2-2019

Temperature Management: All Shook Up! Managing Shivering In Normothermia

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All Shook Up!
Managing Shivering During TTM

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Objectives

- Identify key factors related to maintaining normothermia
- Describe the use of the Bedside Shivering Assessment Scale
- Provide interventions to manage shivering in the Neuro patient population.

Speaker Disclosures

- Neurocritical Care Society
  - Vice President/Board of Directors
- Honorarium
  - Bard
- Medical Advisory Board
  - Brain Trauma Foundation
  - Neuroptics/Cerebrotech
  - Ceribell
- Stock Options
  - Neuroptics/Cerebrotech/Ceribell

Session Goal

Implement tools to assess shivering in normothermia and hypothermia and apply evidence-based strategies to control shivering.

Session Topics

- Definition of Targeted Temperature Management (TTM) and target populations for its use
- The consequence of shivering
- Tools to assess shivering at the bedside
- Pharmacologic and non-pharmacologic strategies to control shivering

Forms of Target Temperature Management

- **Controlled normothermia:** Reduce core temperature, maintain at 36.0°C–37.5°C
- **Therapeutic Hypothermia:** Intentionally reduce core temperature below 36.0°C (32°C–35°C)

Mild	Moderate	Moderate/deep	Deep
35.0°C	**33.9°C**	**31.9°C**	**<30.0°C**
34.0°C	**32.0°C**	**30.0°C**	

Situation: Your patient is a 48 year old female status post ruptured cerebral aneurysm (coiled). Grade IV Hunt and Hess. Day 6 – team is trying to control temperature that has elevated to 38 degrees C. Pt is intubated/sedated on propofol/fentanyl. ICP is 20-25 mm Hg. Interventions include Acetaminophen, ice bags, and cooling measures. The patient is shivering and the temperature is escalating.

Question: What is your temperature threshold for intervention?

1. 37 degrees C
2. 38 degrees C
3. 38.5 degrees C
4. 39 degrees C

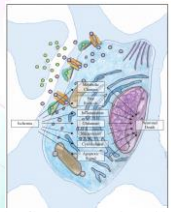
The Good…
The Bad…
The Ugly…

of Temperature

https://fineartamerica.com/featured/clint-eastwood-the-good-the-bad-and-the-ugly-spiros-soutsos.html

Elevated Temperature Causes:

- In the neurologic injured brain or ischemic/anoxic brain



Cellular derangements
Cell damage
Cell death

Hyperthermia exacerbates ischaemic brain injury

C. X. Wang[1,2*], A. Stroink[1], J. M. Casto[2], and K. Kattner[1,2]

Fig. 1 Mechanisms of hyperthermia-enhanced neuronal death in the ischaemic injured brain.

 International Journal of Stroke Vol 4, August 2009, 274–284

Evidence: Hyperthermia and Outcomes

In critically ill neurosurgical patients ▪ 47% of patients had febrile episodes with a mean of 4.7 febrile episodes/patient ▪ Fever seen in 93% of patient who had ICU LOS >14 days	Kilpatrick et al 2000
4925 patients admit to Neuro ICU ▪ Elevated temperature associated with □ Increased ICU stay (3.2days) and hospital LOS (4.3 days) □ Higher mortality rate □ Worse hospital disposition	Diringer et al 2004
▪ **Treatment-refractory fever in the first 10 days after subarachnoid hemorrhage is associated with increased mortality and disability**	**Fernandez, et al 2007**
▪ In acute ischemic stroke, fever or higher body temperature was sign	Greer et al 2008
▪ In acute ischemic stroke patients, the later the hyperthermia occurs within the first week, the worse the prognosis	Saini, et al 2009

Kilpatrick MM, et al. *Neurosurgery*. 2000;47(4):850-856.
Diringer MN, et al. *Crit Care Med*. 2004;32(7):1489-1495.
Fernandez A, et al. Neurology. 2007;68(13):1013-1019.
Saini M, et al. *Stroke*. 2009;;40(9):3051-3059.


