External Ventricular Drain (EVD) - Care and Management using Medtronic Deut TM External Drainage and Monitoring System

Quick Links

- **Quick Reference Guide:** Medtronic Duet™ EDMS
- **Video:** Duet™ EDMS
- **Procedures:**
  - A. Priming of the Medtronic Duet™ EDMS
  - B. Attaching an external pressure transducer to the Medtronic Duet™ EDMS
  - C. Leveling the Medtronic Duet™ EDMS to the patient and opening the system to drainage
  - D. Zeroing the Pressure Transducer to Atmospheric Pressure
  - E. ICP Monitoring
  - F. External Ventricular Drain Transport Guideline
  - G. Obtaining Cerebrospinal Fluid Samples from the Medtronic Duet™ EDMS
  - H. Changing the System Collection Bag

Site Applicability

VGH: ICU, Neuro ICU (NICU), OR, PACU
LGH: ICU, Neuro Critical Care Unit (NCCU), OR, PACU

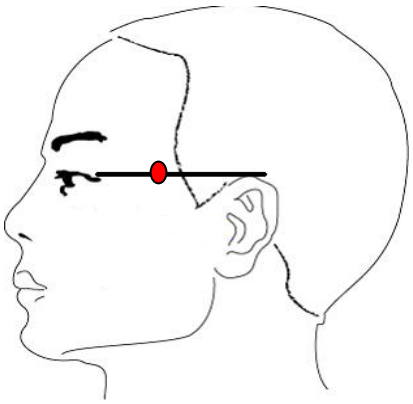
Practice Level

RN: Advanced Skill

- May be performed by RNs in ICU, NCCU, NICU, OR and
- PACU RNs only perform Leveling and Zeroing (procedures C & D)

Policy Statement

- The EVD is leveled at the Foramen of Monroe, using the anatomical reference point of 2 cm from the outer canthus of the eye on the imaginary line drawn from the top of the ear to the outer canthus of the eye.



- **At VGH:** If there is a physician's order for the patient's EVD to be open at a certain level the EVD must be leveled, and open at all times including during transport and diagnostic procedure (except MRI).
- **At LGH:** The EVD is closed during transport unless otherwise ordered by the physician.
- ICP monitoring is completed every hour with the temporary closure of the EVD for accurate ICP measurement.

- If the EVD is ordered to be open, it is only acceptable to temporarily close the EVD for change in position of the head of bed (HOB), which may include transferring the patient from bed to procedure table for diagnostics or when measuring ICP.
- If ICP monitoring is in place, the ICP transducer must be zeroed during system set up, at the beginning of each 12 hour shift, and must continue to be monitored during transport to/from diagnostic area, and during a diagnostic procedure.
- Assessment of neurovital signs, including pupillary response, must be monitored every hour (Q1H), unless otherwise ordered by the neurosurgeon, including during transport and diagnostic procedures. This may include having to temporarily stop a diagnostic procedure to allow for these assessments.
- Any change in the patient's Glasgow Coma Score or pupillary response must be reported to the physician immediately as this may be an indication that the patient is experiencing cerebral ischemia.
- The RN responsible for the patient's care must communicate information regarding the presence of the EVD and related care concerns to all staff involved in caring for the patient including staff in a diagnostic area.
- **At VGH** CSF specimen are to be sent as follows (unless otherwise specified by the Neurosurgeon):
    - **On Admission:**
        - Protein and glucose; 1 ml required
        - Cells; 1 ml required
        - Gram's Stain, and C&S; 1 ml required
    - **Daily:**
        - Cells; 1 ml required
        - Gram's Stain, and C&S; 1 ml required
- **At LGH** CSF specimens will be sent **per Neurosurgeon order**
- CSF specimens are taken to the laboratory department by:
    - **VGH: Patient Escort Porters**
    - **LGH: Nursing Staff (or delegate)**

  CSF specimens are never to be sent to the laboratory via the pneumatic tube system.
- All assessments and interventions must be documented in the patient's chart.

