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| Scenario B: Isolated ICP increase | Scenario C: Isolated PbtO2 drop | Scenario D: ICP Increase + PbtO2 drop |
| TIER 1: must begin within 15 minutes of abnormality* Adjust head of the bed to lower ICP
* Ensure Temperature < 38°C.
* Titrate pharmacologic analgesia or sedation to effect
* CSF drainage (if EVD available)
* Optimize CPP to a max 70 mmHg with fluid boluses or vasopressors as clinically appropriate
* Low dose Mannitol (0.25 – 0.5 g/kg)
* Low does hypertonic saline; (may include 1.5% to 3% HTS). This tier does not include 7.5% or higher concentrations of HTS. Titrate to effect (ICP control) and maintain sNa < 160 mEq/L.
* Initiate or titrate anti-seizure medications (AEDs)
* Adjust ventilator for a target PaCO2 of 35 - 40 mm Hg and target pH of 7.35 - 7.45
 | **TIER 1: must begin within 15 minutes of abnormality*** Adjust head of the bed to improve brain oxygen level.
* Ensure Temperature < 38o C.
* Optimize hemodynamics, if clinically appropriate:
	+ Resuscitation: Address hypovolemia
	+ Diuresis: Avoid hypervolemia, consider furosemide or other agent for diuresis
* Optimize CPP to a max 70 mmHg with fluid boluses or vasopressors as clinically appropriate
* PaO2 Adjustments: **Obtain ABG first**
	+ Increase FiO2: Increase PaO2 by increasing FiO2 to a **maximum of 60%.**
	+ Adjust PEEP: Adjust PEEP by a maximum of 5 cm H20 over baseline. Monitor for any ICP response to this change.
	+ Pulmonary toilet: with suctioning of secretions;. Bronchoscopy is not included in this tier as an option.
* Adjust ventilatory rate to achieve a PaCO2 of 38 - 42 mm Hg while maintaining a target pH of 7.35 - 7.45 .Further lowering of PaCO2 should not be done if pH >7.45, and PaCO2 should not be increased if pH is <7.35.
* Initiate or titrate anti-seizure medications (AEDs). Initiate prophylactically for 1 week only.
 | **TIER 1: must begin within 15 minutes of abnormality*** Adjust head of the bed to lower ICP
* Ensure Temperature < 38o C.
* Adjust pharmacological analgesia or sedation to effect
* CSF drainage (if EVD available).
* Optimize hemodynamics, if clinically appropriate:
* Resuscitation: Address hypovolemia
* Diuresis: Avoid hypervolemia, consider furosemide or other agent
* Optimize CPP to a max 70 mmHg with fluid boluses or vasopressors as clinically appropriate
* Low dose Mannitol (0.25 – 0.5 g/kg)
* Low dose hypertonic saline; (may include 1.5% to 3% HTS). This tier does not include 7.5% or higher concentrations of HTS. Titrate to effect (ICP control) and maintain sNa < 160 mEq/L.
* Initiate or titrate anti-seizure medications (AEDs).
* PaO2 Adjustments: **Obtain ABG first**
* Increase FiO2: Increase PaO2 by increasing FiO2 to a maximum of 60%.
* Adjust PEEP: Adjust PEEP by a maximum of 5 cm H20 over baseline. Monitor for any ICP response to this change.
* Pulmonary toilet: including suctioning of secretions if secretions are problematic. Bronchoscopy is not included in this tier as an option.
* Adjust ventilator rate to achieve a PaCO2 of 38-42 while maintaining a target pH of 7.35-7.45. Adjust in small increments (max of 5). Further lowering of PaCO2 should not be done if pH>7.45 and not increased if pH is < 7.5.

