Intracranial pressure catheter insertion, monitoring, and care

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Introduction

Intracranial pressure (ICP) monitoring measures the pressure exerted by the brain, blood, and cerebrospinal fluid (CSF) against the inside of a patient's skull. Indications for monitoring ICP include traumatic brain injury under certain conditions (such as injuries causing cerebral edema, hematoma, or a ruptured vessel in the intracranial space), hydrocephalus, brain or spinal tumor, infections (such as meningitis), ischemic stroke, hemorrhagic stroke, and seizures.[1] It can also be used for liver failure, intracranial cysts, and subarachnoid hemorrhage.[2] ICP monitoring can detect elevated ICP early, before clinical danger signs develop.[1] Prompt intervention can then help avert or diminish neurologic damage caused by cerebral hypoxia and shifts of brain mass.

The four basic methods for monitoring ICP are intraventricular catheter monitoring, subarachnoid bolt monitoring, epidural or subdural sensor monitoring, and intraparenchymal monitoring. Intraventricular catheter monitoring is considered the gold standard for measuring ICP because the practitioner inserts the catheter directly into the patient's ventricle through a burr hole, which permits ICP monitoring and therapeutic CSF drainage to control ICP.[1] (See *Understanding ICP monitoring*.) Regardless of the system, a neurosurgeon typically performs the procedure in an operating room (OR), emergency department, or intensive care unit. The insertion of an ICP monitoring catheter requires sterile technique to help reduce the risk of central nervous system (CNS) infection. Setting up the equipment for the ICP monitoring system also requires strict sterile technique.[1]

Nursing responsibilities after catheter insertion include monitoring the patient and the system, which takes place in an intensive care setting. The insertion site and entire monitoring system require frequent assessment, which involves checking for cracks in the system and fluid leakage from the insertion site.

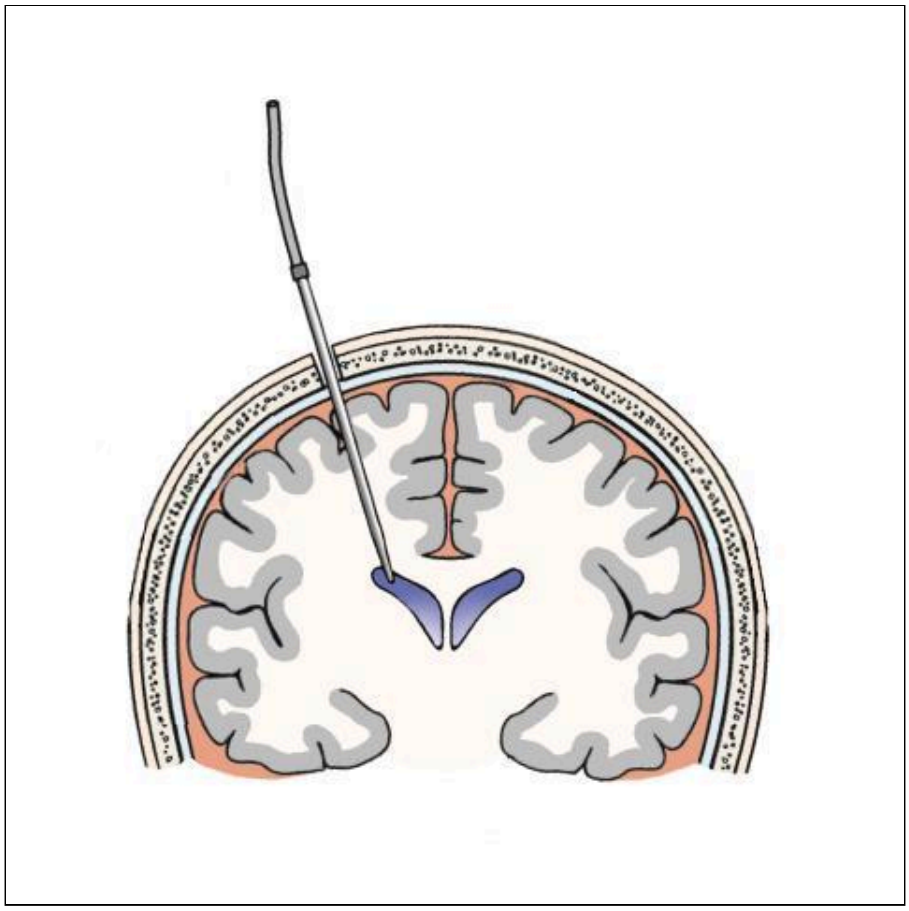
EQUIPMENT

UNDERSTANDING ICP MONITORING

You can monitor intracranial pressure (ICP) using various types of systems, including an intraventricular catheter, a subarachnoid bolt, an epidural or a subdural sensor, and an intraparenchymal catheter.

Intraventricular catheter monitoring

For intraventricular catheter monitoring, which provides direct monitoring of ICP, a practitioner inserts a small catheter into the patient's lateral ventricle through a burr hole (as shown below). Although this system provides the most accurate measure of ICP and is the only type that allows evaluation of brain compliance and drainage of significant amounts of cerebrospinal fluid (CSF), it carries the greatest risk of infection. Contraindications can include stenotic cerebral ventricles, cerebral aneurysms in the path of the catheter placement, and suspected vascular lesions.

