POLICY

This policy provides the guidelines for the nursing care of critically ill patients requiring brain oxygen monitoring.

SCOPE

Registered nurses in the adult intensive care units who have received training in caring for patients requiring brain oxygen monitoring.

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BACKGROUND

Brain tissue oxygen (p$_{bt}$O$_2$) monitoring is used for measuring and monitoring brain tissue oxygenation in patients with brain injury or those at risk for secondary cerebral ischemia. Monitoring brain tissue oxygen provides important information about the delivery of oxygen to cerebral tissue of the injured brain local to the sensor placement.

The normal range for brain tissue oxygen values is between 20 and 35 mm Hg. Treatment goals usually aim to keep the p$_{bt}$O$_2$ greater than 20 mm Hg. A p$_{bt}$O$_2$ of less than 15 mm Hg is associated with a greater chance of functional disability and mortality related to cerebral ischemia. Clinical interventions can be aimed at increasing oxygen delivery, decreasing cerebral oxygen demand, or both.

Contraindications for p$_{bt}$O$_2$ monitoring include patients with a coagulopathy, those receiving anticoagulation therapy, and those having an insertion-site infection. Blood coagulation must be carefully monitored when measuring in the brain during total body hypothermia, hepatic coma, or other diseases that impair blood coagulation.

Mosby extended text for more detailed information and explanation.

PATIENT/FAMILY EDUCATION

• Assess patient or family understanding of the purpose of p$_{bt}$O$_2$ monitoring.
• Explain the standards of insertion, patient monitoring, and care involving the p$_{bt}$O$_2$ monitoring system.
• Explain expected outcomes of the p$_{bt}$O$_2$ monitoring system.
### EQUIPMENT

- Sterile gown pack
- Sterile linen pack
- Shave prep kit
- Betadine bottle
- Brain Oxygen monitor with complete set of cables (green temperature cable, blue oxygen cable and ground cable)
- Cranial Access Tray
- One refrigerated LICOX sensor/probe box
- One OLM Intracranial Pressure Monitoring Catheter (110-4L – for LICOX bolt)
- #11 blade
- Camino monitor
- Two HP red module boxes (One for the brain oxygen monitor, monitor, one for the Camino monitor)
- (2) 4x4 gauze
- (2) large tegaderm
- (1) arm board folded in half
- 2” silk tape

### ASSIST WITH INSERTION

A. Assess the patient's baseline neurologic status, vital signs, and ICP (if available) immediately prior to insertion of the probe and throughout the procedure.

B. Conduct Universal Protocol and document on Universal Protocol/Procedure Note (Refer to HUP policy 1-12-46 Correct Patient Procedure and Site Confirmation; Universal Protocol/Procedure note.)

C. Assess patients need for analgesia and sedation prior to start of procedure.

D. Place the patient in a semi-fowler position raising the head of the bed to the level of the physician's preference.

E. Wash hands. All staff involved in the procedure should wear a hat, surgical mask and gloves.

F. The physician will determine placement, shave and prep the area with Betadine. Strict sterile field and technique will be maintained throughout the procedure. The area will be anesthetized, skin incised, opening created in skull and the bolt placed in proper position.

G. Assist with placement of the intracranial bolt: The Camino 110-4L must be zeroed to air outside of the head according to the HUP Intracranial ICP Bolt policy.

H. Assist as needed with the insertion of the oxygen probe and temperature probe. Obtain the smart card from the probe packaging. If the smart card is discarded with the probe packaging before use, the probe cannot be used. If the wrong smart card is used with a probe, incorrect measurements result.
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I. Connect the blue and green cables to the oxygen and temperature probes. Observe the temperature and $p_{btO2}$ values. Immediately after insertion readings are influenced by the local microtrauma of probe implantation into the brain tissue. This applies during the first 30 to 120 minutes after insertion. The $p_{btO2}$ values displayed during this initial phase after implantation therefore do not provide relevant information about tissue oxygenation. Begin monitoring when readings stabilize.

