Technical aspects of ICP monitoring and EVD placement

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Practice parameters

• Procedures carried out in the ICU, U112, and the ER

• Procedures
  – External ventricular drains
  – Placement of ICP and other intracranial monitors
  – Bur holes for subdural hematomas
Determination of urgency

• Based on clinical and imaging assessment in consultation with neurosurgical staff
• Assign a time priority to the patient (i.e. E0, E1, E4, E6, E12, E24…)
• Communicate urgency to Admitting department (ICU or 112 step down)
• If unable to transfer E0-E4 then book emergency OR.
• If delay would result in catastrophic outcome procedure may be performed in the FMC ER
Consent

- Appropriately signed consent should be in patient’s chart prior to initiating the procedure.
- For E1-E6 to be performed by House Staff and Fellows without delay, it is appropriate for consent to be signed by staff Neurosurgeon within a few hours of the procedures.
  - House staff should document in patient’s chart that case and urgency has been discussed with staff.
  - Notify appropriate family members and document in chart.
Performance of bedside procedure

• May be performed independently by PGY-3 or higher Residents assuming that they have obtained adequate supervised experience in the past

• PGY-1 and PGY-2 require direct supervision of more Senior Resident, Fellow, or attending Neurosurgeon

• Surgeon needs to perform a “time out process” before initiating the procedure
  – Verify correct identity of the patient, correct site, and correct side with the bedside nurse or another (assisting) physician before initiating the procedure
Documentation of Bedside Procedure

• A brief OR note should be dictated (#44444, work type #10)
• The OR note must identify the admitting/attending staff Neurosurgeon and house staff. Copies of the OR note must be sent to the staff neurosurgeon and yourself in care of Patti Sullivan, Residency training Program Coordinator
• The OR note must state the diagnosis, the procedure done as well as the date and the approximate time the procedure was carried out.
• The OR note should contain a brief section outlining the clinical indication and a second brief section indicating the procedure performed including the main finding of the procedure.
External ventricular drains
• An External Ventricular Drainage (EVD) is the temporary drainage of CSF from the lateral ventricles to a closed collection system outside the body

• Indications
  – To divert the flow of CSF to treat acute hydrocephalus (e.g. shunt failure, tumor, or hemorrhage)
  – To divert bloodstained CSF (e.g. following neurosurgery, haemorrhage)
  – To divert infected CSF (e.g. shunt infection)
  – To monitor ICP (e.g. usually GCS=<8 and either abnormal CT or normal CT with risk factors)
  – To relieve raised ICP (e.g. Trauma)
• Kocher’s point
  – Places catheter in frontal horn
  – Right side usually used
  – Entry site 2-3 cm from midline which is approximately the mid-pupillary line, 1 cm anterior to the coronal suture
  – Incision oriented in the sagittal plane in case it needs to be incorporated in flap
  – Drill bit or bur hole
  – Trajectory perpendicular to the surface of the skull, aim towards medial canthus of the ipsilateral eye and in the AP plane towards the EAM
  – Advance with stylet until CSF obtained. Usually 4-5 cm (no more than 7 cm). Get CSF at 3-4 cm with ventricular enlargement
• The catheter is tunnelled under the scalp and brought out 3 cm away.
• Use a 3-Ethilon running suture for drain site and 2-Silk purse string for exit site
• Connected to
  – A self-sealing sampling & injection port.
  – An anti reflux drip/collection chamber.
  – A pressure scale mounting panel or a tape measure.
  – A drainage bag.
• An initial assessment of CSF drainage should be made
• Subsequently checks should be made of
  – Amount of drainage
  – Colour of CSF
  – Exit site
  – The position of the EVD
• Position of drain
  – Prescribe a drain height post-operatively
    • Can be left open (10 to 20 cm)
    • Or left closed and intermittently opened to drain a certain amount of CSF an hour or above a critical ICP (open to drain 10 cc q15m when ICP>20)
• Advantages
  – Low cost
  – Allows ICP monitoring and therapeutic CSF drainage
  – Easily recalibrated to reduce drift

• Disadvantages
  – Difficult to insert into tight or displaced ventricles
  – Obstruction may cause inaccurate readings
    • May flush distally ad lib but proximally with 1-2 cc normal saline (no preservative)
  – Labour intensive (transducer must be maintained at fixed reference point, must close when moving patient)
Codman ICP monitors

Thin (1 mm in diameter)
- Monitor placed in parenchyma or fluid space
  - Usually former
- Same location as EVD in bedside procedure
  - Drill bit hole
  - Tunnel guide goes from incision to exit site
- Connect monitor to Codman ICP EXPRESS
  - Detect monitors
  - Zero in normal saline, hit blue ZERO button
  - Record reference number
- Can bend monitor 90 degrees
- Insert to 2.5 cm from outer cortex of skull
- Tunnel 3 cm away and suture incision and purse string
- Connect back to Codman ICP EXPRESS then to nursing monitors
• Advantages
  – Easy to insert
  – Less invasive than and EVD

• Disadvantages
  – Higher cost
  – Only allows ICP monitoring
  – Cannot be recalibrated and subject to drift
Lycox bolts
• 3 Port system
  – PO2
  – Temperature
  – Port for Codman or microdialysis
• Same location as EVD
  – Place 1-2 cm anterior if EVD present
• Smaller incision
  – Big enough for drill bit (comes with set)
• Screw in bolt
• Use trochar to puncture dura
• Insert port system
• Place monitors
  – If placing Codman must use extra cap and predetermine depth
Subdural drains
• Insert where the subdural is located
  – Usually frontal (2 cm lateral to Kochers) or at parietal boss
  – Incorporate incision to a possible flap
  – Insert drain
    • Small dural opening to subdural space doesn’t fill with air
    • Use a primed drain
    • Soft pass
    • Aim where the money is

• Drugs
  – Local anaesthetic with epinephrine
  – Fentanyl 50ug iv
  – Midazolam 2.5 mg iv
• Tunnel like EVD
  – Use purse strings to scalp
• An initial assessment of drainage should be made
  – Color and consistency should be noted
• Maintenance
  – Usually level to floor
  – Initially may drain a lot, so clamp for several hours if drain more than 75 cc then open and level to drain 10 cc per hour
• Imaging
  – CT scan the next day
• Indications
  – Chronic subdurals mass effect causing
    • Focal neurological deficits (e.g. drift)
    • Global neurological deficits (e.g. decreased LOC)
  – Temporizing complex chronic and subacute SDH for possible definitive procedure

• Complications
  – Infections
  – Injury to brain
  – Acute bleeding