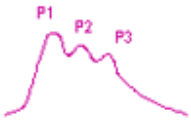
Need to Know

Monroe Kellie Hypothesis
The Monroe Kellie hypothesis states that the skull is a rigid box that is comprised of three components; brain tissue, blood and cerebrospinal fluid. Normally the volumes of these components are in homeostasis and the pressure within the skull is constantly maintained within normal pressure limits of between 10 – 15 mmHg. An increase in volume in any one of these components must result in a decrease in one or both of the other components in order for the intracranial pressure (ICP) to remain static. Even a small increase in one component may result in a detrimental increase in ICP. Intracranial hypertension occurs when the ICP remains greater than 25 mmHg for longer than 5 minutes. Sustained increased ICP may result in global cerebral ischemia and herniation syndromes which could lead to unfavourable neurological outcome and/or death.

Cerebral Perfusion Pressure
In order to prevent cerebral ischemia the cerebral blood flow must be constantly monitored and can be indirectly measured by monitoring cerebral perfusion pressure. Cerebral perfusion pressure (CPP) must be maintained above 70 mmHg to maintain optimal perfusion. CPP can be measured by monitoring both the mean arterial pressure (MAP) and ICP of the patient. CPP = MAP – ICP. A decrease in blood pressure or an increase in intracranial pressure can result in a lower cerebral perfusion pressure.

Cerebral Spinal Fluid (CSF)
An EVD allows for drainage of CSF from the lateral ventricle and also provides a means of measuring ICP. CSF is secreted from the choroid plexus of the 3rd and 4th ventricles at a rate of **20 ml per hour**. It is reabsorbed by the subarachnoid villi allowing for a circulating volume of between 125 – 150 mls. Under normal circumstances the volume maintained in the lateral ventricles is approximately 20 mls. Drainage of CSF can assist in maintaining normal ICP.

ICP Waveform
The ICP pulse waveform not only measures ICP but also provides important information on brain compliance. The normal ICP waveform correlates with the cardiac cycle, with 3 peaks each representing fluctuations in volume within the ventricles:



- P1, or percussive wave, is the first and under normal conditions, the highest wave. It represents the arterial pressure of the choroid plexus.
- P2, or tidal wave, is the second peak, and ends on the dicrotic notch.
- P3, also known as the dicrotic wave, results from the closure of the aortic valve.

Changes in intracranial compliance will result in a change in the intracranial pressure waveform. Increasing ICP will result in an increase in amplitude of the waveform. If intracranial pressure continues to rise the P2 wave will become higher than the P1 wave indicating a decrease in brain compliance.

A decrease in amplitude of the ICP waveform may be due to vasoconstriction of the cerebral blood vessels. This may be due to either vasospasm or hypocapnia. Hypercapnia or severe hypoxia could result in an increase in amplitude. Changes in the waveform from baseline should be reported to the neurosurgeon.

Patient's who have undergone a bone flap removal may have a dampened waveform.

Practice Guideline

A. Priming of the Medtronic Duet™ External Drainage and Monitoring System

NOTE:

Priming of the system will be done in the Operating Room at the time of insertion of the external ventricular catheter by the Neurosurgeons.

At LGH: Priming of the system will be performed by the Operating Room Nurses.

Priming of a NEW system will be done on the unit by the RNs in the event that a system needs to be replaced.

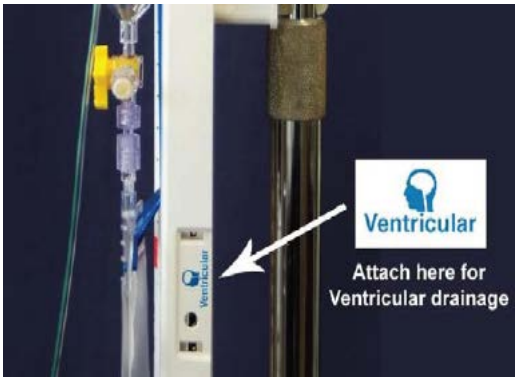
Equipment and Supplies

- Sterile Gloves
- Surgical Mask
- Sterile Drape
- Medtronic Duet™ External Drainage and Monitoring System
- 2 - 10 ml Pre-Filled Preservative Free Sterile 0.9 % Saline Syringe
- External Pressure Transducer
- Yellow sticker – EVD Drainage – Do Not Access (available from Printing Services # VA.0044)