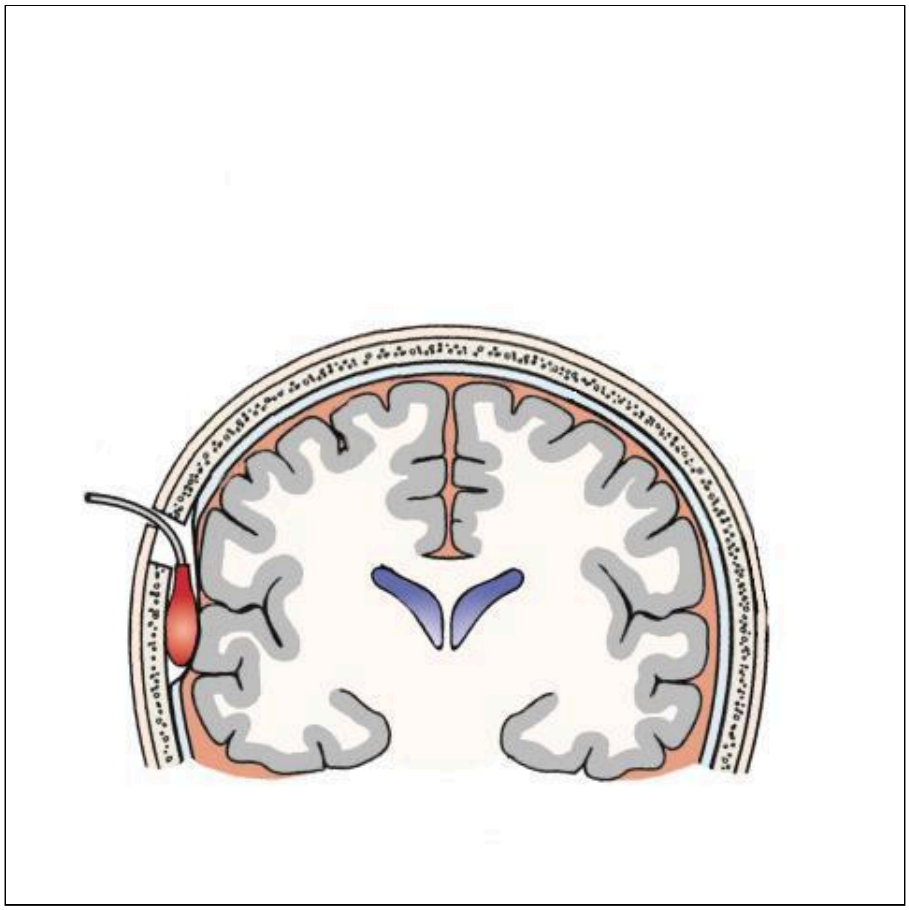


Subarachnoid bolt monitoring

Subarachnoid bolt monitoring involves the insertion of a special bolt into the subarachnoid space through a twist-drill burr hole positioned in the front of the patient's skull behind the hairline (as shown below). Placing a bolt is easier than placing an intraventricular catheter, especially if a computed tomography scan reveals that the cerebrum has shifted or the ventricles have collapsed. This type of ICP monitoring system also carries less risk of infection and parenchymal damage *because the bolt doesn't penetrate the patient's cerebrum.*

Epidural or subdural sensor monitoring

ICP can also be monitored in the patient's epidural or subdural space. For epidural monitoring, a practitioner inserts a fiber-optic sensor into the epidural space through a burr hole (as shown below). The main drawback of epidural monitoring is its questionable accuracy *because ICP isn't being measured directly in a CSF-filled space.* For subdural monitoring, a practitioner tunnels a fiber-optic transducer-tipped catheter through a burr hole, placing its tip on brain tissue under the patient's dura mater. The main drawback of subdural monitoring is its inability to drain CSF.



Intraparenchymal catheter monitoring

For intraparenchymal catheter monitoring, a practitioner inserts a catheter through a small subarachnoid bolt and, after puncturing the dura, advances the catheter a few centimeters into the brain's white matter (as shown below). One advantage of this system is that the equipment doesn't need to be balanced or calibrated after insertion. Although this system doesn't provide direct access to CSF, measurements are accurate *because brain tissue pressures correlate well with ventricular pressures.*

Equipment

- Antiseptic solution or sterile prep kit
- Cardiac monitor with leads and electrodes
- Emergency equipment (code cart with emergency medications, defibrillator, handheld resuscitation bag with mask, intubation equipment)
- Facility-approved pain assessment tool
- Fluid-impermeable pads
- Gloves
- Gown
- ICP monitoring catheter
- Intracranial access kit
- Labels
- Leveling device
- Lidocaine local anesthetic and administration supplies
- Masks with face shields or masks and goggles
- Monitoring system and equipment
- Preservative-free sterile normal saline solution in a 30- or 40-mL syringe
- Pulse oximeter and probe
- Sterile drapes
- Sterile gloves
- Sterile gowns
- Sterile occlusive dressing supplies
- Surgical head coverings
- Vital signs monitoring equipment
- Optional: arterial catheter insertion equipment, external ventricular drainage system, prescribed pain medication, prescribed sedative agent, single-patient-use scissors or disposable-head clippers, sterile

labels, sterile marker, tape

You may need to gather other equipment as instructed by the practitioner, such as the drill and bits, a scalp retractor, and a scalp stapler.