Hyperthermia in the Neurosurgical Intensive Care Unit

Critical Care Medicine

Elevated body temperature independently contributes to increased length of stay in neurologic intensive care unit patients*

Fever after subarachnoid hemorrhage: Risk factors and impact on outcome

Impact of Fever on Outcome in Patients With Stroke and Neurologic Injury: A Comprehensive Meta-Analysis

Effect of Hyperthermia on Prognosis After Acute Ischemic Stroke

Fever Burden & Modified Rankin in SAH

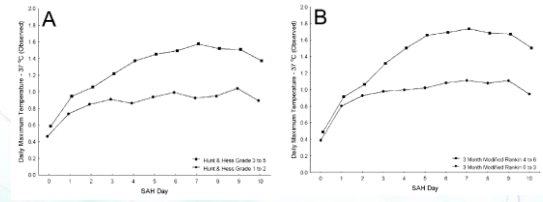


Figure 2. Mean daily T_{max} during the 10-day study period stratified by admission Hunt-Hess grade (A) and 3-month outcome according to the modified Rankin Scale (B). A modified Rankin Scale of 4 to 6 indicates death or moderate to severe disability.

Fever after subarachnoid hemorrhage: Risk factors and impact on outcome
A. Fernandez, J. M. Schmidt, J. Claassen, M. Pavlicova, D. Huddleston, K. T. Kreiter, N. D. Ostapkovich, R. G. Kowalski, A. Parra, E. Sander Connolly and S. A. Mayer
Neurology 2007;68:1013-1019; originally published online Feb 21, 2007;
DOI: 10.1212/01.wnl.0000259543.45879.f5

1016 NEUROLOGY 68 March 27, 2007

Presence of hyperthermia post CA

Study evaluated prevalence of fever in the first 48 hours after cardiac arrest and impact on outcomes

Northwestern and Pittsburgh

- Methods
  - Records from 1/2005-6/30/2010 reviewed for presence of Fever (T≥38C)
    - 336 patients mean age 60 years
    - 63% Out of hospital CA (shockable rhythm 40%)
    - Fever present in 42% of subjects post arrest with median onset of 15 h in non-TH cohort and 36 h in TH cohort
    - Fever common development
    - Fever is associated with death in non-TH patients
    - TH treatment may mitigate the effect

Prevalence and effect of fever on outcome following resuscitation from cardiac arrest☆

Kory Gebhardt[a], Francis X. Guyette[b], Ankur A. Doshi[b], Clifton W. Callaway[b], Jon C. Rittenberger[b,c], The Post Cardiac Arrest Service[b]

Rebound hyperthermia post HACA

Michigan State and Grand Rapids MI

- Risk factors for post rewarming rebound hyperthermia in CA patients undergoing TTM
  - Presence of rebound hyperthermia was associated with an increased risk of in-hospital mortality.
    - 40 of 99 patients (40.4%) without rebound hyperthermia experienced any cause in hospital death
    - 27 of 42 patients (64.3%) patients who experienced rebound hyperthermia had increased risk of in-hospital mortality

Rebound hyperthermia is associated with increased neurologic morbidity as measured by the modified Rankin scale. The two-sided Mann–Whitney *U* test between the two groups of patients gives $p = 0.011$, suggesting that there is a statistically significant difference in neurologic morbidity as measured by a modified Rankin scale between patients that experience rebound hyperthermia and those that do not.