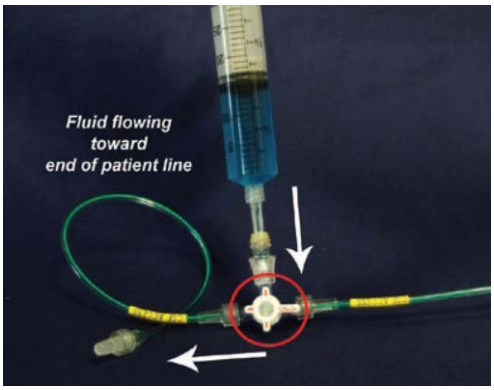
Procedure

1. Don mask
2. Wash hands
3. Prepare sterile field
4. Remove Drainage and Monitoring System from the packaging and add to sterile field
5. Add 10 ml 0.9% saline syringes to sterile field
6. Wash hands

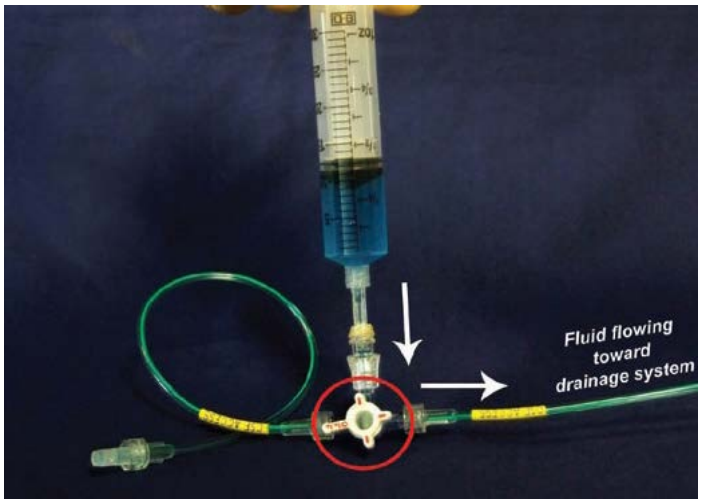
7. Don sterile gloves
8. Attach the main system stopcock to the **Ventricular** location on the side of the back panel as shown below:



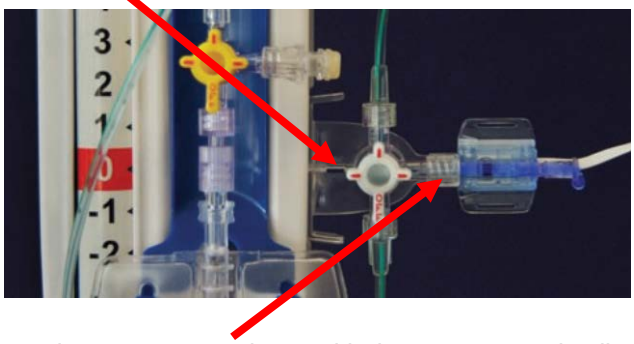
9. Attach the 10 ml 0.9% saline syringe to the patient line stopcock injection site. Rotate the stopcock off to the drainage system and prime the short section of the patient line as shown below:



10. Turn the patient line stopcock off to the pt (section just primed) and prime the drainage tubing all the way to the drip chamber. Inspect the system for air and use second 0.9% saline syringe to ensure line primed thoroughly with saline and no air bubbles exist.



11. **NOTE: If priming of the system is done on the unit and ICP monitoring is ordered, do the following to prime the external pressure transducer at the same time:**
    a. Remove the red cap from the main system stopcock
    b. Attach external pressure transducer and remove the dead ender
    c. Turn the main system stopcock off to the drainage system



    d. Prime the external pressure transducer with the 0.9% normal saline syringe attached at the patient line stopcock to remove all air from the transducer
    e. Replace the dead ender
    f. Turn the main system stopcock off to the transducer

12. Turn the patient line stopcock off to the syringe and remove the syringe from the patient line stopcock injection site.
13. Place yellow "EVD Drainage – Do Not Access" sticker around patient line stopcock injection site
14. Connect to the patient's EVD catheter per the surgeon's instruction
15. Turn the stopcock off to the patient
16. Place the Drainage and Monitoring System on the patient's bed and prepare patient for transfer to the post anaesthetic room or ICU or NICU/NCCU

NOTE: If instructed by the Neurosurgeon to open the drain, first level the system as outlined below.