Preparation of Equipment

Various types of preassembled ICP monitoring systems are available, each with its own setup protocols. These systems are designed to help reduce the risk of infection by eliminating the need for multiple stopcocks, manometers, and transducer dome assemblies.

Inspect all equipment and supplies. If a product is expired, is defective, or has compromised integrity, remove it from patient use, label it as expired or defective, and report the expiration or defect as directed by your facility.

When preparing the equipment, label all medications, medication containers, and other solutions on and off the sterile field.[3] Prepare and set up the ICP monitoring system according to the manufacturer's instructions. (See *Setting up an ICP monitoring system*.)

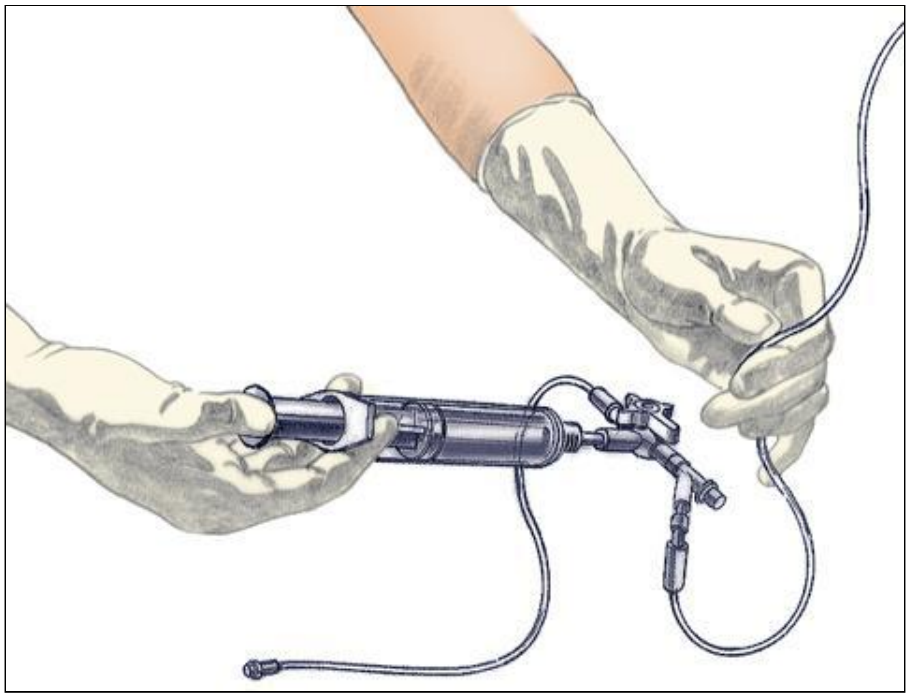
Make sure that emergency equipment is functioning properly and readily available.

EQUIPMENT

SETTING UP AN ICP MONITORING SYSTEM

To set up an intracranial pressure (ICP) monitoring system, use strict sterile technique. Use a two-person method when priming the tubing with preservative-free sterile normal saline solution *so that the second person can monitor the sterile technique and assist as necessary.* Follow these steps:

- Put on a surgical head covering and a mask with a face shield or a mask and goggles.[4][5][6]
- Perform hand hygiene.[7][8][9][10][11][12]
- Open a sterile towel on a bedside table *to create a sterile field.*
- Place a disposable flushless transducer and a 30- or 40-mL syringe filled with preservative-free sterile normal saline solution on the sterile field.
- Put on a sterile gown and sterile gloves.[4][5][6]
- Attach the flushless transducer to the panel mount stopcock.
- Using sterile technique, attach the syringe containing preservative-free sterile normal saline solution to the stopcock at the distal end of the tubing (patient line stopcock).[2]
- Turn the stopcock off to the drainage device.
- Inject the preservative-free sterile normal saline solution slowly toward the distal end (patient end) of the tubing (as shown below). As the solution reaches the distal end of the tubing, allow several drops of the solution to exit the end of the tubing *to ensure that you've cleared air from the tubing.*



- Turn the stopcock off to the distal end of the tubing, keeping the syringe in place. Ensure that the panel mount stopcock is open to the flushless transducer. Prime through the vented caps in the flushless transducer. Replace the vented caps with nonvented caps.[2]
- With the syringe remaining in place, turn the stopcock off to the flushless transducer and prime preservative-free sterile normal saline solution into the drip chamber.[2]
- After priming the system, keep the stopcock on the distal end (patient end) of the tubing off *to ensure that no preservative-free sterile normal saline solution leaks from the system before connection.*
- Connect the flushless transducer to the bedside monitor with a pressure cable that's plugged into the designated pressure module.[2]
- Align the zero point with the centerline of the patient's head, level with the middle of the ear, using a leveling device. Keep in mind that the key to accurate ICP measurement is to use the same landmark each time you check the zero reference level.
- Lower the flow chamber to zero, and turn the stopcock off to the dead-end cap.
- Remove and discard your gloves and other personal protective equipment.[5] [6]
- Perform hand hygiene.[7] [8] [9] [10] [11] [12]
- With a clean hand, balance the ICP monitoring system according to the manufacturer's guidelines.
- Perform hand hygiene. [7] [8] [9] [10] [11] [12]