Clinical paper

Assessment of risk factors for post-rewarming "rebound hyperthermia" in cardiac arrest patients undergoing therapeutic hypothermia☆

S.A. Winters[a,c,*], K.H. Wolf[b], S.A. Kettinger[a], E.K. Seif[a], J.S. Jones[a,c,d,e], T. Baron-Bagsley[a]

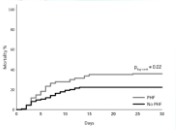
Rebound hyperthermia post HACA

Denmark

Post-hypothermia fever is associated with increased mortality after out-of-hospital cardiac arrest☆

John Bro-Jeppesen[a,b,*], Christian Hassager[a], Michael Wanscher[b], Helle Søholm[c], Jakob H. Thomsen[a], Freddy K. Lippert[c], Jacob E. Møller[a], Lars Køber[a], Jesper Kjaergaard[a]

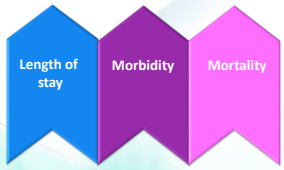
- Presence of hyperthermia post HACA
  - 2004-2010: 270 patients resuscitated after OHCA and survived 24 hour s TH (32-34C)
    - Group 1: Peak Temperature > 38.5 C within 36h of rewarming
      - 36% 30 day mortality rate
    - Group 2: Peak Temperature <38.5 C within 36 h of rewarming
      - 22% 30 day mortality rate
    - Maximum temperature & duration of PHF independent predictors of 30 day mortality



The maximum temperature (HR = 2.0 per °C above 36.5 °C (95% CI: 1.4–3.0), $p = 0.0005$) and the duration of PHF (HR = 1.6 per 8 h (95% CI: 1.3–2.0), $p < 0.0001$) were also independent predictors of 30-days mortality in multivariable models. Good neurological outcome (CPC1-2) versus unfavourable outcome (CPC3-5) at hospital discharge was found in 61% vs. 39% in the PHF group compared to 75% vs. 25% in the No PHF group, $p = 0.02$.

Conclusions: Post-hypothermia fever ≥38.5 °C is associated with increased 30-days mortality, even after controlling for potential confounding factors. Avoidance of PHF as a therapeutic target should be evaluated in prospective randomized trials.

Elevated Temperature in Neurologic Patients Increases:



Question:
Does controlling temperature help????

Evidence: Induced Normothermia Improves Outcomes

- Hata et al 2007
  - Prospective randomized study 10 ICU brain injured patients with T> 38 degrees C
    - Treated with acetaminophen
    - 1 hour indirect calorimetry baseline and 4 hours during cooling method with pad system
    - Reduced temperature from 38.6 degrees C to 36.3 degrees C
      - No Shivering present: VO2 (oxygen consumption) significantly reduced
      - Shivering present: VO2 unchanged
    - Conclusion: Reducing fever in BI appears to significantly reduce systemic VO2 but is depending on shivering

Fever Reduction to decrease systemic oxygen consumption

Evidence: Induced Normothermia Improves Outcomes

- Reduces cerebral metabolic distress (patients with subarachnoid hemorrhage irrespective of ICP)

Oddo, et al 2009

- Reduces fever burden
- Attenuates secondary injury
- Reduces intracranial hypertension burden

Puccio, et al 2009

Induced Normothermia Attenuates Cerebral Metabolic Distress in Patients With Aneurysmal Subarachnoid Hemorrhage and Refractory Fever

Ava M. Puccio · Michael R. Fischer · Brian T. Jankowitz · Howard Yonas · Joseph M. Darby · David O. Okonkwo

Oddo M, et al. *Stroke*. 2009;40(5):1913-1916.
Puccio AM, et al. *Neurocrit Care*. 2009;11(1):82-87.

Temperature and Metabolism

Table 2. Attenuation of Cerebral Metabolic Distress by Induced Normothermia: Relationship With Patient Outcome

	Lactate/Pyruvate Ratio			Cerebral Metabolic Crisis		
Outcome	Fever	Induced Normothermia	*P*	Fever	Induced Normothermia	*P*
Poor outcome (n = 7)	67 ± 56	39 ± 21	<0.001	58%	28%	<0.001
Good outcome (n = 11)	38 ± 41	32 ± 36	<0.05	16%	8%	<0.05

Cerebral metabolic crisis indicates No. of hourly measurements with microdialysis lactate/pyruvate ratio >40. Data are expressed as mean ± SD.

