How do I do it:
Insertion of VP shunt in neonates

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Introduction

- VP shunting is usually the treatment of choice for hydrocephalus in neonates
- Shunt failure ranges from 25-40% at one year follow-up
- Shunt survival decreases progressively and may be as low as 20% ten years after implantation
- Shunt failure is a permanent risk for hydrocephalic patients
- Expressive rates of shunt complications are related to improper surgical technique

Introduction

- Infection remains the most significant complication of VP shunts
- Shunt infection has a great potential for mortality and morbidity
- Neonates have a higher risk of shunt infection
- Shunt infection is usually due to inoculation of microorganisms during surgery
- Several protocols have been introduced to reduce infection rates
- All of them emphasize the need for a thorough surgical technique

Preoperative assessment

Skin inspection

- Previous scars
- Tracheostomy
- Gastrostomy
- Defects of the abdominal wall
- Sores
- Bruises
- Cutaneous / subcutaneous infection

Preoperative assessment

Medical conditions

- Etiology
- Prematurity
- Infections

Preoperative preparation

Hair and body preparation

- Body wash and shampoo (Chlorhexidine 12h and 1h before surgery)
- No shaving
- Scrub the skin for 5 minutes just before start operating

Antibiotic prophylaxis

- Intravenously at anesthetic induction

Shunt selection

No significant differences between shunts
No significant differences in shunt survival

So:

- Selecting shunts remains an individual choice

But:

- Consider the variations between patients

Shunt selection

Variations such as:

- Prematurity
- Skin thickness
- Size of ventricles
- Etiology of hydrocephalus

Relates to:

- Profile of the hardware
- Pressure / resistance
- Flow-regulating valves
- Programmable valves
- Anti-siphon devices (ASD)

…etc

Hardware in neonates

My preference for neonates (at term) and infants:

- Low profile shunt
- Differential pressure shunt as initial option
- Medium pressure valve
- Open-ended distal tubing
- Reservoir
- Impregnated catheters in high-risk patients

Surgery: Operating theater (After Choux et al, 1992)

Schedule / timing:

- Shunts first, whenever possible
- Neonates and infants first
- No more than four shunts / day

Staff:

- Restrict personal to a minimum
- No scrub nurse
- Prevent entry and exit of people in the OR

Surgery: Operating theater

- Change gloves before manipulating the hardware
- Instruments used to manipulate skin and to handle shunt hardware should be kept in separate tables

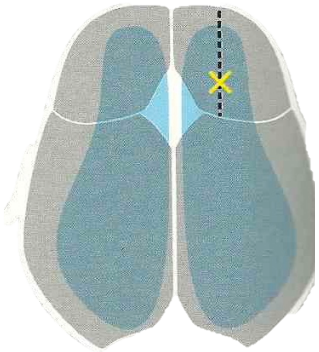
Surgery: positioning

- Supine with the head turned to the opposite side (occipital burr hole)
- Brow-up (frontal burr-hole)
- Neck extended
- Keep a single plane between the skull, cervical and abdominal region

Surgery: positioning

Cranial entry

- Occipital entry is preferred
- Frontal entry is better for smaller ventricles
- No differences regarding function, seizures or infections



Illustrations: Hermes Prado Jr. *In* Oliveira RS, Machado HR. Pediatric Neurosurgey, Di Livros, Rio de Janeiro, 2009
http://www.hermesprado.com

Surgery: positioning

Advantages and disadvantages of cranial entries:

- Occipital entry (OE) allows to enter the lateral ventricle along its major axis
- OE usually does not require intervenient incisions
- Frontal entry (FE) is better in the case of smaller ventricles
- FE often requires an intermediate incision
- FE is a short way to reach the ventricles and do not traverse eloquent areas

Surgery: preparation

- Hair and skin prepared with chlorhexidine solution
- Always mark incisions before draping
- Sterile disposable adhesive drapes with minimal exposition of the skin

Scalp incision and burr hole positioning

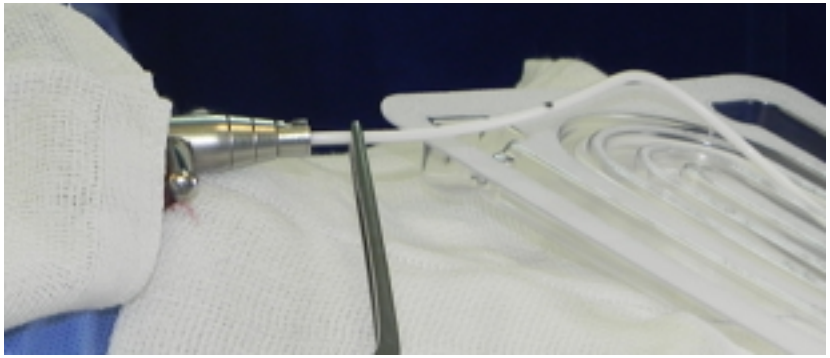
- Semilunar incision usually on the right side ("virgin" patients)
- Avoid coagulating the skin
- Create a subcutaneous pocket to house the reservoir
- Occipital: 2-3 cm from midline, 3-4 cm above the inion
- Frontal: 2-3 cm from midline just in front of the coronal suture or at the fontanel angle (neonates)
- Dandy-Walker: Position burr hole according preoperative imaging

