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Purpose
The purpose of Increased Intracranial Pressure and Monitoring is to learn about intracranial hypertension (ICH) and its effects on patient outcomes.

To understand ICH, it is important to understand the pathophysiology of intracranial pressure (ICP) and how an elevated ICP relates to a patient's clinical signs and symptoms.

This course will review ICP monitoring, monitoring devices, and treatments for ICH. The importance of documentation related to monitoring and treating ICH as well as relevant patient and family education will be covered.

Objectives
Upon successful completion of this course, you will be able to:

1. Describe intracranial physiology and assessment
2. Identify intracranial hypertension pathophysiology
3. Define the Monro-Kellie doctrine
4. Define intracranial pressure (ICP) and cerebral perfusion pressure (CPP)
5. Identify ICP normal range
6. Describe the dangers of an elevated ICP
7. Describe the signs and symptoms of rising ICP
8. Define ICP monitoring and the indications for a ventriculostomy
9. Identify the four methods of ICP monitoring
10. Describe the functions of the catheter
11. Describe the treatments of ICH
12. Identify physician orders, nursing documents, and nursing considerations related to ICP and the ventriculostomy

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Introduction
Elevated intracranial pressure (ICP) can occur as a complication of neurosurgical emergencies, including traumatic brain injury (TBI) and intracranial hemorrhage, or due to medical illnesses, such as meningitis or fulminant hepatic failure (Luks, 2009).

All of these conditions are characterized by the addition of volume in the intracranial vault which can lead to brain damage and/or death. Early recognition of elevated ICP, proper use of invasive monitoring approaches, and the administration of therapy to reduce ICP and address its underlying cause is important to improve morbidity and mortality outcomes for your patient.

Patients with increased ICP are among the most challenging patients to care for. Initiating rapid and effective treatment to protect a patient from a devastating outcome depends on aggressive and thorough clinical assessment (Arbor, 2004).

The treatment goal to reduce ICP is basically to manipulate, and ultimately to decrease the volume of one of three components of the intracranial space: blood, brain tissue, or cerebral spinal fluid (CSF).

The Intracranial Vault
There are three components to the intracranial vault:
- The brain tissue
- CSF
- Intracranial blood

Intracranial pressure refers to the pressure within the intracranial vault (skull).

According to the classic "Monro-Kellie" doctrine hypothesis, the intracranial vault volume within an intact skull is a closed system, meaning that the overall volume of its contents remains fixed.

Various homeostatic mechanisms function to maintain this fixed volume after any pathophysiologic event that influences intracranial contents.

Despite the ability of the Monro-Kellie doctrine to explain and predict the entirety of dynamics (Schaller & Graf, 2005) there are limitations within the doctrine.

Pathophysiology of Intracranial Pressure
Many types of pathologic conditions can disrupt the volume equilibrium processes within and between the three components of the skull.

Since the overall volume of the intracranial vault cannot change, any pathologic condition(s) that prevents equilibrium within and between the components will likely result in an elevated ICP.

In other words, elevated ICP levels result when an increase in the volume of one or more components cannot be offset by a volume reduction/displacement in some other component.
In a healthy brain, small changes in ICP related to coughing, sneezing and straining are well tolerated. However, changes in ICP in a brain-injured individual can be deadly.

ICP Values
Normal intracranial pressure in adults ranges from 0-15 mmHg (IUKS, 2009). In supine adults, normal ICP resides between 5-15 mm Hg, whereas intracranial hypertension is present when ICP rises above 20 mm Hg (Luks, 2009).

Typically, sustained ICP levels above 20 mmHg can result in brain injury.

It is important to understand that the definition of an elevated ICP depends on the specific pathology.

ICP can also depart from a "normal range" based on other factors such as age, body posture, and other clinical conditions.

A key principle underlying ICP is the Monro-Kellie doctrine, which emphasizes that the intracranial compartment is comprised of three components (blood, cerebrospinal fluid (CSF), and brain tissue), residing within a fixed space of the cranium (Luks, 2009). Increases in the size of one component must be matched by decreases in the size of other components, or ICP will rise.

