THE ASEAN JOURNAL OF MILITARY AND PREVENTIVE MEDICINE

ISSN (e): 3031-870X
Vol. 2 No.2 (2025)
https://journal.ajmpm.net/

DOI: https://doi.org/10.47353/ ajmpm.v2i2.29

Trauma and Body Temperature Management in Tropical Regions

Frédéric Lapostolle[1], Dabor Resiere[2], Bruno Megarbane[3], Jean-Marc Pujo[4]

[1] SAMU 93 - UF Recherche-Enseignement-Qualité, Université Paris 13, Sorbonne Paris Cité, INSERM U942
[2] Service de Médecine Intensive Réanimation-Toxicologie, CHU de Martinique
[3] Service de Réanimation Médicale et Toxicologique, Hôpital Lariboisière, Paris, France
[4] Emergency Department, Cayenne General Hospital, Cayenne, French Guiana

Email: frederic.lapostolle@aphp.fr

Abstract

Background: Trauma patients remain vulnerable to hypothermia even in tropical climates. Hypothermia worsens trauma outcomes through deleterious effects on hemostasis and cardiovascular function. **Methods:** This manuscript summarizes published evidence on trauma-related hypothermia, including mechanisms of heat loss, risk factors, physiologic consequences, and prevention strategies applicable to prehospital trauma care in tropical regions. **Results:** Hypothermia in trauma is multifactorial and may be triggered by environmental exposure, wet or undressed patients, head trauma, intubation, severe injury, impaired shivering, and infusion of unwarmed fluids. Body temperature below 36°C should be considered clinically relevant. Evidence indicates that hypothermia is associated with increased mortality, coagulopathy, platelet dysfunction, cardiovascular compromise, and greater transfusion requirements. Prevention requires systematic temperature measurement, limiting heat loss, early thermal protection, heated transport environments, warmed intravenous fluids, and rapid transport to hospital care. **Conclusion:** Trauma-related hypothermia is a poor prognostic factor and should be prevented and corrected worldwide, including in tropical areas. The therapeutic objective is to maintain body temperature at least 36°C.

Keywords: *body temperature; hypothermia; prehospital care; trauma; tropical region*.

Background

Temperature management in trauma patients has become a critical priority. The therapeutic objective has shifted from simply avoiding hypothermia to maintaining or restoring normothermia. A trauma patient with body temperature below 36°C is considered hypothermic.[1,2] Hypothermia contributes to the lethal triad of hypothermia, acidosis, and coagulopathy and worsens outcomes in injured patients.[3]

Thermoregulation maintains body temperature around 36.5-37.5°C through a balance between thermogenesis and thermolysis. Heat loss occurs through conduction, convection, radiation, and evaporation. Conduction occurs through contact with cold materials or liquids; convection occurs through airflow or water flow; radiation transfers heat to nearby cooler surfaces; and evaporation carries heat away from the skin and airways.[4]

Trauma patients are vulnerable to heat loss because of environmental exposure, wet clothing, blood loss, neurologic injury, impaired shivering, medication effects, and administration of unwarmed fluids or blood products. Therefore, all trauma patients should be considered at risk for hypothermia, including those managed in tropical regions.[1,5]

Methods

This article was arranged in the JDVI original article manuscript format based on a synthesis of published literature concerning hypothermia in trauma patients. The focus of the synthesis included definitions, mechanisms of heat loss, risk factors, clinical consequences, and preventive or corrective strategies in prehospital and emergency trauma settings.

The evidence summarized in this manuscript included observational studies, systematic reviews, clinical studies, and guideline-based recommendations cited in the source manuscript. Data on independent factors associated with hypothermia were presented as odds ratios and p-values when available. No new patient recruitment or primary data collection was performed; therefore, ethical approval and informed consent were not applicable to this manuscript.

ISSN (e): 3031-870X
Vol. 2 No.2 (2025)
https://journal.ajmpm.net/

Results

The main findings are presented in four areas: independent factors associated with hypothermia in trauma patients, harmful physiologic effects of hypothermia, practical temperature management strategies, and the relevance of prevention in tropical regions.