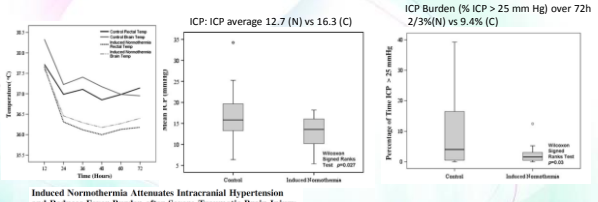
Induced Normothermia Attenuates Cerebral Metabolic Distress in Patients With Aneurysmal Subarachnoid Hemorrhage and Refractory Fever

Oddo et al Temperature and Cerebral Metabolism After SAH 1915

Differences between Induced Normothermia vs Control

ICP: ICP average 12.7 (N) vs 16.3 (C)

ICP Burden (% ICP > 25 mm Hg) over 72h 2/3%(N) vs 9.4% (C)



Induced Normothermia Attenuates Intracranial Hypertension and Reduces Fever Burden after Severe Traumatic Brain Injury

Ava M. Puccio · Michael R. Fischer · Brian T. Jankowitz · Howard Yonas · Joseph M. Darby · David O. Okonkwo

Neurocrit Care (2009) 11:82–87

TTM: Target Populations for Normothermia in ICU

Neurological injury (targeted duration: # days)	
Traumatic brain injury	7
Ischemic stroke	7
Intracerebral hemorrhage	7
Subarachnoid hemorrhage	≤ 14
Spinal cord Injury	7

Post cardiac arrest

- Once patient returns to 37°C following hypothermia treatment
- 72 hours in duration

Hypothalamus: Set Point

Thermoreceptors sense temp increase → Warm sensitive neuron ↑firing rate → Signal heat loss effector neuron:
- vasodilation
- ↑sweating
- ↑blood flow

37°C … Normal body temp

Thermoreceptors sense temp decrease → Cold sensitive neuron ↑firing rate → Signal heat production effector neurons
- vasoconstriction
- **SHIVERING**

Boulant JA. *Clin Infect Dis.* 2000;31 Suppl 5:S157-S161.

TTM Implementation

Success is Dependent on adequate:

- Hypothermia Induction assistance
  - Iced saline (30 ml/kg) at 4 °C
  - Surface external adhesive pads
  - Surface blanket devices
  - Intravascular devices
- Normothermia
  - Acetaminophen IV or per rectum
  - Cool room, wet towels, ice bags
  - Iced saline 20 mL/kg at 4°C bolus over 30 min x 1
  - Surface external adhesive pads
  - Surface blanket devices
  - Intravascular devices

Temperature gradient (actual–37°C)

Sedation/ analgesia

Associated conditions (ie, ICP elevated)

Shivering is identified as one of the most frequent consequences of TTM

Who experienced more shivering?

Surface cooling n = 92	Core cooling n = 75
24%	27%

Tomte Ø, et al. *Crit Care Med.* 2011;39(3):443-449.

TABLE 2. ANTISHIVERING MEDICATION REQUIREMENTS

Total interventions	SC (n = 152)	EC (n = 97)	p
Number of shivering medications per patient day–mean (SD)	2.66 (1.65)	3.28 (1.21)	0.002*
ATC medications[b]			
Acetaminophen, *n* (%)	89 (58.6)	79 (81.4)	<0.001*
Buspirone, *n* (%)	81 (53.3)	73 (75.3)	<0.001*
Step 1 medications[b]			
Dexmedetomidine, *n* (%)	83 (54.6)	57 (58.8)	0.601
Magnesium infusion, *n* (%)	55 (36.2)	50 (51.5)	0.012*
Any fentanyl, *n* (%)	41 (27.0)	38 (39.2)	0.051
Bolus, *n* (%)	26 (17.1)	24 (24.7)	0.148
Infusion, *n* (%)	20 (13.2)	17 (17.5)	0.365
Step 2 medications[b]			
Propofol, *n* (%)	53 (34.9)	18 (18.6)	0.006*

Assessment of Antishivering Medication Requirements During Therapeutic Normothermia: Effect of Cooling Methods

Question: Energy expenditures for patients shivering in their arms/legs is estimated at how many kilocalories/day?

