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
      - "Best practice" recommendations (Albright et al. J Neurosurg 2006)
        - 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
    - Albright et al (J Neurosurg: Pediatrics 2011 & 2009)
        - In patients where anatomy precluded intrathecal placement
        - Catheter implanted into 3rd ventricle
            - Infused baclofen goes directly down the aqueduct & 4th 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
    - Turner et al (J Neurosurg: Pediatrics 2012)
        - 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 sxs (limit for somnolence)
- Enteral/rectal diazepam

    - 5 mg q4 hours prn ongoing withdrawal sxs (limit for somnolence)
- Enteral hydroxyzine
    - 12.5 - 25mg q 6 hours prn itching
- ITB bolus
    - Most will tolerate 50mcg bolus safely
- IV diazepam
    - 1-3 mg q4 hours prn sxs 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
    - Suspected gram negative infection is (even greater) emergency
    - Erosion of skin over pump or catheter
- Increased tone or withdrawal symptoms after pump refill
    - Recheck concentration/dosing/programming
    - 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 prio to pump implantation

- Baclofen withdrawal vs. other problems (It is always the pump!)
    - Constipation
    - Fractures
    - Intercurrent illness
    - 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
    - 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
  - Rhabdomyolsis 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.