Bladder Issues in the Hydrocephalus Population

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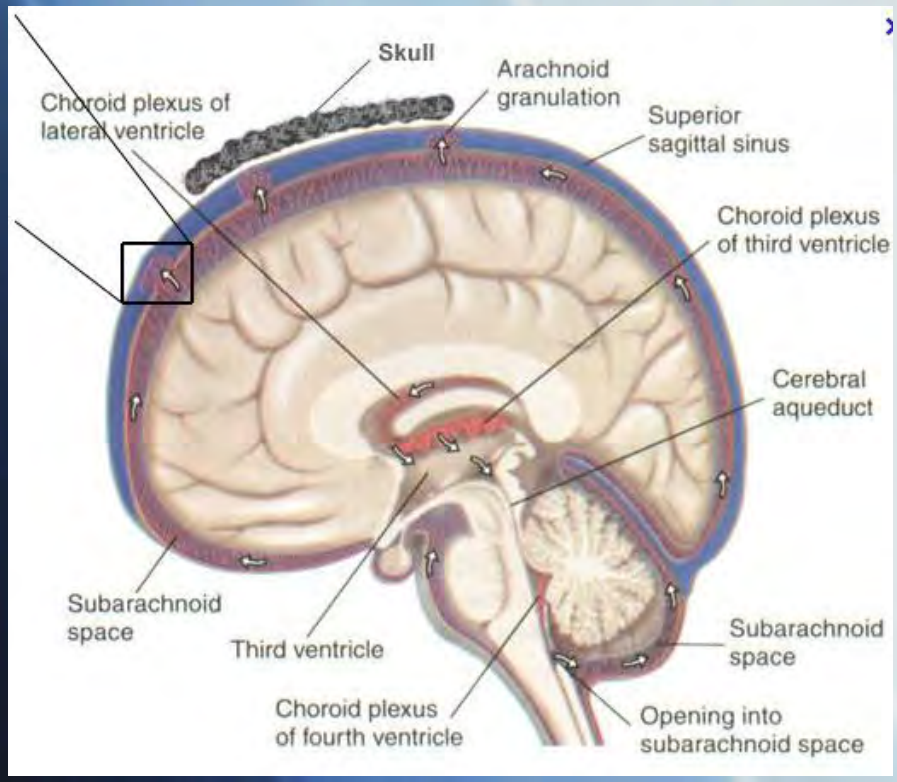
Overview of this talk

- Background on Hydrocephalus
  - Types
  - Cause
  - Symptoms
- Bladder Issues
  - Diagnosis
  - Cause
  - Treatment
- Pudendal Nerve Conduction Studies
  - Role as a predictor of treatment success

What is Hydrocephalus?

- Hydro= Fluid
- Cephlad= Head
- Excess fluid in the brain
- Albucasis
  - Surgical drainage in 1000 AD
- Hippocrates
  - 4th century BC

