Pathway for Management of Intraventricular Haemorrhage (Grade 3 and above) and Post Haemorrhagic Ventricular Dilatation

Start point of pathway: Collapse or grade 3 (or higher) IVH / PHVD identified
End point of pathway: Transfer to RHSC or discharge from the Neonatal Unit

Introduction

Background. Intraventricular haemorrhage (IVH) is a complication of preterm birth that can lead to post-haemorrhagic ventricular dilatation (PHVD). In the acute phase following IVH, small clots can obstruct the ventricular system leading to ventricular dilatation, which is often transient. Over a period of 2- 6 weeks obliterative arachnoiditis may occur, in which extracellular matrix proteins are laid down around the ependyma, the foramina of the fourth ventricle and in the subarachnoid space[1]. This obstructs CSF reabsorption, leading to ventricular enlargement, and ultimately raised intracranial pressure[2]. In this situation the CSF is abnormally rich in inflammatory cytokines, free iron, proteins such as laminin and fibronectin, and free radicals [3-6]. PHVD can lead to progressive brain injury as a consequence of pressure, tissue distortion, free radical injury and inflammation.

Prognosis. PHVD is transient in about half of cases but persists or is rapidly progressive in the remainder. Around 50% of preterm infants with persistent PHVD have adverse neurodevelopmental outcome, and the risk is heightened if there is parenchymal injury or a shunt is required [7-9]

Therapeutic interventions. There is no RCT evidence of efficacy and safety for any therapeutic strategy. There is evidence that intervention aimed at relieving raised intracranial pressure in cases that are severe, persistent and / or progressive reduces the need for later shunt insertion and may improve outcome [10-12]. These observations underpin the consensus that CSF drainage is indicated if [1, 3, 14]:

- OFC crosses 2 centile lines or is enlarging at twice the normal rate over two weeks
- VIs measure > 97th centile +4mm
- there are signs of raised ICP associated with an intracranial pressure of more than 10cm CSF

Recognition of excessive head enlargement

Head circumference enlarges by approximately 1 mm per day between 26 weeks of gestation and 32 weeks, and about 0.7 mm per day between 32 and 40 weeks. Growth >2mm/day for 3 or more days is excessive.

Recognition of ventricular enlargement

The ventricular index (VI) is measured from the falx to the lateral wall of the lateral ventricle in the coronal plane at the level of the 3rd ventricle. We use Levene's reference ranges for VI according to gestational age15 (see chart on page 4). Be aware that sometimes the ventricles do not expand laterally, in which case consider using reference ranges for alternative dimensions to determine the magnitude of dilatation[16].

Recognition of raised ICP

The preterm skull is very compliant and can accommodate an increase in CSF by widening of sutures. The fontanelle may become full or tense. The normal CSF pressure, measured at lumbar puncture is 0-7cmCSF [17] and progressive hydrocephalus is likely if pressure >15cmCSF [18] (HYPERLINK to guideline on how to measure ICP need link).

Indications for Cranial Ultrasound Scan (CUSS) to Diagnose IVH / PHVD

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• If <32 weeks gestational age, follow Badger guideline for minimum frequency of scanning (CUSS Guideline)
• Sudden collapse
• Precipitous drop in haemoglobin level in first week after birth

Clinical signs that may indicate PHVD

If any of these conditions arise, then perform a systemic and neurological examination, document signs of raised ICP, and perform a CUSS:

Rapidly increasing head circumference (≥2mm per day)	Abnormal posturing
Bulging fontanelle	Extended neck posture / opisthotonus
Diastasis of sutures	Fisting
Increased frequency of apnoeas / bradycardia unexplained by other factors	Squint
Hypertension	Sun-setting
Hyponatraemia attributed to SIADH	Seizures
Vomiting	Excessive sleep / lethargy

Actions on day of diagnosis of Grade 3 IVH / PHVD

Medical	Nursing
Check blood results: Haemoglobin Platelets Coagulation screen	**Nursing interventions to minimise the occurrence and or sequelae of IVH** **Supporting literature to assist care planning**
Transfuse according to clinical need and / or blood results -(see use of blood products)	
Plot VI and OFC on page 4	
Plot OFC on growth chart (in addition to the monitoring schedule on page 4)	
Follow monitoring schedule on page 3	

Monitoring Schedule (all babies or grade 3 and above)

The following is the minimum schedule for scans and should be increased if condition indicates.