ICP and Volume
The other component of the intracranial vault, the brain tissue, has a relatively constant volume. There are times when the volume of the brain tissue can be altered, but ICP is usually more dependent on changes in the volumes of CSF and cerebral blood than as a result of changes in the brain tissue.

CSF is produced continuously and is normally reabsorbed into the venous system. Cerebral blood flow (CBF) determines the volume of the cerebral blood in the intracranial vault. Compensatory mechanisms exist to allow for volume increases of CSF and cerebral blood with minimal elevation of ICP.

When such mechanisms are compromised or exhausted, even a slight increase in volume can increase pressure, and in turn, result in an abnormally elevated ICP.

Additionally, the rate of volume change of the intracranial contents plays a significant role. Acute, quick changes in volume will usually lead more rapidly to the potential of elevated ICP than those that occur slowly.

Compensatory mechanisms can help to decrease intracranial pressure by reducing the volume. CSF can be effectively shunted away to the venous system or spinal cord and cerebral blood vessels can reduce blood flow volume through vasoconstriction.

Causes of Increased ICP
Common causes of increased intracranial pressure include:

Increased Cerebrospinal Fluid Volume
- Nonobstructive hydrocephalus
- Obstructive hydrocephalus
- Pseudotumor cerebri
Increased Blood Volume
- Acidosis
- Increased right atrial pressure
- High arterial PaCO2
- Dural sinus thrombosis

Increased Brain Tissue Volume
- Ischemia and necrosis
- Infection
- Hemorrhage
- Tumor
- Cytotoxic edema
- Vasogenic edema
(Copstead & Banasik, 2005)

Tracheal suctioning has also been linked to increased intracranial pressure, and thus should only be performed when absolutely clinically necessary, and with close monitoring of the patient before, during and after the procedure (Moore & Woodrow, 2009).

Cerebral Perfusion Pressure
Inadequate cerebral perfusion pressure (CPP) is a major factor that can affect cerebral blood flow (CBF) to the brain.

CPP measurements aid in determining the amount of blood volume present in the intracranial space. It is used as an important clinical indicator of cerebral blood flow and hence adequate oxygenation.

CPP measurement is expressed in millimeters of mercury and is determined by measuring the difference between the patient's mean arterial pressure (MAP) and ICP.

CPP = MAP – ICP

CPP should be maintained above 70 – 80mmHg to prevent further neurological injury (also known as secondary injury) and to reduce the risk of ischemia (trauma.org, n.d).

Achieving and maintaining adequate cerebral blood flow is critically influenced by CPP.

CPP can be significantly diminished by an increased intracranial pressure.

Signs & Symptoms of Elevated ICP
Patients with increased ICP often present with headache, nausea, vomiting, and progressive mental status decline.

Sustained elevated levels of ICP usually result in a reduction in cerebral blood flow (CBF) and the potential for brain herniation. Herniation creates pressure that will lead to brain injury and the possibility of death.

Therefore, it is extremely important to identify patients with increased ICP as soon as possible.
**Cushing’s Triad**

Cushing's triad refers to a classic presentation of increased ICP that is caused by intracranial hemorrhage (ICH).

The triad is identified as the presence of hypertension, bradycardia, and respiratory depression. It occurs after a patient's ICP has been elevated for some time and thus often requires an urgent and aggressive response.

Cushing’s triad may cause focal neurologic deficits that develop from mass lesions or herniation.

Computed tomographic (CT) scan may indicate an elevated ICP related to the presence of mass lesions or evidence of hemorrhage.

Even if signs and symptoms are present in the patient and radiologic studies (CT scan) also support the ICH diagnosis, ICP is only accurately known to be elevated if it is measured directly through ICP monitoring devices.

**The Glasgow Coma Scale**

The Glasgow Coma Scale assigns a numeric value to a patient’s neurologic response to different variables.