Implementation

Assisting with catheter insertion

- Verify the practitioner's order.
- Gather and prepare the necessary equipment and supplies. Also gather the appropriate number of personnel for the procedure.
- If required by your facility, confirm that informed consent has been obtained and that the signed consent form is in the patient's medical record.[13] [14] [15] [16]
- Conduct a preprocedure verification *to make sure that all relevant documentation, related information, and equipment are available and correctly identified with the patient's identifiers.*[17] [18]

- Verify that laboratory and imaging studies have been completed as ordered and that the results are in the patient's medical record. Notify the practitioner of any unexpected results.
- Review the patient's medical record for a history of allergies to iodine, latex, or the lidocaine local anesthetic.
- Perform hand hygiene.[7][8][9][10][11][12]
- Confirm the patient's identity using at least two patient identifiers.[19]
- Provide privacy.[13][14][16][20]
- Reinforce the practitioner's explanation of the procedure to the patient and family (if appropriate) according to their individual communication and learning needs *to increase their understanding, allay their fears, and enhance cooperation.*[21] Answer any questions.[13][14][15][16]
- Raise the bed to waist level before providing care *to prevent caregiver back strain.*[22]
- Perform hand hygiene.[7][8][9][10][11][12]
- Put on personal protective equipment, as needed, *to comply with standard precautions.*[4][5][6]
- Ensure that the patient is attached to a cardiac monitor and pulse oximeter *to monitor heart rate and rhythm and oxygen saturation level during the procedure.* Ensure that alarm limits are set appropriately for the patient's current condition and that alarms are turned on, functioning properly, and audible to staff.[23][24][25][26]
- Assist with arterial catheter insertion if ordered *because vigilant monitoring of mean arterial blood pressure (MAP) is necessary to avoid decreased cerebral perfusion pressure (CPP).* (See the "Arterial catheter insertion, assisting" procedure.) Make sure that alarm limits are set appropriately for the patient's current condition and that alarms are turned on, functioning properly, and audible to staff.[24][25][26]
- Obtain the patient's baseline vital signs and perform a neurologic assessment *to help detect decompensation promptly during the procedure.*[2]
- Assess the patient's sedation and pain management needs in collaboration with the practitioner.[2][27] Administer medications as indicated and prescribed following safe medication administration practices *to ensure the patient's comfort during the procedure.*[28][29][30][31]
- Place the patient in the supine position with the head in a neutral position and the head of the bed elevated 30 to 45 degrees (or as ordered) for placement of the ICP catheter.[2]
- Place fluid-impermeable pads under the patient's head.
- Verify that the ICP monitoring catheter insertion site has been identified before preparing the site *to minimize the risk of preparing the wrong area.*[32]
- Braid or clip the patient's hair at the ICP monitoring catheter insertion site as necessary. If clipping the hair, use tape or a similar sticky product to remove residual hair clippings.
- Immobilize the patient's head *to prevent patient movement and facilitate catheter insertion.*
- Remove and discard your personal protective equipment, if worn.[5]
- Perform hand hygiene.[7][8][9][10][11][12]
- Put on a surgical head covering and a mask with a face shield or a mask and goggles.[2][4][5][6]
- If the ICP monitoring catheter will be inserted outside an OR, ensure that the conditions are modeled on those of an OR and close the doors to the room where the procedure is being performed. Ensure that everyone in the room wears a mask with a face shield or a mask and goggles and a surgical head covering.
- Perform hand hygiene.[7][8][9][10][11][12]
- Put on a gown and gloves.[4][5][6]
- The practitioner puts on a surgical head covering, a mask with a face shield or a mask and goggles, a sterile gown, and sterile gloves.[1][2][4]
- Assist the practitioner with preparing the ICP monitoring catheter incision site using an antiseptic solution or a sterile prep kit following the manufacturer's instructions.[2]

◆ ***Clinical alert:*** Note that guidelines don't recommend using 2% chlorhexidine preparation when contact with the patient's meninges is possible.[33] ◆

