

SICU Brain Injury Management Guidelines has been an extensive work in progress and have been compiled as a consensus statement by
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SICU Treatment Recommendations for Intraparenchymal Hemorrhage (IPH), Subarachnoid Hemorrhage (SAH) and Traumatic Brain Injury (TBI)

	IPH	SAH	TBI
Monitoring^{1,2}			
Basic monitoring			
A-line			
CVC	As needed	As needed	As needed
PAC/PICO/LidCO	As needed	As needed	As needed
ICP-Monitoring	As needed	As needed	As needed
12-lead ECG on admission			
Echo	As needed	As needed	As needed
TCD	As needed	As needed	As needed
BNP	As needed	As needed	As needed
CRP	As needed	As needed	As needed
Chest X-Ray	As needed	As needed	As needed
CT	As needed	As needed	As needed
Therapeutic Goals and treatment options¹⁻³			
PaCO2	35 mmHg-40 mmHg (tolerate moderate self-hyperventilation in spontaneous breathing modes during weaning) Set end tidal CO2 alarms at low of 30 mm Hg and high of 36 mm Hg	35 mmHg-40 mmHg (tolerate moderate self-hyperventilation in spontaneous breathing modes during weaning when no signs of vasospasm are present) Set end tidal CO2 alarms at low of 30 mm Hg and high of 36 mm Hg	35 mmHg-40 mmHg (tolerate moderate self-hyperventilation in spontaneous breathing modes during weaning) Set end tidal CO2 alarms at low of 30 mm Hg and high of 36 mm Hg
PaO2	> 70 mmHg (adjust PEEP and FiO2 as needed)	> 70 mmHg (adjust PEEP and FiO2 as needed)	> 70 mmHg (adjust PEEP and FiO2 as needed)

<p>ICP⁴⁻¹¹</p>	<p>< 20 mmHg (for ICP treatment use Mannitol or hypertonic NaCl to Osmolarity ~ 330 mosmol/l or Na⁺ ~ 155 mmol/l; CSF-drainage if possible, deep sedation with fentanyl and propofol/midazolam /lorazepam, consider ketamine or dexmed for special cases, use neuromuscular blockade if necessary; consider barbiturates to EEG-burst suppression if refractory, short term (< 6 hours) hyperventilation for peak control, consider mild hypothermia to 34°C if refractory, consider decompressive craniectomy if ICP> 35 mmHG for > 8 h refractory to everything mentioned above</p>	<p>< 20 mmHg (for ICP treatment use CSF-drainage, Mannitol or hypertonic NaCl to Osmolarity ~ 330 mosmol/l; deep sedation with fentanyl and propofol/midazolam/lorazepam, consider ketamine or dexmed for special cases, muscle relaxation if necessary; consider barbiturates to EEG-burst suppression if refractory, short term (< 6 hours) hyperventilation for peak control if no manifest vasospasm, consider mild hypothermia to 34°C if refractory, consider decompressive craniectomy if ICP > 35 mmHG for > 8 h refractory to everything mentioned above</p>	<p>< 20 mmHg (for ICP treatment use Mannitol, hypertonic NaCl to Osmolarity ~ 330 mosmol/l; CSF-drainage if possible, deep sedation with fentanyl and propofol/midazolam/lorazepam, consider ketamine or dexmed for special cases, muscle relaxation if necessary; consider barbiturates to EEG-burst suppression if refractory, short term (< 6 hours) hyperventilation for peak control, consider mild hypothermia to 34°C if refractory, consider decompressive craniectomy if ICP > 35 mmHG for > 8 h refractory to everything mentioned above</p>
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BP¹²⁻¹⁴	CPP > 60 mmHg (use volume and norepinephrine/ dobutamine as needed) Tolerate MAP 110-130 mmHg and avoid quick reductions in BP	CPP > 60 mmHg (use volume and norepinephrine/ dobutamine as needed), keep BP_{syst} < 160 mmHg if aneurysm is not secured, BP_{syst} > 160 mmHg and or optimizing CI or specific goals according to clinical picture for treatment of vasospasm	CPP > 60 mmHg (use volume and norepinephrine/ dobutamine as needed)
Temperature	~ 36-37° C (use acetaminophen, external cooling, (if cooling initiated, orders for anti-shivering required))	~ 36-37° C (use acetaminophen, external cooling, (if cooling initiated, orders for anti-shivering required))	~ 36-37° C (use acetaminophen, external cooling, (if cooling initiated, orders for anti-shivering required))
Volumestatus¹⁵	Euvoemia (by CVP or PAOP, PICCO, LidCO or systolic pressure variation)	Euvoemia (by CVP or PAOP, PICCO, LidCO or systolic pressure variation) Hypertension/Hypervolemia for therapy of vasospasm as needed for optimization of CI and BP	Euvoemia (by CVP or PAOP, PICCO, LidCO or systolic pressure variation)
Urine output	> 0.5 ml/kg/h (use volume, furosemide as needed after assurance of euvoemia)	> 0.5 ml/kg/h (use volume, furosemide as needed after assurance of euvoemia)	> 0.5 ml/dg/h (use volume, furosemide as needed after assurance of euvoemia)
Hb	> 8 mg/dl	> 8 mg/dl	> 8 mg/dl
Glucose¹⁶	80 - 110 mg% (use insulin sliding scale or insulin infusion as needed according to SICU Insulin Protocol)	80 - 110 mg% (use insulin sliding scale or infusion as needed according to SICU Insulin Protocol)	80 -110mg% (use insulin sliding scale or infusion as needed according to SICU Insulin Protocol)
K	4-5 mmol/l (replace as needed)	4-5 mmol/l (replace as needed)	4-5 mmol/l (replace as needed)