J. After the system has been placed, apply sterile dry gauze at the insertion point. A dressing (formed with sterile dry gauze and tegaderm) should be applied in a conical fashion to provide a base to secure the device to an arm board to promote stabilization. See photo in Securing the Cables section.

**SETTING UP THE MONITOR**

A. Connect ground cable to back of brain oxygen monitor.

![Connect ground cable](https://via.placeholder.com/150)

B. Open the Side Door on the Main Bedside Monitor and Locate the Grounding Probe.

![Open the Side Door](https://via.placeholder.com/150)
C. Attach the distal end of the grounding cable to the bedside monitor.

D. Connect power cord to red AC wall outlet.

E. Connect blue oxygen cable to the blue socket on the brain tissue oxygen monitor (cable that connects the \( p_{\text{O}_2} \text{ probe} \)).

F. Connect green temperature cable to the green socket on the brain tissue oxygen monitor (cable that connects to the tissue temperature probe).

G. Manually adjust temperature on front of the monitor to 22 degrees Celsius.

H. Insert the “smart card” that comes in the oxygen probe packaging into the slot on monitor front.
SECURING THE CABLES

A. The cables should have three tension points when secured to the patient. The first two tension points are directly at the patient's head. Using an arm board that has been folded in half, secure the base of the conical dressing and the cables to the arm board with tape.

B. Anchor the cables from the patient's head to his or her shoulder with a transparent or soft cloth adhesive dressing to create the third tension point.

C. Place rolled towels under the secured system.

D. Place the cables so they are not touching the ground.

SLAVING TO THE BEDSIDE MONITOR

A. Connect the brain tissue oxygen monitor to the bedside monitor with the attached cable.

B. Select the label IC1 or IC2. A waveform need not be displayed, only a numeric display.

C. Manually adjust temperature on front of the monitor to 22 degrees Celsius.

D. Disconnect the blue and green cables from the brain oxygen monitor.

E. Select the designated module and zero the bedside monitor.

F. Plug the blue and green cables back into the front of the brain tissue oxygen monitor.
G. Note the difference between the brain tissue oxygen monitor reading and the bedside monitor reading.

H. Readings should be within 1mmHg when the blue and green cables are connected to the system at the head of the patient and after the brain tissue has had time to settle (30–120 minutes) after insertion.

**NURSING CARE OF THE PATIENT WITH A BRAIN TISSUE OXYGEN MONITOR**

**DOCUMENTATION**

A. Neurological assessment hourly or as indicated by patient condition; when patient exam, intracranial pressure and brain oxygenation has been stable: every two hours.

B. Obtain the patient’s systemic temperature every 2 hours. Although there is a temperature probe/monitor in place, one must continue to check and record patient’s temperature every two hours.

C. Brain oxygenation and temperature, intracranial pressure and cerebral perfusion pressure (MAP-ICP) and other hemodynamic parameters should be recorded hourly in created columns next to the vital signs.

D. Label your brain oxygen value as IC1 or IC2 and set alarm parameters to baseline PbtO2 20-40 or as ordered by the neurosurgical team. Record on the flowsheet.

E. It is imperative to use consistent and detailed charting in the comments/notes section of the critical care flow sheet. For example, all care to the patient must be documented, including turning (left or right side); suctioning; family or medical teams at the bedside; medication given such as Mannitol; sedation or paralytics; ventilator changes; new central line placement, etc.

**SITE CARE AND DRESSING CHANGES**

A. Inspect the catheter insertion site every 4 hours and assess the site for signs of infection or leakage of CSF. Dressing Changes are performed every 72 hours or whenever wet or loose.

B. Gather Supplies:
   1. (2) 4x4 gauze
   2. Dressing change kit
   3. (1) additional large Tegaderm dressing

C. Procedure:
   1. Using sterile technique, a mask and sterile gloves, cleanse the insertion site with chlorhexadine.
   2. Sterile dry gauze should be placed in a conical fashion at the insertion point before applying the dressing.
3. Apply a dry sterile occlusive dressing. Date and initial the dressing.
4. Secure the cables as noted above.