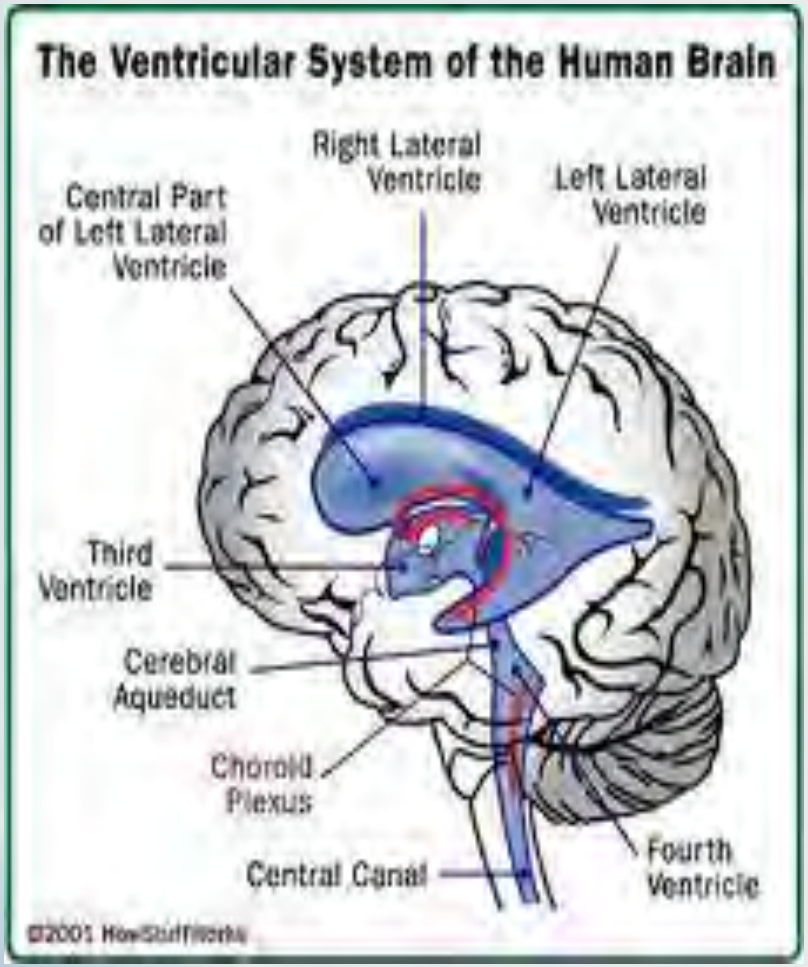
Cerebrospinal fluid (CSF) pathway



- Produced by Choroid Plexus of third ventricle (500cc)
- Flows from lateral ventricles through foramina of Monro into third ventricle
- Enters fourth ventricle through aqueduct of Sylvius
- Enters subarachnoid space through foramen of Megendie/Luschka
- Resorbed by arachnoid villi at top of brain (500cc)

Types of Hydrocephalus

1. Communicating
   - Production/absorption
   - NPH (normal pressure hydrocephalus)
2. Non-communicating
   - obstructing
   - Tumor
   - Narrowing in the ventricular system



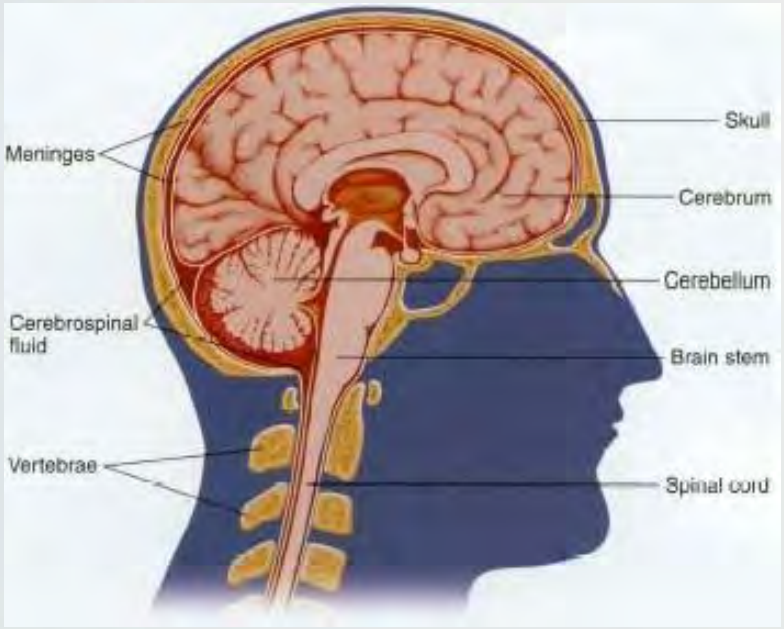
Why does NPH happen?