B. Attaching an external pressure transducer to an already primed Medtronic Duet™ External Drainage and Monitoring System

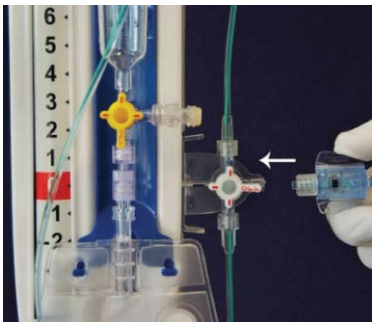
NOTE: In order to attach the pressure transducer to the system the entire system must be primed with fluid through to the drip chamber. If the physician has ordered ICP monitoring and the system is not primed with fluid completely to the drip chamber call the Resident (at VGH) or Neurosurgeon (at LGH) to prime the system prior to adding the transducer.

Equipment and Supplies

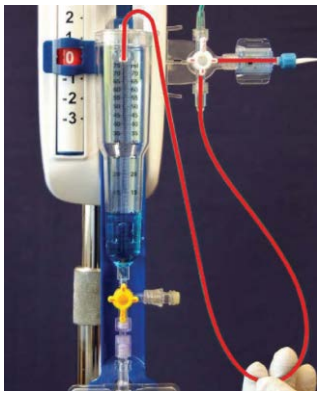
- Sterile Dressing Tray
- Sterile Gloves
- Surgical Mask
- Smiths-Medical MX-950 External Pressure Transducer
- 10ml Pre-Filled Preservative Free Sterile 0.9 % Saline Syringe
- 2 -Tinted 2% Chlorhexidine Gluconate with 70% Isopropyl Alcohol Maxi swabsticks
- Yellow sticker – EVD Drainage – Do Not Access

Procedure

1. Don mask
2. Wash hands
3. Turn patient line stopcock off to the patient
4. Prepare sterile field
5. Add 10ml 0.9% saline syringe to sterile field
6. Add disposable flushless transducer to sterile field
7. Add 2% Chlorhexidine Maxi swabsticks to sterile field
8. Ensure that the main system stopcock is “OFF” to the dead ender
9. Wash hands
10. Don sterile gloves
11. Remove the dead ender from the female end of the flushless transducer
12. Attach 10ml 0.9% saline syringe to the female end of the transducer
13. Holding the transducer vertically with the male end pointing up flush through the transducer
14. Using one 2% Chlorhexidine Maxi swabstick cleanse the dead ender of the main system stopcock scrubbing the connection for 15 seconds
15. Allow to dry for 1 minute
16. Repeat with second swab
17. Remove the dead ender
18. Attach the male end of the flushless transducer to the main system stopcock as below:



19. Turn the main system stopcock 90° so that it is **off to the patient line** and open to the drip chamber and flush with the saline syringe to remove all air bubbles in the section between the transducer and the drip chamber as **highlighted in the red below**:



20. Turn the stopcock back to “OFF” to transducer position
21. Remove syringe and replace dead ender
22. Place yellow “EVD Drainage – Do Not Access” sticker around dead ender

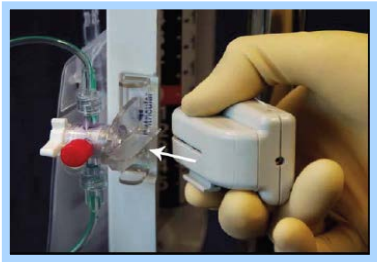
C. Leveling the Medtronic Duet™ External Drainage System to the patient and opening the system to drainage

Equipment and Supplies

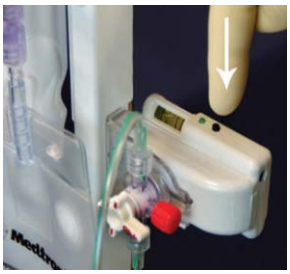
- IV Pole
- Clear Site™ Laser Level

Procedure

1. Attach the Duet™ EDMS to an IV pole using **BOTH** the built in pole clamp and hanging the integral cord from the pole as a safety tether
2. Ensure the main system stopcock is attached to the **Ventricular** location on the side of the back panel
3. Attach the ClearSite™ Laser Level to the bracket on the back of the main system stopcock