Mg	2-2.5 mmol/l (replace as needed)	2-2.5 mmol/l (replace as needed)	2-2.5 mmol/l (replace as needed)
PO4	Normal	Normal	Normal
Special Medication/Orders			
Analgesia	Avoid oversedation to allow neuroexam! Morphine/Fentanyl preferable as bolus as needed if refractory to weaker opioids like Codeine and Tramadol, Acetaminophen 650 mg q 6 as baseline Titrate to VAS or Riker-scale Prefer use of PCA	Avoid oversedation to allow neuroexam! Morphine/Fentanyl preferable as bolus as needed if refractory to weaker opioids like Codeine and Tramadol, Acetaminophen 650 mg q 6 as baseline Titrate to VAS or Riker-scale Prefer use of PCA	Avoid oversedation to allow neuroexam! Morphine/Fentanyl preferable as bolus as needed if refractory to weaker opioids like Codeine and Tramadol, Acetaminophen 650 mg q 6 as baseline Titrate to VAS or Riker-scale Prefer use of PCA
Sedation	Propofol or Midazolam or Lorazepam or Dexmed as needed Titrate to Riker 4	Propofol or Midazolam or Lorazepam or Dexmed as needed Titrate to Riker 4	Propofol or Midazolam or Lorazepam or Dexmed as needed Titrate to Riker 4
Nimodipine	-	60 mg q 4 hours	Consider for tSAH
Fluids	Crystalloid for maintenance, Hetastarch as needed, Blood products as needed	Crystalloid for maintenance, Hetastarch as needed, Blood products as needed	Crystalloid for maintenance, Hetastarch as needed, Blood products as needed
Nutrition	Early tube feeding as tolerated, dose according to dietician, otherwise CVN	Early tube feeding as tolerated, dose according to dietician, otherwise CVN	Early tube feeding as tolerated, dose according to dietician, otherwise CVN
Lansoprazol	30 mg q d	30 mg q d	30 mg q d
Thrombosis prophylaxis¹⁷⁻²⁴	Pneumatic compression device, post insult day 3: Heparin 5000 U s.c. BID	Pneumatic compression device, post insult or clipping day 3: Heparin 5000 U s.c. BID	Pneumatic compression device, post trauma day 3: Heparin 5000 U s.c. BID
Antibiotics	Prophylactic antibiotics (e.g. nafcillin) for surgery/ventricu- lostomy according to surgeon preference	Prophylactic antibiotics (e.g. nafcillin) for surgery/ventricu- lostomy according to surgeon preference	Prophylactic antibiotics (e.g. nafcillin) for surgery/ventricu- lostomy according to surgeon preference

