State-of-the-Science Nursing Review

Temperature Management and Nursing Care of the Patient With Acute Ischemic Stroke

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The term targeted temperature management (TTM) encompasses both induced hypothermia and fever reduction (normothermia).\(^1\,^2\) For patients with acute ischemic stroke (AIS), the use of TTM has been increasingly explored as a form of neuroprotection.\(^3\,^4\) The growing body of TTM literature provides pathophysiologic evidence but does not specifically provide evidence to address the role of the nurse.\(^6\) Therefore, the purpose of this review is to provide a summary of the current state of the evidence for TTM nursing care of the patient with AIS.

**Background**

Although thrombolytic therapy (tissue-type plasminogen activator [tPA]) and mechanical thrombectomy are associated with improved outcome for AIS, a large percent of patients are unable to receive tPA based on various exclusion criteria.\(^7\) Recent estimates indicate that <30% of eligible patients receive tPA.\(^8\) So, there are ≈565,000 patients for whom neuroprotection will be a primary strategy.

Before the use of intravenous tPA, there were few therapeutic options to treat the vascular cause (blocked arterial blood flow) of an AIS event.\(^9\) Thus, throughout the majority of the 20th century, nursing research focused on stroke prevention and subsequent rehabilitation after AIS.\(^6\) With tPA, and now mechanical thrombectomy, the focus has shifted toward early intervention to restore blood flow. However, restoring flow to the penumbra is only part of the solution because neurons have to recover.

Evidence suggests that in patients with stroke or other brain injuries, fever is associated with worse outcomes, leading to higher mortality rate, disability, loss of function, and longer hospital stay.\(^9\) In response, cooling was developed as a neuroprotection for ischemic cerebral tissues. Cheung et al\(^10\) did systematic review of randomized controlled trials and found that despite differences in cooling protocols between the studies, the pooled results demonstrated that mild hypothermia is associated with statistically significant and clinically important decreases in hospital mortality and improvements in neurological outcome after cardiac arrest.\(^10\)

Despite the fact that TTM is a changing landscape, nursing care must continue to be delivered. Two recent articles provide direction to understand the nurses’ role. Olson et al\(^6\) divided the evidence by systems and provide 23 recommendations. Rockett et al\(^11\) discussed about TTM from a disease-driven perspective and provided additional insight by comparing results from a recent national survey with results noted in 2007 by the finding of Thompson et al\(^12\) that there was an 8% increase in respondents having institutional fever protocol specific for neurological patients. This shows positive change in evidence-based nursing practice for the past several years. On the basis of data available to date, cooling seems necessary and beneficial in patients with AIS, and more research is needed to provide evidence for nursing interventions.

**Methods**

A comprehensive literature review was performed to update a previously published set of recommendations.\(^6\) An online search was performed using combinations of the MeSH terms hypothermia, normothermia, and temperature cross referenced with the words nursing or nurse (in any field). To capture those publications since the 2011 article, a search was conducted from the years 2011 through 2015 to include human, full text, and clinical or randomized clinical trials. This yielded 46 articles. A secondary search based on reference lists from the 35 articles included in the 2011 article resulted in an additional 173 citations, for a total of 219. Then, for any article that was listed twice in data set, the second (duplicate) was removed, and 175 articles were left to review for title an abstract inclusion. Of these, 150 were: not English (9), not evidence-based (1), not adult (28), not stroke (81), not in hospital/critical care (6), not temperature management (13), and not nursing related (12). The 25 remaining articles were subjected to full-text read: 22 did not address nursing care, 2 did not address stroke or critically ill patients, and 1 was not evidence-based.

