An Overview of Intrathecal Baclofen Management and Troubleshooting
AACPDM 2014 Instructional Course 31

Introduction - 5 minutes - Krach

- ITB-very effective intervention for tone reduction but requires:
  - A team that is knowledgeable about ITB and can provide evaluation for the intervention (including teaching), implantation of the system, management-including access to emergency care
  - Access to individuals experienced in the management of ITB 24 hours a day 7 days a week.
  - Ongoing evaluation of management and complications that occur
  - Return of explanted hardware to the manufacturer for evaluation. When information received attempt to correlate with clinical information available.

Initiation of Treatment & Early Management (implantation to stable dose): 15 minutes - Aldahondo

- Pump Implantation
  - To test dose or not?
  - Catheter position
    - Entry point
      - L2-3 & L3-4 associated with less movement than L4-5 and therefore less catheter wear-and-tear
      - Oblique & paramedian insertion
    - Intrathecal tip
        - T10-12 spastic diplegia
        - C5-T2 spastic quadriplegia
        - C1-C4 generalized secondary dystonia
      - Sivakumar et al. (Childs Nerv Syst 2010)
        - Compared cervical vs. thoracic vs. lumbar vs. sacral tip
        - In children with spasticity of cerebral origin there was no significant correlation between catheter position & maintenance dose or clinical response
        - Didn’t look systematically at differences in tone reduction upper vs. lower extremities
      - McCall & MacDonald (Neurosurgery 2006)
        - Compared cervical (C5-C7) vs. thoracic (T2-T12) placement
- Significant reduction in upper extremity tone with cervical but not thoracic placement
- Both groups had significant reduction in lower extremity tone

- Burns & Meythaler (Spinal Cord 2001)
  - 14 quadriplegic patients from SCI (C1-T1 levels)
  - Catheter tip placed midthoracic (T6)
  - Significant improvement in both upper & lower extremity spasticity

- Grabb et al. (Neurosurgery 1999)
  - Compared midthoracic (T6-7) vs. lower thoracic (T11-12) placement in previously published study
  - Greater decrease in upper extremity spasticity with mid-thoracic placement

- Intraventricular tip

    - In patients where anatomy precluded intrathecal placement
    - Catheter implanted into 3\textsuperscript{rd} ventricle
      - Infused baclofen goes directly down the aqueduct & 4\textsuperscript{th} ventricle to the subarachnoid spaces and distributes over cerebral convexities
    - Series of 10 patients with dystonia treated with intraventricular baclofen (IVB)
      - Dystonia improved significantly in 8/10 patients

    - Series of 22 patients with intractable spasticity or dystonia
      - After multiple revisions of ITB pump received IVB therapy
      - Catheter placed into lateral ventricle
      - Surgical revision rate was lower for IVB therapy
      - IVB may be beneficial therapeutic option for patients with multiple ITB pump revisions and risk of spinal arachnoiditis

  - Rocque & Albright (Neurosurgery 2013)
    - Compared complication rates between IVB (37%) vs. ITB (48%)
      - May be lower risk of catheter or leak-related complications in IVB group
- **Post-operative care**
  - PO Baclofen: discontinue or wean?
  - Activity restrictions
    - 24 vs. 72 hours bed rest
  - Imaging
  - Complications
    - CSF leak
      - Immediately or up to 2 weeks after insertion
      - 6-15% in children vs. 1% in adults
        - Occult hydrocephalus
          - Albright et al (Neurosurgery 2005): 24 children with CP & asymptomatic ventriculomegaly 96% had high CSF opening pressures on LP. No correlation between ventricle size & opening pressure.
      - Reduced with oblique & paramedian insertion of Tuohy needle for catheter placement (Albright et al. J Neurosurg 2006)
        - Catheter obliquely traverses several centimeters of paravertebral musculature before dura is punctured
      - Impaired wound healing & increased risk of infection
    - Infection
      - Usually within 90 days of surgery
      - Pump pocket vs. CSF
    - Wound dehiscence or pump erosion
    - Effects on sleep and sleep-related respiratory parameters
      - Bensmail et al (Arch Phys Med Rehabil 2012) compared ITB continuous infusion with bolus dosing in 11 patients with severe spasticity (SCI, MS or stroke)
        - ITB reduced periodic limb movements & increased respiratory disturbance index & central apneas
        - Significant increase of respiratory events in bolus vs. simple continuous dosing
      - Emergency plan established on discharge
        - PO Baclofen Rx

- **Dosing & Concentration**
  - Initial dose & titration
  - Simple continuous vs. Flex
    - Intrathecal baclofen pharmacokinetics
      - Onset of action
- Bolus 0.5-1hr
- Continuous infusion 6-8hrs

- Peak effect
  - Bolus ~4 hrs
  - Continuous infusion 24-48hrs

- Elimination clearance from CSF
  - 30mL/hr

- Drug concentration in cisternal CSF is considerably lower (1/3 to 1/7) than that of lumbar CSF
  - Lumbar to cisternal gradient of ~ 4:1

