MANAGEMENT OF NEUROGENIC BLADDER IN SPINAL CORD INJURY

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DISCLOSURES

- None
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INTRODUCTION
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- Bladder function
- Highly regulated, neurologic event
- Supra-pontine
- Spinal Cord
- Lower motor neuron reflex arc
- Coordination of bladder and urethra
OUTLINE – NEUROGENIC BLADDER, SCI

- Initial Patient Evaluation
- Voiding Patterns
  - Normal
  - Abnormal
- Urodynamics
- Treatment Algorithm
- Urinary Diversion
- Complications
OBJECTIVES

- Understand the urologic workup for the patient with spinal cord injury
- Review the neurophysiology of the bladder
- Predict bladder functional pattern based on level of injury
- Describe treatment options for bladder (and upper tract) management
Case 1

- 43 year old male with urinary frequency
HISTORY - PERTINENT QUESTIONS?

- Specific urologic history
  - History of symptoms
  - Frequency of urination (day and night)
  - Urge episodes
  - Incontinence
  - Volume voided
  - Is there bladder sensation
  - Is there relief with voiding
  - Mode of voiding (use of catheter, etc)
  - Infections
  - Hematuria
  - History of stones
HISTORY

- Past medical history
  - Pediatric voiding dysfunction
  - Hereditary disorders
  - Obstetric history
  - Diabetes
  - Pelvic surgery
  - Trauma
  - Neurologic diseases
  - Bowel habits
  - Sexual history
PHYSICAL EXAM

- Neuro-Urologic Exam
  - Sensation (S2-5)
  - Reflexes
    - What is the bulbocavernous reflex?
      - Anal sphincter contraction with glans squeeze
    - Lower limb
PHYSICAL EXAM

- Palpation of bladder
- Digital Rectal Exam
  - Anal Sphincter tone
  - Palpation of Prostate
CASE 1

- 43 year old male
- C5 spinal cord injury after dirt bike accident, many years ago
- Experiences urinary urgency with incontinence
- Voids in small volumes
- Has 1 to 2 urinary infections per year
- Chronic constipation
- No other medical issues
- Medications: Gabapentin
- Wheelchair bound, quadriplegic
**Figure 3** - Normal bladder cycle. In the normal cycle the sphincters hold the urine until the bladder is filled, and open to allow full emptying.
Urinary Function

Filling/Storage
- Detrusor Activity
  - (normal, overactive, neurogenic)
- Bladder Sensation
- Bladder Capacity
- Compliance
- Urethral Function

Emptying/Voiding
- Detrusor Activity
  - (normal, underactive, acontractile, areflexic)
- Urethral Function
  - (mechanical obstruction, DSD, non-relaxing)
NEUROPHYSIOLOGY OF THE BLADDER

STORAGE/FILLING

- Stretch receptors activated
- Spinal afferents

Sacral reflex: Detrusor contraction

Bladder fills

- Pontine micturition center
- Brain

- Inhibition of detrusor contraction
- Sphincter Coordination and Contraction
- Sympathetic NS

Sympathetic NS
NEUROPHYSIOLOGY OF THE BLADDER

VOIDING

- Stretch receptors activated
- Spinal afferents

Sacral reflex:
- Detrusor contraction

BLADDER FILLS

Pontine micturition center
- Brain

- Detrusor Contraction
- Sphincter Relaxation
- Parasympathetic NS
- Pelvic Nerve
NEUROPHYSIOLOGY OF THE BLADDER

- Disturbance of neural pathway
- Neurogenic lower urinary tract dysfunction
NEUROGENIC DYSFUNCTION

- Variety of problems may arise
- Renal damage is most serious consequence
- Elevated bladder storage pressure is most important risk factor for renal damage
  - Classic study implicated >40 cm/H20 as increased risk for upper tract deterioration

Spinal Cord Injury

- May be symptomatic or asymptomatic
  - 2/3 SCI patients experience silent deterioration of bladder function on long-term urodynamic follow-up
- Life-long urologic followup
- Renal dysfunction from long term neurologic effects on bladder
  - Bladder spasticity
  - Fibrosis and poor compliance
  - Vesicoureteral Reflux
  - Urinary Infections
SCI - Neurogenic Bladder

- Goals of management:
  - Prevent upper tract deterioration
  - Relieve symptoms
  - Increase bladder capacity
  - Treat incontinence
  - Improve quality of life
SCI - NEUROGENIC BLADDER

- Determine if:
  - Storage failure
  - Emptying failure
  - Both
Predicting Dysfunction...

