Periventricular-Intraventricular Hemorrhage Surgery

- Influence of hypotension on the short-term prognosis of preterm infants with a gestational age of <32 weeks
- Antenatal administration of vitamin K1: relationship to vitamin K-dependent coagulation factors and incidence rate of periventricular-intraventricular hemorrhage in preterm infants; Egyptian randomized controlled trial
- Epidemiology of peri/intraventricular haemorrhage in newborns at term
- Neonatal porencephaly in very low birth weight infants: ultrasound timing of asphyxial injury and neurodevelopmental outcome at two years of age
- Hemodynamic and antecedent risk factors of early and late periventricular/intraventricular hemorrhage in premature infants
- Evaluation of periventricular-intraventricular hemorrhage in premature infants using cranial ultrasounds
- Extracorporeal membrane oxygenation in the treatment of acute respiratory failure in full-term neonates
- Response to "The risk of periventricular-intraventricular hemorrhage with vacuum extraction of neonates weighing 2000 grams or less"

Surgical/interventional treatment for the clot

Due to poor operative results, surgical evacuation of an intracerebral hemorrhage in the newborn is not indicated with the possible exception of a posterior fossa hemorrhage causing brainstem compression that does not respond to medical treatment [1]. Supportive measures are usually in order.

Intervention for intraventricular blood

34% of infants < 1500 g require shunt/reservoir drainage after failed medical management. Grade III and IV PIVH: >70% of cases develop progressive ventricular dilatation, and 32–47% of this subset will ultimately require shunting [2].

Indications for intervention

Intervention for intraventricular blood is indicated in the setting of progressive ventriculomegaly with the OFC crossing percentile curves and clinical evidence of increased ICP (split sutures, tense fontanelle...).

Serial lumbar punctures

Used at many facilities for hemorrhages with intraventricular extension and communicating hydrocephalus (the usual type of HCP that occurs with PIVH) [3].

This should be undertaken with the knowledge that meta-analysis [4] showed sequential lumbar or ventricular taps of ≈ 10ml/kg/tap for prophylaxis or treatment of progressive hydrocephalus offers no clear benefit over conservative treatment, and had an infection rate of 5–9%. In rare cases, LPs may succeed in temporizing progressive HCP for a few weeks until the infant is large enough for shunt placement.

Infants < 800 gm may not tolerate LPs because of desaturation when lying on their side, or the LP itself may be difficult. In these patients, consider 1–2 ventricular taps to at least obtain fluid for analysis (in some cases nothing further needs to be done).

Serial ventricular taps

May be a viable short-term option for those infants who cannot tolerate LPs or in whom there is obstruction to CSF flow in the lumbar subarachnoid space (e.g. due to spinal subdural hematoma from previous LP).

However it is not desirable for long-term use because of repeated trauma to brain (risk of porencephaly) and risk of intracerebral, intraventricular, or subdural hemorrhage. If continued taps are likely (i.e. large hemorrhage, or rapid recurrence of intracranial hypertension as determined by palpation of fullness of anterior fontanelle (AF) following several taps) the accept- able options include:

1. continuing serial LPs

2. percutaneous ventricular taps: not recommended for more than a few treatments as it causes porencephaly

3. placement of a temporary ventricular access device (TVAD) – a ventricular catheter connected to a subgaleal reservoir (either a Rickham reservoir, or a low profile McComb reservoir [5]).

These can be inserted safely at the bedside, obviating the need for transport to the O.R [6].

a) temporary ventricular access: the reservoir can be used for serial percutaneous taps. Usually tapped QD or QOD (see below). Use a 27 Ga butterfly needle, clean with at least 3 betadine stick swabs, withdraw ≈ 10 ml and send for culture. Reported infection rate: 8–12% [7].

b) ventricular-subgaleal shunt: the side-port of the reservoir is left uncapped. A subgaleal pocket must be created at the time of surgery. Fluid is reabsorbed from this potential space. First per- formed in 1893 by Mikulicz-Radecki (1850–1905). Use has been reported up to 35 days [8].