Early trauma studies demonstrated that hypothermia is common and associated with increased mortality. Mortality increases as body temperature decreases, and temperatures below 35°C on hospital arrival have been associated with a fourfold to fivefold increase in mortality.[5,8-11] Despite this risk, temperature measurement in trauma patients remains inconsistent in several settings.[12,13]

Hypothermia in trauma is associated with both patient-related and care-related factors. Wet patients, low Glasgow Coma Scale scores, and lower ambient temperature were associated with hypothermia at first arrival of a mobile intensive care unit (Table 1). Other factors associated with hypothermia on hospital arrival included intubation, head trauma, undressed patient status, revised trauma score, temperature of infused fluids, and mobile intensive care unit temperature at site arrival (Table 2).[14,15]

Table 1. Independent factors associated with hypothermia (body temperature <35°C) upon arrival of the mobile intensive care unit

Factor	Odds ratio (95% CI)	p-value
Wet patient	2.08 (1.08-4.00)	0.03
Glasgow Coma Score	0.87 (0.81-0.92)	<0.001
Ambient temperature	0.93 (0.91-0.96)	<0.001

Adapted from Lapostolle et al.[15]

Table 2. Independent factors associated with hypothermia (body temperature <35°C) upon hospital arrival of trauma patients managed by a mobile intensive care unit

Factor	Odds ratio (95% CI)	p-value
Intubation	4.23 (1.61-11.02)	0.003
Head trauma	2.78 (1.20-6.25)	0.01
Undressed patient	2.5 (1.11-5.56)	0.03
Revised trauma score	1.68 (1.29-2.20)	0.001
Temperature of infused fluids	0.85 (0.76-0.95)	0.003
MICU temperature upon arrival at site	0.83 (0.72-0.96)	0.01

MICU: mobile intensive care unit. Adapted from Lapostolle et al.[14]

Although hypothermia can reduce biochemical activity and has been studied for neuroprotection, clinical studies have not confirmed expected benefits in trauma patients. In trauma, harmful effects predominate. Hypothermia impairs coagulation-factor activity, promotes coagulopathy, reduces platelet aggregation, and may increase transfusion requirements.[22-27]

Hypothermia also affects the cardiovascular system. Below approximately 34°C, myocardial contractility, cardiac output, blood pressure, and heart rate may decrease. Peripheral vasoconstriction and increased blood viscosity may further compromise circulation, especially in hemorrhagic shock.[30,31]

Body temperature should be systematically measured and continuously monitored in trauma patients. In prehospital care, epitympanic temperature measurement may be practical, provided the probe is properly placed and insulated from environmental influences.[32] The target is to maintain body temperature at least 36°C.[1,5]

The patient should be rapidly protected from the environment. Undressing should be limited to situations in which clothing is wet. Emergency blankets, heated ambulances, active warming devices when available, and warmed intravenous fluids should be used. The HYPOTRAUM2 strategy combining continuous monitoring, thermal protection, heated mobile unit, and warmed fluids reduced hypothermia rates compared with conventional management (Table 3).[17,50]

ISSN (e): 3031-870X
Vol. 2 No.2 (2025)
https://journal.ajmpm.net/

Table 3. Strategy for prevention or correction of hypothermia in trauma patients

No.	Recommended strategy
1	Continuous measurement and monitoring of body temperature; epitympanic probe is practical for prehospital use.
2	Limit patient undressing to situations where clothing is wet.
3	Protect the patient with at least an emergency blanket.
4	Move the patient rapidly to a sheltered location, ideally inside the ambulance.
5	Place the patient in an ambulance heated to approximately 37°C.
6	Warm the patient; use an emergency blanket if active warming devices are unavailable.
7	Infuse warmed fluids at approximately 37°C.
8	Ensure rapid transport to a hospital facility.

Source: adapted from the strategy summarized in the uploaded source manuscript.