Anticonvulsants	Phenytoin for documented seizures or for two weeks according to surgeons preference	Phenytoin for documented seizures or during the first 21 days according to surgeons preference	Phenytoin for one week if no documented seizure
Metoprolol	As tolerated in patients with known CAD/CHF Titrate to HR ~70-80 bpm	As tolerated in patients with known CAD/CHF Titrate to HR ~70-80 bpm	As tolerated in patients with known CAD/CHF Titrate to HR ~70-80 bpm
ACE-Inhibitor	As tolerated in patients with known CHF	As tolerated in patients with known CHF	As tolerated in patients with known CHF
Colace/Senna/Metoclopramide	Dulcolax/consider neostigmin if no improvement	Dulcolax/consider neostigmin if no improvement	Dulcolax/consider neostigmin if no improvement
Albuterol/ Ipratropium	As needed (Indications: obstructive physiology on ventilator flow volume loop or capnometry)	As needed (Indications: obstructive physiology on ventilator flow volume loop or capnometry)	As needed (Indications: obstructive physiology on ventilator flow volume loop or capnometry)
Ventilation strategy	prefer lung protective ventilation with TV ~ 5-8 ml/kg body weight for acute lung injury	prefer lung protective ventilation with TV ~ 5-8 ml/kg body weight for acute lung injury	prefer lung protective ventilation with TV ~ 5-8 ml/kg body weight for acute lung injury
PEEP²⁵⁻²⁷	5 cm H20 or adjusted to Pressure/Volume loop Use recruitment maneuver as needed	5 cm H20 or adjusted to Pressure/Volume loop Use recruitment maneuver as needed	5 cm H20 or adjusted to Pressure/Volume loop Use recruitment maneuver as needed
Intubation	Orotracheal, early tracheostomy if ventilation seems to be necessary > 10 days	Orotracheal, early tracheostomy if ventilation seems to be necessary > 10 days	Orotracheal, early tracheostomy if ventilation seems to be necessary > 10 days
Restraints	To prevent unplanned extubation as needed	To prevent unplanned extubation as needed	To prevent unplanned extubation as needed

Extubation	Stop tube feedings 6 hours prior to extubation. Stop insulin infusion accordingly	Stop tube feedings 6 hours prior to extubation. Stop insulin infusion accordingly	Stop tube feedings 6 hours prior to extubation. Stop insulin infusion accordingly
Position ²⁸⁻³⁴	HOB 30°	HOB 30° (flat in patients with vasospasm according to surgeons preference)	HOB 30°

Abbreviations

BNP: Brain Natriuretic Peptide

BP: Blood Pressure

CAD: Coronary Artery Disease

CDC: Centers for Disease Control and Prevention

CHF: Congestive Heart Failure

CPP: Cerebral Perfusion Pressure

CRP: C-reactive protein

CVC: Central Venous Catheter

CVN: Central Venous Nutrition

CVP: Central Venous Pressure

ET: Endotracheal

GCS: Glasgow Coma Scale

HOB: Head of bed

ICB: Intracranial Bleeding

ICP: Intracranial Pressure

MAP: Mean Arterial Pressure

MRSA: Methacillin resistant Staph. Aureus

PAOP: Pulmonary Artery Occlusion Pressure (Wedge-Pressure)

PEEP: Positive Endexpiratory Pressure

SAH: Subarachnoid Hemorrhage

TBI: Traumatic Brain Injury

TCD: Transcranial Doppler Sonography

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These recommendations are an approach to early goal directed therapy and should serve as a reference for residents and fellows. They do not replace the individual assessment and a clinical care decision for every single patient.

For the SICU-Neuro-Recommendation-Workgroup on March 31st 2005:

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