- 50% cases idiopathic
  - Leading theory is a functional impairment of arachnoid granulations
- 50% cases secondary to other illnesses
  - Subarachnoid hemorrhage
  - Meningitis
  - Cranial trauma
  - Congenital malformations

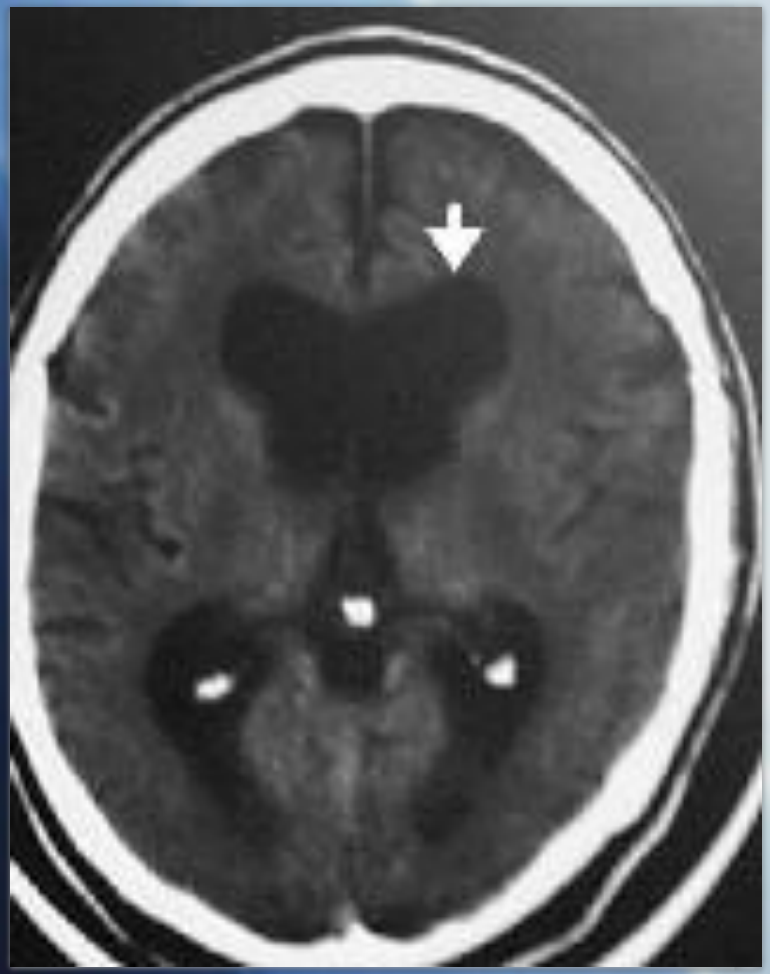
Normal Ventricles

What Happens to CSF in Hydrocephalus?

- Over-Production vs. Under-Absorption
- The skull has a fixed volume
  - Brain, Blood, CSF
  - Any increase in CSF fluid, without an equal decrease in another, will increase pressure which distorts the normal brain tissue



Enlarged Ventricles



Diagnostic Symptoms

- "Wet, wacky and wobbly"
  - Gait Disturbance
  - Dementia
  - **Loss of bladder control**

Gait Disturbance

- No classic gait disturbance
- Gait may be wide based, shuffling
- More severely affected patients have “magnetic gait”- feet stuck to ground and difficult to initiate walking
- Not associated with limb weakness or sensory deficits

Dementia

- Presence of dementia in NPH extremely variable
  - Dementia usually least responsive of symptoms to intervention

Loss of bladder control

- Urinary urgency
  - The sudden, compelling need to void
- Urinary frequency
  - Need to void many times during the day or at night
- Urinary incontinence
  - Involuntary loss of urine

Diagnosis of the bladder problem

- History
  - Do you…
    - leak urine when you don't want to?
    - leak urine with exercise, coughing, laughing?
    - Do you use pads, tissue or cloth in your underwear?
- Physical Exam
  - Neurodiagnostics, PNC, pelvic floor EMG