- May be able to predict neurologic deficits based on level of injury/lesion
- However, each lesion is different
  - Complete vs incomplete lesion
  - Cord Fibrosis
  - Reorganization of neural pathway
  - Combined lesions
- Urodyamics should be performed
NEURAL INJURY
3 BASIC CATEGORIES

- Supra – Pontine
- Supra – Sacral
- Lower Motor Neuron
NEURAL INJURY

- Supra – Pontine
SUPRA – PONTINE LESIONS

- Examples?
- Brain Tumors
- Dementia (Alzheimers, Lewy body, etc)
- Parkinsons
- Cerebrovascular Pathology
**SUPRA – PONTINE LESIONS VOIDING DYSFUNCTION**

- Involuntary bladder contractions
  - Enhanced excitability
  - Loss of inhibition
- Coordinated sphincter function
- Sensation preserved
- Incontinence due to detrusor overactivity
Neural Injury

- Supra – Sacral
SUPRA — SACRAL LESIONS

- Examples?
- Multiple sclerosis
- Spinal cord lesions (myelodysplasia)
- Disc disease, spinal stenosis
- Spinal cord injury
Supra – Sacral Lesions Voiding Dysfunction

- Detrusor Overactivity
  - “Brake” is affected

- Detrusor – Sphincter Dyssynergia
  - Bladder-sphincter coordination is affected
Detrusor – Sphincter Dyssynergia

- Normally,
  - External sphincter relaxation is coordinated with detrusor contraction

- Disruption of Pontine coordination
  - Supra-pontine lesions don’t have this problem

- Inappropriate increase in sphincter activity during involuntary contraction

- Causes elevated bladder pressures
DETRUSOR SPHINCTER DYSSYNERGIA
SUPRA – SACRAL SPINAL CORD INJURY

- Urologic Function generally 3 phases
  - Spinal Shock
  - Recovery
  - Stable
Spinal Cord Injury – Phase 1

- Spinal Shock
  - Immediate cord swelling/edema
  - Ischemic cord injury
- Absence of reflex activity below lesion
  - Time period?
  - Variable...
  - 2 to 12 weeks, or 6 to 12 months
Spinal Cord Injury – Phase 1

- Phase 1: Storage/Void Pattern:
  - Urinary retention
  - Overflow incontinence
- Optimal management:
  - Intermittent catheterization
Spinal Cord Injury – Phase 2

- Recovery phase
- Reflex activity returns
- Disconnection from pontine micturation center:
  - Voiding is not centrally mediated
  - Rather as a volume initiated detrusor contraction
    - sacral reflex arc
Spinal Cord Injury – Phase 3

- Stable phase
- No further neurologic recovery
- Requires lifelong urologic followup
- Detrusor dysfunction may develop poor bladder compliance, high pressure
  - Detrusor/Bladder fibrosis
Neural Injury

- Lower Motor Neuron
LOWER MOTOR NEURON INJURY?

- S2 - S4
- Detrusor areflexia
- Loss of Sensation
- Fixed external sphincter
  - Unable to voluntarily relax
REMEMBER CASE 1?

- 43 year old male urinary frequency
- C5 spinal cord injury after dirt bike accident
- Experiences urinary urgency with incontinence
- Voids in small volumes
- Has 1 to 2 urinary infections per year
- Chronic constipation
- Otherwise Healthy
- Medications: Gabapentin
- Wheelchair bound, quadriplegic
CASE 1: NEXT STEPS

- Voiding Diary
- Uroflow, Postvoid Residual
- Creatinine Clearance
- Imaging
  - Ultrasound, CT (hydronephrosis)
  - Cystogram (reflux)
- Urodynamics
URODYNAMICS – GOALS FOR SCI

- Describes bladder function
  - Capacity
  - Sensation
  - Ability to contract
- Defines relationship between detrusor and external sphincter
  - Bladder Storage
  - Bladder Emptying (Voiding)
- Identifies patients at risk for complications
- Determines need for intervention
URODYNAMICS
URODYNAMICS SUITE
INTERNATIONAL CONTINENCE SOCIETY
LOWER URINARY TRACT CLASSIFICATION

URODYNAMICS

Filling/Storage
- Detrusor Activity
  - (normal, overactive, neurogenic)
- Bladder Sensation
- Bladder Capacity
- Compliance
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Emptying/Voiding
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URODYNAMICS
CASE 1

- Urodynamic
  - Low compliance, low volume bladder
  - Detrusor overactivity
  - Detrusor – Sphincter Dyssynergia
CASE #2428080

- Management Options?
- Conservative
  - Clean intermittent Catheterization
  - Indwelling catheterization
  - Contained Incontinence
- Medication
  - Anti-cholinergics
  - Botox
- Surgery
CASE #2428080

- Started CIC
- Anti-cholinergic Therapy
MANAGEMENT – CIC

- Lapides 1972: Clean intermittent catheterization
- Begin once patient is medically stable from SCI
- Allows for
  - low bladder volumes
  - low bladder pressure
- Reduces incidence of UTI
  - As compared with indwelling catheters
  - If indwelling catheter is required, use SPT
MANAGEMENT – CIC

- Disadvantages
  - Need for manual dexterity
  - Need for training
  - Mental capacity
MANAGEMENT – ANTICHOLINERGICS

