UBC Department of Urologic Sciences Lecture Series

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Voiding Dysfunction
&
BPH

Objectives Today

- 1. Anatomy of the lower urinary tract
  - A) Innervation of the bladder
  - B) Normal voiding
- 2. Classify Neurogenic Bladder
- 3. Classify Urinary Incontinence
  - A) Rx for different types of incontinence
- 4. BPH & LUTS

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Disclaimer:

- This is a lot of information to cover and we are unlikely to cover it all today
- These slides are to be utilized for your reference to guide your self study

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Disclaimer:

- These concepts were all addressed in Year 1 FERGU block: Normal and Dysfunctional Voiding

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MCC Objectives

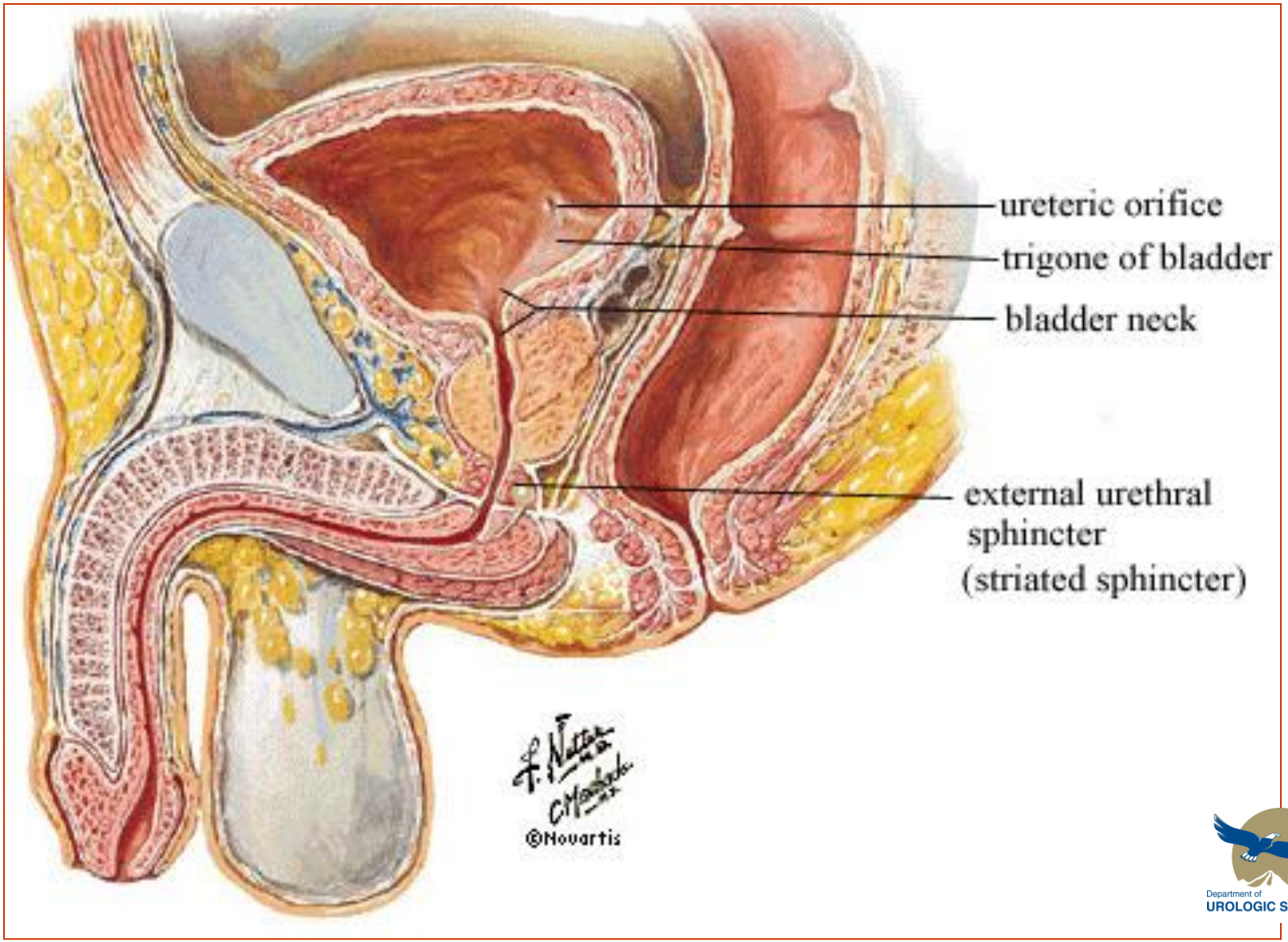
http://mcc.ca/examinations/objectives-overview/

For LMCC Part 1

Objectives applicable to this lecture:

- Urinary Tract Obstruction

Male Anatomy



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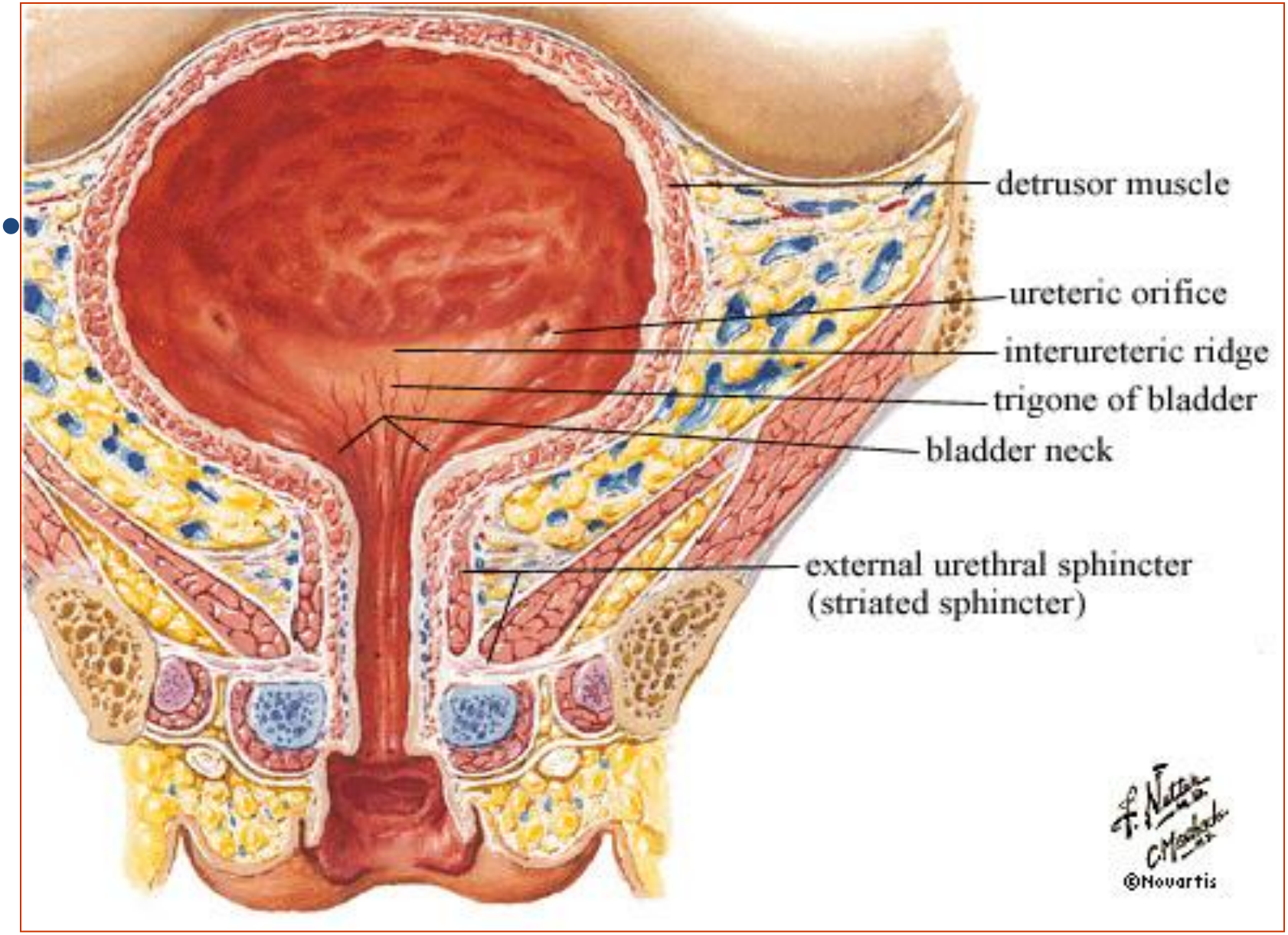
Female Anatomy



Anatomy

- Bladder Innervation
  - Detrusor → (parasympathetic S2,3,4)
  - Trigone → (sympathetic L1,2)