4. Turn the laser on by pressing and releasing the black power button (Green LED indicates that the laser is turned on)

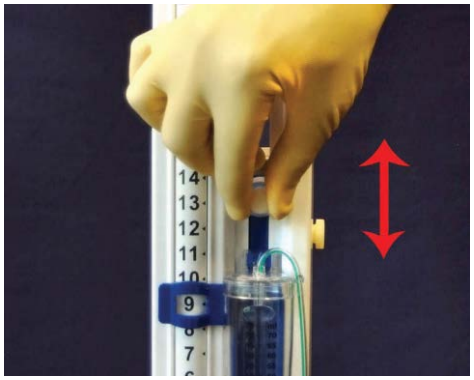


5. Turn the laser towards patient's head and use the yellow bubble levels to insure that the laser is horizontally level (i.e. level to the floor)

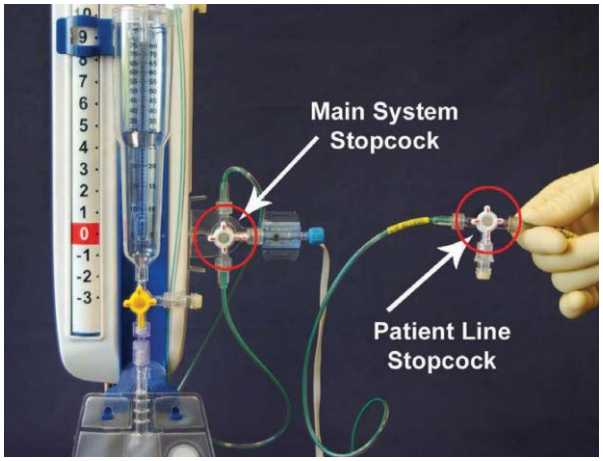
6. Raise or lower the drainage system so the "zero" position on the pressure scale (level of the laser) is level with the anatomical position for the Foramen of Monroe (using the anatomical reference point of 2cm from the outer canthus of the eye on the imaginary line drawn from the top of the ear to the outer canthus of the eye) i.e. level to the patient

7. Using the blue knob at the top of the pressure scale, rotate the pressure scale to **Ventricular cmH20** as seen below:

8. Raise or lower the drip chamber to the desired pressure level indicated by the physician.



9. Once the system set-up is complete, the stopcocks can be opened to allow the drainage of CSF. Turn the patient line and main system stopcock as shown to allow fluid drainage into the drip chamber. **(If monitoring ICP and draining simultaneously open the stopcock to drain, patient and transducer.)**



D. Zeroing the Pressure Transducer to Atmospheric Pressure

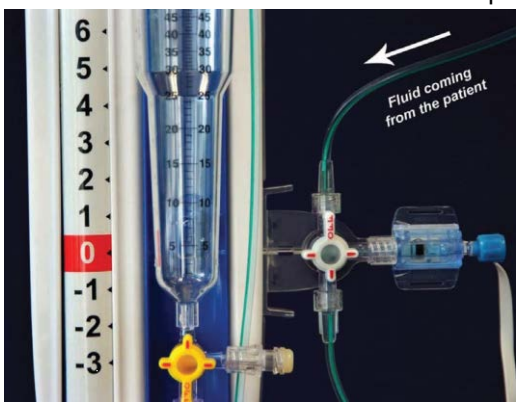
IMPORTANT NOTE: **Zeroing of the pressure transducer is a change in practice – follow the procedure as outlined below**

Equipment and Supplies

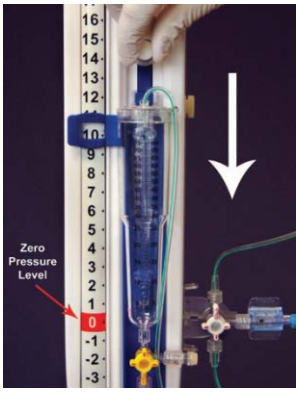
- Primed Medtronic Duet™ External Drainage and Monitoring System (EDMS) with pressure transducer
- Monitor
- Monitor Cable