Diagnosis of the bladder problem

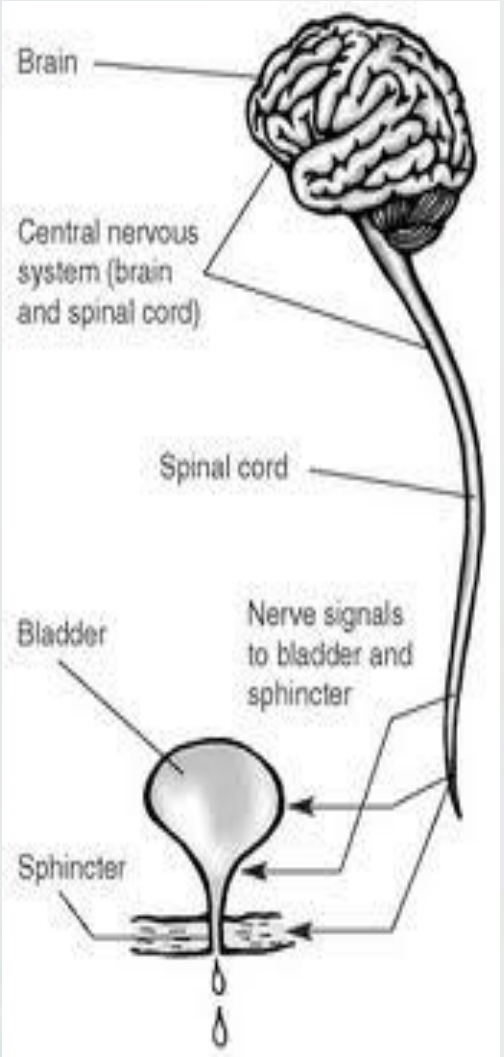
- Urinalysis
- Urine culture
- Cystoscopy
- Urodynamic studies
- Imaging of the kidneys, ureters, bladder
  - Ultrasound, X-ray, CT scan, MRI

Differential Diagnosis

- Urinary tract infection
- Enlarged prostate
- Diabetes
- Bladder cancer
- Neurogenic detrusor overactivity
- Other neurologic problems
  - Stroke, Parkinson's, Spinal Cord Injury

Why does this happen?

- The brain sends signals down the spinal cord to control the bladder muscle
- When fluid builds up in the brain, the brain tissue is distorted and it cannot send the proper signals to the bladder muscle
- Contraction of the bladder muscle occur sporadically giving the patient the sensation of urgency and increasing frequency of voiding



Bladder Filling

- Bladder is low pressure, sphincters are high pressure
- Sympathetic Nervous system
  - Inhibits parasympathetic NS from triggering contractions
  - Directly cause relaxation of detrusor muscle
  - Constricts internal urethral sphincter
- As bladder fills, pudendal nerve becomes excited, which constricts external urethral sphincter
  - Maintains urethral pressure > bladder pressure

