**Inclusion Criteria:** A child that presents with a pre-existing shunt (VP/VA/Vpleural) AND has symptoms associated with malfunction (see below)

- **Infants:** Enlargement of head, full and tense fontanelle while positioned upright and calm, prominent scalp veins, swelling along the shunt tract, vomiting, irritability, sleepiness, downward deviation of the eyes
- **Toddlers:** Enlargement of head, vomiting, headache, irritability, sleepiness, loss of previous abilities (sensory or motor function)
- **Children and adults:** Vomiting, headache, vision problems, photophobia, irritability, sleepiness, personality change, difficulty in waking up or staying awake

**Exclusion Criteria:** Concern for neurosurgical shunt infection (see Shunt Infection Pathway), identification of alternate source for symptoms, or symptoms not related to shunt malfunction as defined

**ED Evaluation**

**Triage:**
- Vital’s: BP, HR, O2 sat, RR
- Weight
- Head circumference (if age <2 years)
- Pain score
- Place on continuous cardiac and respiratory monitoring
- Notify NSG attending immediately if bradycardia, hypertension, depressed level of consciousness (LOC)

**Initial evaluation:**
- Obtain a detailed history and initial exam (see Appendix A)

**Initial Management**

**Labs:**
- CBC, CRP, BMP

**Imaging:**
- Head ultrasound if fontanelle is open
- CT or MRI of the brain without contrast
- Abdominal ultrasound if abdominal symptoms are present
- Shunt series at the discretion of the neurosurgery attending:
  - 2 view head/lateral chest
  - AP abdominal

**FEN/GI:**
- NPO
- IVF DS NS with 20 mEq KCl at maintenance rate

**Medications:**
- Ondansetron 0.1 mg/kg/dose q8hr PRN nausea (max 8 mg/dose)
- Acetaminophen 15 mg/kg/dose q6hr PRN pain/headache (max 75 mg/kg/day OR 4,000 mg/day)

**Notify NSG attending via Intellidesk**

**Pre-Op:**
- Admit to NSG service on the floor if stable, or to the PICU if unstable
- Shunt tap by neurosurgery (at the discretion of NSG attending)
  - If tapped, send STAT cerebrospinal fluid culture and gram stain
- OR case request for shunt revision to be completed by NSG attending or APP
- Continuous CR monitoring (close monitoring for bradycardia)
- NPO and IVF at maintenance
- NSG to consent to OR

**To OR**

**Post-Op:**
- See Suspected Shunt Malfunction Inpatient Pathway

**NEXT PAGE**
Inclusion Criteria:
post-operative care for any patient diagnosed by Neurosurgery to have shunt malfunction requiring surgical correction

Exclusion Criteria:
none

Post-operative Care:
- Transfer to Med/Surg floor if stable
- Transfer to PICU if unstable

Antibiotics
- Cefazolin 90-100 mg/kg/day div q8hr (max 2000 mg/ dose)
  OR
- Nafcillin 200 mg/kg/day div q6hr (max 12 g/day); adult dose 2g q6hr
  if β-Lactam allergy:
  - Vancomycin 15 mg/kg/dose q6hr (≥18 yrs old: q8hr) max initial dose 1 g/dose

Pain Control
- Toradol 0.5 mg/kg/dose q6hr x 6 doses (max 30 mg/dose)
  - 6 hours after toradol dose, start Ibuprofen 10 mg/kg/ dose q6hr PRN (max 40 mg/kg/day or 2,400 mg/ day, whichever is less)
- Acetaminophen 12.5 mg/kg q4hr
  - ATC x 24 hours followed by q4hr PRN for mild/moderate pain
  - Hydrocodone/acetaminophen 0.2 mL/kg hydrocodone q4hr PRN severe pain

Nursing & Monitoring
- Head of bed at 30 degrees
- 24 hours post-op: OT, PT consults
- POD 3: may shower

Activity
- Incentive spirometer or bubbles 4-10x/hr while awake
- Sequential compression device (SCD)/stockings while in bed

Fluids, Electrolytes, Nutrition
- Clear liquid diet, advance as tolerated
- Polyethylene glycol 17 g daily or BID PRN constipation
- Docusate 50-100 mg PRN constipation

Diet:
- Clear liquid diet, advance as tolerated when recovered from anesthesia per PACU

Bowel regimen:
- Polyethylene glycol 17 g daily or BID PRN constipation
- Docusate 50-100 mg PRN constipation

Discharge Criteria:
- Baseline neurological examination
- Pain well-controlled on oral medication
- Fæbre x 24 hours
- Bowel movement
- Taking adequate fluid and nutrition orally
- Cleared by PT & OT

Discharge Medications:
- Ibuprofen 10 mg/kg q6hr PRN (max 600 mg/dose) for mild/moderate pain
- Acetaminophen 12.5 mg/kg q4hr PRN (max 650 mg/dose, 4g/day) for mild/moderate pain
- Hydrocodone/acetaminophen 0.2 mL/kg/dose of hydrocodone q4hr PRN (max 5-10 mg/dose) for severe pain
- Polyethylene glycol and/or Docusate to prevent constipation

Discharge Instructions:
- Call NSG for fever > 101.5, vomiting >3x in 12 hr period, excessive irritability or sleepiness, severe headache
- Follow up outpatient 2-3 weeks after discharge
Important factors to include:

- Shunt history, including:
  - Location of shunt (ventricular-atrial shunt, ventricular-pleural shunt, ventricular-peritoneal shunt)
  - Date of shunt placement
  - Date of last shunt revision
  - Signs/symptoms present at presentation/last revision

- Headache history, including:
  - Quality
  - Duration
  - Location
  - Past treatment

- Vomiting history, including:
  - Timing
  - Any precipitating events

- Neurological symptoms, including:
  - Change in LOC
  - Increased irritability
  - Weakness
  - Seizures
  - Upward or downward gaze
  - Increased lethargy

- Abdominal symptoms, including:
  - Significant increase in abdominal girth
  - Pain
  - Tenderness
  - Mass

- Trauma history

- Physical exam findings:
  - Fontanels
  - Head circumference
  - Decreased breath sounds for pleural shunt