

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**POLICIES:**

1. The Codman EDS3 CSF External Drainage System may be utilized in the intensive care setting to allow for:
  - a. the ability to decrease the pressure within the cranium by removing CSF
  - b. the ability to instill medication directly into the brain
  - c. the ability to collect CSF specimens
  - d. CSF drainage into the drip chamber
2. Insertion and removal of all intracranial pressure monitoring devices must be performed by a neurosurgeon or a practitioner with clinical privileges.
3. All licensed personnel who care for patients with ICP monitoring devices must demonstrate competency and should participate in periodic in-service training to maintain that competency.
4. For monitoring ICP, The Codman EDS3 CSF External Drainage System is either connected to a transducer system or used in conjunction with an ICP EXPRESS Monitor. (Refer to procedure for ICP Monitoring using the ICP EXPRESS system.)
5. Sterile gloves, mask, and hat will be worn when assisting with initial ventriculostomy catheter insertion and drainage system hook-up. Sterile gloves and mask will be worn when performing site care, replacing the drainage collection bag, or obtaining a sample of CSF.

**DEFINITIONS:**

CSF (cerebrospinal fluid)

MAP (mean arterial pressure):  $\frac{(2 \times \text{DBP}) + \text{SBP}}{3}$

CPP (cerebral perfusion pressure): CPP = MAP - ICP

Normal CPP is between 70 - 90mmHg

ICP (intracranial pressure): Normal ICP is 9 - 14 mmHg.

**ASSESSMENT:**

The following will be assessed initially, Q12 hours, and PRN:

1. HOB is at the ordered height.
2. HOB control is *Locked Out*.
3. No air bubbles are noted in the system.
4. All connectors in the system are tight.
5. Position of the transducer is at the "Foramen of Monroe".
6. Dressing for intactness and drainage.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**REPORTABLE CONDITIONS:**

1. Any neurological deterioration.
2. CSF suddenly becomes bloody. (Sign of re-bleeding.)
3. CSF leaking at catheter insertion site. (Increased risk of infection.)
4. No waveform after troubleshooting.
5. Pupillary dilatation, bradycardia, hypertension. (Late sign of increased ICP.)
6. ICP catheter falling out. (If this happens, place a sterile dressing over site.)
7. Elevated ICP that does not respond to ordered therapy.
8. Elevated leukocyte count and/or temperature. (Sign of infection.)

**DOCUMENTATION:**

1. Level of drainage system.
2. Color and character of CSF fluid every 12 hours and PRN.
3. ICP and CPP Q1- 2 hours as ordered by practitioner.
4. ICP waveform analysis Q shift and with any morphologic changes. (Hardcopy of ICP waveform and ICP waveform trends; P1, P2, P3.)
5. GCS and neuro assessment Q 1 - 2 hours as ordered by practitioner.
6. Significant interventions and responses to interventions. (Accurate and ongoing documentation is essential to trend patient condition.)

**PATIENT AND FAMILY TEACHING:**

Nurses will educate patients and/or their families on the purpose of the ICP monitoring device. Topics to cover may include but are not limited to:

1. Reasons for brain swelling and elevated ICP
2. Management of elevated ICP
3. Monitoring devices
4. Insertion of ICP devices
5. Medications used to manage increased ICP
6. Keeping head elevated
7. Activity restrictions
8. Teaching family members not to put the bed up or down
9. Rehabilitation
10. Discharge planning

**PROCEDURE:**

Equipment needed:

- Codman EDS 3 CSF External Drainage System
- IV pole
- Codman EDS 3 Leveling Device (obtained from ICU Pyxis)

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

disposable transducer with "dead end" cap and stopcock (unless system is to be monitored using ICP Express)  
(2)10 ml luer-lok syringes  
sterile preservative free saline solution  
sterile needle-less injection cap  
18 gauge needle

**MOUNTING**

1. Obtain Codman EDS 3 CSF External Drainage System and remove the product from its packaging, being careful not to drop extension pieces. Maintain sterile technique.
2. Mount the EDS 3 to an IV pole with the Blue Screw.
3. Place the cord over the IV pole and secure in place using the CORD-LOC Locking mechanism until it is tight against the pole. For extra security, knot the cord above the CORD-LOC.

