### 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. |
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<td><strong>INTERVENTIONS</strong></td>
<td>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°</td>
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<td><strong>DIAGNOSTICS</strong></td>
<td>Bedside CBG if altered mental status</td>
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<td><strong>PHYSICIAN (LIP)</strong></td>
<td>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 Zofran Oral dose: 4-11 years: 4 mg &gt;11 years: 8 mg IV dose 6mo – 18 years of age: 0.15 mg/kg/dose Tylenol PO/PR dose: 15 mg/kg Pain Medication 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</td>
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Clinical Pathway Decision Making Process
Shunt Malfunction
Updated: August 2009

Immediate Action
1. Notify MRI of urgent scan
2. CBG if altered LOC
3. Cardiac monitoring
4. Frequent neuro assessments
5. Elevate HOB 30°

Assessment / H&P

Radiology studies
Cardiac monitor
Elevate HOB

Altered Mental Status?

Notify Neurosurgery
Cardiac monitor
Rapid CT scan with RN
IV access
LIP to consider tapping shunt to relieve pressure if symptomatic / in consultation with neurosurgery

Quick brain (<60 minutes) or CT
Ondansetron
Tylenol, consider narcotic pain management
Evaluate for dehydration

Headache
Nausea or Vomiting?

Continue ED eval with frequent neuro assessments

Fever, drainage or signs of infection?

Radiology studies as ordered
Labs per provider
antipyretics
Shunt tap set-up

Abdominal pain, nausea, or fever with history of shunt

Cath urine with mandatory culture
Consider abd ultrasound +/- non-shunt sources
## Pediatric Shunt Malfunction

### Goals of Clinical Pathway

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)

Authors: Denise Langley, RN & David Spiro, MD
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