- Assist the practitioner with draping the areas surrounding the ICP monitoring catheter insertion site with sterile drapes.
- Conduct a time-out immediately before starting the procedure *to perform a final assessment, ensuring that the correct patient, site, positioning, and procedure are identified and, as applicable, all relevant information and necessary equipment are available.*[18] [34]
- The practitioner opens the interior wrap of the intracranial access kit, infiltrates the patient's scalp with a lidocaine local anesthetic, and inserts the ICP monitoring catheter. Assist the practitioner with the procedure as necessary.
- During insertion, monitor the patient's heart rate and rhythm, respiratory rate, oxygen saturation level, blood pressure, and neurologic status as directed by your facility *to help identify neurologic changes immediately and ensure prompt treatment.*
- After insertion, assist the practitioner with connecting the catheter to the monitoring equipment while maintaining the sterility and preventing contamination of the catheter insertion site, catheter, and sterile field.[1] Trace the tubing from the patient to its point of origin *to make sure you're connecting the tubing to the proper port.*[35] [36]
- Assist the practitioner with cleaning around the catheter insertion site with an antiseptic solution and applying a sterile occlusive dressing to the site.[2]
- Using a sterile label and marker, clearly label the access port of an external ventricular drainage system (if used) *to indicate that it's an external ventricular drain, preventing any accidental mix-up of the port with an IV line.*[2]
- Position the patient with the head of the bed elevated 30 degrees (or as ordered) *to promote venous return,* to level the transducer and zero, and to calibrate the ICP monitoring catheter. Ensure that the patient's head is at the top of the bed in a midline position to the rest of the body *because flexion or rotation of the head or neck can obstruct venous return, increasing ICP.*[2]
- Maintain the flushless transducer at the level of the patient's foramen of Monro. Anatomically, the reference point is equivalent to the level of the patient's ear or the outer canthus of the eye.[2] *Placing the flushless transducer above or below the anatomically correct position can result in false readings.*
- Zero and calibrate the ICP monitoring catheter after insertion as required by the type of device. If the device requires recalibration after it's in use, rezero it as prescribed according to the manufacturer's instructions or as directed by your facility. Also rezero the transducer if a connection becomes dislodged and when an ICP value doesn't correspond with the patient's clinical signs and symptoms.[2]
- If the patient has an external ventricular drain, maintain the drip chamber at the prescribed zero reference and pressure levels.[2]
- Ensure that the ICP monitor's alarm limits are set appropriately for the patient's current condition and that alarms are turned on, functioning properly, and audible to staff.[24] [25] [26]
- Begin ICP monitoring; obtain an ICP tracing and assess the ICP waveform. Use this tracing as a baseline for comparison. (See *Interpreting ICP waveforms*.) If the patient has an external ventricular drain, turn the stopcock off to the drain and open it to the flushless transducer *to obtain an accurate ICP numeric value and waveform.*
- Observe ICP in relation to other hemodynamic parameters such as MAP.

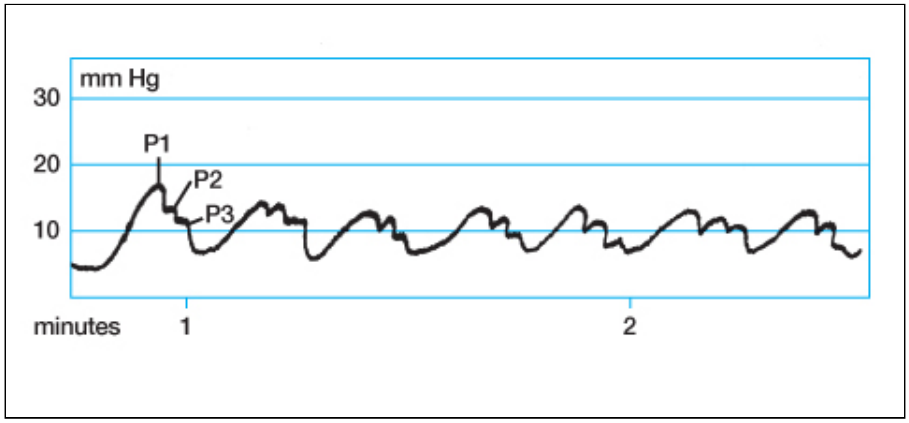
INTERPRETING ICP WAVEFORMS

You must be familiar with intracranial pressure (ICP) waveforms so that you can quickly identify and respond to changes that may indicate decreased brain compliance.

Normal ICP waveform

A normal ICP waveform (shown below) typically has three main peaks: the pressure wave (P1), tidal wave (P2), and dicrotic wave (P3). The pressure wave (P1) originates from choroid plexus pulsations. The tidal wave (P2) varies more in shape and amplitude and ends on the dicrotic notch. The dicrotic wave (P3) falls after the dicrotic notch and commonly tapers downward. The dicrotic wave is caused by

closure of the aortic valve. Some people have additional peaks, but they aren't as clinically significant as the three main peaks. This waveform occurs continuously and indicates an ICP in the normal range (between 0 and 15 mm Hg).

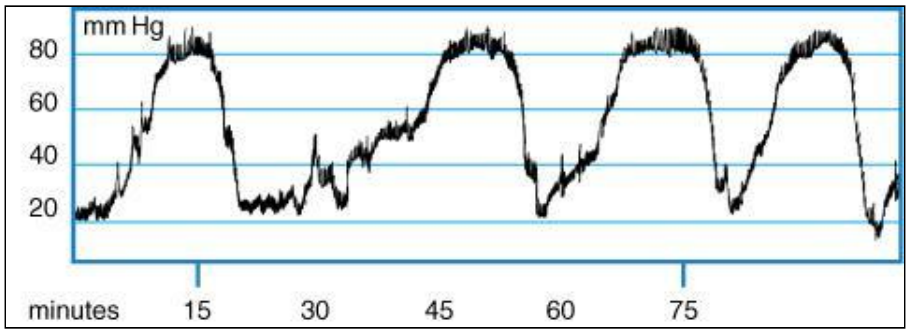


Abnormal ICP waveforms

The P2 portion of the ICP waveform most directly reflects the state of the brain's compliance. Abnormal ICP waveform trends include A, B, and C waves.

