Clinical Pathway
Suspected Shunt Malfunction
Updated: August 2009

Outcomes/Goals	1. Rapid identification and treatment of children with shunt failure 2. Team-oriented approach to efficient, timely evaluation and workup. 3. Identification of appropriate disposition.
NURSE documentation	Chief complaint. Onset of symptoms. Pain assessment. Last shunt revision. Neuro exam, note any deviations from baseline. Activity level, LOC. Seizure history. History of fever, external shunt drainage, shunt or shunt tubing swelling, history of shunt infections. Assess for signs of increased intercranial pressure and meningismus. Ask/document programmable vs nonprogrammable shunt (if known).
INTERVENTIONS Initiate on arrival	ESI Triage level II Full set of vitals per standard of care Place on continuous cardiac monitoring and document rhythm Notify LIP if hypertension, bradycardia, or depressed LOC noted Evaluate/consider Zofran for nausea/active vomiting Evaluate need for pain control Evaluate need for seizure pads NPO Place topical Lidocaine (LMX) in anticipation of peripheral IV start Elevate HOB 30°
DIAGNOSTICS	Bedside CBG if altered mental status
PHYSICIAN (LIP)	
Radiology	Quick brain MRI – first choice if able to obtain **within 60 minutes of presentation** Head CT without contrast - if unstable or MRI delayed more than 60 minutes Plain films – shunt series – do not delay MRI or CT for plain films. Plain films are required *in addition* to MRI or CT Shuntogram – nonemergent - usually scheduled after consult with neurosurgery
Programmable Shunts	Neurosurgery must be consulted prior to MRI on programmable shunts
Medication Anti-emetics Pain Medication	Zofran Oral dose: 4-11 years: 4 mg >11 years: 8 mg IV dose 6mo – 18 years of age: 0.15 mg/kg/dose Tylenol PO/PR dose: 15 mg/kg Fentanyl (2 mcg/kg IN or 1-2 mcg/kg IV / IM) Morphine (0.1-0.2 mg/kg IV) *Narcotics should not be used with altered mental status or clinical evidence/suspicion of raised ICP.*
ADMISSION	Notify primary care physician Notify peds ward attending if other than Neurosurgery admitting pt Prepare family/infant for admission to PICU, ward or observation
Goals of Therapy	Hemodynamically stable Neurologically stable Pain/nausea control Admission to PICU for positive shunt malfunction Admission to OR for unstable positive shunt malfunction Admission to 10N for suspected shunt malfunction with normal imaging Observation admission for stable or questionable shunt malfunction or infection
Discharge Criteria	Neurologically at baseline Hemodynamically stable Pain/nausea controlled

Clinical Pathway Decision Making Process

Shunt Malfunction

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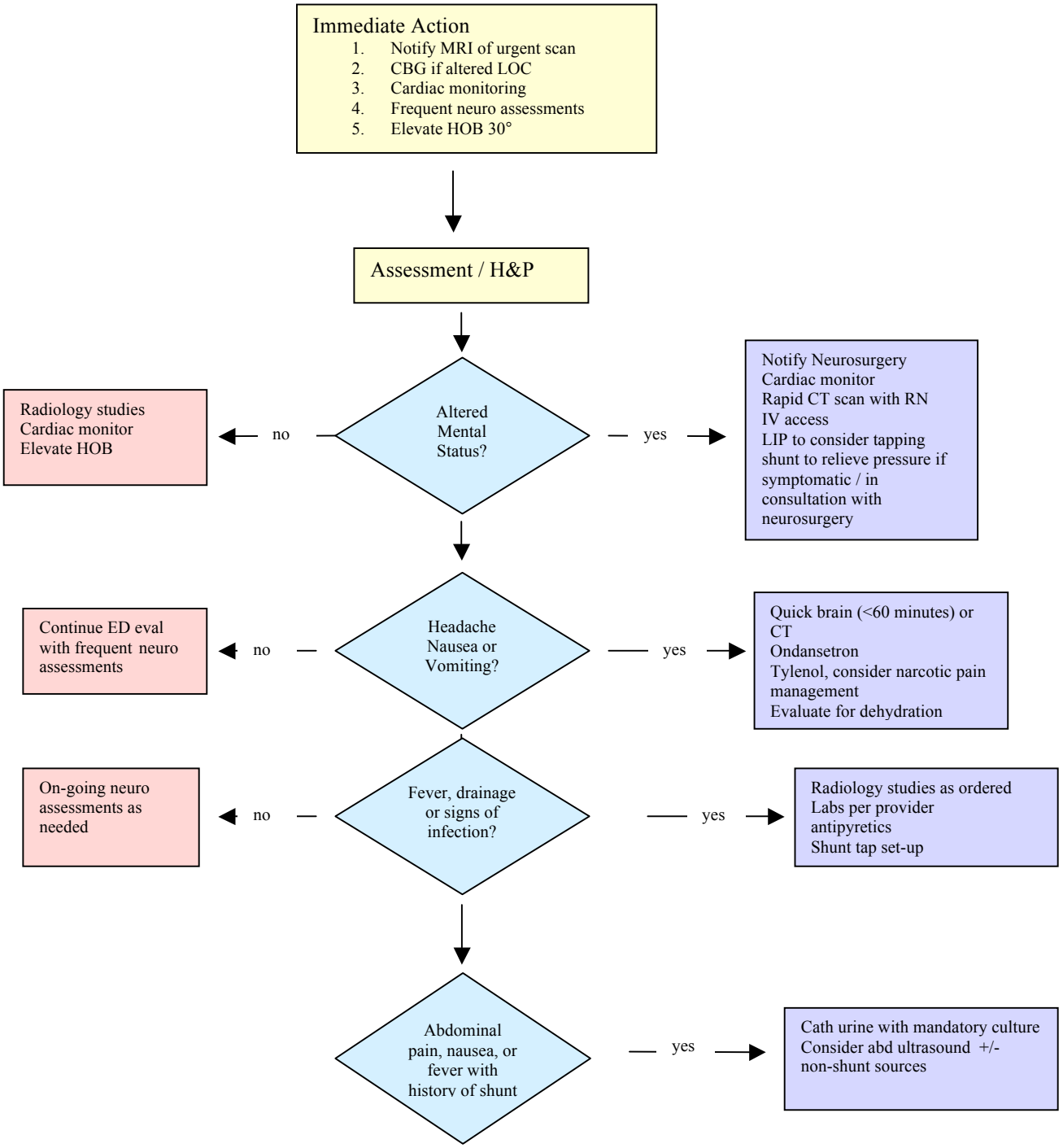