Schedule		Notes
Cranial Ultrasound	• Routine scanning schedule • On diagnosis (suspicion) of IVH or PHVD • 24hrs after diagnosis • Weekly thereafter (minimum)	Record VI if there is ventriculomegaly
Head Circumference	• Admission to NNU	Assess twice weekly. Reviewing 7 days of head growth is more useful than reviewing a single

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	• On diagnosis of IVH or PHVD • Weekly thereafter	day, head enlargement should be around 7mm in 7 days (>2mm/day over three days is excessive).
MRI	• Between 38-42 weeks CGA or prior to discharge home for all cases of persistent PHVD or those with focal lesions on CUSS	
Structured Neurological Examination	• From 38 weeks CGA or prior to discharge	Experienced doctor / ANP or physiotherapist

Referral pathway

Contact consultant of the week (COW) for paediatric neurology at RHSC. S/he will liaise with the on call neurosurgeon covering paediatrics and management decisions will be made jointly.

Neurosurgical management
Surgical options include endoscopic washout +/- Rickham reservoir drainage into the subgaleal space, endoscopic washout alone, endoscopic washout + VAD and taps, and shunt insertion. Early discussion with neurosurgical colleagues is important to enable optimal surgical planning based on clinical and radiological features per case.

Preparing for discharge from NNU
Discharge must be planned in collaboration with the managing neurosurgical consultant / paediatric neurologist to ensure that appropriate out-patient monitoring and follow-up procedures are in place.

Ventricular Index and HC Monitoring (place in infant record alongside growth chart)

See Appendix 1 Ventricular Index and HC Monitoring graph

If the VI and HC reach the 97th percentile, refer to page 5 for guidelines regarding escalation.

Pathways for escalation

A. Increasing ventricular index

See Appendix 2 Increasing ventricular index pathway

B. Excessive head growth and / or symptoms of raised intracranial pressure

See Appendix 3 Excessive head growth and / or symptoms of raised intracranial pressure pathway

C. Established PHVD with ventricular access device in situ (assessing need for shunt)

See Appendix 4 Established PHVD with ventricular access device in situ pathway

Nursing
Care and positioning if ventricular shunt in place.

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Position according to fontanelle status:
Fontanelle sunken = position flat, and reduce normal handling, reducing excessive upright positions
Fontanelle remains full = position at 30 degrees up