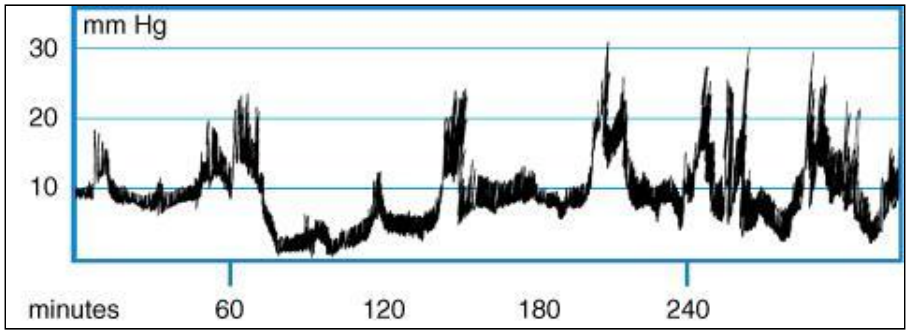
A waves

As mean ICP rises, P2 progressively elevates and causes the pulse wave to appear more rounded. The most clinically significant ICP waveforms are A waves (shown below), which can reach elevations of 50 to 100 mm Hg, persist for 5 to 20 minutes, and then drop sharply—signaling exhaustion of the brain's compliance mechanisms.[2] A waves may come and go, spiking in response to temporary increases in thoracic pressure or to any condition that increases ICP beyond the brain's compliance limits. Certain activities, such as sustained coughing and straining during defecation, can cause temporary elevations in thoracic pressure. *Because A waves are an ominous sign,* they require emergency treatment.



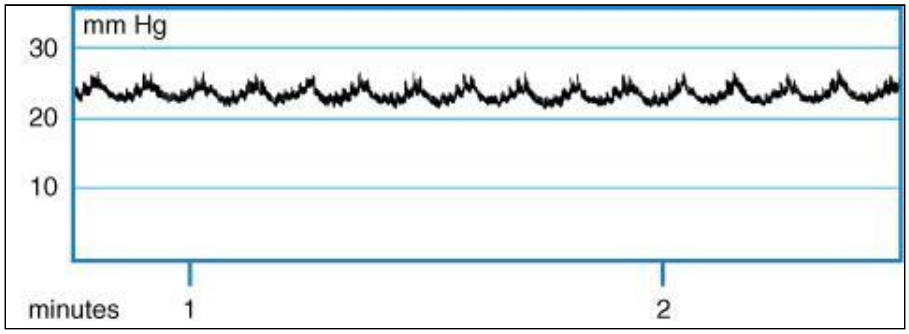
B waves

B waves (shown below), which appear sharp and rhythmic with a sawtooth pattern, occur every 30 seconds to 2 minutes and can reach elevations of 50 mm Hg. [2] The clinical significance of B waves isn't clear, but these waves correlate with respiratory changes and occur more frequently with decreasing compensation. *Because B waves sometimes precede A waves,* notify the practitioner if B waves occur frequently.



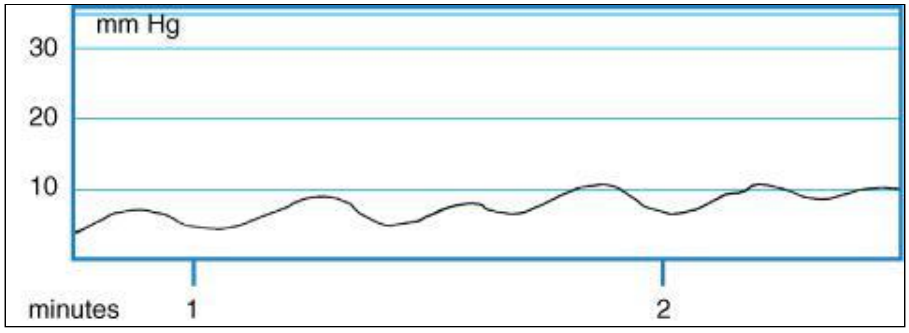
C waves

C waves (shown below) are rapid and rhythmic, but not sharp, and last 1 to 2 minutes with an ICP of 20 to 50 mm Hg. They're clinically insignificant and may fluctuate with respirations or systemic blood pressure changes.



ICP waveform showing equipment problem

A waveform such as the one shown below typically signals a problem with the flushless transducer or monitor. Check for line obstruction and determine whether the transducer needs rebalancing. If the patient has a low ICP value, this waveform might be normal.