A score of 3 is the lowest (worst) response and 15 is the best (no deficit).

A score between 9-12 correlates with moderate injury.

A score of 8 or lower correlates with severe brain injury.

**Closed Head Traumas**

ICP monitoring is often recommended in patients with closed head traumas. A great deal of research has been performed that indicates ICP monitoring can contribute to improved patient outcomes. Literature also provides an evidence base for the use of ICP monitoring when intracranial hemorrhage is suspected in patients with a severe head injury, particularly those who are comatose.

The Guidelines for the Management of Severe Head Injury recommends ICP monitoring in comatose head injury patients if the Glasgow Coma Score (GCS) is between 3-8 and they have an abnormal CT scan.

In patients with a normal CT, ICP monitoring is still warranted if the GCS is 3-8 and they have any one of the following characteristics:

- Age >40 years old
- Unilateral or bilateral motor posturing
- Systolic blood pressure <90 mmHg

**The Use of ICP Monitoring**

The use of ICP monitoring depends on the specifics of the patient's circumstances.
Since ICP monitoring is associated with a small risk of serious complications, such as CNS infection and intracranial hemorrhage, it should only be used for patients at high risk for significant ICP.

It is important to note that an alert patient with a reliable neurologic exam is a good monitor of ICP level, especially if the risks of invasive monitoring outweigh the benefits.

If a reliable neurologic exam is not possible and there is intracranial pathology associated with increased ICP, then invasive monitoring is almost always required.

**ICP Monitoring: Importance and Indications**

The most reliable method of diagnosing an elevated ICP is to measure it directly. ICP can only be measured directly with an ICP monitoring device.

As earlier discussed, ICP is required to calculate cerebral perfusion pressure (CPP) which provides essential information about the sufficiency of cerebral blood flow. Also, ICP levels aid in determining the likelihood of herniation.

Continuous ICP monitoring is important following an initial diagnosis of significant increased ICP. This is essential in order to best direct a treatment algorithm with the goal of reducing the intracranial volume and pressure (Mayer & Chong, 2002).

It is critically important to the outcome of the patient that ICP is monitored correctly especially since treatment modalities can also be harmful.

Monitoring ICP measurements can also provide valuable information to forecast patient prognosis. Although it is possible to identify the presence of elevated ICP by clinical manifestations, the current consensus is that an ICP monitoring device should be used if the likelihood of cerebral blood flow reduction and/or herniation is elevated due to possible ICH.

**Indications for ICP Monitoring**

Some of the indications for ICP monitoring include:

- Intracranial hemorrhage
- Cerebral edema
- Severe traumatic brain injury
- Post-craniotomy
- Space-occupying lesions such as subdural and epidural
- Hematomas, abscesses, tumors or aneurysms that occlude the CSF pathway
- Reye syndrome patients who develop coma, posturing, and abnormal responses to noxious stimuli
- Encephalopathy from hypertensive crisis, lead ingestion, or liver failure
- Meningitis/encephalitis that causes malabsorption of CSF

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End Chart Methods to Monitor ICP

There are two basic types of ICP monitors:
- Monitors that provide ICP data only
- Monitors that allow for concurrent drainage of cerebrospinal fluid (CSF) while measuring ICP

There are four standard methods to monitor ICP, namely:
- Subarachnoid screw / bolt (provides ICP data only)
- Subdural/epidural catheter (provides ICP data only)
- Intraparenchymal of a fiberoptic transducer tipped catheter (provides ICP data only)
- Ventriculostomy (provides ICP data and drainage): most commonly used in ICU

There are unique risks and benefits to each of the four monitoring devices. In the neurointensive care unit, the most commonly used method is the ventriculostomy.

Subarachnoid Screw
The subarachnoid screw, also known as a bolt, connects to an external traducer via tubing. It is placed into the skull abutting the dura. It is a hollow screw which allows CSF to fill the bolt, allowing the pressures to become equal.

The positives of this method are that infection and hemorrhage risks are low.