**LEVELING**

Leveling in Relationship to the Floor:

1. Insert Codman EDS 3 Leveling Device to the Codman EDS 3 CSF External Drainage System by sliding the securing tab over the slot on the EDS system  
(Note: Laser device should be pointing toward the patient.)
2. Level the Codman EDS 3 system to the floor with the grey screw. Bubble in center indicates level. Once leveled, tighten the grey screw.

Leveling in Relationship to the Patient:

3. Rotate the laser to emit laser beam toward the patient.
4. Loosen the blue screw and adjust the height of the EDS on the IV pole, centering the laser point to the patient's external auditory meatus. This represents the "zero" reference point.
5. Rotate the laser point until the laser is extinguished.

**POSITIONING THE DRIP CHAMBER**

1. Obtain an order for the level of the drainage chamber.
2. Loosen the white screw and adjust the chamber until the black reference line is at the ordered level for drainage.
3. Intracranial pressure is controlled by the height of the drip chamber relative to the patient. It is important that neither the drip chamber nor the patient be raised or lowered accidentally. Put sign above bed not to move bed. Apply "lockout" adjustment to head of bed.

**PRIMING THE EDS 3**

1. Fill a 10 ml luer-lok syringes with sterile preservative free saline solution.
2. Place the patient line stopcock in the monitoring only position ("off"- prong points toward drip chamber).

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

3. Remove cap from the monitoring port of the patient line stopcock
4. Screw on syringe to the monitoring port.
5. Remove the cap from the end of the tubing (proximal end of the patient line).
6. Flush the length of the line until all air has been expelled between the patient line stopcock and the end of the tubing.
7. Replace the cap at the end of the tubing.
8. Turn the patient line stopcock to the "closed" position ("off"-prong points towards end of tubing (proximal end)).
9. Flush the length of the line to the drip chamber.  
(Verify that fluid flows freely into the drip chamber and into the collection bag. Verify absence of leaks.)
10. Turn the patient line stopcock to the "Drainage Only" position ("off" - prong points toward stopcock).
11. Remove the syringe and replace the cap on the monitoring port of the patient line stopcock.

**USING THE PATIENT LINE STOPCOCK**

The Patient Line Stopcock controls the flow of CSF from the patient line to the parts of the EDS 3:

1. Drainage Position - this position is for drainage of CSF and potentially for monitoring as well if system is hooked to a fluid coupled transducer at the system stopcock (recommended placement).
2. Monitoring Position - this position stops the flow of CSF to the system stopcock. This is for monitoring ICP with a fluid coupled transducer attached to this port (alternative placement site for a transducer).
3. Closed Position - stops the flow of CSF to the system stopcock and disables the monitoring port.
4. Null Position - not recommended. May result in inaccurate ICP readings.

**USING THE SYSTEM STOPCOCK**

The System Stopcock regulates the flow of CSF to the drip chamber. It is also the port used to connect the FC transducer.

1. Drainage Only Position - this position disables the monitoring port. This is for drainage of CSF.
2. Monitoring Only Position - this position stops flow of CSF to the drip chamber. This is the position for monitoring ICP with a fluid coupled transducer.
3. Closed Position - stops flow of CSF to the drip chamber and disables the monitoring port.
4. Null Position - not recommended. May result in inaccurate ICP readings.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**USING THE DRIP CHAMBER STOPCOCK**

The Drip Chamber Stopcock controls whether CSF flows into the collection bag or accumulates in the drip chamber. It provides a port for CSF sampling.