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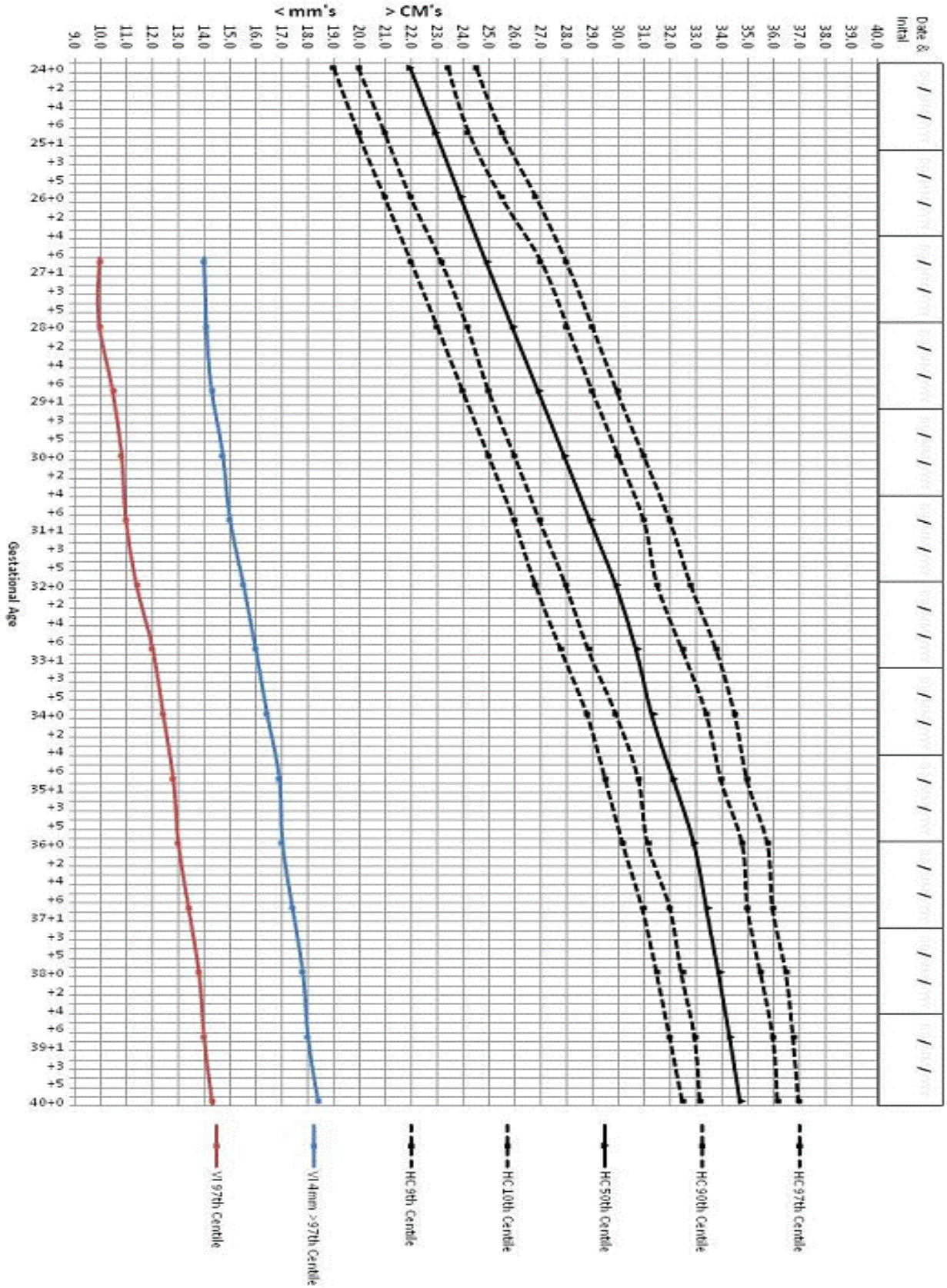
Appendix 1 Ventricular Index and HC Monitoring graph