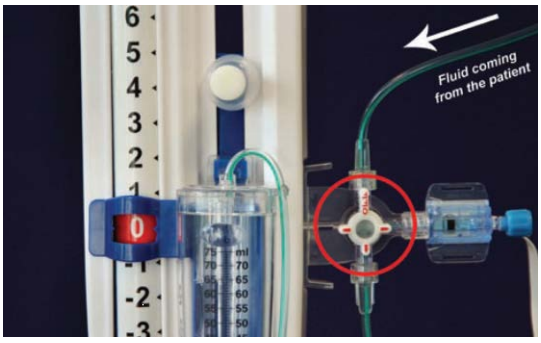
Procedure

1. Attach the transducer cable to the monitor cable
2. Label the pressure waveform 'ICP'
3. Select the scale '0 – 30 mmHg'
4. Set the high pressure alarm to '20 mmHg'
5. Turn the main system stopcock 90° so that it is turned "OFF" to the patient as seen below:



6. Lower the drip chamber until the pressure indicator window is centered over the "0" position on the pressure scale



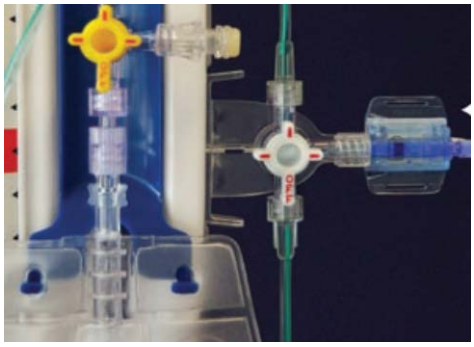


7. Zero the bedside monitor and the transducer is now "zeroed" to atmospheric pressure
8. Once the pressure transducer has been "zeroed", raise the drip chamber back to the ordered setting
9. Open the stopcock to the patient again

E. ICP Monitoring

Procedure

1. Turn the main system stopcock open to transducer, patient and drain to "trend" the intracranial pressure
   NOTE: This is not a true measurement of ICP
2. Q1H turn the main system stopcock "OFF" to the drainage so that the transducer is open to the patient as pictured below:



3. Wait 1 – 2 minutes for ICP tracing to stabilize and record measurement on Critical Care Flowsheet
4. Q12H obtain strip of ICP waveform and attach to Nursing Assessment Record
5. Turn the main system stopcock open to transducer, patient and drain as before

F. External Ventricular Drain Transport Guideline

General

IMPORTANT NOTE:

- **At VGH:** If there is a physician's order for the patient's EVD to be open at a certain level the EVD must be leveled, and open at all times including during transport and diagnostic procedure **(except MRI – See MRI Transport Guideline below)**.
- **At LGH:** The EVD is closed during transport unless otherwise ordered by the physician.
- If the EVD is ordered to be open, it is only acceptable to temporarily close the EVD when transferring the patient from bed to procedure table for diagnostics
- If ICP monitoring is in place it must continue to be monitored during transport to / from diagnostic area, and during a diagnostic procedure.
- Assessment of neurovital signs, including pupillary response, must be monitored Q1H, unless otherwise ordered by the neurosurgeon, including during transport and diagnostic procedures. This may include having to temporarily stop a diagnostic procedure to allow for these assessments.
- The RN responsible for the patient's care must communicate information regarding the presence of the EVD and related care concerns to all staff involved in caring for the patient including staff in a diagnostic area.

Equipment and Supplies

- Flashlight
- Clear Site™ Laser Level
- Portable Monitor
- Portable Suction

Procedure

1. Obtain flashlight, Clear Site™ Laser level, portable cardiac monitor and portable suction
2. Connect the patient to a portable cardiac monitor as per unit procedure
3. If EVD is ordered to be open, it must remain open during transport
4. Communicate all pertinent information regarding EVD to the Technologist, RN or Physician in the diagnostic treatment area
5. Turn the main system stopcock "OFF" to patient before lowering the head of bed in the procedure area prior to transferring the patient from the bed to the procedure table
6. Transfer the patient to the procedure table
7. Confirm with staff in diagnostic area the level of the procedure table and Level the EVD as outlined above
8. Open EVD if ordered
9. Ensure monitor is facing you, so you can see the ICP monitoring and vital signs throughout the procedure
10. To obtain accurate ICP reading close EVD for 1 – 2 minutes if there is concern regarding patient ongoing status
11. At conclusion of procedure close EVD before transferring patient from procedure table back to the bed.
12. Transfer to bed and elevate HOB to required level
13. Re-level EVD
14. Open EVD if ordered
15. Continue monitoring ICP en route back to Unit Area
16. Document all assessments and interventions in the patient chart