- Anticholinergics improve urodynamic parameters by:
  - Decrease detrusor overactivity
  - Increase bladder capacity
  - Reduce bladder filling pressure
  - Improve compliance
  - Reduce urge incontinence
Management – Anticholinergics

- Side effects:
  - Dry mouth
  - Constipation
  - Blurred vision
  - Drowsiness
  - Confusion
  - Urinary Retention
ANTICHOLINERGICS

- Different formulations may contribute to confusion...
- Oxybutynin, tertiary amine, penetrates blood-brain barrier
  - Transdermal avoids first pass effect, minimizes dry mouth
- Trospium, quaternary amine, does not cross BBB
Followup – Annual Monitoring

- Assess upper urinary tract (Ultrasound)
- Renal function testing
- Postvoid residual (if patients are voiding)
- Voiding diary
FOLLOWUP – URODYNAMICS

- Repeat or increase frequency of UDS if:
  - Change in voiding pattern
    - Increasing incontinence, urgency, frequency, etc
  - Urinary tract infection
  - Stones
  - Medication change
  - Presence of detrusor sphincter dyssynergia
  - Presence of low compliance
  - Development of vesicoureteral reflux
FOLLOWUP

- Regular, screening urine cultures NOT recommended
- Bacteriuria is common
  - Especially with intermittent catheterization
- Routine testing leads to overtreatment of clinically insignificant bacteriuria
CASE 1, CONTINUED

- 7 months later
- Returns with spasms, and incontinence
- Next step:
- Botox
Management – Botulinum Toxin

- Mechanism of Action:
  - Inhibits acetylcholine release at neuromuscular junction
  - Blocks neuromuscular contraction
  - Injected evenly throughout bladder into suburothelium

- Side effect:
  - High post void residuals and need for CIC
**MANAGEMENT – BOTOX**

- Phase 3, multicenter, double-blind, randomized, placebo-controlled study
- 275 patients (50% with SCI)
- 200 or 300 U botox or placebo
- Improvements in urinary incontinence, urodynamic parameters, quality of life
- No difference between 200 and 300 units

**Management – Botox**

- 570 injections in 199 patients (Spinal Cord Injury)
- Improved:
  - Mean capacity
  - Bladder compliance
- Reduced:
  - Weekly incontinence episodes
- Maintained benefit for 10 – 12 months
  - 20% for >12 months

CASE SUMMARY

- 43 year old male
- C5 spinal cord injury after trauma
- Low compliance bladder with DESD
- Returns after Botox with infection, incontinence, and high bladder pressures
- Worsening UDS parameters despite
  - CIC
  - Anticholinergics
  - Botox
- Next option:
  - Surgery
SURGICAL MANAGEMENT

- Incontinent Urinary Diversion
  - Ileovesicostomy
  - Ileal Conduit
- Augmentation Cystoplasty
- Continent Catheterizable Urinary Diversion
- Neobladder
ILEOvesicostomy
ILEOVESICOSTOMY

- Incontinent diversion
- Best in patients with:
  - Detrusor sphincter dyssynergia
  - High spinal cord lesions
    - Quadriplegia or limited upper extremity dexterity
    - Unable to perform CIC
ILEAL CONDUIT
AUGMENTATION CYSTOPLASTY

detubulated bowel

new bladder wall

bladder wall

urethra
AUGMENTATION CYSTOPLASTY

- Increases capacity
- Low-pressure reservoir
- Good for patients with intractable overactivity
- Requires ability to perform CIC
CUTANEOUS CONTINENT DIVERSION
Metabolic Considerations Intestinal Use in Urology

- Segment of intestine used
  - Stomach, jejunum, ileum, colon
  - Electrolyte abnormalities
  - Acid – Base Abnormalities
Metabolic Considerations in Urology

- Bone Demineralization
  - Acidosis
INFECTION

- Increase incidence of bacteriuria, bacteremia, and sepsis
- Acute pyelonephritis develops in 10 - 17% of patients with conduits (colon and ileum)
- 75% patients with conduits have bacteriuria
- Intestinal mucus becomes a source for ascending infection
UROLITHIASIS

- Persistent hypercalciuria
  - Acidosis and release of calcium from bone
- Presence of staples or nonabsorbable suture
- Intestinal mucus
  - Nidus for stones
  - May impede emptying --> leading to infection and stone formation
DIARRHEA

- Decreased bowel transit time
  - Resection of ileum, colon, ileocelecal valve

- Bile salt malabsorption
  - Normally occurs in ileum
  - Bile salts cause colonic mucosal irritation and diarrhea
  - Increased lipid delivery to colon --&gt; fatty diarrhea
**Vitamin B12 Deficiency**

- **Consequence of:**
  - Resection of distal ileum

- **Results in:**
  - Megaloblastic anemia
    - MCV > 100
  - Neurologic abnormalities
    - Demyelination of spinal cord
    - Sensory and motor deficiencies, dementia, psychosis
THANK YOU!

Questions?