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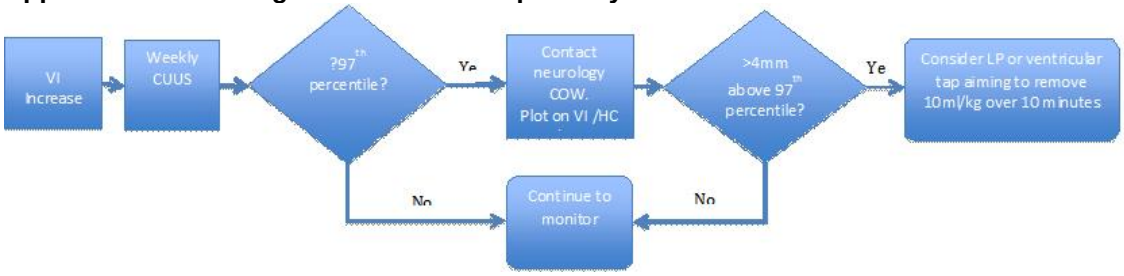
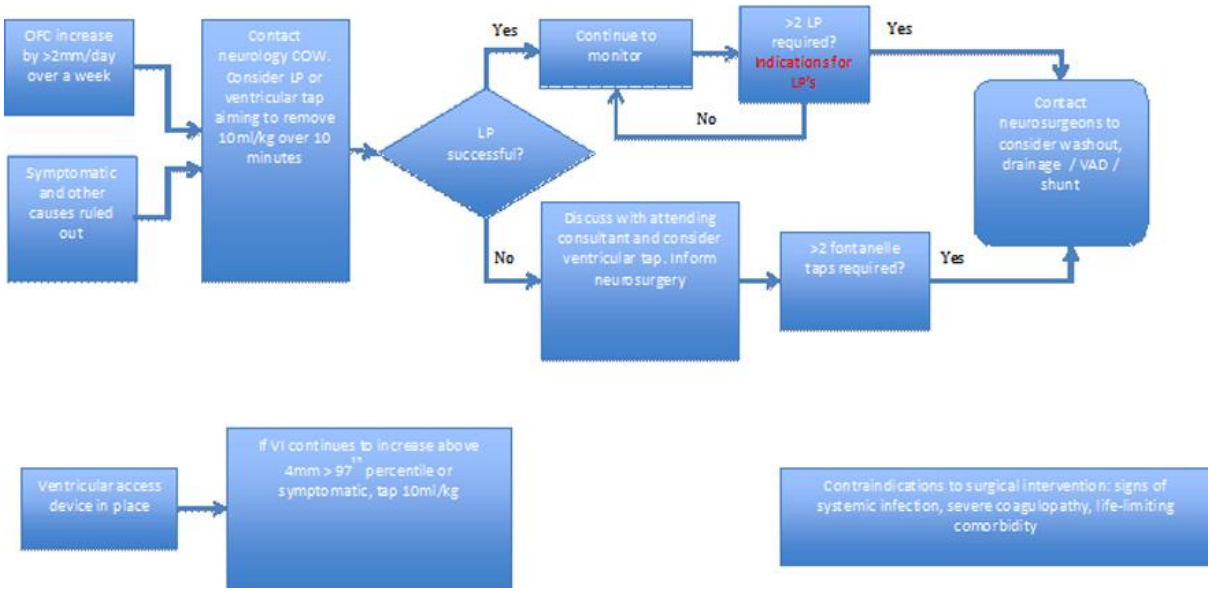
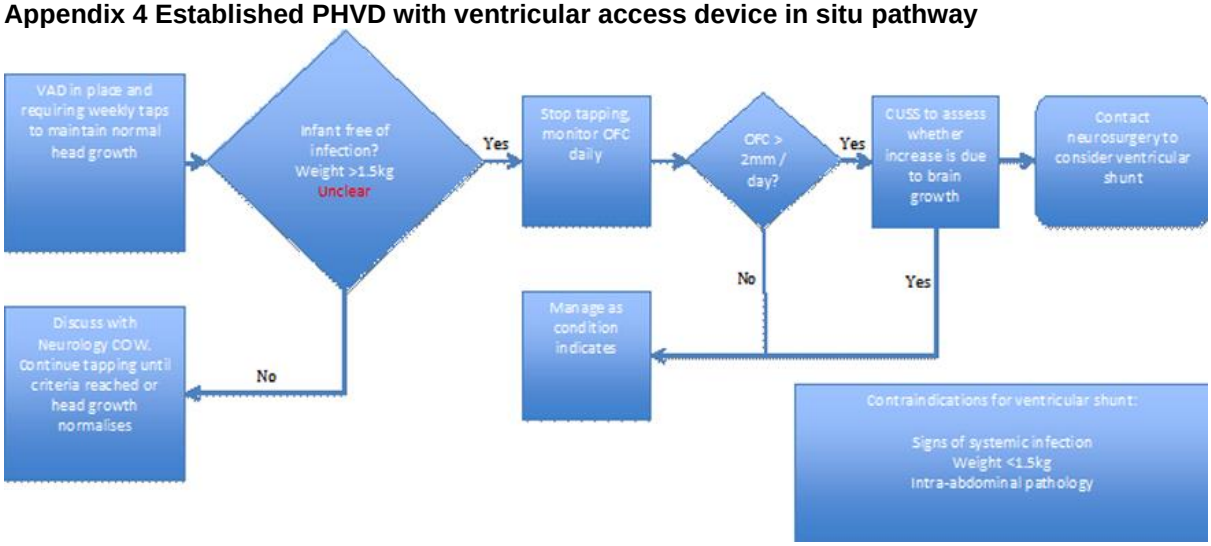
Appendix 2 Increasing ventricular index pathway



Appendix 3 Excessive head growth and / or symptoms of raised intracranial pressure pathway



Appendix 4 Established PHVD with ventricular access device in situ pathway



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