West Virginia University Healthcare
Shivering Protocol

Therapeutic hypothermia and therapeutic normothermia are commonly prescribed modalities in the treatment of refractory ICP, fever and post-arrest coma. A consequence of thermomodulation is shivering. Shivering increases a patient's systemic oxygen consumption, brain tissue oxygenation and raises intracranial pressures which can be prevented with deep sedation and in some cases, paralysis. Although deep sedation and paralysis are effective means to treating shivers, they are not without consequence. Heavy use of sedatives have been associated with prolonged mechanical ventilation, increased length of stay and ICU delirium. Pharmacologic paralysis specifically has been linked to critical illness polyneuropathy and myopathies.

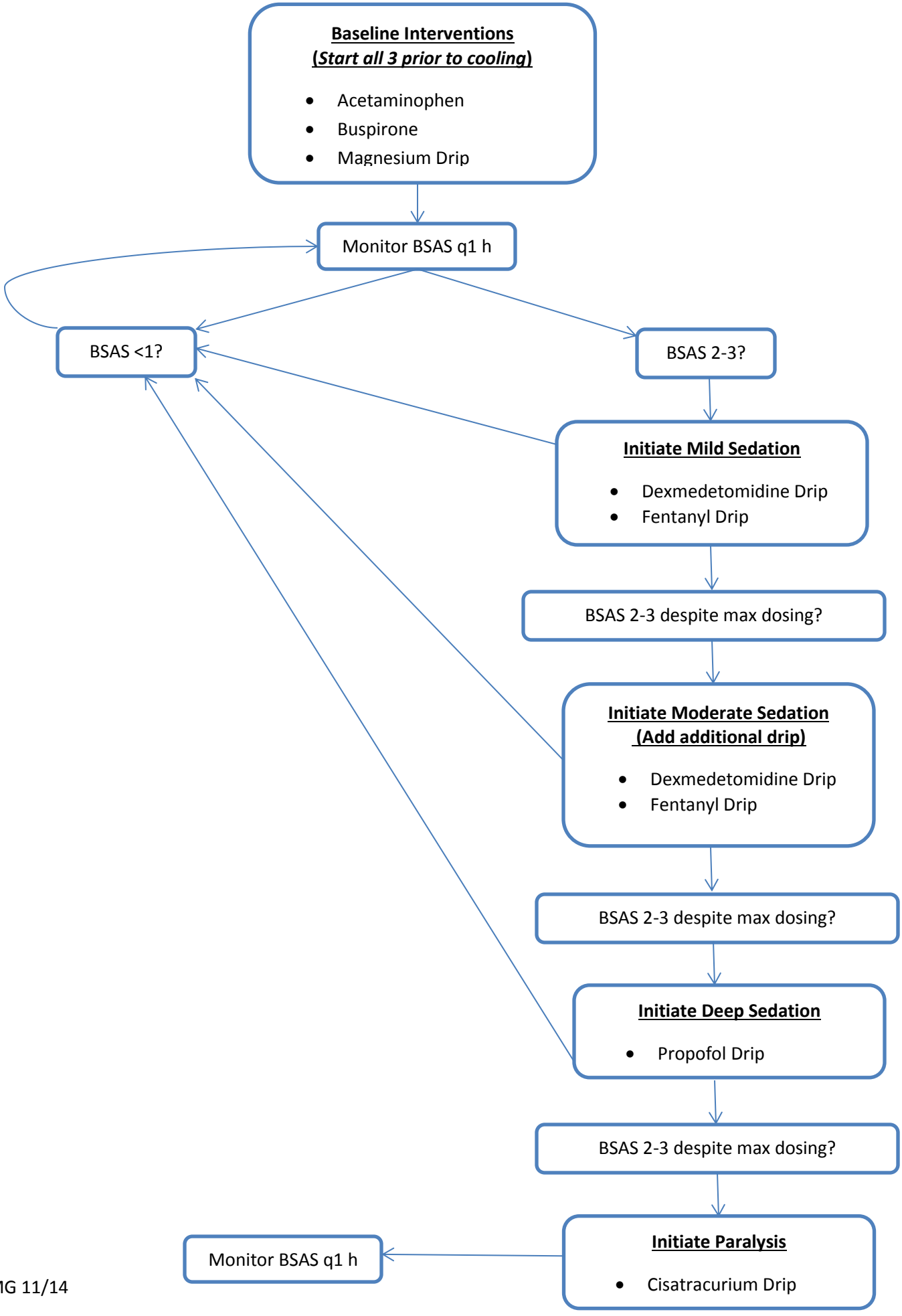
WVU has adopted the Columbia Protocol to reduce shivers and the risk of oversedating/paralyzing patients during thermomodulation. Titration of medications is based off the Bedside Shivering Assessment Scale (BSAS). The Columbia Protocol was validated by a single center prospective study that had 213 patients enrolled. The protocol was used in patients maintaining normothermia as well as those with induced hypothermia. In 18% of patients and 33% of the total patient days, only non-sedating baseline interventions were needed to prevent shivers. A total of 5 patients (2.4%) required pharmacologic paralysis. Younger men and patients with decreased body surface area were at risk for requiring more interventions. Overall, the protocol was successful in preventing shivers in a significant portion of patients undergoing temperature modulation without over-sedation or paralysis. WVUH's implementation of the protocol is outlined below.