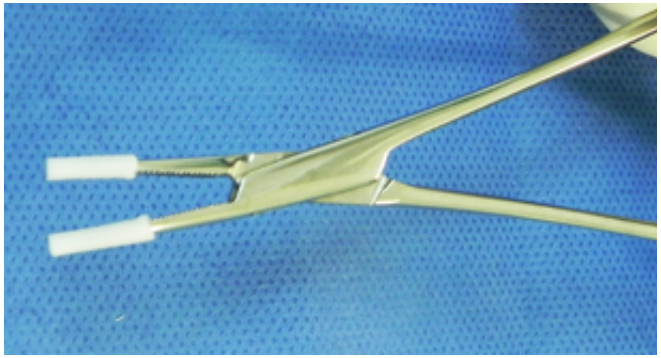
Creating a burr hole

- Use a twist drill or a even an 15 scalpel blade
- Dural opening large enough to allow entry of the ventricular catheter
- Do not place the burr hole underneath the incision line

Handling the hardware

- Select the shunt prior surgery
- Be sure the valve profile is adequate
- Open the pack at the last moment
- Do not test the valve
- Do not touch the valve components (Faillace WJ, 1995)
- Protect forceps with small pieces of tubing





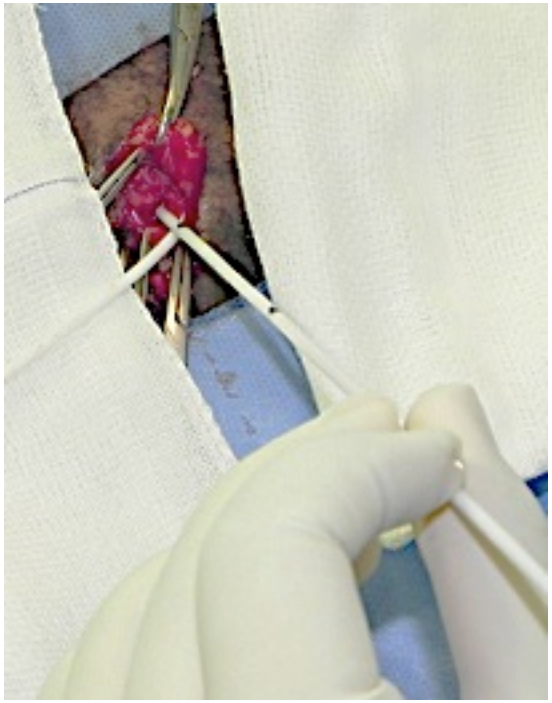
Ventricular catheter placement

Landmarks for occipital entry

- Ipsilateral mediopupillary line parallel to the sagittal suture

Landmarks for frontal entry

- Inner canthus of the ipsilateral eye
- Opposite tragus



Ventricular catheter placement

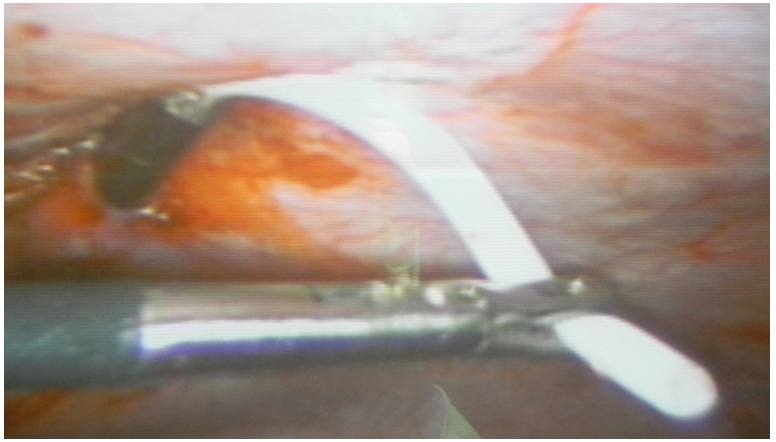
- Place the tip of the catheter in the frontal horn, in front of the choroid plexus
- Alternatively: Place the tip of the catheter in the most dilated part of the lateral ventricle
- Allow CSF to flow before connecting the valve
- Collect CSF for examination

Ventricular catheter placement

- Length of ventricular catheter varies according individual data
- US, Endoscopy, NNav may be used if available and/or required
- Do not place the valve underneath the incision line
- Fix the ventricular catheter to the periosteum of the skull