- Urethra
  - Male
    - Internal/Involuntary Sphincter (Sympathetic L1,2)
    - Prostatic
      - External/Voluntary Sphincter (Pudental S2,3,4)
    - Membranous
    - Bulbar
    - Penile (spongy, pendulous etc)

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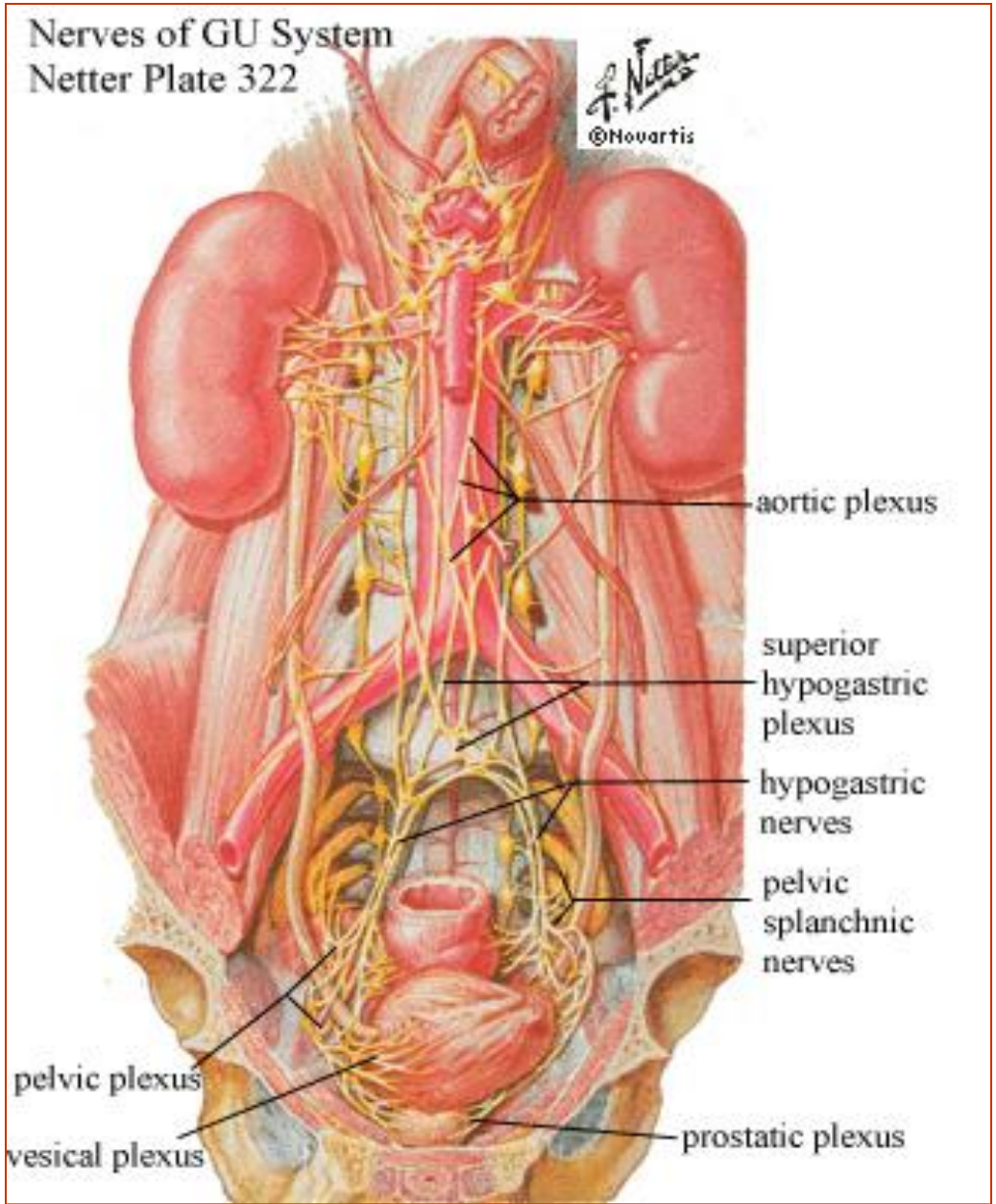
Conceptual Neuro-anatomy

- Parasympathetic PEE
- Sympathetic STORE

Anatomy



- Sympathetics(T11-L2) = Store
  - From aortic and superior hypogastric plexis → hypogastric nerves → pelvic plexus cause detrusor relaxation and bladder neck contraction
- Parasympathetics(S2,3,4) = Pee
  - From pelvic splanchnic nerves cause detrusor to contract
- Somatic (voluntary) control
  - → Pudendal nerve(S2,3,4)
  - External Spincter

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Anatomy

- Nerve Summary
  - Parasympathetic S2,3,4
    - + Bladder contraction, relax sphincters
    - Arise from sacral Cord
  - Sympathetic L1,2
    - + Tight trigone, + internal sphincter tone, relax detrusor
    - Arise from lumbar
  - Somatic S2,3,4
    - + External sphincter tone

Conceptual Neuro-anatomy

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Voiding

- Voiding
  - Filling
  - Emptying

Voiding

- Normal Filling Requires:
  - Accommodation of urine volume at low pressure (compliance)
  - Closed bladder outlet
  - No involuntary detrusor contractions
  - Normal sensation of bladder filling

How does filling work?

- As bladder fills → sympathetic reflex initiated to keep you dry!
  - →Stimulation of alpha adrenergic receptors at bladder neck → increase resistance of bladder neck
  - →Activation of beta3 receptors in detrusor inhibiting contraction
  - →Direct inhibition of detrusor motor neurons in sacral spinal cord
- Gradual increase in urethral pressure as bladder fills due to pudendal nerve →activation of external sphincter
- Formation of urethral mucousal seal

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How does emptying work?

- Emptying Requires:
  - Coordinated detrusor contraction of adequate magnitude
  - Lowering of resistance at the level of the urinary sphincters (bladder outlet)
  - Absence of obstruction (either anatomical or functional)

How does emptying work?

- Emptying → Specifically:
  - Increased intravesical pressure produces the sensation of distension → I want to void!!
  - Coordination of detrusor contraction and external sphincter relaxation
    - Brain (pontine micturition center) → inhibits the steady state spinal reflex of staying continent:
      - Stimulates Parasympathetics → contraction of detrusor
      - Inhibits sympathetics = internal sphincter relaxation
      - Inhibits pudendal = External Sphincter relaxation

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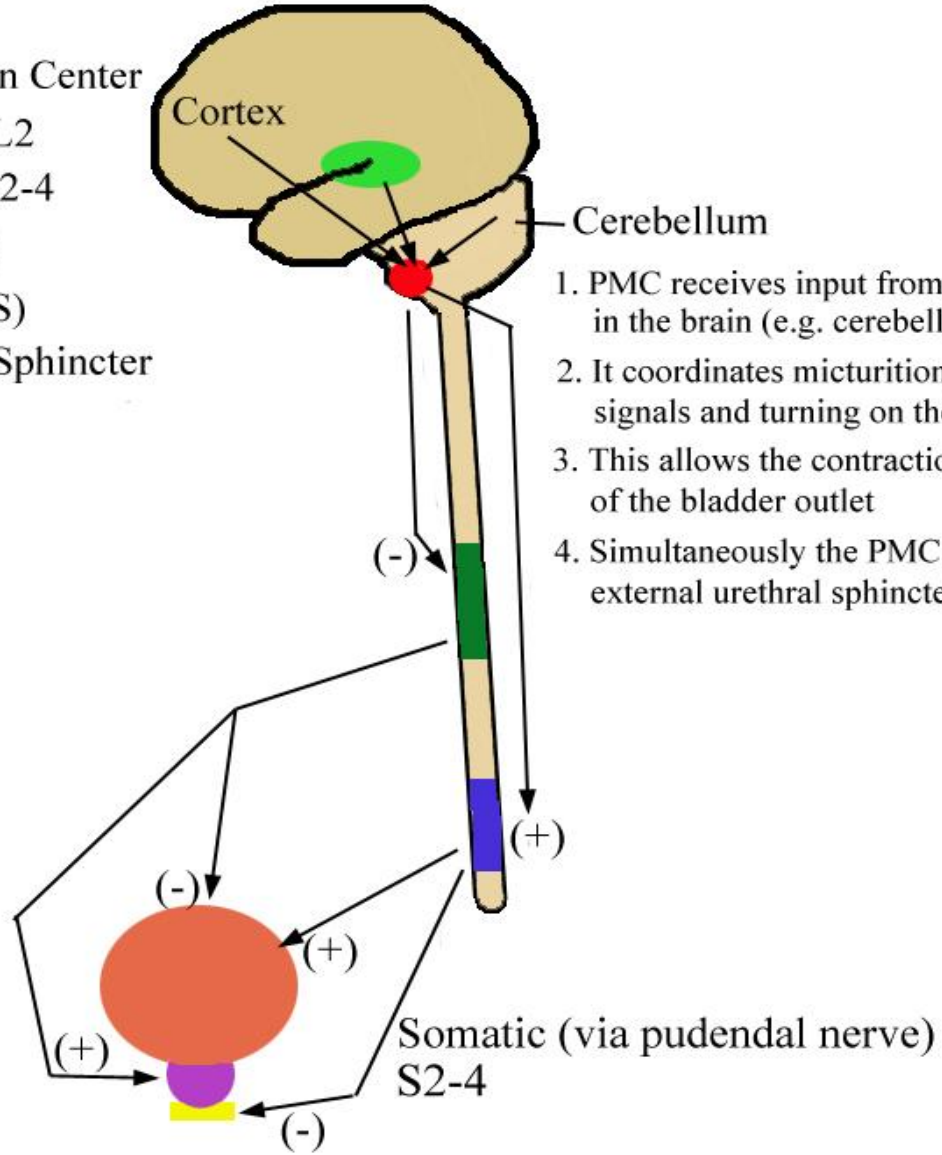
Control of Micturition