1. Drainage Only Position - the position disables the sampling port. This is for draining CSF into the collection bag.
2. Sampling Only Position - This does not allow fluid to drain into the collection bag and allows sampling of collected CSF from the sampling port.
3. Drip Chamber Position - stops flow of CSF to the collection bag and disables the sampling port. CSF collects in the drip chamber, but it cannot be sampled.
4. Null Position - not recommended. (The Codman EDS 3 drainage system uses 4-way stopcocks. The stopcock can be opened in 3 directions simultaneously. The Null Position is not recommended because it may result in inaccurate ICP readings.)

**CONNECTING THE EDS 3 TO THE PATIENT CATHETER**

Remove the LUER-LOK cap from the distal end of the ventricular catheter and attach the connector to the patient line.

**DRAINING CSF INTO THE DRIP CHAMBER**

1. Obtain an MD/APRN order for whether the system is to remain open to drain, or will be intermittently drained to maintain a specified ICP.
2. Obtain an MD/APRN order for the maximum amount of CSF drainage/hour. (Leaving the drainage system open to drain for a sustained period of time can result in collapsed ventricles resulting in false readings.)
3. Obtain an MD/APRN order for the drip chamber level. (If the drainage system is not at the correct level it may result in over or under drainage.)
4. If continual drainage is ordered:
  - a. Place Patient Line stopcock in the *Drainage Only* position.
  - b. Place the System stopcock in the *Drainage Only* position.
  - c. Place the Drip Chamber stopcock in the *Drip Chamber* position.
  - d. Verify that CSF drains into the Drip Chamber.
5. If intermittent drainage is desired;
  - a. Maintain the Patient Line stopcock in the *Drainage Only* position
  - b. Maintain the System stopcock in the *Monitoring Only* position
  - c. Turn the System stopcock to the *Drainage Only* position. Verify that CSF drains into the Drip Chamber and maintain this position until the specified level of ICP is reached.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

- d. Place the System stopcock back to the *Monitoring Only* position when drainage is complete.
6. Observe the color, clarity, and amount of CSF every hour.
7. Notify practitioner of any changes in CSF (color/clarity/amount).

**DRAINING CSF FROM THE DRIP CHAMBER INTO THE COLLECTION BAG**

1. Turn System stopcock to *Closed* position. (Ensures accurate measure of the fluid contained in the Drip Chamber.)
2. Turn Drip Chamber stopcock to *Drainage Only* position.
3. Verify that CSF drains from the Drip Chamber into the collection bag.
4. Return the System stopcock to its original position (*Monitoring only or Drainage only*).

**SAMPLING CSF**

1. Obtain MD/APRN order to collect sample and tests to be done on sample. (CSF specimen for lab analysis provides early detection of CSF infection.)
2. Apply mask and sterile gloves.
3. Place Drip Chamber stopcock in the *Sampling Only* position. (This is the desired port to use for a fresh sample.)
4. Cleanse the port with betadine stick and allow to dry for 1 minute.
5. Withdraw sample with a 6 ml syringe, place sample in a sterile container, label properly and deliver to the lab immediately. (Usually CSF specimen is sent for culture and sensitivity, gram stain, and cell count. Glucose and protein may also be ordered.)
6. Return Drip Chamber stopcock to previous position.
7. Note: A sampling port is also located at the bottom of the collection bag, however this would not be the desired port for obtaining a fresh sample.
8. Sampling of CSF may also be obtained from the port closest to the insertion site on the ventriculostomy drainage system. This is performed only by the neurosurgeon or by a practitioner .