- Discard ICP monitoring catheter insertion instruments and equipment appropriately *to protect health care workers from exposure to potentially infectious materials.*
- Remove and discard your personal protective equipment.[5]
- Return the bed to the lowest position *to prevent falls and maintain the patient's safety.*[37]
- Perform hand hygiene.[7][8][9][10][11][12]
- Arrange for a computed tomography scan if ordered *to confirm ICP monitoring catheter placement.*

Performing ICP monitoring and care

- Assess the patient's neurologic status and vital signs as ordered or as directed by your facility.[2] Notify the practitioner immediately if the patient's ICP value exceeds established parameters. If no parameters exist, notify the practitioner if ICP exceeds 20 mm Hg. Watch for signs of increased ICP, such as decreased level of consciousness, nausea, vomiting, headache, lethargy, and agitation. (See *Managing ICP*.)

MANAGING ICP

By performing nursing care gently, slowly, and cautiously, you can help manage—or even significantly reduce—increased intracranial pressure (ICP). If possible, urge the patient to participate in the care. Here are some steps you can take to help manage increased ICP:

- Plan care to include rest periods between activities and minimize external stimulation *to allow the patient's ICP to return to baseline and avoid lengthy and cumulative pressure elevations.*
- Speak to the patient before attempting any procedures, even if the patient appears comatose. Touch the patient on an arm or a leg first before touching in a more personal area, such as the face or chest. This action is especially important if the patient doesn't know you or is confused or sedated.
- Suction the patient only when necessary to remove secretions and maintain airway patency.
- Hyperventilate the patient with 100% oxygen as ordered. *Hyperventilation with oxygen from a handheld resuscitation bag or ventilator helps rid the patient of excess carbon dioxide; this constricts cerebral vessels and reduces cerebral blood volume and ICP.* However, keep in mind that only normal brain tissue responds to hyperventilation because blood vessels in damaged areas have reduced vasoconstrictive ability. *Because hyperventilation can cause ischemia,* use it to decrease ICP only in an acute situation until you can institute other measures.
- *To promote venous drainage,* keep the patient's head in the midline position, even when the patient is in a side-lying position. Avoid flexing the patient's neck or hip more than 90 degrees, and keep the head of the bed elevated 30 to 45 degrees.[2] Keep endotracheal tube ties and rigid cervical collars secure but loose enough to help prevent compression of the patient's jugular veins.
- Avoid placing the patient in the prone position.
- *To avoid increasing intrathoracic pressure, which increases ICP,* discourage use of the Valsalva maneuver and isometric muscle contractions. *To avoid isometric contractions,* distract the patient when giving painful injections (such as by instructing the patient to wiggle the toes or by massaging the area before injection to relax the muscles), and instruct the patient to concentrate on breathing through difficult procedures such as bed-to-stretcher transfers. *To keep the patient from holding the breath when moving around in bed,* instruct the patient to relax as much as possible during position changes. If necessary, administer a stool softener *to help prevent constipation and unnecessary straining during defecation.*
- If the patient is heavily sedated, monitor respiratory rate and arterial blood gas levels. *Depressed respirations compromise ventilations and oxygen exchange. Maintaining adequate respiratory rate and volume helps reduce ICP.*

- If the bedside monitor doesn't calculate CPP, calculate CPP by subtracting the patient's ICP from the MAP (CPP = MAP – ICP). If the patient's CPP isn't within the specified parameters, notify the practitioner.

- Assess continuous CSF drainage every 1 to 2 hours and intermittent drainage as ordered. Observe the amount, color, and clarity for all drainage.[2]
- Assess external ventricular drainage system patency as necessary by briefly lowering the entire system to assess drip rate into the graduated burette.
- Check the patient's position to ensure that the flushless transducer is at the ordered reference level *to prevent overdrainage or underdrainage if an external ventricular drain is in place and to help ensure accurate ICP values.*
- Assess the catheter system at least hourly to ensure that the system is intact and has no leaks, kinks, or clots *to help decrease the risk of increased ICP related to catheter flow and drainage and to help ensure accurate ICP values and waveforms consistent with neurologic assessment.*[2]
- Record an ICP tracing each shift and as ICP waveform changes occur. Compare these tracings with previous tracings.
- If the patient has an external ventricular drain, inform the patient and family (if appropriate) that the patient should change the bed's position only with assistance *because raising the level of the patient's bed with the external ventricular drain at fixed zero and reference levels can result in a large increase in CSF drainage.*[2]
- Clamp an external ventricular drain any time that a patient response occurs (such as coughing, vomiting, or response to care) or whenever you perform a procedure (such as suctioning, repositioning, or transport) that can cause CSF overdrainage.
- If an ICP waveform doesn't appear, troubleshoot the ICP monitoring system. If the patient has an external ventricular drain, the cause may be air bubbles, clots, or debris within the drainage tubing or across the flushless transducer. Assess the system systematically for air and debris. Be sure to level the drain at the appropriate landmark and rezero the system. If an ICP waveform still fails to appear, replace the pressure cable, pressure module, or transducer; change only one at a time.
- Don't change the drainage tubing routinely. Leave it in place for the duration of external ventricular drainage. If the drainage tubing becomes accidently disconnected, maintain the sterility of the ventricular catheter and obtain and connect a new sterile drainage system.[2]
- When accessing an external ventricular drainage system, perform hand hygiene, put on a mask with a face shield or a mask and goggles, set up a sterile field, and put on sterile gloves. Scrub the system access port for 3 minutes using a facility-approved antiseptic solution (such as povidone-iodine) following the manufacturer's instructions for use.[5][6][7][8][9][10][11]
- Maintain the external ventricular drainage system bag in an upright position. If you must lay it down, drain the CSF to the lower collection bag *to decrease the transfer of bacteria in the collection chamber to the drainage bag.* Change the drainage bag when it's nearly full while wearing sterile gloves and a mask with a face shield or a mask and goggles.
- Change the catheter insertion site dressing as directed by your facility.[2] Follow these steps when changing the dressing:
  - Put on a mask with a face shield or a mask and goggles.[6]
  - Perform hand hygiene.[7][8][9][10][11][12]
  - Put on sterile gloves.[5][6]
  - Remove and discard the old dressing.[5]
  - Clip any hair that has grown back at the insertion site as necessary.
  - Inspect the insertion site for CSF leakage and signs of infection.
  - Remove and discard your gloves.[5][6]
  - Perform hand hygiene.[7][8][9][10][11][12]
  - Put on a new pair of sterile gloves.[5][6]
  - Place a new sterile occlusive dressing over the insertion site.[2]
  - Discard used supplies in appropriate receptacles.[5]
  - Remove and discard your personal protective equipment.[5][6]