- Basal Ganglia
- Pontine Micturition Center
- Sympathetic T11-L2
- Parasympathetic S2-4
- Bladder (detrusor)
- Bladder Neck (IUS)
- External Urethral Sphincter



1. PMC receives input from GU afferents as well as areas in the brain (e.g. cerebellum, cerebral cortex, basal ganglia)
2. It coordinates micturition, by turning off the sympathetic signals and turning on the parasympathetic signals
3. This allows the contraction of the detrusor and the relaxation of the bladder outlet
4. Simultaneously the PMC coordinates the relaxation of the external urethral sphincter

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Neurogenic Bladder

- Definition: dysfunction of the urinary bladder due to neurologic dysfunction or insult

Classifying Neurogenic Bladder

- Upper Motor Neuron "spastic"
- Lower Motor Neuron "flaccid"

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Neurogenic UMN

- Upper Motor Neuron
  - *Cerebral Injury* (stroke,tumour,brain injury)
    - Normal function to inhibit reflexive bladder emptying
    - Allows socially acceptable timing of voiding
    - Dysfunction leads to loss of voluntary control of micturition
    - Detrusor Overactivity

Neurogenic UMN

- Upper Motor Neuron Diseases
  - *Basal Ganglia disease* (Parkinson's disease)
    - Detrusor overactivity
    - Contractions are short, relaxation of ext. sphincter is slowed → urgency, urge incontinence, slow flow

Neurogenic UMN

- Upper Motor Neuron Diseases
  - *Suprasacral spinal cord damage*
    - Above T6
      - →reflex micturition with detrusor-sphincter dyssynergia
    - Below T6
      - → reflex micturition with detrusor-sphincter synergia

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Neurogenic UMN

- Upper Motor Neuron Diseases
  - *Cerebral Injury* (stroke,tumour,brain injury)
    - → detrusor overactivity
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  - *Suprasacral spinal cord damage*
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      - → reflex micturition with detrusor-sphincter synergia

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Neurogenic LMN

- Lower Motor Neuron
  - *Sacral Spinal cord damage*
    - Pelvic fracture, cauda equina
    - Acontractile bladder, poor bladder sensation
  - *Peripheral Nerve Damage*.
    - Diabetes, pelvic surgery, XRT

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Voiding Dysfunction

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Voiding Dysfunction

<u>Etiology</u>

- *Failure to Store (AKA Incontinence)*
  - Detrusor overactivity
  - Outlet incompetence
- *Failure to Empty (AKA Retaining)*
  - Detrusor underactivity
  - Outlet obstruction

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Voiding Dysfunction

- Failure to Store
  - *Urge Incontinence* -involuntary loss of urine with a strong desire to void.
  - *Stress Incontinence* -loss of urine with increased intra-abdominal pressure (cough, laugh, jump, rise to standing etc).
  - *Overflow Incontinence* -loss of urine with bladder over-distension.
  - *Functional Incontinence* -loss of urine associated with cognitive or physical impairment.
  - *Mixed Incontinence* -combinations of above

Urge Incontinence

- Etiology
  - Stone, UTI, Tumor, Overactive Bladder
- Investigations
  - Hx, PE +/- urodynamics

Urge Incontinence

- Treatment
  - Treat underlying cause
  - Timed voiding
  - Bladder training – Biofeedback
  - Pharmacologic
    - Anticholinergic – Oxybutinin
    - TCA's – Imipramine
  - Surgical
    - Bladder pacemaker
    - Bladder denervation (rare)
    - Bladder Augmentation – Mitrofanoff
    - Urinary Diversion

Stress Urinary Incontinence

- Etiology
  - Urinary retention + incr abdo pressure
  - Detrusor overactivity + incr abdo pressure
  - Intrinsic sphincter deficiency
  - Urethral hypermobility
    - Often related to weak pelvic floor muscles
- Risk Factors
  - Obesity, female, pregnancy, Vaginal deliveries, hysterectomy, prostatectomy, family Hx, caucasian, smoking, strenuous activity.

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Stress Incontinence

- Treatment
  - Kegel exercises
  - Biofeedback
  - Pharmacologic
    - Alpha agonist (TCA, SSRI's, pseudoephedrine) → incr sphincter tone and bladder outflow resistance
    - Estrogen cream/pill
  - Periurethral collagen injections
  - Pessaries
  - Surgery
    - Bladder neck suspension (Burch, MMK)
    - Urethral Slings (TVT, TOT)
    - Artificial sphincter

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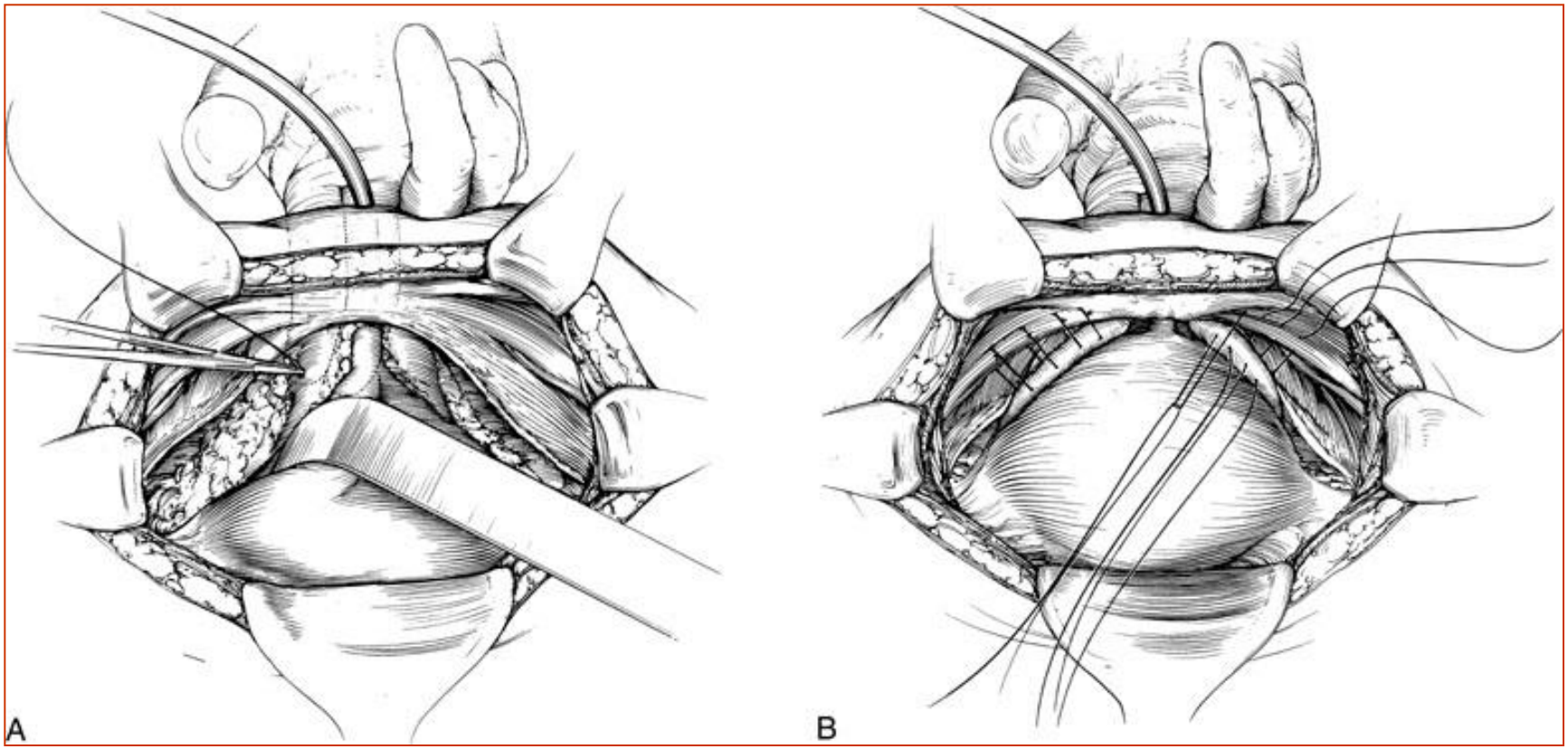
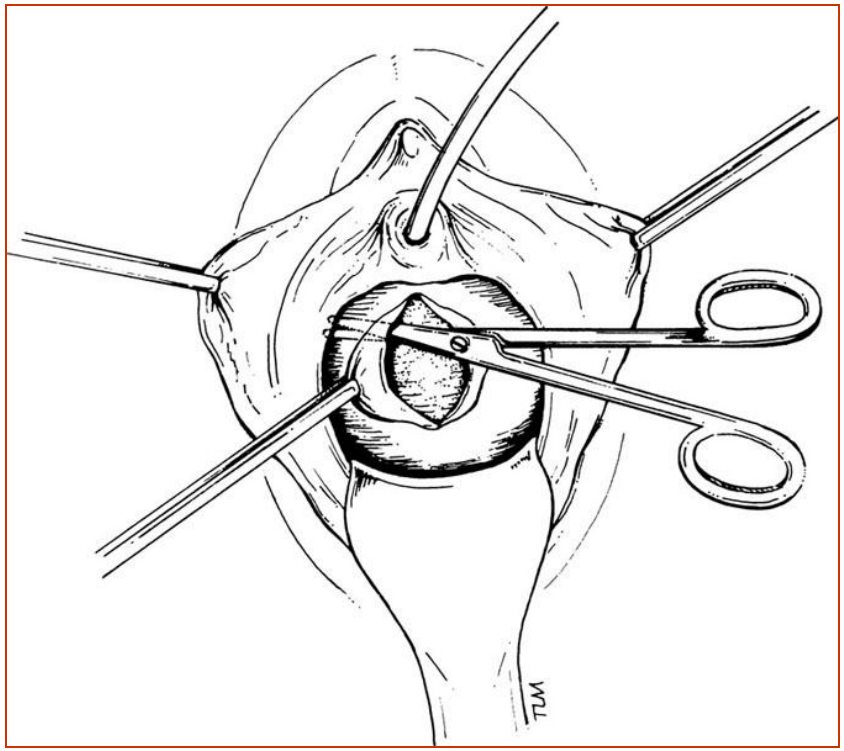
Stress Incontinence