High outdoor temperatures do not eliminate the risk of hypothermia. In tropical settings, ambient temperature is often still lower than body temperature, and rain, wind, injury severity, and prehospital interventions can contribute to heat loss. In a French Guiana cohort, where the annual average temperature was approximately 26°C, hypothermia below 36°C occurred in trauma patients and was associated with higher mortality.[51]

Discussion

The findings emphasize that hypothermia is not restricted to cold climates. Trauma-related hypothermia should be viewed as a dynamic clinical condition caused by the interaction of environmental exposure, injury severity, physiologic failure, and therapeutic interventions. Tropical climate may reduce but does not remove the temperature gradient between the patient and the environment; additionally, rain, wind, wet clothing, hemorrhage, and prolonged extrication can accelerate heat loss.

The deleterious interaction between hypothermia, coagulopathy, and acidosis is particularly important in trauma care. Decreased coagulation enzyme activity, impaired platelet aggregation, and reduced cardiovascular performance can worsen hemorrhagic shock. These effects support a preventive approach, because correction after hypothermia develops may be more difficult than early thermal protection.

The practical implications are clear for prehospital and emergency settings. Temperature should be treated as a vital sign, measured early, and monitored continuously when possible. Basic measures such as limiting exposure, removing wet clothing only when necessary, using emergency blankets, placing patients rapidly in a sheltered or heated ambulance, and warming infused fluids are feasible steps that can be implemented even when advanced warming devices are unavailable.

This manuscript has limitations. The article is based on a narrative synthesis of available evidence and the source manuscript rather than newly collected prospective data. Some details from the scanned source, including one affiliation and selected bibliographic page data, were not fully legible and should be verified before journal submission.

Conclusion

Trauma patients are at risk of hypothermia, which is a poor prognostic factor. Hypothermia has harmful interactions with hemostasis and the cardiovascular system. Its causes are environmental, clinical, and therapeutic. Optimal management requires early measurement and continuous monitoring, prevention of heat loss, warming strategies, warmed fluids, and rapid transport. These measures should be applied worldwide, including in tropical regions.

Acknowledgments

None.

Funding

None.

Author Contributions

FL conceptualized the manuscript and contributed to literature interpretation and writing. DR, BM, and JMP contributed to literature interpretation, critical revision, and final approval of the manuscript.

Conflict of Interest

ISSN (e): 3031-870X
Vol. 2 No.2 (2025)
https://journal.ajmpm.net/

The authors declare no conflict of interest.