Completing the procedure

- Perform hand hygiene.[7][8][9][10][11][12]
- Document the procedure.[38][39][40][41]

Special Considerations

- The Joint Commission issued a sentinel event alert concerning medical device alarm safety *because alarm-related events have been associated with permanent loss of function or death.* Among the major contributing factors were improper alarm settings, alarm settings turned off inappropriately, and alarm signals that were inaudible to staff. Make sure alarm limits are set appropriately set and that alarms are turned on, functioning properly, and audible to staff. Follow facility guidelines for preventing alarm fatigue.[26]
- The Joint Commission issued a sentinel event alert related to managing risk during transition to new International Organization for Standardization tubing standards that were designed to prevent dangerous tubing misconnections, *which can lead to serious patient injury and death.* During the transition, make sure to trace the tubing and catheter from the patient to the point of origin before connecting or reconnecting any device or infusion, at any care transition (such as to a new setting or service), and as part of the handoff process; route tubes and catheters having different purposes in different standardized directions; when there are different access sites or several bags hanging, label tubing at both the distal and proximal ends; use tubing and equipment only as intended; and store medications for different delivery routes in separate locations.[36]
- If the patient develops increased ICP, open the external ventricular drain to drain CSF as ordered. Administer hyperosmolar therapy with hypertonic saline solution or mannitol as prescribed.[42]
- Be aware that guidelines don't recommend induced hypothermia for treatment of increased ICP. Although it can reduce ICP initially, it may cause cerebral edema during rewarming.[42]

Complications

Complications associated with ICP catheter insertion, monitoring, and care may include:

- CNS infection[1][2]
- hemorrhage with sudden lowering of ICP due to rupture of existing hematomas or aneurysms at insertion[1][2]
- results of overdrainage (from faulty stopcock placement or low position of drip chamber)
    - rapid decompression of the cranial contents and damage to cortical bridging veins, leading to hematoma formation
    - facial numbness or weakness
    - hearing changes
    - lateral gaze that produces double vision
    - mental status changes
    - postural headache that's relieved in the supine position
    - small pupils
    - vertigo.

Documentation

Documentation associated with ICP catheter insertion, monitoring, and care includes:

- ICP monitoring catheter insertion procedure
    - date and time
    - response to the procedure
    - catheter insertion site
- type of ICP monitoring system used
- zero reference level
- ICP digital values
- ICP waveforms
- CPP calculations
- factors that might affect ICP (such as drug therapy, stressful procedures, or sleep)
- vital signs and neurologic assessments
- clinical status

- CSF drainage assessment
  - amount
  - characteristics
  - frequency
- ICP value in response to CSF drainage
- teaching provided to the patient and family (if applicable)
  - understanding of that teaching
  - follow-up teaching needed.

Related Procedures

- Intracranial pressure monitor catheter insertion, assisting, pediatric
- Intracranial pressure monitoring and care, pediatric
- Positioning a patient with increased intracranial pressure (ICP), pediatric

References

(Rating System for the Hierarchy of Evidence for Intervention/Treatment Questions)

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Rating System for the Hierarchy of Evidence for Intervention/Treatment Questions

The following leveling system is adapted from *Evidence-Based practice in nursing & healthcare: A guide to best practice,* Fifth edition, by Bernadette Mazurek Melnyk and Ellen Fineout-Overholt (2023).

Level I	Evidence from a systematic review or meta-analysis of all relevant randomized controlled trials (RCTs)
Level II	Evidence from well-designed single RCTs (experimental)
Level III	Evidence from well-designed nonrandomized controlled trials (quasi-experimental), systematic reviews of a complete body of evidence, and intervention studies using mixed methods
Level IV	Evidence from well-designed case-control and cohort studies (observational)
Level V	Evidence from systematic reviews of qualitative and descriptive studies
Level VI	Evidence from single descriptive and qualitative studies, evidence-based practice implementation, and quality improvement projects
Level VII	Evidence from expert opinion, expert committee reports, and literature reviews

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