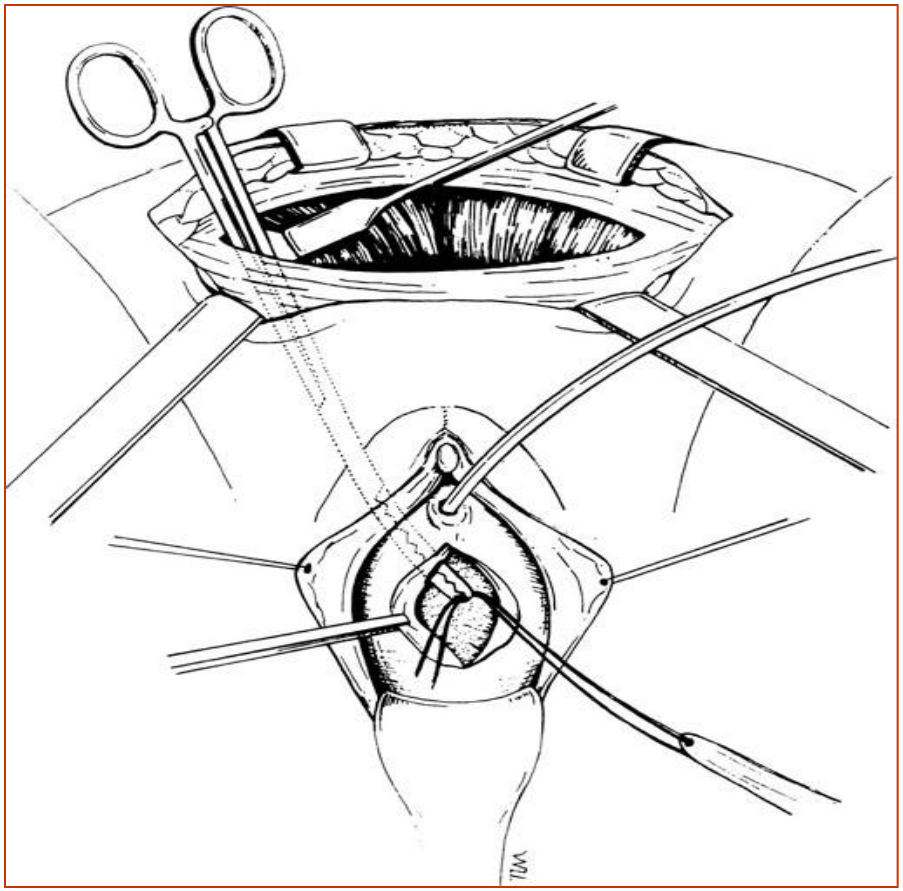
- Retropubic Bladder Neck Suspension (BURCH)



Stress Incontinence

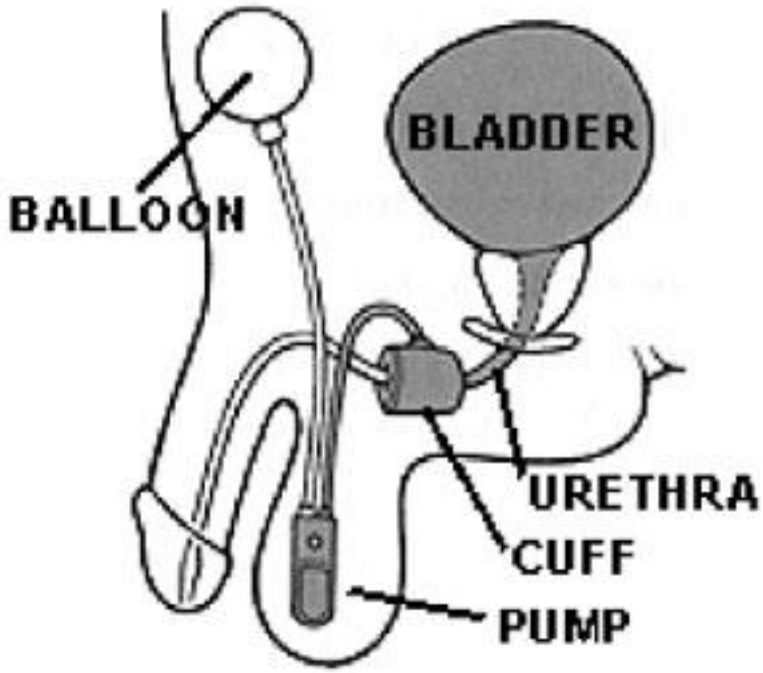
- Urethral Slings





Stress Incontinence

- Artificial Sphincter



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Overflow Incontinence

- Etiology
  - Obstruction
    - Treatment
      - Treat underlying cause, eg BPH
  - Acontractile Bladder
    - Treatment
      - Timed Voiding
      - Double voiding
      - Clean intermittent Catheterization → Keep bladder volumes < 400ml and pt dry between catheterizations
      - Indwelling Catheter
      - Suprapubic Catheter

Transient Urinary Incontinence

- DIAPERS

D Delirium – cognitive dysfunction can impair voiding
I Infection – bladder irritation
A Atrophic Vaginitis – post menopausal may cause, nocturia, freq, urgency
P Pharmaceuticals/ Polypharmacy
E Excessive Urine production – diuretics, untreated DM
R Restricted mobility
S Stool Impaction/Constipation impairs bladder function and pelvic floor muscle function

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Transient Urinary Incontinence

- Pharmaceuticals
  - Diuretics
  - Anticholinergics – impair bladder contraction
  - Sedatives- bzd's – delirium
  - Narcotics – impair bladder contraction, constipate, delirium
  - Alpha agonist – increase sphincter tone – retention (nasal decongestants, imipramine)
  - Alpha blocker – lead to stress incontinence
  - CCB's impair bladder contraction

Voiding Dysfunction Case

- So, you have this “friend” that has mentioned they occasionally have a case of wet undies…

Dx?