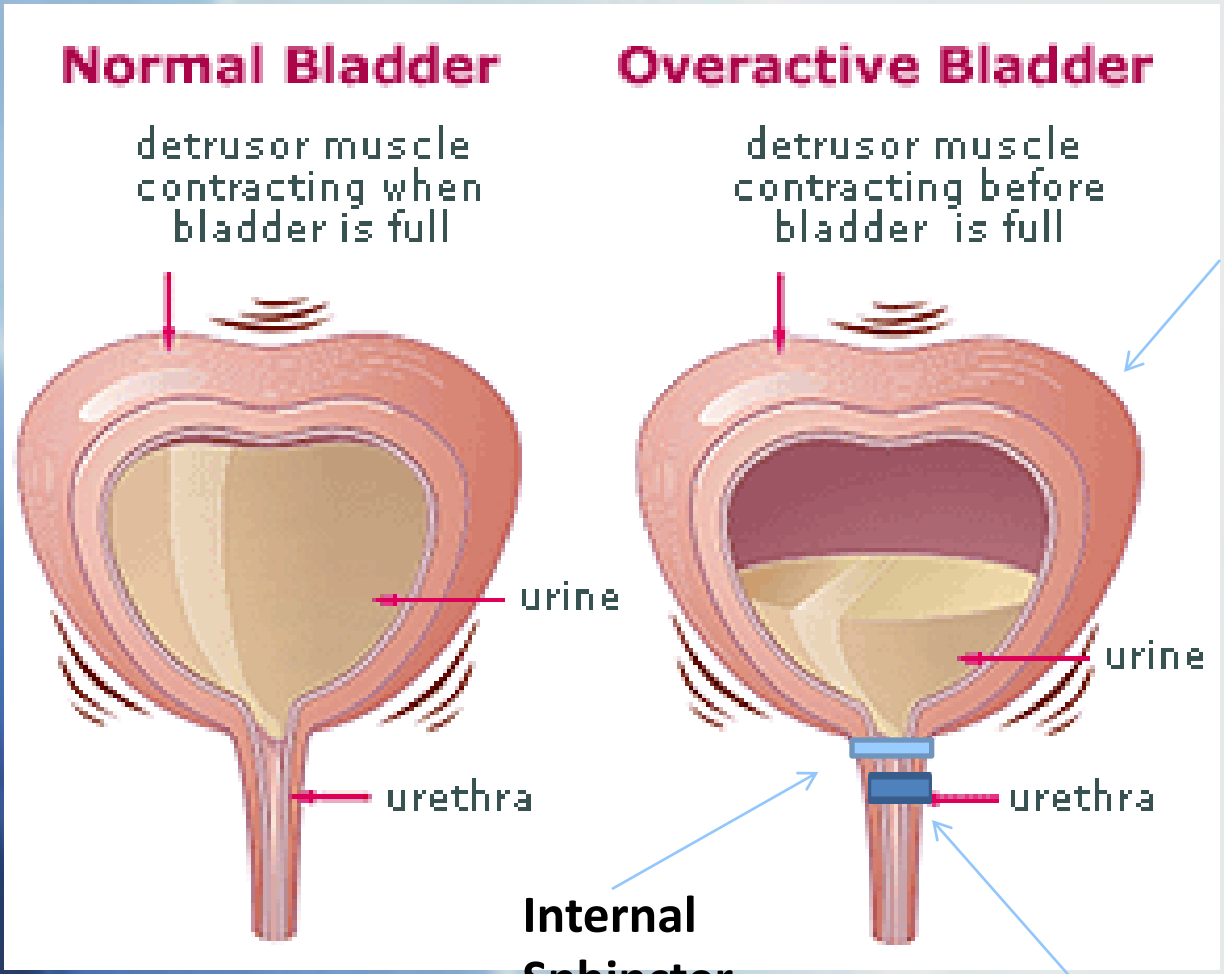
Bladder Emptying

- Reflexive
  - Intrinsic bladder reflex to contract after activation of stretch receptors
  - Pudendal nerve causes relaxation of levator ani (pelvic floor relaxation) and external urethral sphincter
  - Sympathetic NS causes relaxation of internal urethral sphincter
  - Relaxation of sphincter complex causes parasympathetic activation (contraction) of detrusor muscle

Bladder Emptying

- Executive control of urination by the Pontine Micturition Center (PMC)
  - Stretch receptors signal brain stem that bladder is full
  - Conscious suppression of urination causes bombardment of inhibitory signals on detrusor muscle
  - Voluntary contraction of levator ani to keep external urethral sphincter closed

Why does this happen?



Neurogenic Incontinence

- Results from dysfunction of urinary bladder, sphincter complex, or both…
  - Bladder Overactivity (spastic bladder)
    - Urge incontinence
  - Sphincter Underactivity
    - Stress incontinence
  - Mixed symptoms

What are the options for treatment?

- Treat the underlying problem
  - Too much CSF
- Gait impairment is the symptom that is most responsive to shunting
- Urinary incontinence response varies significantly between patients
  - 36-90% of patients show improvement
  - Most do not obtain complete resolution

What are the options for treatment?