Next, combinations of the keywords (stroke, hypothermia, and nursing) were entered without being limited to MeSH terms. Five articles were found that contribute to evidence-based nursing care of the patient with stroke during TTM.\(^13\)–\(^17\) Finally, a secondary search of articles included in the review of Rockett et al\(^11\) was performed, which identified 2 additional articles that met inclusion criteria.\(^18\) One additional article was identified during the peer-review process.\(^20\)

**Results**

There were 7 new articles found that provided specific evidence to support TTM nursing care for AIS. Of these, 3 provided evidence that nurses can and should use a variety of TTM interventions.\(^15\)–\(^18\) Three articles provide evidence to support TTM practice protocols.\(^13\)–\(^18\) One provided evidence...
to support shivering assessment.\textsuperscript{16} One provided evidence about temperature measurement.\textsuperscript{17}

**Discussion**

The 2011 summary provided 23 recommendations based on data from 35 articles.\textsuperscript{6} This review found only 7 recent articles that provide new data to specifically guide evidence-based nursing practice for the TTM patient. The original 23 recommendations were revised and condensed for clarity, which resulted in 8 specific recommendations scored using the American College of Cardiology/American Heart Association grading schema (Table).\textsuperscript{21}

The strongest revised recommendation (class-I level-B evidence) is that nurses should develop protocols for TTM that include induction (initial phase during which the patient’s temperature is lowered until the target temperature is reached), maintenance (the phase during which the target temperature is maintained), and rewarming (the phase during which patient is rewarmed until normal temperature is reached) during TTM. These protocols should address monitoring for pain and sedation level, shivering, ventilator-associated pneumonia symptoms, arrhythmias, volume status, skin breakdown, and abnormal laboratory values. This recommendation amalgamates more than a dozen of the 2011 recommendations for which the common thread is the need for structured monitoring during TTM. Two new citations\textsuperscript{13,18} were added in support of this recommendation. There is no evidence that protocols are harmful, but it fails to meet the strength of evidence required for a level-A evidence rating.

The 2 recommendations that (1) nurses should use a variety of TTM interventions, including surface and intravascular, pharmacological, and nonpharmacological\textsuperscript{15,18,19} and (2) it is reasonable to include surface counterwarming to treat shivering\textsuperscript{16} are both graded class-IIa level-B evidence. There is strong recommendation that nurses should use continuous temperature monitoring during TTM (class-I level-C evidence).\textsuperscript{17} The recommendation that nurses should treat abnormal blood glucose using insulin therapy protocols specific to the needs of the TTM patient is similar to the 2011, recommendations except that intravenous insulin protocols are de-emphasized. Recent literature discussing the use of IV intravenous in neurocritical care calls into question whether intravenous infusion is the best option.\textsuperscript{22}

There were 3 recommendations for which there are no new data, and these recommendations have been remaining unchanged from 2011. The recommendation that nurses should reposition patients at least once every 2 hours during TTM and the recommendation that nurses should initiate, maintain nutritional support, and monitor the nutritional status of patients during TTM are both graded class-IIa level-C evidence. The recommendation that nursing work assignments should be adjusted for patients undergoing TTM remains class-IIa level-B evidence.

It is a recognized limitation that this review includes only research that specifically addresses nursing care of the TTM patient. Although articles included were not required to have nursing authors, they were required to identify the role or effect of nursing. Hence, articles that may provide secondary evidence for nurses may not have been considered.

**Conclusions**

The lack of class-I level-A recommendations is a clear signal that there is further need to study nursing interventions associated with TTM and AIS. The internal validity of clinical trials of TTM and stroke is at least partially dependent on nursing care. As more of the nursing care surrounding TTM becomes evidence-based, researchers will be more apt and able to incorporate these practices into study design. The results confirm and extend the sentiments of previous authors who call for research that provides evidence on which to base nursing interventions during TTM.\textsuperscript{5,23}

**TAKE-HOME POINTS**

- The strongest evidence to date continues to support nursing care of the targeted temperature management should be guided by comprehensive evidence-based protocols.
- There is a critical need for additional research to fully explore the contribution of specific nursing interventions for patients with stroke who receive targeted temperature management.
Disclosures
Dr Olson received speaker’s bureau funding from Bard Medical. Dr Kurashvili reports no conflicts.

References

**Key Words:** nursing – stroke – temperature – tissue-type plasminogen activator
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*Stroke*. 2015;46:e205-e207; originally published online July 28, 2015; doi: 10.1161/STROKEAHA.115.010077

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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