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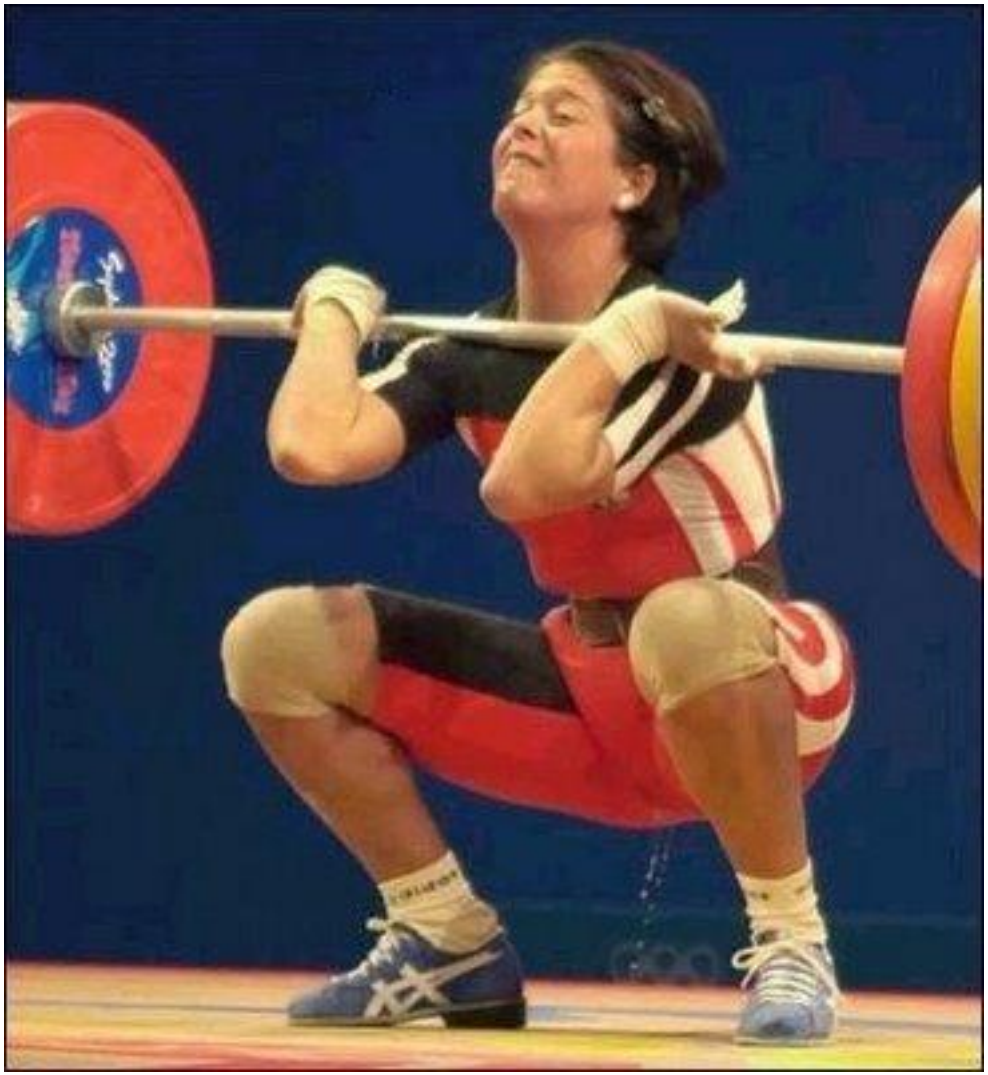
Dx?



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Voiding

- Evaluation
  - *History*
    - Urgency, frequency, dysuria
    - Association with valsalva maneuver (sneeze,cough,lifting etc.)
    - Medications (diuretics,benzos,narcotics)
    - Fluid intake
    - Back or head injury
    - Parathesias, fecal incontinence
    - Diabetes
    - Other neurological disease (MS, Parkinson etc.)

Voiding

- *Physical*
  - mental status, mobility
  - abdominal and pelvic exam
  - neurological exam
  - anal tone, peri-anal sensation
  - Bulbocavernosus reflex (S2,3,4)
- *Investigations*
  - Urinalysis, serum creatinine
  - Voiding Diary
  - Post Void Residual (PVR; by U/S or catheterization)
  - Urine cytology- pts with irritative voiding symptoms

Voiding

- Special Urology Tests
  - Urodynamics
    - Uroflowmetry
    - Multichannel urodynamics
    - Video-urodynamics
  - Endoscopy (Cystoscopy)
  - Upper tract imaging (renal ultrasound)

Voiding

- Indications for Referral:
  - History or physical suggestive of neurologic disease
  - Hematuria, recurrent UTIs, bladder stones, renal insufficiency (post-renal) with incontinence
  - Elevated PVR, overflow incontinence
  - Incontinence in pts with prior lower GU surgery
  - Persistence of incontinence once reversible causes are corrected

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Lower Urinary Tract Symptoms (LUTS)

- ".. A constellation of obstructive and irritative voiding disturbances of the lower urinary tract"

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LUTS

- LUTS
  - Storage symptoms/ irritative
    - Frequency, urgency, nocturia
  - Voiding symptoms/ obstructive
    - Hesitancy, slow stream, “stuttering” stream, straining to void, sense of incomplete emptying, “doub;e” voiding, post void dribble
  - Dysuria and incontinence are not usually seen in uncomplicated BPH.
  - Microhematuria is common

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DDx of LUTS in Old Men

- Prostate: BPH, prostate cancer, prostatitis
- Bladder: cystitis, bladder tumour, bladder stone
- Urethra: urethral stricture, meatal stenosis, phimosis
- Neurologic: Parkinson's disease, stroke, Alzheimer's disease, spinal cord disease
- Other: Diabetes, sleep apnea, medication, diet, distal ureteral stone, pelvic mass

Evaluation of LUTS

- Hx
  - IPSS/AUA symptom score
- PE
  - General & GU exam, DRE, Focused Neurourologic Exam
- UA/ UCx

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Evaluation of LUTS

+/- Serum Creatinine
+/- PSA
+/- Post void residual (PVR)
- Measures amount of urine after voiding
- Large volume may suggest blockage
- Measured by bladder scanner (U/S) or Catheter

+/- Abdo Ultrasound
- If hematuria, renal impairment, UTI's, atypical symptoms

+/- Cystoscopy
+/- Urodynamics
- If urinary retention, incontinence, atypical symptoms, neurological disease.

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LUTS History

- Some specific questions to ask
  - Hematuria
  - Dysuria
  - Incontinence
  - Abdo/flank pain
  - Previous transurethral surgery
  - CNS, neurologic diseases (parkinson's, stroke)
  - Meds (oral decongestants, antidepressants)
  - DM
  - Previous STD's or perineal trauma

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LUTS

- Risk Factors

  Increasing age

  Weight gain and abdominal adiposity in adulthood may contribute to LUTS

  Excessive alcohol drinking (>75 g/day) was associated with LUTS and BP

  Smoking – Nicotine increases sympathetic nervous system activity exacerbating LUTS

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- IPSS

Patient name : _____ DOB : _____ ID : _____ Date of assessment : _____

INTERNATIONAL PROSTATE SYMPTOM SCORE (I-PSS)							
	Not at all	Less than 1 time in 5	Less than half the time	About half the time	More than half the time	Almost always	
1. Over the past month, how often have you had a sensation of not emptying your bladder completely after you finished urinating ?	0	1	2	3	4	5	
2. Over the past month, how often have you had to urinate again less than two hours after you finished urinating ?	0	1	2	3	4	5	
3. Over the past month, how often have you found you stopped and started again several times when you urinated ?	0	1	2	3	4	5	
4. Over the past month, how often have you found it difficult to postpone urination ?	0	1	2	3	4	5	
5 Over the past month, how often have you had a weak urinary stream ?	0	1	2	3	4	5	
6. Over the past month, how often have you had to push or strain to begin urination ?	0	1	2	3	4	5	
	None	1 time	2 times	3 times	4 times	5 or more times	
7. Over the past month, how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning ?	0	1	2	3	4	5	
							Total I-PSS Score =

QUALITY OF LIFE DUE TO URINARY SYMPTOMS							
1. If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that ?	Delighted	Pleased	Mostly satisfied	Mixed about equally satisfied and dissatisfied	Mostly Dissatisfied	Unhappy	Terrible
	0	1	2	3	4	5	6
							Quality of Life assessment index QOL=