**MANAGEMENT AND GOALS OF TREATMENT**

**A. Goals of Treatment:**

- $P_{bO2}$ normal values are between 20 and 35mm Hg.

For adults maintain:
- $P_{bO2} > 20$mm Hg
- ICP < 20mm Hg for adults

<table>
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<tr>
<th>$P_{bO2}$ Low (&lt;20mmHG)</th>
<th>Increased Demand</th>
<th>Decreased Delivery</th>
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<tr>
<td></td>
<td>↑ ICP</td>
<td>Hypotension ↓ (CPP)</td>
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**Oxygen Challenge Test:**

After brain tissue has had time to settle from the initial insertion, perform an oxygen challenge particularly if the PbtO2 reading is unexpectedly low or there is a question of probe accuracy, reliability or validity. To do this, place the ventilator FIO2 on 100% for 2 to 5 minutes. An accurate probe will demonstrate an increase in PbtO2. If there is no response to increased FIO2, a head CT should be obtained to confirm correct probe placement.
TRANSPORTING THE PATIENT

A. The LICOX probe system is not MRI compatible. If a patient requires a MRI the entire system must be removed from the patient.

B. The LICOX probe system is compatible with CT scan.

C. The blue and green cables should be disconnected from the monitor, coiled, and taped to the patient’s chest. **DO NOT LET THEM DRAG OR LAY ON THE FLOOR.**

D. Upon return to the patient’s bedside. Plug the blue and green cables into their appropriate slots on the monitor. The device will automatically recalibrate itself.

DISCONTINUATION OF THE MONITOR

A. The device is to be removed by a physician or CRNP from the neurosurgical service.

B. Continue to monitor the patient’s neurological status every two hours or more frequently if indicated by the patient’s condition and record findings on the flow sheet. During this time, observe for subtle changes in the patient’s level of consciousness and neurological exam. Record and report these changes to the team.

C. Cover the insertion site with a sterile occlusive dressing.

D. Assess for bleeding, CSF leak, and signs/symptoms of infection. Notify the primary service if this occurs and document findings. They may need to place an additional suture to stop the leakage.

E. Change the dressing every 72 hours or whenever wet or loose, until site is healed.

F. Disposal:
   1. Dispose of single-use probes and bolt system.
   2. **DO NOT DISPOSE OF THE BLUE AND GREEN CABLES.** Clean the cables with a towel and soap solution. Disinfectants containing a high percent of alcohol or phenol will damage the cables.

MONITOR AND CABLES

A. Removal of the Smart Card During Measurement
Measurements are interrupted when the smart card is removed. The message “Please Insert Probe Card” is displayed on the LCD display. Reinsert the same smart card that was removed to continue obtaining measurements. The number on the smart card MUST match the number on the brain oxygen probe.

B. Electrical Disturbances
Strong electromagnetic disturbances can result in pbtO2 measurement errors. Errors can continue for a few seconds after the disturbance. These disturbances may occur when using a high-frequency scalpel, during cardioversion, or during cauterization.
C. The pbtO2 probe is not waterproof. Do not allow liquids to the connector. Do not dip into liquids.

D. Temperature Gradient in the Housing of the Temperature Probe
   The temperature measurement may be inaccurate if the connector of the temperature probe is
   subjected to significant changes in temperature or if the temperature of the connector is beyond
   the defined range of 18°C to 30°C (e.g., direct sunlight, and rheumatological cryotherapy). If the
   probe connector is held with a warm hand, the temperature measurement may be inaccurate until
   it is released.

E. In the Event of Catheter Malfunction:
   1. Do not discard probe, cables, or smart card after removal. The entire system must be
      saved.
   2. Place system into a biohazard specimen bag. Place the smart card into a plastic lab
      specimen bag. Staple the biohazard bag to the clear plastic bag.
   3. Forward all bagged components to the Nurse Manager for return to INTEGRA
      Neurosciences, Inc. for probe interrogation.

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REVIEWS/APPROVALS

Critical Care Nursing Practice and QI Committee
Chairperson, Division of Neurosurgery

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