Infection rate: ≈ 6%.

c) the reservoir may be converted to VP shunt if and when appropriate. Not recommended in infants <1100 gms due to very high infection rate

4. external ventricular drainage (EVD): similar to reservoir placement, but with possibility of inadvertent dislodgment (13%) and comparable infection rate (6%)

5. early VP shunting: high infection rate, peritoneal cavity not suitable in many cases, e.g. due to necrotizing enterocolitis (NEC), paucity of subcutaneous tissue through which to pass shunt tube… Not recommended for infants <2000 gms

Temporary ventricular access device (TVAD) Advantages of TVAD

1. avoids shunt in unhealthy children at risk of infection, skin breakdown or other operative/anesthetic complications

2. clears protein and cellular debris (more favorable for subsequent shunting).

3. avoids repeated penetration of brain with risk of porencephaly

4. provides port for infusion of medication (e.g. antibiotics) PRN

5. avoids cumbersome, easily dislodged EVD with infection risk 6 % on average of 13 days of EVD

6. up to 25%of patients will recover and avoid permanent shunt placement [9) 10)].

Disadvantages of TVAD

1. requires services of a neurosurgeon (not always available)

2. increases risk of infection of subsequent permanent shunt from 5%to 13% [11)].

3. inherent risks of surgery including hemorrhage, infection, ventriculitis, meningitis, CSF leak

4. risks of overdrainage including subdural hematoma, impaired skull growth

Technical considerations for serial taps (via ventricular reservoir or LP) 8–20 cc of fluid are removed initially, and this is repeated daily (or more often if AF become very tense before 24 hours elapse) for several days, and then usually varies from 5–20 cc qod to 15 cc TID depending on response. The frequency and volume of the taps are modified based on:

1. fullness of AF:attempt to keepAF from becoming tense

2. appearance of ventricles on serial U/S: strive to prevent progressive enlargement, reduction in size can usually be achieved

3. follow OFC: should not cross percentile curves (need to differentiate from the so-called “catch-up phase” of brain growth which may occur once the infant overcomes their overall medical prob- lems and is able to adequately utilize nutrition184,185; serial U/Swill show rapid brain growth without progressive ventriculomegaly in cases of catch-up brain growth)

4. CSF protein concentration: controversial. Diminishes with serial taps. Some feel that as long as it is ≥100 mg/dl it is unlikely that significant spontaneous resorption will occur and continued seri- al taps will probably be needed

5. NB: removal of this volume of fluid may cause electrolyte disturbances, primarily hyponatremia;

follow serum electrolytes on regular basis

Follow with serial U/S on day 3–5, and then weekly for several weeks, and then bi-weekly. A baseline CTscan is often obtained prior to placement of a permanent shunt.

Insertion of VP shunt or conversion of sub-Q reservoir to VP shunt Indications and requirements:

1. symptomatic hydrocephalus and/or progressive ventriculomegaly

2. infant is extubated (and thus o ventilator)

3. infant weighs ≥2000 grams (some prefer ≥ 2500 grams)

4. no evidence of NEC(might create problems with peritoneal end of catheter)

5. CSF protein ideally <100 mg/dl (because of concerns about plugging of the shunt, or causing ileus or malabsorption of the fluid – which was not seen with high protein fluid shunted from the subdural space [12] – and also to see if patient will start reabsorbing CSFon their own)

Technical recommendations:

1. do not tap reservoir for at least 24 hrs before inserting a new ventricular catheter (allows ventricles to expand to facilitate catheterization)

2. obtain U/S the day prior to conversion

3. use a low or very-low pressure system(if CSF protein is high, consider a valveless system), upgrade later in infancy if necessary

4. avoid placing shunt hardware in areas on which these debilitated infants tend to lay (to prevent skin breakdown with hardware exposure).

Neuroendoscopic lavage

Neuroendoscopic lavage.

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