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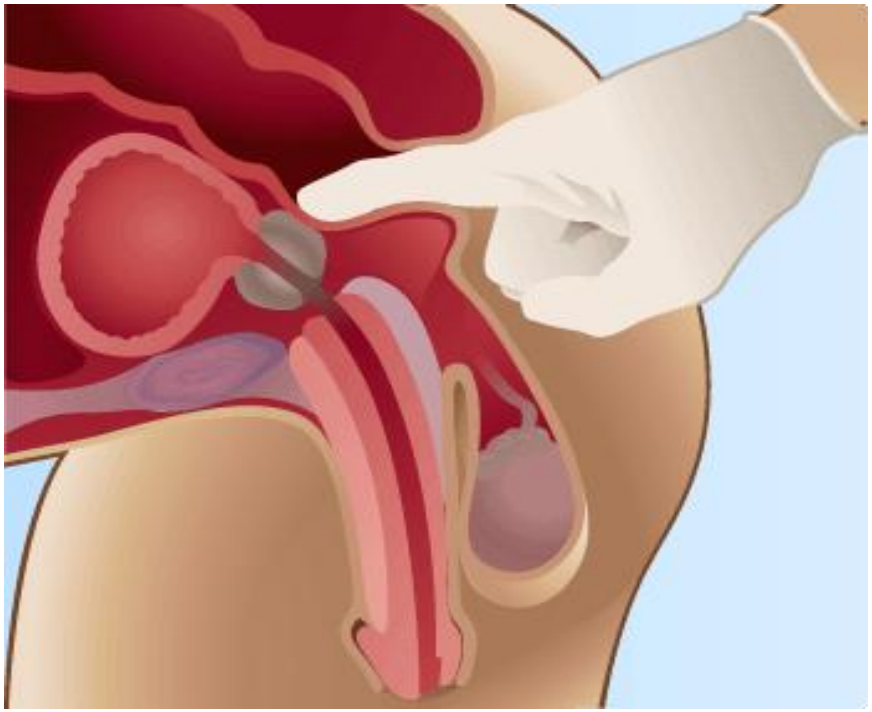
LUTS

- DRE
  - Healthy
    - Symmetric
    - soft
    - Size – walnut/20g at 20 years of age
  - Unhealthy
    - Hard
    - Assymetrical
    - Nodule
    - enlarged



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LUTS

- Size of gland NOT = LUTS severity

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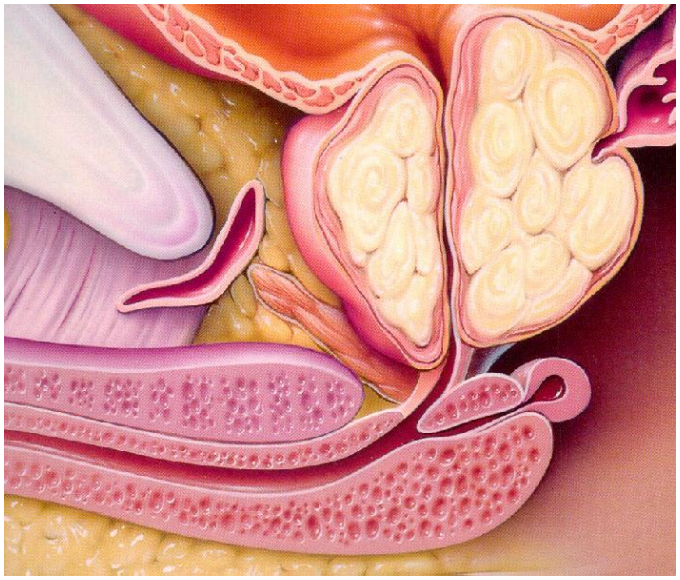
Benign Prostatic Hyperplasia

- BPH is prevalent and relevant
  - Don’t forget it.



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BPH Anatomy

- Prostate has 2 main types of tissue
  - Stroma
    - Smooth muscle
    - Collagen
  - Epithelium

- BPH occurs in transitional zone
- Prostate Cancer typically occurs in peripheral zones

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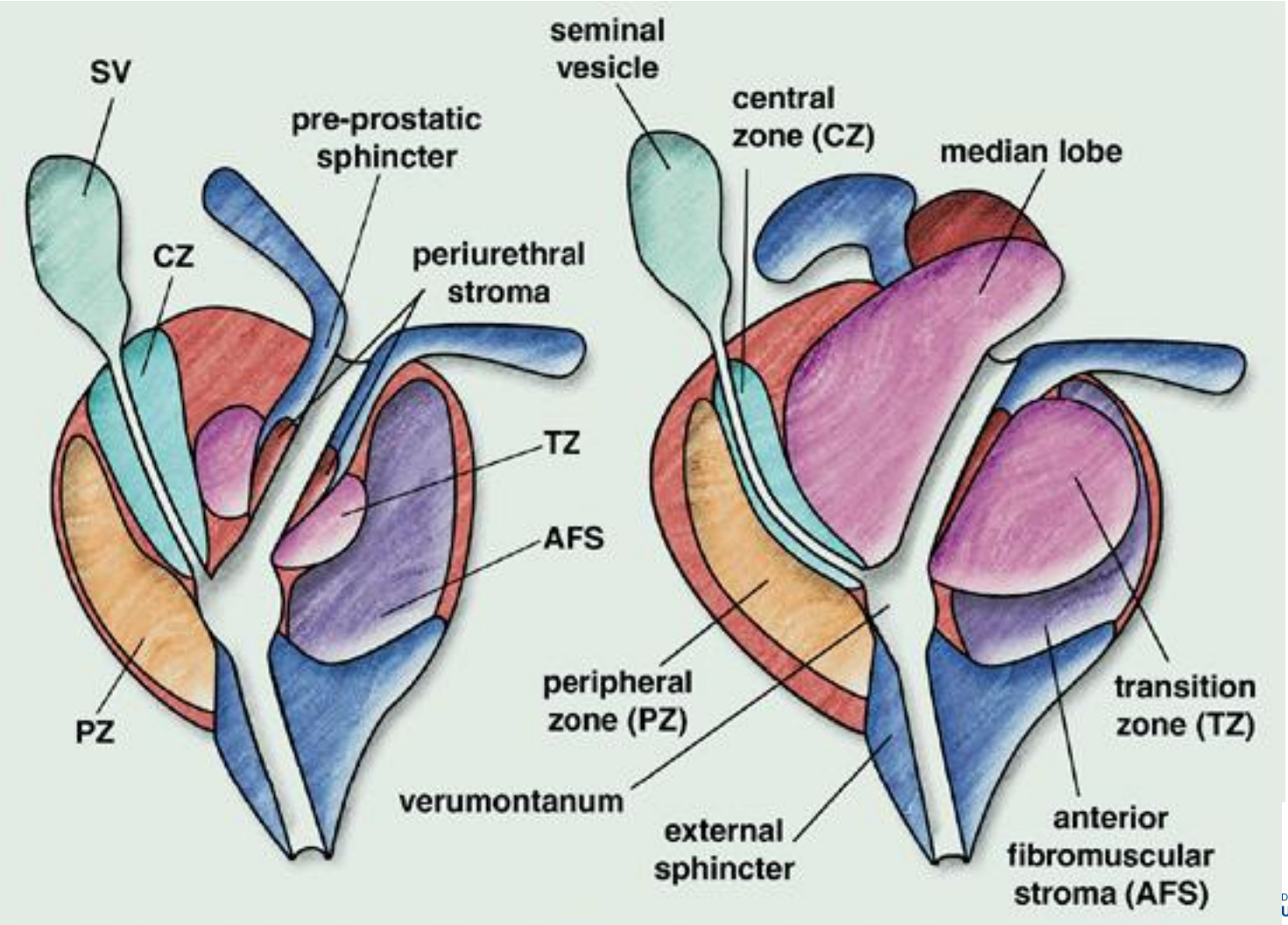
LUTS