Bedside Shivering Assessment Scale (BSAS)[1]

Score	Term	Description
0	None	No shivering on palpation of the masseter, neck or chest wall and no electrophysiological evidence of shivering
1	Subclinical	Electrophysiological evidence of shivering (using EKG), without clinical evidence of shivering
2	Mild	Shivering localized to the neck and/or thorax only
3	Moderate	Shivering involves gross movement of upper extremities
4	Severe	Shivering involves gross movements of trunk, upper and lower extremities

The Columbia Protocol Interventions

	Intervention
Baseline	▪ Acetaminophen 650mg q4 hours ▪ Buspirone 30mg q8 hours ▪ Magnesium Sulfate IV Drip (See titration below)
Mild Sedation	▪ Dexmedetomidine 0.2-1.5mcg/kg/h (Do not titrate/set for RASS) OR ▪ Fentanyl 0.1mcg/kg/hr IV continuous infusion (Do not titrate/set for CPOT)
Moderate Sedation	▪ Dexmedetomidine or Fentanyl, see doses above
Deep Sedation	▪ Propofol 15-75mcg/kg/min (Do not titrate/set for RASS)
Paralysis	▪ Cisatracurium IV Drip (Titrate for TOF 1-2 Twitches)


Baseline Interventions
(Start all 3 prior to cooling)
Acetaminophen
Buspirone
Magnesium Drip
Monitor BSAS q1 h
BSAS <1?
BSAS 2-3?
Initiate Mild Sedation
Dexmedetomidine Drip
Fentanyl Drip
BSAS 2-3 despite max dosing?
Initiate Moderate Sedation
(Add additional drip)
Dexmedetomidine Drip
Fentanyl Drip
BSAS 2-3 despite max dosing?
Initiate Deep Sedation
Propofol Drip
BSAS 2-3 despite max dosing?
Initiate Paralysis
Cisatracurium Drip
Monitor BSAS q1 h

JMG 11/14

References

1. Badjatai et al. Metabolic impact of shivering during therapeutic temperature modulation: the Bed Shivering Assessment Scale. Stroke 2008; 39(12) 3242-7
2. Choi et al. Prevention of Shivering During Therapeutic Temperature Modulation: The Columbia Anti-Shivering Protocol. Neurocrit Care 2011 Jun; 14(3): 389-94

Appendix

1. Magnesium Sulfate Titration
    a. Obtain baseline serum magnesium level and every 4-6 hours while on treatment
    b. Drip Titration
        i. If Mg <2.0, give 2 gram IV bolus over 1 hour followed by initial maintenance infusion at a rate of 0.5g/hr
        ii. If Mg >2.0, initiate magnesium infusion at rate of 0.5g/hr
        iii. Caution in patients with renal insufficiency
    c. Goal serum magnesium level 3.0-3.5mg/dL

Serum Magnesium Level	Intervention
2.0-2.5mg/dL	Increase drip by 0.5g/h
2.5-3.0mg/dL	Increase drip by 0.25g/h
3.0-3.5mg/dL	Continue at current rate
3.5-4.0mg/dL	Decrease drip by 0.25g/h
>4.0 mg/dL	Hold drip. Recheck Mag level in 4 hours and resume drip at rate of 0.5g/h less than previous rate