MRI Transport Guideline

IMPORTANT NOTE:
Medtronic Duet™ External Drainage and Monitoring System is MRI compatible.
The Clear Site™ Laser Level is NOT MRI compatible

Equipment and Supplies

- Flashlight **(Not MRI Compatible)**
- Clear Site™ Laser Level **(Not MRI Compatible)**
- Portable Monitor
- Portable Suction

Procedure

1. Obtain portable cardiac monitor and portable suction
2. Connect the patient to a portable cardiac monitor as per unit procedure
3. If EVD is ordered to be open, it must remain open during transport
4. Communicate all pertinent information regarding EVD to the Technologist, RN or Physician in MRI area
5. Drain the CSF present in the drip chamber into the collection bag
6. Rotate the main system stopcock **'off'** to patient drainage
7. **NOTE:** Remove Clear Site™ Laser Level before entering MRI suite
8. Remove the EVD from the IV Pole and lay beside patient – this will be considered to be level with the Foramen of Monroe.
9. Transfer the patient to the procedure table
10. Connect the patient to the MRI monitor and zero monitor accordingly
11. Ensure the ICP waveform is visible throughout procedure to allow for continuous monitoring of ICP and Vital Signs **as system is closed**

12. **NOTE:** If patient's ICP increases above 25 mmHg and remains elevated for greater than 5 minutes the procedure must be stopped and NVS must be assessed
13. At conclusion of procedure and once outside the MRI suite reattach the Clear Site™ Laser Level to the drainage system
14. Elevate HOB to required level
15. Re-level EVD as ordered
16. Open EVD if ordered
17. Continue monitoring ICP en route back to Unit Area
18. Document all assessments and interventions in the patient chart

G. Obtaining Cerebrospinal Fluid Samples from the Medtronic Duet External Drainage and Monitoring System

IMPORTANT NOTE:

To ensure accurate results from CSF sampling the entire volume collected in the drip chamber must be sent. In order to send the 2 - 3 milliliters required the drip chamber must be emptied into the collection bag prior to sampling, allowing for time to re-accumulate 2 – 3 mls in the drip chamber.

If the EVD has been ordered closed, open the drain to allow only 2 mls of CSF to accumulate in the drip chamber and then once accumulated close drain again immediately prior to taking samples.

Equipment and Supplies

- Dressing Tray
- One 10 ml sterile luer lock syringe
- 2 or 3 sterile CSF tubes (3 if Protein and Glucose sample to be sent with initial sample)
- Mask
- Sterile gloves
- 2 - Tinted 2% Chlorhexidine Gluconate and 70% Isopropyl Alcohol Maxi swabsticks

Procedure

1. Don mask
2. Wash hands
3. Prepare sterile field
4. Add 10 ml sterile luer lock syringe sterile field
5. Add 2% Chlorhexidine Maxi swabsticks to sterile field
6. Ensure stopcock under drip chamber is closed to collection bag
7. Wash hands
8. Don sterile gloves
9. Cleanse sample port under drip chamber using one tinted 2% Chlorhexidine Maxi swabstick scrubbing for 15 seconds
10. Wait 30 – 60 seconds until dry
11. Repeat with second swab
12. Attach 10 ml luer lock syringe to sampling port under drip chamber
13. Aspirate ALL accumulated CSF from drip chamber - 3 mls for initial sample and 2 mls for daily sample
14. Separate collected CSF into appropriate number of sterile CSF tubes as required for each test **REMINDER:** to ensure accurate results the entire volume collected in the drip chamber must be sent
15. **REMINDER:** **At VGH** CSF must be sent via porter through Transport Tracking and not through the pneumatic tube system. **At LGH** CSF is taken to the lab by the unit RN or delegate.