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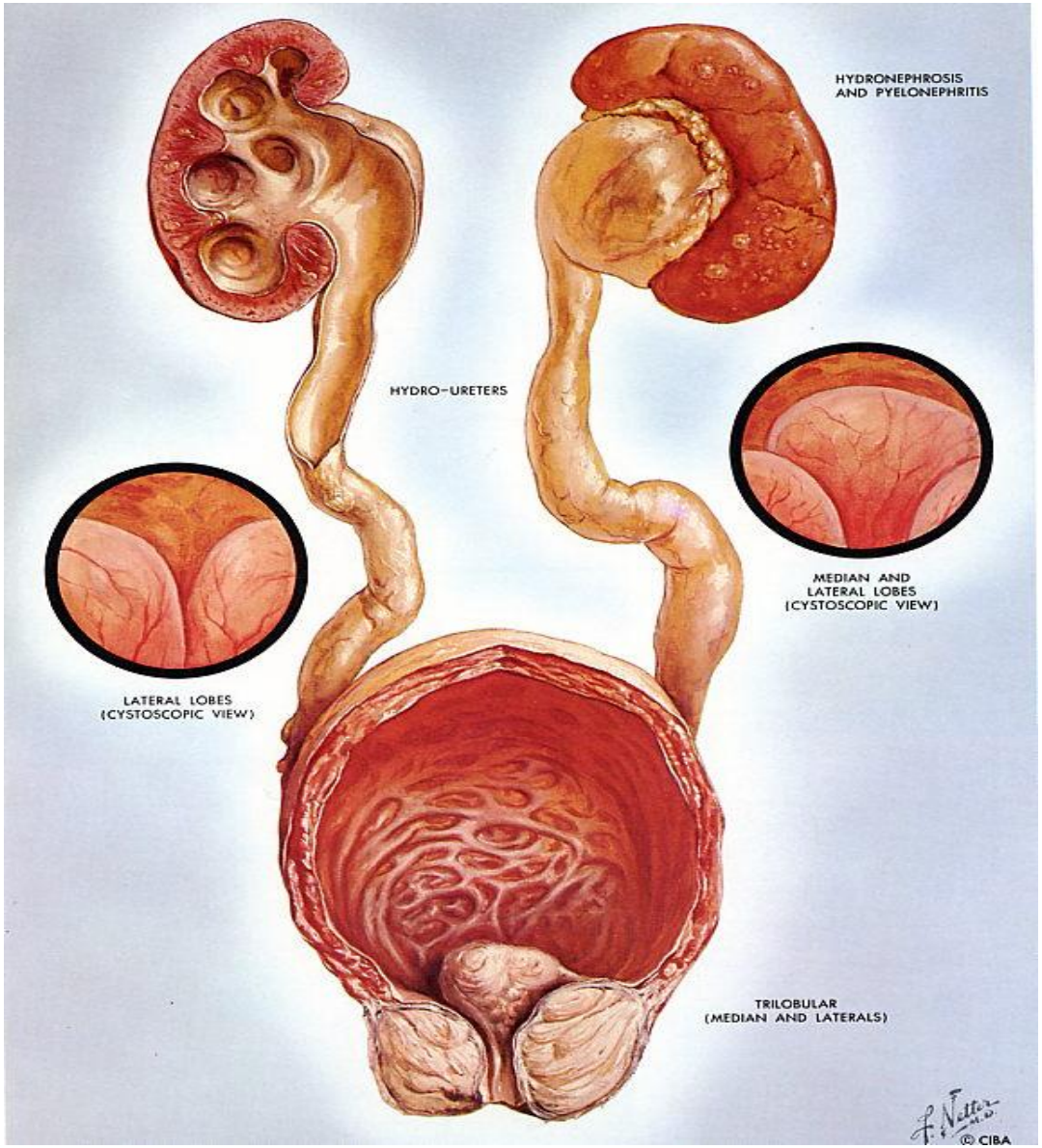
BPH

- Prevalence
  - Increasing prevalence with age, 80% of 80yo's
- Pathophysiology
  - Growth of stromal component of prostate
  - Increased alpha 1A receptors leading to increased smooth muscle tone
  - Size and degree of BOO (bladder outlet obstruction) do not fully correlate with degree of symptoms



Complications of BPH

- Urinary retention (acute or chronic)
- Renal failure
- Recurrent UTIs
- Bladder stones
- Hematuria

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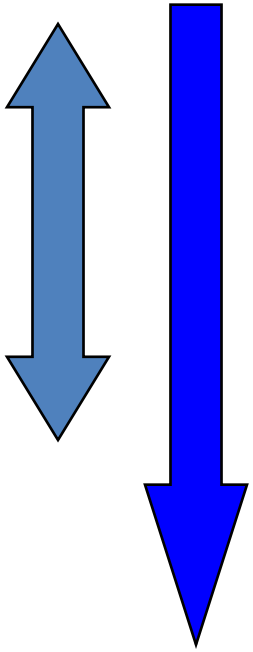
Current practice

The therapeutic cascade (step-up):

lifestyle measures,
phytotherapy
alpha blockade
5 ARIs
combination med therapy
anticholinergics (occasionally)
intermediate therapies (MIS)
intervention under GA (TUR, etc)



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Lifestyle Modification

- decrease fluids
- caffeine
- alcohol
- time diuretics
- decongestants
- exercise
- weight loss
- sleep apnea
- diet

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BPH Pharmacotherapy

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- Alpha Blockers
- Tamsulosin (Flomax): α1-subtype A selective; 0.4 mg daily; similar effectiveness but significantly fewer side effects compared to other α-blockers; retrograde ejaculation prevalent
- Silodosin (Rapaflo): α1-subtype A selective; 8 mg daily.SE: retrograde ejaculation. Rapid onset action
- Terazosin (Hytrin): α1 selective; 2 mg – 10 mg daily; approximately 70% of men experience "satisfactory" improvement in symptoms; common side effects include dizziness, fatigue and rhinorrhea
- Doxazosin (Cardura): α1 selective; 4 mg – 8 mg daily; side effects similar to terazosin; effectiveness similar to terazosin
- Alfuzosin (Xatral): α1-subtype A selective; 10 mg daily; similar to flomax but less retrograde ejaculation

BPH Pharmacotherapy

- Alpha Blockers
  - Side Effects
    - Dizziness
    - Asthenia (fatigue)
    - Nasal congestion
    - Retrograde ejaculation
    - Orthostatic hypotension (uncommon)
    - Syncope (rare)

BPH Pharmacotherapy

- 5 alpha reductase inbhibitors…
  - Finasteride
  - Dutasteride

Lets look at physiology....

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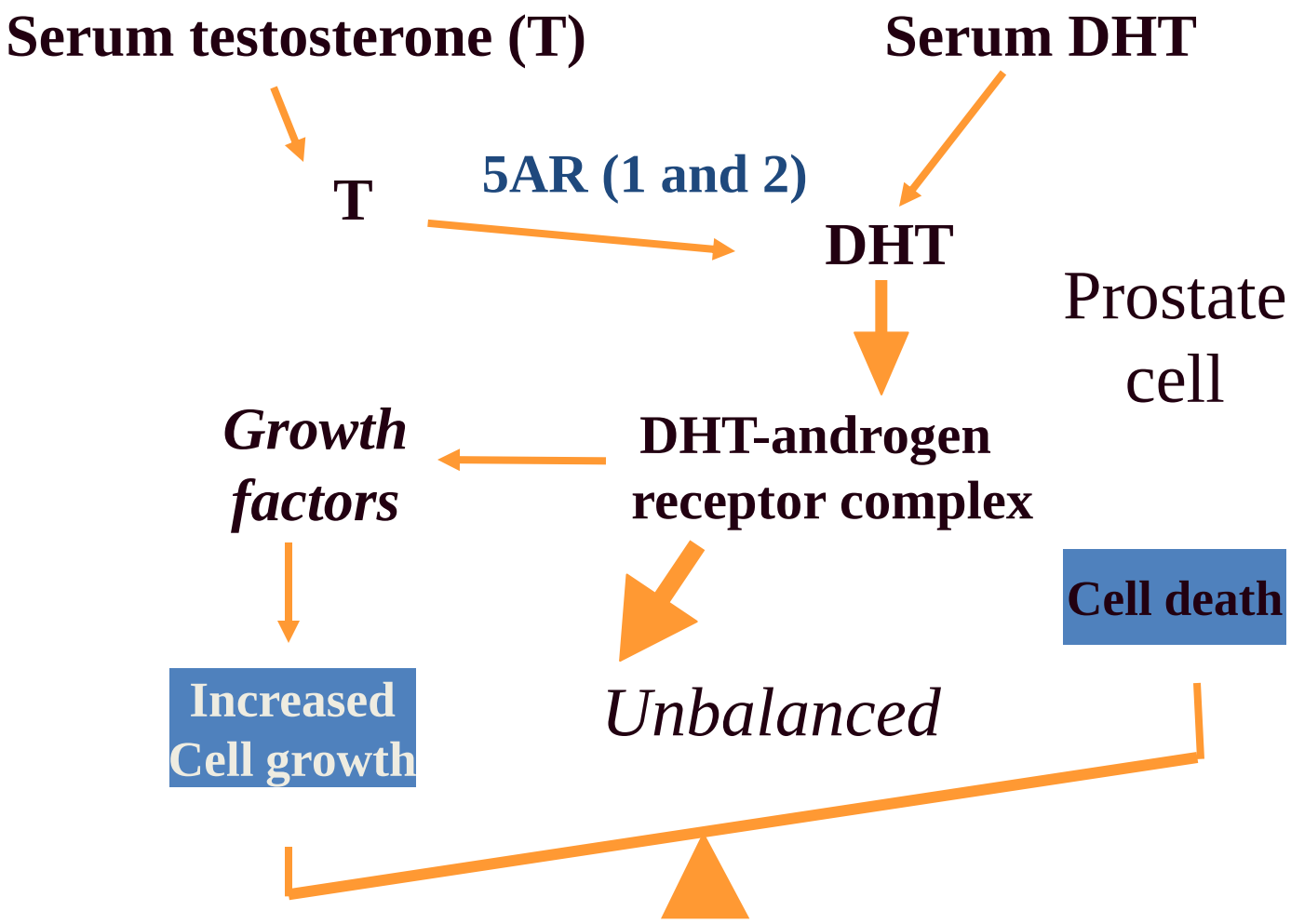
Regulation of Cell Growth in the Prostate in BPH