**MONITORING ICP**

1. Prime the transducer/stopcock with sterile preservative free saline solution using a 10 ml syringe. NOTE: drip chamber attachment must be removed and a dead-end cap is applied to the transducer. NO FLUSH SYSTEM is to be attached.
2. Attach the transducer to the System stopcock (preferred site) and to the bedside monitor pressure cable. Configure the monitor to display ICP with the appropriate label / scale.
3. Zero the system to atmospheric pressure by turning the Transducer stopcock off to the drainage system and opening it to air. Press "Zero" on the bedside monitor pressure module.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

4. Adjust the System stopcocks to the Monitoring Only position for ICP monitoring. (Patient stopcock will be in the *Drainage* position.)
5. To obtain accurate ICP readings, wait at least 1 minute after adjusting stopcocks.
6. Note: the *Null* position is not recommended for ICP monitoring, as pressure measured with the stopcock in the *Null* position will be a reflection of a blended pressure from both the patient and the drainage bag and will result in inaccurate ICP readings.

**SITE AND SYSTEM CARE:**

1. Components of the ventriculostomy set up are changed only when a new ventriculostomy catheter is inserted, the system is malfunctioning (e.g., wet vent), or when ordered.
2. Change ventriculostomy collection bag when full, system is changed, or prior to transporting a patient.
3. Change head dressing every 72 hours or when no longer occlusive:
  - a) Apply sterile gloves and a mask
  - b) Swab the site with a betadine stick in a circular motion, from the center outward, and allow to air dry for at least one minute.
  - c) Apply sterile gauze dressing.
  - d) Secure with tape or transparent dressing.

**FLUSHING THE SYSTEM**

The monitoring /drainage system may develop air bubbles or debris that requires flushing the pressure tubing. Flushing the system ensures CSF can freely drain from the patient as required. Nurses may flush the system from the patient line stopcock to the drip chamber, transducer, or collection bag. Sterility must be maintained, and any solution must be flushed AWAY FROM the patient. Nurses are not approved to flush between the Patient Line stopcock and the patient catheter.

**TO FLUSH THE SYSTEM FROM THE PATIENT LINE STOPCOCK TO THE COLLECTION BAG:**

1. Turn Patient Line stopcock to *Closed* position.
2. Turn System stopcock to *Drainage Only* position.
3. Turn Drip Chamber stopcock to *Drainage Only* position.
4. Open all slide clamps.
5. Attach a 10 ml syringe with sterile preservative free saline solution to the Patient Line stopcock.
6. Inject saline solution into the Patient Line stopcock monitoring port.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**IRRIGATING THE VENTRICULOSTOMY CATHETER**

1. ICP waveforms should be monitored for dampening. The ICP waveform generally has 3 distinct components, P1, P2, and P3. If the waveform is dampened, the patency of the catheter or the drainage and monitoring system may be in question and the pressure values may be inaccurate. If there is no drainage of CSF or fluctuation with respirations the catheter may be occluded. Debris such as tissue or blood clots can obstruct the catheter and cause large increases in ICP which places the patient at greater risk for secondary brain injury.
2. If unable to restore patency of the monitoring system, notify neurosurgeon or practitioner. Only a neurosurgeon or a practitioner, under the guidance of a neurosurgeon, may irrigate the ventriculostomy catheter.

**INJECTING MEDICATION INTO THE SYSTEM**

Administration of medication to the patient can be accomplished via the injection site on the Y-connector next to the Patient Line stopcock. Only a neurosurgeon or practitioner, under a neurosurgeon's guidance, may inject medication into the system.

**TRANSPORTING A PATIENT CONNECTED TO THE EDS**

1. Verify order from practitioner to place Patient Line stopcock to the *Closed* position.
2. Drain Drip Chamber into drainage bag.
3. Replace the collection bag if necessary.
4. Place the Drip Chamber stopcock into the *Drip Chamber* position.
5. Transport the patient with the ESD on the IV pole if possible. (It is recommended that the EDS 3 system be suspended, rather than allowed to lie flat on a surface during transport. If the microbial retentive atmospheric vent in the Drip Chamber becomes wet, the EDS 3 System should be changed. Wetting of the vent inside the collection bag by fluid for a prolonged period may cause air entrapment and reduce the capacity of the bag.)
6. After transport completed, re-level the EDS 3 system to floor and the patient.
7. Resume or verify Drip Chamber height settings.
8. Resume drainage or monitoring by placing Patient Line stopcocks in their original positions