Pediatric Shunt Malfunction

Goals of Clinical Pathway

1. Rapid identification and treatment of children with shunt failure.
2. Team-oriented approach to efficient, timely evaluation and workup.
3. Identification of appropriate disposition.

Hydrocephalus	Lack of absorption, over production or blockage of flow of CSF. May be present at birth (congenital) or develop later in life (acquired). Occurs in approximately 1 out of every 500 births. 20-70% chance of developing hydrocephalus following intraventricular hemorrhage (Cartwright, Wallace 2007)
Communicating hydrocephalus	Ventricles are open but reabsorption of CSF back into the venous system are blocked. This occurs with hemorrhage or infection.
Noncommunicating hydrocephalus	Physical obstruction within the ventricles such as congenital block, brain tumor or shunt malfunction
Shunt Failure /Intracranial Pressure/ /Infection	
Shunt Failure	Shunt failure rate is approximately 45-60% the first year following placement. Most common reasons for failure of shunting are infection, obstruction and disconnection. (Greenburg, 2007). Shunt failure can occur as a result of proximal malfunction (the intracranial catheter can become displaced, the valve can fail), shunt tubing disruption, or distal malfunction (migration of abdominal catheter or formation of CSF cyst at distal end with abdominal swelling).
Intracranial Pressure **Infant**	Bulging fontanel, increasing head circumference, irritability, poor feeding, vomiting, scalp vessel distension, sunset eyes (inability to look up), episodic bradycardia, apnea and excessive sleepiness
Intracranial Pressure **Child**	Headache, vomiting, irritability, change in personality, change in cognition, lethargy, hypersonmolence, uncoordination, gait disturbance, seizure, nystagmus or upgaze paresis
Infection	Fever, irritability, lethargy, erythema at insertion site or tracking along shunt tubing. Abscesses at the drainage site (abdominal) usually occur in first 1-3 months post placement. Staphylococcus epidermidis is the most common cause of shunt infections (Fan-Havard, 1987). Shunt infection is almost always associated with shunt malfunction.

Radiation Risks

With all forms of ionizing radiation, the amount of radiation needed to produce a clear image is directly proportional to the subject's body size. Children require much less ionizing radiation than adults do when they get X-rays and CT scans. Given the fact that children's cells are more sensitive to ionizing radiation than adult cells are, this translates to approximately eight times the amount of ionizing radiation that an adult would be exposed to for a similar procedure (Kim, 2006).

New England Journal of Medicine reported on this growing danger. The report states that in America, there are currently more than 62 million CT scans being performed on patients each year, compared with just 3 million in 1980. Furthermore, the article states that the radiation from these CT scans can cause strand breaks in our DNA resulting in mutations linked to the creation of cancer. Currently, the authors suggest that over 20 million adults are being exposed to potentially unnecessary radiation. The authors suggest that the lifetime risk of *fatal* malignancy is 1:1000 for children < 1 year old from a single CT scan and 1:2000-1:5000 for older children. Children with VPS are likely to receive dozens of CT scans over their lifetime, significantly adding to the lifetime risk of malignancy from these tests. The article reaches the same conclusion that I have been speaking about for years: we need to urgently reduce the number of questionable CT scans in order to dramatically reduce our risk of cancer. (Brenner, NEJM 2007) ◄

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