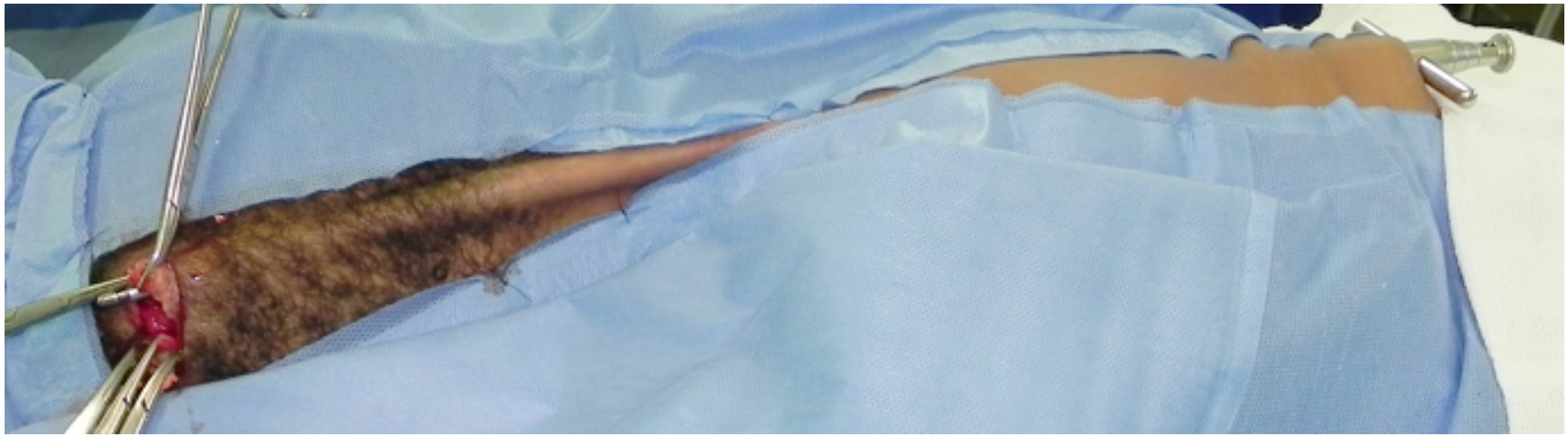
Abdominal incision

- Minilaparotomy: paraumbilical incision
- Alternatively: midline incision, umbilical incision
- Catheter insertion under direct vision
- Alternatively: Peritoneal trocar, video-laparoscopy
- Caution: Assure bladder is empty if a trocar is considered



Tunneling

- From abdominal to cranial
- Alternatively: from cranial to abdominal

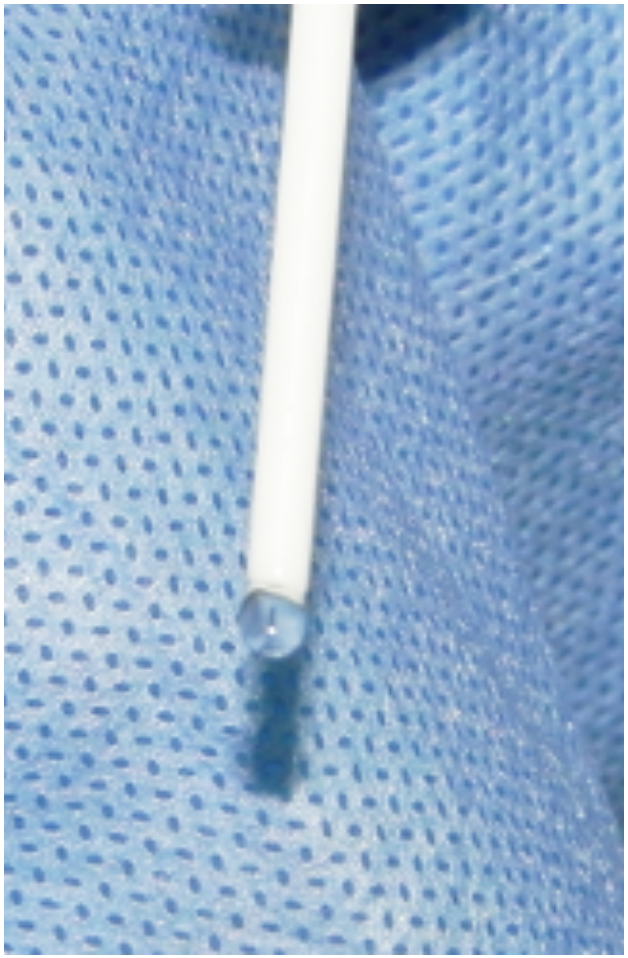


Connecting the shunt components

- Tie tightly the shunt components
- Be sure there the suture does not constrict the lumen of the tubing

Testing the shunt

- Allow CSF to flow from the distal end for some time
- Lower the distal end to increase flow
- Alternatively: Aspirate CSF / pump the reservoir (except if ASD)
- Be sure the shunt is working properly before insertion in the peritoneal cavity.



Closure

Closing the scalp:

- Two layers closure whenever possible
- Avoid pressure over the wound

Abdomen:

- Peritoneum: Purse-string suture
- Alternatively: No suture at all
- Wound closed in separate layers with absorbable sutures
- Skin closure with nylon sutures

Postoperative care

- Avoid pressure over the valve
- Flat bed for 24-48h
- Antibiotics for 24 h
- Dressings changes: every 24h until discharge (mean 2 days)
- Shampoos 24 and 48h after surgery
- Discharge: 48h after surgery
- Sutures removal: 10 days after surgery
- Follow-up consultations: 30, 90, 180 days after surgery

Thank you!