The negative aspects include the possibility of errors from ICP underestimation, misplacement of the screw, and occlusion by debris.

Subdural/Epidural Catheter
The subdural/epidural catheter is another method to monitor ICP. It is less invasive but also less accurate. It cannot be used to drain CSF; however the catheter has a lower risk of infection or hemorrhage (Zhong et al., 2003).

The intraparenchymal of a fiberoptic transduced tipped catheter is seen very often in the ICU. It is the second most accurate way to obtain an ICP. There is no way to drain CSF, but infection and hemorrhage rates are low.

A brain oxygen and cerebral blood flow monitor is inserted into the brain tissue and secured to the skull with a bolt. A catheter is inserted into the ventricle of the brain to monitor intracranial pressure (ICP). If pressure is too high, the CSF fluid can be drained from the ventricles.

Intraparenchymal of a Fiberoptic Transducer Tipped Catheter
The intraparenchymal of a fiberoptic transduced tipped catheter is seen very often in the ICU.
It is the second most accurate way to obtain an ICP.

There is no way to drain CSF, but infection and hemorrhage rates are low.

**Ventriculostomy**
The ventriculostomy is also referred to as the intraventricular catheter or ventriculostomy drain. It is a soft tube placed through a burr hole into the lateral ventricle of the brain. The tubing connects to a standard transducer set which is never pressurized.

Care of a patient with ventriculostomy requires precise training on how to carefully level the transducer to the Foramen of Monro to minimize risk of infusion or improper drainage.

The ventriculostomy is the most accurate way to receive and monitor an ICP (Zhong, 2003), and also allows for the therapeutic drainage of CSF.

One drawback to monitoring ICP with a ventriculostomy is that debris, such as tissue fragments or blood clots, can obstruct the catheter. If this occurs, it is likely that the obstruction will compromise the ability to monitor the ICP accurately. An obstruction can also alter proper drainage of the CSF. Insertion of a ventriculostomy also increases the risk for infection since it is invasive. Like any foreign material in a sterile area of the body, there is a risk of intracranial infection and an associated risk of bleeding (Kocan, 2002).

**Complications of Ventriculostomy**
Additional complications of a ventriculostomy include:
- CSF leakage
- Air leakage into the subarachnoid space or ventricle
- Overdrainage of CSF leading to ventricular collapse and herniation
- Inappropriate therapy related to ICP readings with dampened waveforms, electromechanical failure, or operator error such as inappropriate leveling

(NIH, 2012)

A normal ICP waveform generally has 3 distinct components, P1, P2, and P3. If the waveform is dampened, the patency of the catheter may be compromised.

To troubleshoot a dampened waveform, first examine the drainage tubing distal to the patient for the presence of air bubbles, clots, or tissue. If any are present, flush the tubing away from the patient to remove the debris.

If the waveform remains dampened, you can further assess patency of the catheter by observing for flow of CSF (Kocan, M. J., 2002).

**Ventriculostomy Catheter**
As previously discussed, among the intracranial pressure monitors, ventriculostomy is the only monitoring technique that allows both ICP monitoring and therapeutic drainage of cerebrospinal fluid (CSF), if necessary. The drainage of the CSF helps to lower ICP and also can be sampled for laboratory
studies to help guide clinical decisions. Ventriculostomy is an important option when a patient requires immediate intervention following a confirmed ICH diagnosis.

Assisting with Insertion of the Catheter

A physician will place the ventriculostomy catheter. The area of the head where the catheter will be placed is usually shaved.

The nurse will be responsible to provide patient care and to perform procedural sedation per hospital policy, if required. The nurse will also monitor vital signs and inform the physician of relevant changes. The nurse is also responsible for setting up and maintaining the system according to manufacturer's directions.

*Note! The ventriculostomy catheter should be filled with normal saline that has no bacteriostatic preservative.*

Catheter Indwelling Time

According to current literature, the length of time a ventriculostomy catheter can safely remain inside a patient varies.