1. 1400 kcal/day
2. 2000 kcal/day
3. 3000 kcal/day
4. 3600 kcal/day

Normothermia

- Maintaining temperature at 36-37 degrees C

Metabolic Impact of Shivering During Therapeutic Temperature Modulation
The Bedside Shivering Assessment Scale

Neeraj Badjatia, MD, MSc; Evangelia Strongilis, RD; Errol Gordon, MD; Mary Prescutti, RN; Luis Fernandez, MD; Andres Fernandez, MD; Manuel Buitrago, MD, PhD; J. Michael Schmidt, PhD; Noeleen D. Ostapkovich, MSc; Stephan A. Mayer, MD, FCCM

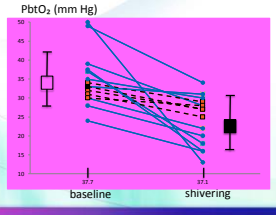
Results—Fifty consecutive cerebrovascular patients underwent indirect calorimetry between January 2006 and June 2007. Fifty-six percent were women, and mean age 63±16 years. The majority underwent fever control (n=40 [80%]) with a surface cooling device (n=44 [87%]) and had signs of shivering (Bedside Shivering Assessment Scale >0, 64% [n=34 of 50]). Low serum magnesium was independently associated with the presence of shivering (Bedside Shivering Assessment Scale >0; OR, 6.8; 95% CI, 1.7 to 28.0; P=0.01). The Bedside Shivering Assessment Scale was independently associated with the hypermetabolic index (W=16.3, P<0.001), oxygen consumption (W=26.3, P<0.001), resting energy expenditure (W=27.2, P<0.001), and carbon dioxide production (W=18.2, P<0.001) with a high level of interobserver reliability (κ_w=0.84, 95% CI, 0.81 to 0.86).

Conclusion—The Bedside Shivering Assessment Scale is a simple and reliable tool for evaluating the metabolic stress of shivering. (***Stroke.* 2008;39:3242-3247.**)

REE, kcal/d	1390±383	1730±481	2303±688	3686±960	<0.001
O_2 consumption, mL/min	198±62	251±74	337±119	568±152	<0.001
CO_2 production, mL/min	165±36	200±61	233±55	325±93	<0.001

Effect of Shivering on Brain Tissue Oxygenation

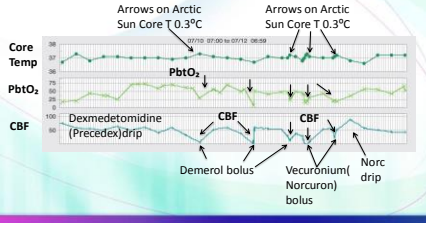
During Induced Normothermia in Patients with Severe Brain Injury



The occurrence of shivering is associated with significant reduction of $PbtO_2$

Oddo M, et al. *Neurocrit Care*. 2010;16:10-16.

CBF, Brain Oxygen, and Shivering



Shivering Assessment Methods

1. Subjective:
   - Observe for piloerection (goosebumps)
   - Bedside Shivering Assessment Scale (BSAS)
2. Objective:
   - Bispectral index (BIS)monitoring

1. Subjective: BSAS

Type of Shivering

Prevent rigorous shivering

Assess every hour

Use BSAS: Goal ≤1

- Look for goosebumps (piloerection)
- Palpate pectoralis muscle and neck/mandible region
- Humming or vibration is an early indication of shivering

0: No shivering	No shivering is detected on palpation of the masseter, pectoralis, deltoids, or quadriceps muscles
1: Mild	Shivering localized to neck and/or chest
2: Moderate	Shivering involving arms and neck and/or chest
3: Severe	Intermittent generalized shivering involving all 4 extremities

Badjatia N, et al. *Stroke*. 2008;39:3242-3247.