\*Hyperventilation to PaCO2 below 35 mm Hg is not recommended |
| TIER 2: initiate within 60 minutes if Tier 1 therapies are ineffective* Optimize CPP: May increase CPP above 70 mm Hg with fluid boluses or vasopressors.
* Adjust ventilatory rate for target PaCO2 of 33 – 38 mm Hg and target pH of 7.35-7.45.
* High dose Mannitol (1-1.5 g/kg) or higher frequency of low dose mannitol (0.25-0.5g/kg) if Sosm<320 mOsm.
* High dose hypertonic saline bolus (e.g.7.5%, 30 ml of 23.4%). May repeat if Na levels are <160mEq/L.
* Repeat CT; treat surgically remediable lesions according to guidelines.
* Adjust temperature to 35 – 36°C, using active cooling measures.
* Neuromuscular blockade with short acting agents, use a bolus dose to determine effect. Initial bolus dose used to determine effectiveness first. NMB should be rapidly weaned upon clinical stabilization.
 | **TIER 2: initiate within 60 minutes if Tier 1 therapies are ineffective*** Adjust ventilatory rate to increase PaCO2 to 40 – 45 mm Hg while maintaining a pH of 7.35 - 7.45. (In general, any single PaCO2 should not be increased if pH is < 7.30.)
* PaO2 Adjustments: **Obtain ABG first**
	+ Increase FiO2: Increase PaO2 by increasing FiO2 to a maximum of 100%. Wean rapidly when clinically stable. (Decrease FiO2 by 5% q 30 min.)
	+ Adjust PEEP: Adjust PEEP in increments of 3 - 5 cm H20. Monitor for any ICP response to this change.
	+ Perform bronchoscopy
* Optimize CPP: May increase CPP above 70 mm Hg with fluid boluses or vasopressors.
* Neuromuscular blockade (NMB) with short acting agents
* Transfusion of pRBCs.
* Decrease ICP to < 15 mm Hg.
* CSF drainage.
* Increased sedation
 | **TIER 2: initiate within 60 minutes if Tier 1 therapies are ineffective** * High dose Mannitol (1-1.5 g/kg) or higher frequency of low dose mannitol (0.25-0.5g/kg) May repeat if  Sosm < 320 mOsm.
* High dose hypertonic saline bolus (e.g., 7.5%, 30 ml of 23.4%).
* Optimize CPP: May increase CPP above 70 mm Hg with fluid boluses or vasopressors.
* Transfuse pRBCs.
* Repeat CT; treat surgically remediable lesions according to guidelines.
* Adjust temperature to 35 – 36°C, using active cooling measures.
* Neuromuscular blockade with short acting agents, use a bolus dose to determine effect
* PaO2 Adjustments: **Obtain ABG first**

 Increase FiO2: Increase PaO2 by increasing FiO2 to a maximum of 100%. Increase FiO2 to max of 100%; \*Use only when PaO2 >200 if PbtO2 <20 and you have addressed other contributing variables; \*Wean rapidly once patient is stable (decrease FiO2 by 5% q30. Min.)* Adjust PEEP: Adjust PEEP in increments of 3 - 5 cm H20. Monitor for any ICP response to this change.
* Perform bronchoscopy

**See reverse side for Optional Tier 3 Interventions—Providers may move to Tier 3 Interventions if ICP and/or PbtO2 remain abnormal, and at least one intervention from Tier 1 AND Tier 2 has been used.** |
| Tier 3 Scenario B: Isolated ICP increase | **Tier 3 Scenario C: Isolated PbtO2 drop** | **Tier 3 Scenario D: ICP Increase + PbtO2 drop** |
| TIER 3 (Tier 3 therapies are optional). * Pentobarbital coma, according to local protocol.

Decompressive craniectomy. An initial bolus dose of 5 mg/kg should be used to determine effectiveness. If the bolus dose demonstrated effectiveness, a continuous infusion may be used. Pentobarbital should be rapidly weaned upon clinical stabilization* Adjust temperature to 32-35°C, using active cooling measures.
* Adjust ventilatory rate for target PaCO2 of 30 – 35 mm Hg and target pH of less than 7.5.
* Other salvage therapy per local protocol and practice patterns.

 | **TIER 3 (Tier 3 therapies are optional).** * Adjust ventilatory rate to increase PaCO2 to > 45 mm Hg while maintaining a target pH of 7.30 – 7.45. \*In general, any single PaCO2 adjustments should be in small increments (maximum of 5).

\*PaCO2 should not be increased if pH is < 7.30.* Increase cardiac output with inotropes (milrinone, dobutamine).
* Assess for vasospasm with transcranial dopplers, CT angiogram, or cerebral angiogram. If present, treat with augmentation of CPP.
* Hyperventilation (per the CO2 challenge described in MOP) to address possible ‘reverse Robin-Hood syndrome’.
* Other salvage therapy based on local protocol and practice patterns.
* Other potential causes / interventions for low PbtO2 should be considered:
	+ Consider cortical spreading depolarization via ECog
	+ Assess for pulmonary embolism per local protocol If present, initiate anticoagulation or IVC filter.
	+ Assess for cerebral venous thrombosis
 | **TIER 3 (Tier 3 therapies are optional).** * Pentobarbital coma, according to local protocol.
* Decompressive craniectomy.
* Adjust temperature to 32-35°C, using active cooling measures.
* Increase cardiac output with inotropes (milrinone, dobutamine).
* Assess for vasospasm with transcranial dopplers, CT angiogram, or cerebral angiogram. If present, treat with augmentation of CPP.
* Hyperventilation (per the CO2 challenge described in MOP) to address possible ‘reverse Robin-Hood syndrome’.
* Other salvage therapy based on local protocol and practice patterns.
* Other potential causes / interventions for low PbtO2 should be considered:
	+ Consider cortical spreading depolarization via ECog
	+ Assess for pulmonary embolism per local protocol If present, initiate anticoagulation or IVC filter.
	+ Assess for cerebral venous thrombosis
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**Questions? Please Contact Study Coordinator at:**

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