A general length of time is about 2 weeks, however hospital policy and physician's orders based on the patient's condition will ultimately determine the length of indwelling time.

The risk of infection is always increased if the catheter remains in situ for longer periods of time.

Care of the Drain

Any time the brain is exposed (e.g. during dressing changes), sterile gloves should be donned and a mask should be worn.

The nurse should follow the appointed policy and procedure at the facility.

This usually involves placing a sterile dressing over the insertion site.

Routine irrigation to prevent obstruction is usually avoided because it may increase the risk of infection.

*The reference point must ALWAYS be leveled to the same point on the patient.*

Reading Intracranial Pressure

According to American Association of Critical Care Nurses Procedure Manual (2011), the head of the patient’s bed should consistently remain elevated at 30-45 degrees for measurement. The transducer should be leveled to a reference point. Although discussion over the exact location for transducer placement varies, there should be a fixed point to achieve consistency in measuring ICP (Luks, 2009).

The most common reference point is the Foramen of Monro (see next screen for image). According the American Association of Neuroscience Nurses Clinical Guideline (2011), the zero reference point is the imaginary line between the top of the ear and the outer canthus of the eye (the point at which the upper and lower eyelids meet). Check your organization's P&P to determine if the zero reference point used at your organization is the outer canthus of the eye, the top of the ear, or a point midway between
the canthus of the eye and the opening of the ear canal.

**Drainage**
The nurse should monitor the CSF hourly (or as prescribed) for the amount, color, and clarity of drainage.

Draining the CSF can be performed continuously or intermittently depending on the physicians orders.

Both infectious and noninfectious processes can change the appearance of CSF. Normal CSF is clear and colorless. Xanthochromia is the term used for pink or yellow tint in CSF.

CSF samples maybe taken by physicians or in some hospitals, it is in the scope of practice for the nurse practitioner to obtain the CSF and evaluate the cell count for protein, glucose, cytology, and lactate.

It is important to remember the height of the CSF drainage bag is also a specific order from the physician.

**ICP Precautions**
The following list of precautions is useful information that can aid in providing quality care and improved outcomes for any patient with a ventriculostomy.

The precautions include:

- Decreasing the risk of central nervous system infection by using aseptic technique when assembling, manipulating, or accessing the fluid-filled monitoring system
- Using only sterile 0.9% NaCl to fill the pressure tubing and never using a heparinized solution
- Maintaining tight connections
- Always having the patient alarms on at all times
- Never using a flush device for ICP monitoring
- Keeping the system free of air to ensure maximal accuracy
- Maintaining proper leveling and zeroing of the system (proper level for the transducer being the Foramen of Monro measured at the level of the outer canthus of the eye)

**ICP Precautions**

- Using extreme care when turning or positioning the patient to avoid accidental disconnection of the tubing
- Maintaining patients in a 30-45 degree head up position, avoiding Trendelenberg position, hyperextension or flexion of the neck to avoid an increase in ICP
- Keeping the drainage cylinder upright to avoid getting the filter in the drainage system wet (will slow or stop drainage)
- Keeping the stopcock to the drainage system closed when performing pressure monitoring (affects accuracy)
- Avoiding over-drainage of CSF by draining only approximately two ml of fluid per time (the height
Treatment of High ICP
The goal for patients presenting with ICP is to identify and address the underlying cause and lower the ICP as quickly as possible.

There are urgent situations also that require immediate reduction in ICP regardless of the underlying cause. Such situations include those where elevated ICP is clearly evident by its clinical manifestations. Whichever therapy is used, the goal is usually to keep ICP <20 mmHg and CPP between 60 and 75 mmHg (Luks, 2009).

Draining the CSF is the gold standard in treatment of high intracranial pressure. CSF is drained through the ventricles with one of the devices previously discussed.

There are patient positioning issues that are important in treating increased ICP. Patients with an elevated ICP will often have physician orders to keep the head of the bed at 30 – 45 degrees. It is important not to lift the patient's legs or position the patient on his/her side.