- Kroin et al (Neurosurgery 1993)
  - Measured concentration of drug at 0cm (T12) and 20cm from catheter tip (T2) & found gradual decrease in concentration along the thoracic spine with an average drop of 43% when administered by slow infusion

- CSF flow dynamics
  - CSF flow is influenced by the circulation of CSF from its formation to absorption sites (bulk flow) & an oscillatory flow during the cardiac cycle (pulsatile flow)
  - Hettiarachchi et al (Annals of Biomedical Engineering 2011)
    - Compared dispersion of drug bolus in a surrogate model of the spinal canals in stagnant vs. pulsatile (oscillatory flow) conditions
    - Pulsatile condition showed increased speed of drug dispersion & overall drug dispersion
    - Both pulse frequency & stroke volume have a significant effect on dispersion speed

- Simple continuous vs. Bolus
  - Bernards (Anesthesiology 2006)
    - Characterized CSF & spinal cord distribution of ITB during infusion in pigs (20 microliters/hr vs. 1000 microliters/hr vs. 1000 microliter boluses over 5 mins)
      - Limited distribution of baclofen from site of administration
      - Most of the drug recovered in CSF & spinal cord was w/in 1cm of site of administration
      - Distribution w/in CSF and/or spinal cord parenchyma was increased in the 1000 microliter/hr & bolus group vs. 20 microliter/hr group
- Subtle evidence that bolus group achieved better drug distribution than 1000 microliter/hr group
  - Saval & Chiodo (Journal of Spinal Cord Medicine 2008)
    - 3 cases of improved tone control after decreasing concentration
    - Higher volumes given for same total dose at the lower concentration which may enhance distribution & efficacy of drug
  - Heetla et al (Spinal Cord 2010)
    - 4 patients transitioned to flex dosing due to “tolerance”
    - All had drop in total dose with improved clinical effect with flex dosing

- Concentration
  - Diluted concentrations
    - 250mcg/mL, 1000mcg/mL
  - Implications of concentration changes on flow dynamics and life of pump
  - Transitioning between concentrations

- Assessment of efficacy
  - H-reflex as an objective index of spinal cord response of ITB administration
  - Stokic & Yablon (Acta Neurochir Suppl 2007)
    - ITB bolus significantly reduces H/M ratio in dose- and time-dependent fashion
    - Temporal profile of H/M ratio change precedes peak and persists beyond duration of apparent Ashworth score change
  - Stokic & Yablon (Clinical Neurophysiology 2012)
    - Greater decrease in H/M ratio in complex vs. simple continuous mode
    - Faster & greater decrease in H/M ration at lower ITB concentration & faster bolus administration

- Refills
  - Common pitfalls
  - Safeguarding guidelines
Management of Intrathecal Baclofen Withdrawal and Overdose - 15 minutes - Ward

Withdrawal presentation
- Florid withdrawal
  - usually 12-24 hours after an acute medication delivery failure
  - Symptoms may develop slowly or be rapid onset
  - May be life threatening, but deaths rare
- Intermittent withdrawal
  - The symptoms come and go
  - Perhaps with position changes or related to flex dosing schedule
  - Temporary improvement in tone may be seen if boluses are delivered
- Symptoms may be seen close to patient’s refill date

Possible Withdrawal symptoms
- Neurologic:
  - Increased muscle tone/spasticity/spasms/involuntary movements/“Cycling” movements of the limbs → earliest symptom
    - rhabdomyolysis
  - Seizures
  - Itching
  - Malaise
  - Fever → hyperthermia (→ malignant hyperthermia)
  - Diaphoresis
  - Vomiting
- Cardiovascular:
  - Tachycardia (autonomic instability)
  - Priapism
  - DIC
  - Multi-organ failure
- Psychiatric:
  - Hallucinations, delirium, delusions, paranoia

Withdrawal treatment
- Phone triage by experienced ITB care provider:
  - Emergent transfer to hospital for stabilization if:
    - Seizure
    - Severe pain
    - Severe spasms
    - Vomiting
    - Worsening course
  - Supportive management at home with urgent evaluation in clinic if:
    - Symptoms relieved with enteral baclofen/diazepam
    - Symptoms minimally problematic for patient and family
- Enteral baclofen
  - 5-10 mg q4 hours prn ongoing withdrawal sx (limit for somnolence)
- Enteral/rectal diazepam
- 5 mg q4 hours prn ongoing withdrawal sx (limit for somnolence)
- Enteral hydroxyzine
  - 12.5 - 25 mg q 6 hours prn itching
- ITB bolus
  - Most will tolerate 50 mcg bolus safely
- IV diazepam
  - 1-3 mg q4 hours prn sx not responding to enteral meds
- Propofol infusion
  - ICU
- ITB bolus
  - 50 – 100 mcg bolus
  - If cannot deliver via CAP then consider via LP if pt’s withdrawal is severe