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**TROUBLESHOOTING ELEVATED PRESSURES**

The stopcock could be open to pressure monitoring but closed to drainage:

1. Check all stopcocks
2. Ensure that all stopcocks are open to both the drainage unit and to the patient catheter

The drainage unit could be positioned higher than the pressure in the patient's head:

1. Ensure that the zero on the Drip Chamber is positioned at the external auditory canal, and the arrow on the Drip Chamber is positioned at the correct position above the head
2. Note that drainage occurs when the system is open and the ICP exceeds the level of the drainage unit.
3. Ensure that ICP reading is taken when the stopcock is closed to drainage and open between pressure system and the patient catheter.

The catheter may be blocked:

1. Lower the drainage chamber below the patient's head. If the catheter is patent, CSF drainage should occur.
2. Evaluate the ICP waveform:
  - a) Appropriate scale is selected to ensure good visibility of the waveform.
  - b) A crisp waveform should be present. The waveform should demonstrate pressure changes that correspond to the heart rhythm.
  - c) A flat waveform suggests catheter is not patent. Brain edema could obstruct the catheter tip and impair waveform transmission.
3. The ICP elevation may be the result of severe brain swelling, but the ventricles are either empty or collapsed

**REPLACING A COLLECTION BAG**

1. Maintain sterile technique when replacing the collection bag. Mask and sterile gloves are worn.
2. Turn the Drip Chamber stopcock so that it is in the *Drip Chamber* position. (This stops the flow of CSF to the collection bag and allows the drainage bag to be changed.)
3. Using the slide clamp on the drainage bag, occlude the tubing leading to the collection bag.
4. Twist the connector on the bag counterclockwise to disengage.
5. Dispose the collection bag as per hospital policy.
6. Connect the new bag to the tubing and hang collection bag on built in hooks.
7. Open slide clamp in the tubing.

**PROTOCOL FOR: Intracranial Pressure Monitoring / Cerebrospinal Fluid Drainage using the Codman ESD3 External Drainage System**

**REPLACING THE CODMAN EXTERNAL DRAINAGE SYSTEM**

Maintain sterile technique during replacement of the external drainage system.

1. Occlude catheter with rubber coated forceps.
2. Disconnect the LUER-LOK between the intraventricular catheter and drainage line in counterclockwise motion.
3. Discard the old EDS 3 system
4. Install the new EDS 3 system by following the procedure for installing the EDS 3 system.

**REMOVAL OF THE INTRAVENTRICULAR CATHETER**

The neurosurgeon will determine when the catheter will be removed.

Obtain supplies:

sterile gloves  
hat  
mask  
suture material  
2 suture removal kits  
1% lidocaine and 5 cc syringe  
sterile clamps  
sterile towels  
betadine ointment  
sterile 2 X 2 gauze dressing  
large tegaderm dressing  
sterile specimen cup

After removal of the catheter by the neurosurgeon:

1. Apply betadine ointment, 2 X 2 dressing, and tegaderm to site.
2. Culture intraventricular catheter if ordered.
3. Monitor site for swelling, CSF leakage, signs and symptoms of infection and . report to practitioner if any noted.

**REFERENCES:**

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Greenberg, M.S. (2001). Handbook of Neurosurgery (5<sup>th</sup> ed., rev.) Thieme: New York

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Refer to the **CODMAN® EDS CSF External Drainage System with Ventricular Catheter**, **CODMAN® External Drainage System II Collection Bag**, and **CODMAN® EDS Leveling Device** package inserts for diagrams and additional information.

**APPROVAL:** ICU Standards Committee  
Nursing Standards Committee

**EFFECTIVE DATE:** 4/05

**REVISION DATE:** 3/06

**REVIEW DATE:** 2/06