Maintaining good neck and head alignment is a recommended nursing intervention to prevent further elevations in intracranial pressure. Flexing the patient's neck or turning the head to either side is not recommended in cases of elevated ICP.

Positioning of patients with elevated ICP may be controversial at times. For example, sitting the patient up lowers the ICP, yet laying the patient down helps with cerebral perfusion.

Environment
Patients with increased intracranial pressure require a controlled environment. The patient’s room should be dark and free from noise to minimize any stimulus which can increase the ICP.

Discuss visiting limitations with the healthcare team prior to entering the patient's room and follow their instructions.

All healthcare providers and visitors should speak softly and limit conversations with and around the patient.

The family needs to be instructed and educated as to the importance of a calming environment. Discussions should be light and pleasant.

Instruct the family to tell the nurse if the patient needs assistance with patient care: eating, drinking, turning, positioning, controlling temperature, and/or toileting.

There is a mnemonic to help remember the relationship between serum osmolarity and fluid status.
"High is Dry, Low is Overload"

**Hyperventilation versus Mannitol**

The goal of hyperventilation is to decrease the PCO2 to 30 mmHg. Decreasing the PCO2 causes vasoconstriction which decreases intracranial volume. However, PCO2 levels that are below 30 can cause cerebral ischemia.

Hyperventilating the patient continues to be controversial. In previous years it has been common practice to over ventilate the patient to lower the pCO2 in an attempt to lower the ICP. This practice can constrict the cerebral blood vessels in patients with a high ICP, and is therefore contraindicated.

Currently, the use of Mannitol or hypertonic saline as an osmotic diuretic is the preferred method for lowering ICP. It removes extra cellular fluid by creating an osmotic gradient across the capillary gradient.

Hypertonic saline is the better agent for patients with marginal or low blood pressure, as the diuretic effect of Mannitol can cause hypovolemia and lower blood pressure even further (Luks, 2009). Frequent monitoring of serum sodium and osmolarity is necessary, with goal serum osmolarity of 300-320 mOsm/L and serum sodium of 140-150 mEq/L (Luks, 2009).

When using hypertonic saline, care must be taken to avoid hypernatremia as well as sudden decreases in sodium concentration upon cessation of therapy, as such drops may cause intracerebral fluid shifts and worsen ICP. Concerns persist that either agent may cross the altered blood-brain barrier in injured brain and, paradoxically cause fluid movement into the injured and swollen tissue (Luks, 2009).

**Intravenous (IV) Fluids**

Hypertonic or isotonic IV fluids are usually used for patients with elevated ICP. Examples of hypertonic or isotonic IV fluids include normal saline, lactated ringers and albumin. Hypotonic fluids should never be administered.

Steroids are commonly given to decrease inflammation. Steroids are not commonly given for patients who had head traumas or strokes. An example of a good use of steroids is when it is given to reduce swelling around a brain tumor.

Anti-convulsants are often prescribed to decrease the patient's chance of having a seizure. A healthcare provider should always check for therapeutic drug levels when using anti-convulsants, such as phenobarbital or dilantin, that can accumulate and become toxic to the patient. A sub-therapeutic drug level will not protect the patient from seizures. A high drug level may cause a variety of side effects including a decreased level of consciousness.

**Methods to Lower Metabolic Rate**

**Barbiturate coma:** Placing the patient in a barbiturate coma lowers ICP by lowering the rate of the body's metabolic process, oxygen consumption, and CO2 production. A lower metabolic rate will decrease the work of the brain during a recovery period. Barbiturate comas are usually only used when other methods to decrease intracranial hypertension fails.

**Sedation:** Sedating the patient will also lower the metabolic rate of the brain. The common sedative is
a continuous infusion of propofol due to the short half-life of the drug. Turning off the drip will allow the patient to wake up within a few minutes to an hour. This is beneficial for neurological exams necessary to assess the progress or decline of the patient’s status.