**Possible overdose symptoms**
- Overdose symptoms vary base on level of load:
  - Somnolence, decreased level of responsiveness, delirium, seizures, coma
  - Flaccid paralysis
  - Respiratory depression
  - Hypotension, bradycardia/tachycardia, cardiac abnormalities
- Intermittent overdose
  - Seen with intermittent delivery of drug or with varying positioning

**Overdose treatment**
- Airway/breathing/circulation
  - Close monitoring of respiratory status and vital signs
  - Oxygen
  - Bipap, ventilatory support
    - ICU
  - Pressors if needed to support blood pressure
    - ICU
- Stop the pump (restart pump within 48 hours of stopping it)
- Consider CAP or LP to remove excess ITB
  - Send CSF for evaluation of baclofen concentration

**Common Presentations of Hardware Problems** - 15 minutes-Krach
- ITB withdrawal-obvious need for urgent intervention
- Need for increasing dose after a period of dose stability
- Puffiness around the back or abdominal incision that increases with upright posture
- Lack of response to dose changes or boluses
- Tone that varies depending on the time of day/posture of the individual
- Incidental findings on x-ray
- What do you do when a pump is replaced for low battery and the catheter doesn’t have spontaneous CSF flow?
- Implication of concentration changes for distribution of drug and life of the pump
- Infection presentation
• Usually within 90 days of surgery
  o Suspected gram negative infection is (even greater) emergency
  o Erosion of skin over pump or catheter
• Increased tone or withdrawal symptoms after pump refill
  o Recheck concentration/dosing/programming
  o Case reports of catheter being punctured at the time of refill
• ITB has never seemed to be effective, or never as effective as the ITB trial prior to pump implantation

• Baclofen withdrawal vs. other problems (It is always the pump!)
  o Constipation
  o Fractures
  o Intercurrent illness
  o Tone may increase and stabilize if it is not withdrawal; other symptoms will appear over hours if tone increase is due to other illness

• Initial Workup
  o History
    ▪ Sudden vs. gradual increase in tone
    ▪ Ever at a stable dose? How long?
    ▪ Any recent falls, surgeries, etc. (physically active patients are harder on their catheters)
    ▪ Did the oral baclofen help relieve symptoms?
    ▪ Interrogate pump and check logs
      • Is the pump empty?
      • Was it programmed correctly last time?
      • Check concentration, dose, bridge bolus, session data report status
      • Consider checking amount of baclofen in reservoir for discrepancies
      • Do the logs show evidence of motor stalls or other abnormal activity?
  ▪ Physical Exam
    • Increased tone, spasms, bicycling movements, jerking, any involuntary movements
    • Intermittent or mild symptoms suggest positional tear
    • Any changes in pump pocket, posterior incision or fluid collection anterior or posterior
  ▪ Imaging
    • A break or disconnect may be visible on exam (not with new Ascenda catheters)
    • A small crack or tear may not show up
    • A “kink” or other obstruction may not show up
    • Note old catheter segments from previous surgeries if applicable
    • Contrast studies should be done ONLY if it is possible to aspirate from the CAP. Contrast must be preservative free, and compatible with the intrathecal space
A roller study may be done if there is a large difference in the expected vs. actual amount of baclofen in the pump (i.e. expected 4mL and got 17mL back)

- Intervention
  - Most catheter problems ultimately require surgery
  - Routine imaging may be normal
  - Contrast studies may also be normal
  - Surgery may be done if withdrawal symptoms continue to progress despite ability to aspirate from CAP

- If oral baclofen relieves symptoms:
  - Patient may be seen within a few days to 1 week
  - Increase dose (patient may be getting some ITB)
  - Try flex mode with intermittent boluses
  - Maintain close follow up. A crack or tear will worsen over time. May want to check CAP at a scheduled visit
  - Surgery can be planned electively
  - May try programming a bolus in clinic and observe for response
  - Continue oral baclofen as needed

- If oral baclofen does not relieve symptoms:
  - Patient must be seen same day or next morning as admission will be needed
  - Check CAP- ability to aspirate does not always rule out catheter problems
  - Inability to aspirate may occur with a well-functioning VP shunt
  - Try programming a bolus over a short interval and watch for response
  - Admit the patient for further evaluation, intervention, and surgery
  - Rhabdomyolysis is a rare complication
  - Treatment in the Intensive Care Unit may be needed

- Withdrawal symptoms are usually due to catheter problems, less likely due to pump stalls

- Post-operative management
  - If the catheter is replaced completely, start dosing from scratch
  - If a crack or a tear is found, start dose at the last stable dose level
    - Preferable to under dose and catch up with boluses and dose increases than overdose
  - Adjust prior to discharge
  - Resume abdominal binder use for 6-8 weeks
  - Oral baclofen should not be needed once catheter has been replaced
  - Reschedule return appointment for pump refill- it may be very different post-op.