- Conservative
  - Timed voiding
  - Behavior modification
    - Decrease caffeine intake
    - Decrease alcohol intake
    - Citrus, tomatoes, spicy foods, artificial sweetener, chocolate, corn syrup, sugar, honey in moderation
    - Stop fluid intake hours before going to bed

What the options for treatment?

- Oral medications
  - Ditropan (Oxybutynin)
  - Toviaz (Festoterodine)
  - Vesicare (Solifenacin)
  - Sanctura (Trospium)
  - Detrol (Tolterodine)
  - Enablex (Darifenacin)

What are the options for treatment?

- Side effects of oral medications
  - Dry mouth
  - Dry eyes
  - Constipation
  - Blurred vision
  - Dizziness
  - Cognitive and memory impairments
  - Rapid heartbeat

What are the options for treatment?

- Biologic agent
  - Botox
    - Injected directly into the bladder muscle
    - Average of 3 months of symptom relief
    - Injection can be repeated

What are the options for treatment?

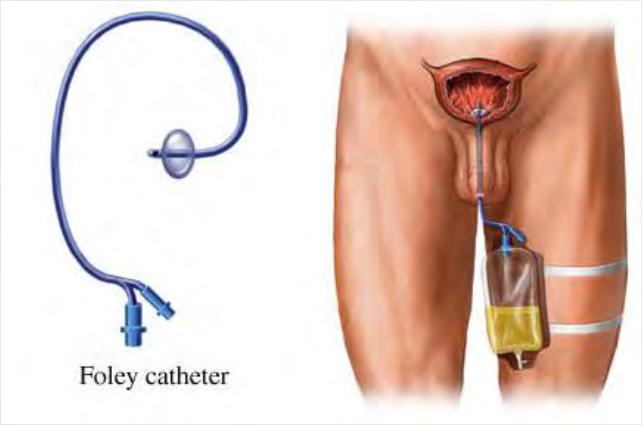
- Side effects of Botox
  - Temporary irritation to the urethra and/or bladder
  - Discomfort with voiding
  - Blood in the urine
  - Urinary tract infection

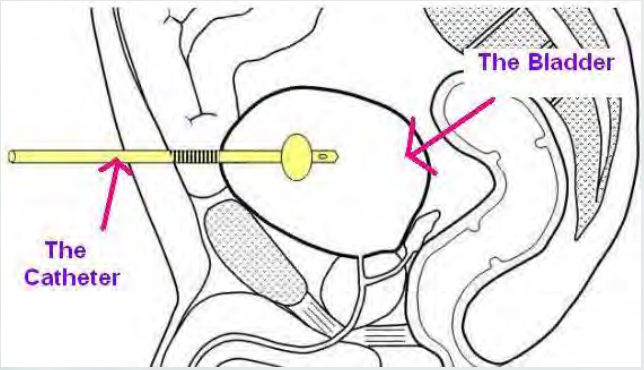
Treatment Success

- Pudendal Nerve Conduction Studies
  - Measures nerve velocities >30 nerves
    - 35-45ms normal
  - Identifies objective nerve dysfunction/damage
  - Predicts medical response success in patients with neurogenic detrusor overactivity
    - Patients with PNC velocities <100ms have greatest response

What if none of the treatments are effective?

- Indwelling Foley catheter
- External Catheter (Men only)
- Suprapubic Catheter





Take Home Points

- Hydrocephalus causes enlargement of the ventricles, damaging normal brain tissue
- The pathways that help control the bladder are affected
- A diagnosis of hydrocephalus is not always the reason for bladder problems

Take Home Points

- A thorough work-up should be done to determine the cause of the bladder problems
- Treatment of bladder problems in hydrocephalus should include shunting to correct the underlying problem
- There are many forms of symptomatic treatment including conservative measures medications, and catheters

Thank You!

- Questions?