Question: What types of technology used at the critical care bedside is helpful in detecting shivering?

1. EEG
2. Bispectral Index Monitor
3. Train of 4
4. Shiverometer

2. Objective: BIS Shivering Assessment:

Pre-intervention

Patient sedation with midazolam and fentanyl. Hypothermia at 33°C
BIS =75
EMG = Max BSAS = 0

Post-intervention

Patient bolused with norcuron
BIS = 33
EMG = 0
BSAS = 0

The Implementation of Targeted Temperature Management: An Evidence-Based Guideline from the Neurocritical Care Society

NEUROCRITICAL CARE SOCIETY

In neurocritical care patients undergoing TTM, should shivering be assessed using standardized tools?

Studies	Design	Comments	Overall Quality of Evidence
Accuracy of tool (Outcome)			
Badjatia	Cohort	BSAS validation utilising energy expenditure measurements	⊕⊕⊕ MODERATE
Olson	Cohort	Inter-rater reliability in diverse user groups. No randomization, 5 observers, most pts shiver less one confounder	⊕⊕ LOW
Length of stay, energy expenditure, patient experience, burden of care, accuracy of tool			
May	Cohort	dEMG correlated with BSAS. Difference between 0 ,1 statistically different	⊕⊕ LOW
Earp	Cohort	Cardiac bypass (n= 28) population. Ratio change between PA and bladder ratio measurement	
Death, increased energy expenditure, increased shivering (Outcome).			
Sund-Lavendar	Quasi-experimental	Tympanic & toe tip measurement (n=7). Increased T and shivering. Patient risk used invalidated shiver scale, interventions not controlled	⊕ VERY LOW

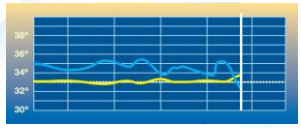
- BSAS only measurement tool identified in literature
- Additional data regarding impact on length of stay or long term outcome lacking

neurocritical care society Neurocrit Care DOI 10.1007/s12028-017-0469-5

2. Objective Shivering Assessment: Water Temperature —

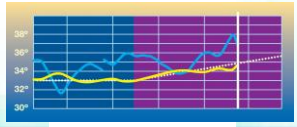
Pre-intervention

Water temp 11.9°C with patient temp escalating past the 33°C set point

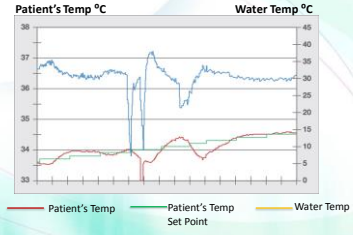


Post intervention

Water temp 30.4°C with patient temp stable on slope — rewarming to 37°C



Shivering: How to Recognize



Helpful Tips for Controlling Shivering

MONITOR!

- Water and patient temperature and trend indicator
  - Watch for drop in water temp to <12°C
  - >1 arrow = overexertion and machine is working hard to reduce patient temperature
- Foley temperature probe position
  - Assure Foley is wrapped in towel and is positioned straight down to end of bed
    - Prevents backflow of urine
- Esophageal temperature probe correct placement
- Microshivering
  - Check BIS and watch EMG line for activity
  - Look for elevated goosebumps or feel for raised bumps

NEUROCRITICAL CARE SOCIETY

The Implementation of Targeted Temperature Management: An Evidence-Based Guideline from the Neurocritical Care Society

In neurocritical care patients undergoing TTM, does treatment of shivering result in similar functional outcomes as compared to no treatment?