H. Changing the System Collection Bag

Equipment and Supplies

- Dressing Tray
- New Sterile Collection Bag
- Mask
- Sterile gloves
- 2 - Tinted 2% Chlorhexidine Gluconate and 70% Isopropyl Alcohol Maxi swabsticks

Procedure

1. Don mask
2. Wash hands
3. Prepare sterile field
4. Sterile Collection Bag
5. Add 2% Chlorhexidine Maxi swabsticks to sterile field
6. Ensure stopcock under drip chamber is closed to collection bag
7. Wash hands
8. Don sterile gloves
9. Cleanse the connection port under drip chamber using one tinted 2% Chlorhexidine Maxi swabstick scrubbing for 15 seconds
10. Wait 30 – 60 seconds until dry
11. Repeat with second swab
12. Disconnect collection bag
13. Connect new collection bag
14. Discard full collection bag in the yellow Blood and Body Fluid garbage bin on unit.

Expected Patient Outcomes

Patient will remain free from signs and symptoms of infection.

Documentation

- Document drainage and ICP measurement on Critical Care Flowsheet
- Document EVD assessment on the Critical Care Nursing Assessment Record (ICU and PAR at VGH) or the Special Care Nursing Assessment Record (NICU VGH)

References

American Association of Neuroscience Nurses (2011). Care of the Patient Undergoing Intracranial Pressure Monitoring/External Drainage of Lumbar Drainage. AANN Clinical Practice Guideline Series. Retrieved June 17, 2011, from AANN Web site: http://www.aann.org/uploads/AANN11_ICPEVDnew.pdf

Arbour, R., (2004) Intracranial Hypertension Monitoring and Nursing Assessment. *Critical Care Nurse, 24(5), 19 – 32.*

Bader, M. (1999). Ask the Experts – Reference Point for Zeroing an ICP. *Critical Care Nurse, 19(6), 92 – 93.*

Littlejohns, L., & Bader, M. (Ed.). (2009). *Monitoring Technologies in Critically Ill Neuroscience Patients.* Jones and Bartlett (MA): AACN – AANN Protocols for Practice

Medtronic. *Intracranial Pressure Monitoring A Handbook for the Nursing Professional.* Retrieved June 21, 2011, from Medtronic Website

Wong, F., (2011). Cerebrospinal fluid collection: A comparison of different collection sites on the external ventricular drain. *Dynamics, 22(3), 19 – 24.*

Consolidation of the following CPDs from VCH Vancouver Acute & Coastal with current practice updates:

- VCH, Vancouver Acute Clinical Practice Document 2001; *C-340 Cerebrospinal Fluid: External Ventricular Drainage System: Leveling*
- VCH, Vancouver Acute Clinical Practice Document 2001; *I-060 Attach Disposable ICP Transducer to Ventricular Catheter or Subdural Screw*
- VCH, Vancouver Acute Clinical Practice Document March 2008 (Dec/2010-product change only to Max Plus Clear cap) – *C-320 Cerebrospinal Fluid: External Drainage System – Extraventricular Drain (EVD) and Lumbar Drain Samples*
- VCH, Vancouver Acute Clinical Practice Document September 2008; *C-300 Cerebrospinal Fluid: External Drainage System – Extraventricular Drain (EVD) Transport Guideline*
- VCH, Coastal Clinical Practice Document January 2009 – *CCG-NU-01 External Ventricular Drains (EVDs) – Medtronic Becker EDMS System*

Developed by

CPD Developer Lead: Clinical Nurse Educator, Neuroscience Program VGH
Other members:
Clinical Nurse Educator Neuroscience Program, VGH
Clinical Nurse Educator Neuroscience, LGH
Clinical Nurse Educator Post Anesthetic Room, VGH
Clinical Nurse Educator Intensive Care Unit, VGH
Clinical Nurse Educator Intensive Care Unit, LGH
Clinical Nurse Educator Intensive Care Unit, VGH
Department of Neurosurgery, VGH
Department of Neurosurgery, VGH

Endorsed by

Regional SharePoint 2nd Reading - Endorsement by:
Health Authority Profession Specific Advisory Council Chairs (HAPSAC)
Health Authority & Area Specific Interprofessional Advisory Council Chairs (HA / AIAC)
VCH Operations Directors
VCH Professional Practice Directors

Final Sign-Off / Approved for Posting by

Chief Nursing Officer & Executive Lead Professional Practice - VCH

Date of Approval/Review/Revision

Posted: August 3, 2012
Effective: VGH: August 7, 2012
LGH: October 16, 2012
Revised: December 5, 2012 (Minor Change)