References

1. Perlman R, Callum J, Laflamme C, et al. A recommended early goal-directed management guideline for the prevention of hypothermia-related transfusion, morbidity, and mortality in severely injured trauma patients. Crit Care. 2016;20:107.
2. Waibel BH. Hypothermia in trauma patients: predicting the big chill. Crit Care. 2012;16:155.
3. Cannon JW. Hemorrhagic shock. N Engl J Med. 2018;378:1852-1853.
4. Gilbert M, Busund R, Skagseth A, et al. Resuscitation from accidental hypothermia of 13.7 degrees C with circulatory arrest. Lancet. 2000;355:375-376.
5. Rosli D, Schnuriger B, Candinas D, et al. The impact of accidental hypothermia on mortality in trauma patients overall and patients with traumatic brain injury specifically: a systematic review and meta-analysis. World J Surg. 2020;44:4106-4117.
6. Andrews PJD, Sinclair HL, Rodriguez A, et al. Hypothermia for intracranial hypertension after traumatic brain injury. N Engl J Med. 2015;373:2403-2412.
7. Gentilello LM, Jurkovich GJ, Stark MS, et al. Is hypothermia in the victim of major trauma protective or harmful? A randomized, prospective study. Ann Surg. 1997;226:439-447.
8. Luna GK, Maier RV, Pavlin EG, et al. Incidence and effect of hypothermia in seriously injured patients. J Trauma. 1987;27:1014-1018.
9. Jurkovich GJ, Greiser WB, Luterman A, et al. Hypothermia in trauma victims: an ominous predictor of survival. J Trauma. 1987;27:1019-1024.
10. Aitken LM, Hendrikz JK, Dulhunty JM, et al. Hypothermia and associated outcomes in seriously injured trauma patients in a predominantly sub-tropical climate. Resuscitation. 2009;80:217-223.
11. Balmer C, Hib N, Daley BJ, et al. Continued relevance of initial temperature measurement in trauma patients. Am Surg. 2022;88:424-430.
12. Mize J, Kozlo-McLain J, Lowenstein SR. The forgotten vital sign: temperature patterns and associations in 642 trauma patients. Am J Emerg Med. 1996;14:303-305.
13. Langhelle A, Lockey D, Harris T, et al. Body temperature of trauma patients on admission to hospital: a comparison of anaesthetised and non-anaesthetised patients. Emerg Med J. 2012;29:239-242.
14. Lapostolle F, Sebbah JL, Couvreur J, et al. Risk factors for onset of hypothermia in trauma victims: the HypoTraum study. Crit Care. 2012;16:R142.
15. Lapostolle F, Couvreur J, Koch FX, et al. Hypothermia in trauma victims at first arrival of ambulance personnel: an observational study. Am J Emerg Med. 2017;35:43-48.
16. Hsieh TM, Kuo PJ, Hsu SY, et al. Effect of hypothermia in the emergency department on outcome of trauma patients: a cross-sectional analysis. Int J Environ Res Public Health. 2018;15:1769.
17. Lapostolle F, Garrigue B, Richard O, et al. Prevention of hypothermia in trauma victims: the HYPOTRAUM2 study. J Adv Nurs. 2021;77:2908-2915.
18. Williams GR, Spencer FC. The clinical use of hypothermia following cardiac arrest. Ann Surg. 1958;148:462-468.
19. Yenari MA, Han HS. Neuroprotective mechanisms of hypothermia in brain ischaemia. Nat Rev Neurosci. 2012;13:267-278.
20. Chun H, Wu F, Yang P, et al. Therapeutic hypothermia after out-of-hospital cardiac arrest: a systematic review and meta-analysis. Ann Med Surg. 2022;74:103327.
21. Cooper DJ, Nichol A, Bailey M, et al. Effect of early sustained prophylactic hypothermia on neurologic outcomes among patients with severe traumatic brain injury. JAMA. 2018;320:2211-2220.
22. Rohrer MJ, Natale AM. Effect of hypothermia on the coagulation cascade. Crit Care Med. 1992;20:1402-1405.
23. Wolberg AS, Meng ZH, Monroe DM, et al. A systematic evaluation of the effect of temperature on coagulation enzyme activity and platelet function. J Trauma. 2004;56:1221-1228.
24. Brohi K, Cohen MJ, Ganter MT, et al. Acute coagulopathy of trauma: hypoperfusion induces systemic anticoagulation and hyperfibrinolysis. J Trauma. 2008;64:1211-1217.
25. Moore EE, Moore HB, Kornblith LZ, et al. Trauma-induced coagulopathy. Nat Rev Dis Primers. 2021;7:30.
26. Lester ELW, Fox EE, Holcomb JB, et al. The impact of hypothermia on outcomes in massively transfused patients. J Trauma Acute Care Surg. 2019;86:458-463.
27. Klauke N, Graff I, Fleischer A, et al. Effects of prehospital hypothermia on transfusion requirements and outcomes. Emerg Med J. 2016;33:493-499.
28. Watts DD, Trask A, Soeken K, et al. Hypothermic coagulopathy in trauma: effect of varying levels of hypothermia on enzyme speed, platelet function, and fibrinolytic activity. J Trauma. 1998;44:846-854.
29. Van Veelen MJ, Brodmann Maeder M. Hypothermia in trauma. Int J Environ Res Public Health. 2021;18:8719.