Studies	Design	Comments	Overall Quality of Evidence
Shiver (Critically Important)			
Mort	RCT	Post-op cardiac patients randomized to warm blankets or forced warm air	⊕⊕ LOW
Badjatia	Crossover cohort	Indirect calorimetry (IDC) measured during TTM during surface counterwarming (> 30m), after counterwarming removed & again when counterwarming reinitiated	
Lascarrou	Cohort	Retrospective review of TTM after CA with + coma for variations in use & outcomes between those that received NMBA or not	
Sladen	Cohort	Evaluation of meperidine 50-75 mg and vecuronium (vec) bolus & continuous infusion for shiver in post cardiac surgery patients	
Choi	Cohort	Evaluation of step-wise treatment for shiver based on BSAS showed overall ability to treat shivering effectively utilizing stepwise approach	
May	Cohort	During induction and maintenance of TTM; Propofol, lorazepam, midazolam, dexmetomidine; fentanyl	
Jurado	Cohort	Compared vecuronium continuous infusion compared to bolus dosing during TTM	
Milne	RCT	Propofol 2mg/kg/h vs midazolam titrated to RASS post-op CABG with VO_2 monitoring	
Perman	Cohort	Compared sedation/analgesia given between those cooled to 33°C vs 36°C. No difference in medications given between groups	

- Despite universal acceptance that shivering is detrimental, few studies investigating impact of anti-shivering therapies.
- Most studies have investigated impact of CW or use of paralytics

neurocritical care society Neurocrit Care DOI 10.1007/s12028-017-0469-5

NEUROCRITICAL CARE SOCIETY

The Implementation of Targeted Temperature Management: An Evidence-Based Guideline from the Neurocritical Care Society

In neurocritical care patients undergoing TTM, does treatment of shivering result in similar functional outcomes as compared to no treatment?

Good Practice Statements
Clinicians should treat shivering promptly.
We suggest a step-wise approach to shivering which prioritizes non-sedating interventions (acetaminophen, counterwarming, magnesium) over narcotic analgesics, sedatives, or paralytics.

neurocritical care society Neurocrit Care DOI 10.1007/s12028-017-0469-5

Prevention of Shivering During TTM: The Columbia Anti-shivering Protocol

Step		Intervention
0	Baseline	▪ Acetaminophen ▪ Buspirone ▪ Magnesium sulfate ▪ Skin counter warming
1	Mild sedation	▪ Dexmedetomidine ***or*** opioid
2	Moderate sedation	▪ Dexmedetomidine ***and*** opioid
3	Deep sedation	▪ Propofol
4	Neuromuscular blockade	▪ Vecuronium

Choi HA, et al. *Neurocrit Care*. 2011;14(3):389-394.

Columbia Group Experience: TTM patients

- 18% had shivering controlled with:
  - Counterwarming
  - Buspirone
  - Acetaminophen
  - Magnesium
- 50% of time added dexmedetomidine infusion then
  - Opiates
  - Propofol (<10% of time)
- Factors influence use of antishivering agents:
  - Age
  - Gender
  - BSA: may be associated with muscle mass
  - Young man higher muscle mass—more shivering

Choi, Neurocrit Care 2011 Jun;14(3):389-394

Guidelines to Assist with Hospital Based Guidelines

NEUROCRITICAL CARE SOCIETY

neurocritical care society Neurocrit Care
DOI 10.1007/s12028-017-0469-5

The Implementation of Targeted Temperature Management: An Evidence-Based Guideline from the Neurocritical Care Society

Lori Kennedy Madden[1] · Michelle Hill[2] · Teresa L. May[3] · Theresa Human[4] · Mary McKenna Guanci[5] · Judith Jacobi[6] · Melissa V. Moreda[7] · Neeraj Badjatia[8]

Question: Which of the following should be used first to counter shivering?