**Cooling core body temperature:** Keeping the patient in a cold room or on a cooling blanket is beneficial for patients with high ICP. A change of one degree in temperature produces approximately 7% decrease change in the overall metabolic demand. The room should not be so cold as to cause the patient to shiver. Shivering can increase metabolic workload.

**Oxygenation and Blood Pressure Management**

Although there is controversy regarding over oxygenation and the release of free radicals in the blood, oxygenation is a key aspect to consider. The nurse should keep oxygen saturation around 95% (or per physician order) since this will keep the brain adequately oxygenated to prevent ischemia.

Blood pressure control needs to be closely managed to keep ICP within normal limits. Remember that **MAP - ICP = CPP.** A patient needs a CPP 60-75; therefore, the systolic blood pressure needs to be at a range where ischemia is not occurring.

Increased blood pressure may increase intracranial pressure, decrease cerebral blood flow or worsen bleeding. Intravenous drip medications such as Nipride, Nicardipine, or Labetalol may be given to lower the patient’s blood pressure.

In addition, if the MAP is too low, intravenous medications, such as neosynephrine, levophed, or vasopressin, may be ordered to increase the MAP and thereby increase the CPP.

**Coagulation**

If increased ICP is a result of intracranial hemorrhage from anticoagulation use, reversal agents may be necessary.

Freshly frozen plasma, Vitamin K, platelets, and other factors may need to be given.

*The main complication of this therapy is arterial thromboembolic events, such as myocardial infarction and ischaemic stroke (Kase, CS, 2008).*

**Documentation**

According to AACN (2005), there are important aspects a nurse must document during monitoring ICP and treating ICH.

Follow your organization’s policy for the frequency of documentation. Any provisions for patient and family education should be noted.

As a general guideline, ICP and CPP should be measured hourly. A description of CSF (clarity, color, characteristics) should be documented every shift and with every change. The nurse should print out the ICP waveform, and document the correct value. The nurse should always document any nursing interventions used to treat ICP or CPP deviations, and any expected or unexpected outcomes.

Complete neuro exams should be performed per physician order. At a minimum, neuro checks should be done hourly unless stated otherwise. Along with a full neuro exam, a nurse should monitor and
document the Glasgow Coma Scale. It is also important to document zeroing the transducer every four hours or every shift depending on your organization's policy as well as the height of the drainage bag.

**Family Considerations**
Family dynamics is also an important consideration in treating elevated ICP.

Family and significant others are encouraged to visit and speak softly to the patient. Engage the family in the patient's care and ask them to help when appropriate. The family members and other care givers should utilize therapeutic touch and other methods to calm the patient which can lead to a lower ICP.

Educating the family will indirectly and directly help to decrease the ICP. Honesty and answering all questions and addressing all concerns will help to keep the family at ease when visiting with their loved one.

Monitoring the patient for the desired effect is important, however, since some patients may react with higher ICP pressures. In order to decrease the time a patient has increased ICP, try to group care and then let the patient rest. Do not repeatedly stress the patient with tasks to be done.

**Conclusion**
Patients with any neurological issues need to be closely monitored for signs and symptoms associated with an elevated ICP.

When increased intracranial pressure is evident or strongly suspected, the use of a ventriculostomy is the gold standard as a monitoring device.

Managing a ventriculostomy requires intensive care monitoring by experienced ICU nurses. Knowing and understanding how to treat high ICP is essential in order to decrease potential morbidity and mortality associated with ICH.

Experienced caregivers will appreciate the benefits of educating and engaging a patient’s family in interventions that will contribute to appropriate care of the patient experiencing an elevated ICP. Always follow your organization's policy for treating and documenting elevated ICP. This action will help ensure standardized and quality care for your patient.

**References**
At the time this course was constructed all URL's in the reference list were current and accessible. rm.com. is committed to providing healthcare professionals with the most up to date information available.


American Association of Neuroscience Nurses Clinical Practice Guideline Series (2011). Care of the Patient Undergoing Intracranial Pressure Monitoring/ External Ventricular Drainage or Lumbar Drainage.


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