ISSN (e): 3031-870X
Vol. 2 No.2 (2025)
https://journal.ajmpm.net/

30. Tveita T, Ytrehus K, Myhre ES, et al. Left ventricular dysfunction following rewarming from experimental hypothermia. J Appl Physiol. 1998;85:2135-2139.
31. Paut O, Bissonnette B. Effects of temperature and haematocrit on blood flow velocity and blood flow. Br J Anaesth. 2002;88:277-279.
32. Hasper D, Nee J, Schefold JC, et al. Tympanic temperature during therapeutic hypothermia. Emerg Med J. 2011;28:483-485.
33. Dankiewicz J, Cronberg T, Lilja G, et al. Hypothermia versus normothermia after out-of-hospital cardiac arrest. N Engl J Med. 2021;384:2283-2294.
34. Henriksson O, Lundgren PJ, Kuklane K, et al. Protection against cold in prehospital care. Work. 2017;57:375-385.
35. Henriksson O, Bjornstig U, Saveman BI, et al. Protection against cold: a survey of available equipment in Swedish pre-hospital services. Acta Anaesthesiol Scand. 2017;61:1354-1360.
36. Nobben T, Fenwick R, Smith J, et al. A comparison of demographics, injury patterns and outcome data for patients injured in motor vehicle collisions who are trapped compared to those patients who are not trapped. Scand J Trauma Resusc Emerg Med. 2012;20:17.
37. Haverkamp FJC, Giesbrecht GG, Tan ECTH. The prehospital management of hypothermia: an up-to-date overview. Injury. 2018;49:149-164.
38. Webb P. Afterdrop of body temperature during rewarming: an alternative explanation. J Appl Physiol. 1986;60:385-390.
39. Savard GK, Cooper KE, Veale WL, et al. Peripheral blood flow during rewarming from mild hypothermia in humans. J Appl Physiol. 1985;58:4-13.
40. Mykkes S, Thomassen O. Afterdrop in prehospital use of active external warming: a systematic review. Scand J Trauma Resusc Emerg Med. 2017;25:287.
41. Ireland S, Endacott R, Cameron P, et al. The incidence and significance of accidental hypothermia in major trauma: a prospective observational study. Resuscitation. 2011;82:300-306.
42. Zafren K, Giesbrecht GG, Danzl DF, et al. Wilderness Medical Society practice guidelines for the out-of-hospital evaluation and treatment of accidental hypothermia. Wilderness Environ Med. 2014;25:S66-S85.
43. Singleton M, McLean M, Smale M, et al. An analysis of the temperature change in warmed intravenous fluids during administration in cold environments. Air Med J. 2016;35:127-130.
44. Horowitz PE, Delagarza MA, Pulaski JJ, et al. Cold flow rates and warming efficacy with Hotline and Ranger blood/fluid warmers. Anesth Analg. 1998;87:pages not legible in uploaded scan.
45. Piek R, Stein C. Three insulation methods to minimize intravenous fluid administration set heat loss. Prehosp Emerg Care. 2013;17:68-72.
46. Lapostolle F, Catineau J, Le Toumelin P, et al. Intravenous fluid temperature management by infrared thermometer. Am J Emerg Med. 2014;32:174-176.
47. Weatherall A, Gill M, Milligan J, et al. Comparison of portable blood-warming devices under simulated pre-hospital conditions: a randomised in-vitro blood circuit study. Anaesthesia. 2019;74:1026-1032.
48. Sessler DI. Perioperative thermoregulation and heat balance. Lancet. 2016;387:2655-2664.
49. Forristal C, Van Aarsen K, Columbus M, et al. Predictors of hypothermia upon trauma center arrival in severe trauma patients transported to hospital via EMS. Prehosp Emerg Care. 2020;24:15-23.
50. Lapostolle F, Debaty G, Silmani I, et al. Prevention of hypothermia in trauma victims: the HYPOTRAUM2 study. Resuscitation. 2024;196:110796.
51. Fremery A, Higel N, Ho-Kee-King B, Pujo JM, Martin A, Lapostolle F. Hypothermia in tropical east under reality: the multicenter study of trauma patients in tropical areas. Source details as cited in the uploaded scan.