1. Paralytic
2. Warmed Normal saline
3. Meperidine
4. Forced warm air devices/bath blankets

Nonpharmacological Management of Shivering

- **Why does counterwarming work?**

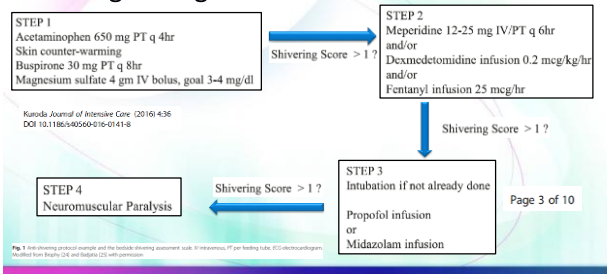
Baseline mean skin temperature contributes approximately:

20%

to the input the hypothalamus receives about body temperature

Insulation of cutaneous thermoreceptors on hands, feet, and head
- Hot packs to palms of hands and soles of feet
- Socks
- Head wrap (towel)
- Bair Hugger

Shivering Management



Kuroda *Journal of Intensive Care* (2016) 4:36
DOI 10.1186/s40560-016-0141-8

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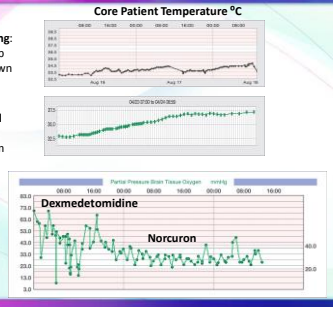
Cases: Shivering Response During Rewarm

Shivering: temp up and down

Good control during rewarm



Guidelines to Assist with Hospital Based Guideline

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

Pimen Kurashvili, MD; DaiWai Olson, PhD, RN

(*Stroke*. 2015;46:e205-e207. DOI: 10.1161/STROKEAHA.115.010077.)

Table. Summary of Recommendations

Recommendations (New References)	Class	Evidence
Nurses should develop protocols for TTM that included induction, maintenance, and rewarming during TTM.[10,18,20] These protocols should address monitoring for pain and sedation level, shivering, VAP symptoms, arrhythmias, volume status, skin breakdown, and abnormal laboratory values[20]	I	Level B
It is reasonable for nurses to use a variety of TTM interventions, including surface and intravascular, pharmacological, and nonpharmacologic[15,18,19]	IIa	Level B
Nurses should use continuous temperature monitoring during TTM[17]	I	Level C
It is reasonable to include surface counterwarming along with pharmacological interventions to treat shivering[16]	IIa	Level B
It is reasonable for nurses to reposition patients at least once every 2 h during TTM	IIa	Level C
Nurses may consider treating abnormal blood glucose using insulin therapy protocols specific to the needs of the TTM patients	IIb	Level C
It is reasonable for nurses to initiate, maintain nutritional support, and monitor the nutritional status of patients during TTM	IIa	Level C
Nurses may consider adjusting work assignments for patients undergoing TTM	IIb	Level C

TTM indicates targeted temperature management; and VAP, ventilator-associated pneumonia.

Guidelines to Assist with Hospital Based Guideline

Guidelines for the Management of Aneurysmal Subarachnoid Hemorrhage
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association
DOI: 10.1161/STR.0b013e3182587839

Guidelines for the Management of Spontaneous Intracerebral Hemorrhage
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association
DOI: 10.1161/STR.0000000000000069

2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association
DOI: 10.1161/STR.0000000000000158

TRAUMATIC BRAIN INJURY: ACS 2015

Summary

- Targeted temperature management is aimed at limiting the cascade of damage following injury
- Both normothermia and targeted hypothermia are important strategies to limit damage; both can cause shivering
- Assess the patient hourly with subjective and objective methods: the Bedside Shivering Assessment Scale (BSAS) and BIS and EMG monitoring
- Identify and treat shivering as early as possible to prevent rigorous shivering and worsening neuro insult