dwell
3	175	79	Male	Continuous, Dwell
4	180	67	Male	Dwell, Continuous, Continuous, Dwell
5	168	57	Female	Dwell, Continuous, Dwell



No Significant Difference in Rewarming Rate

	Continuous Rewarming Rate	Dwell Rewarming Rate
Mean	1.67	1.73
Median	1.34	1.33
25% Percentile	0.96	0.74
75% Percentile	2.50	2.03
Range	2.81	4.54
Std. Deviation	1.01	1.50
Std. Error of Mean	0.41	0.57



- Two-tailed Wilcoxon signed-rank test: p=0.688
- Two-tailed T-Test: p= 0.935

Conclusions & Limitations

- These results suggest that the thoracic lavage rewarming technique does not significantly impact the core temperature rewarming rate.
- Therefore, physicians should consider additional factors, such as resource availability, when choosing the appropriate thoracic lavage rewarming technique.

- *Limitations to the study include*:
  - Small sample size.
  - Cadaver three had an anatomical esophageal obstruction which required placement of the core temperature probe in the left ventricle.
  - The cadaveric model system lacks endogenous heat production and associated physiological compensatory mechanisms.
  - No additional methods of rewarming were used.
  - Chest compressions and ventilation were not performed.

References

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