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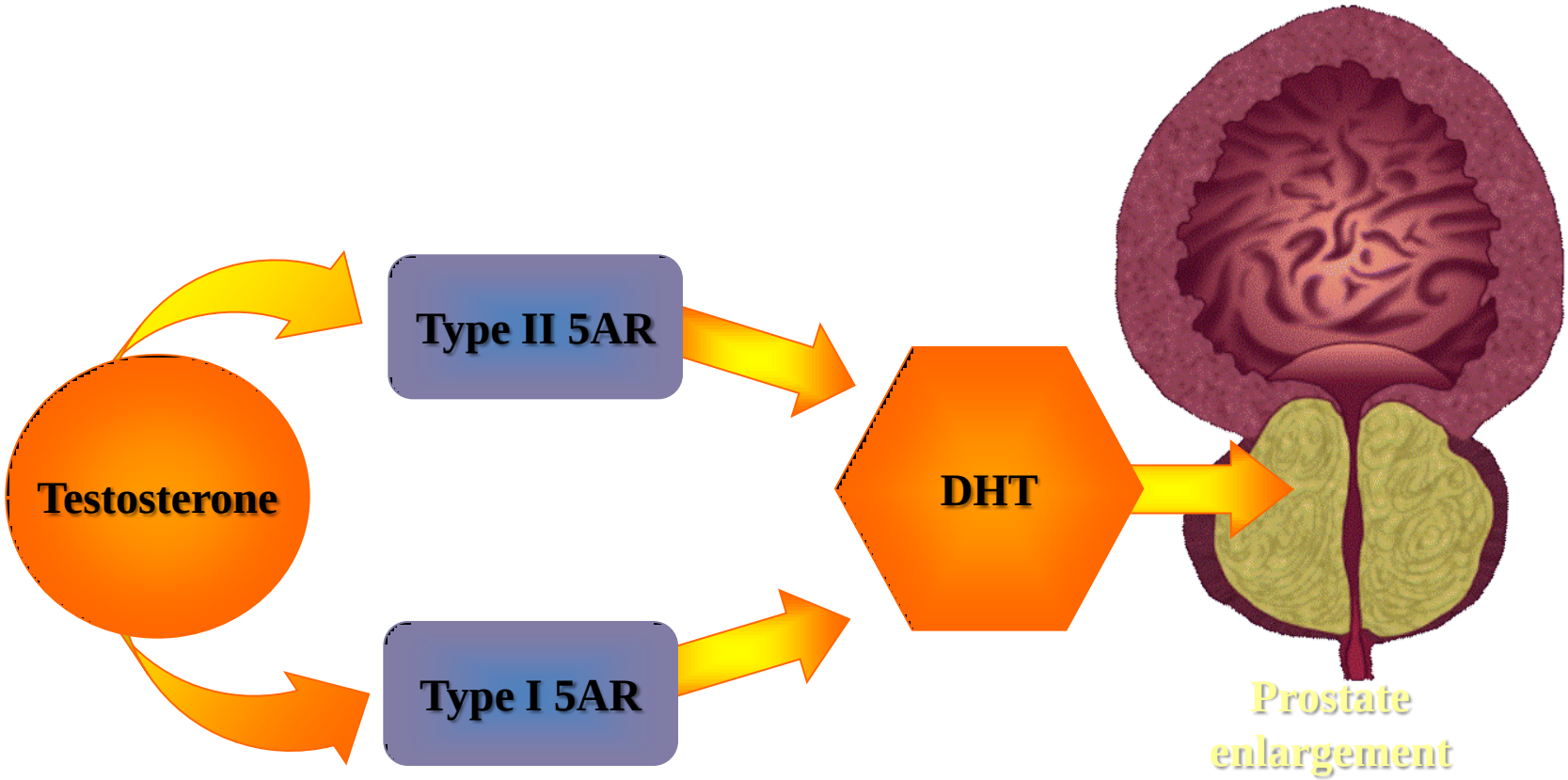
Two 5a-reductase (5-AR) Isoenzymes Convert Testosterone to DHT



Bartsch G et al. *Eur Urol*. 2000;37:367–380

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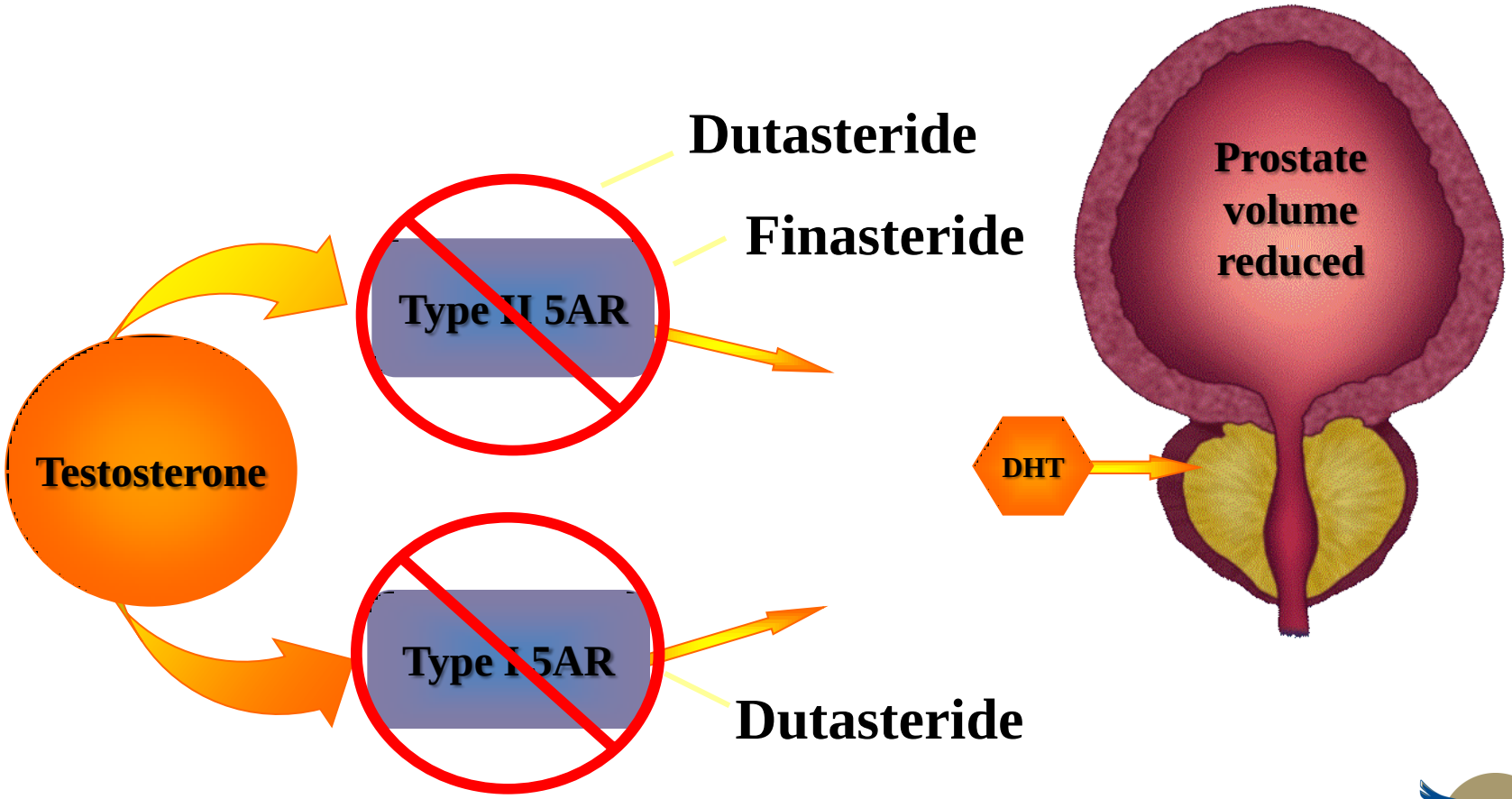
Different Type I and Type II 5-AR Isoenzyme Inhibition by Dutasteride and Finasteride



Bartsch G et al. *Eur Urol*. 2000;37:367–380.

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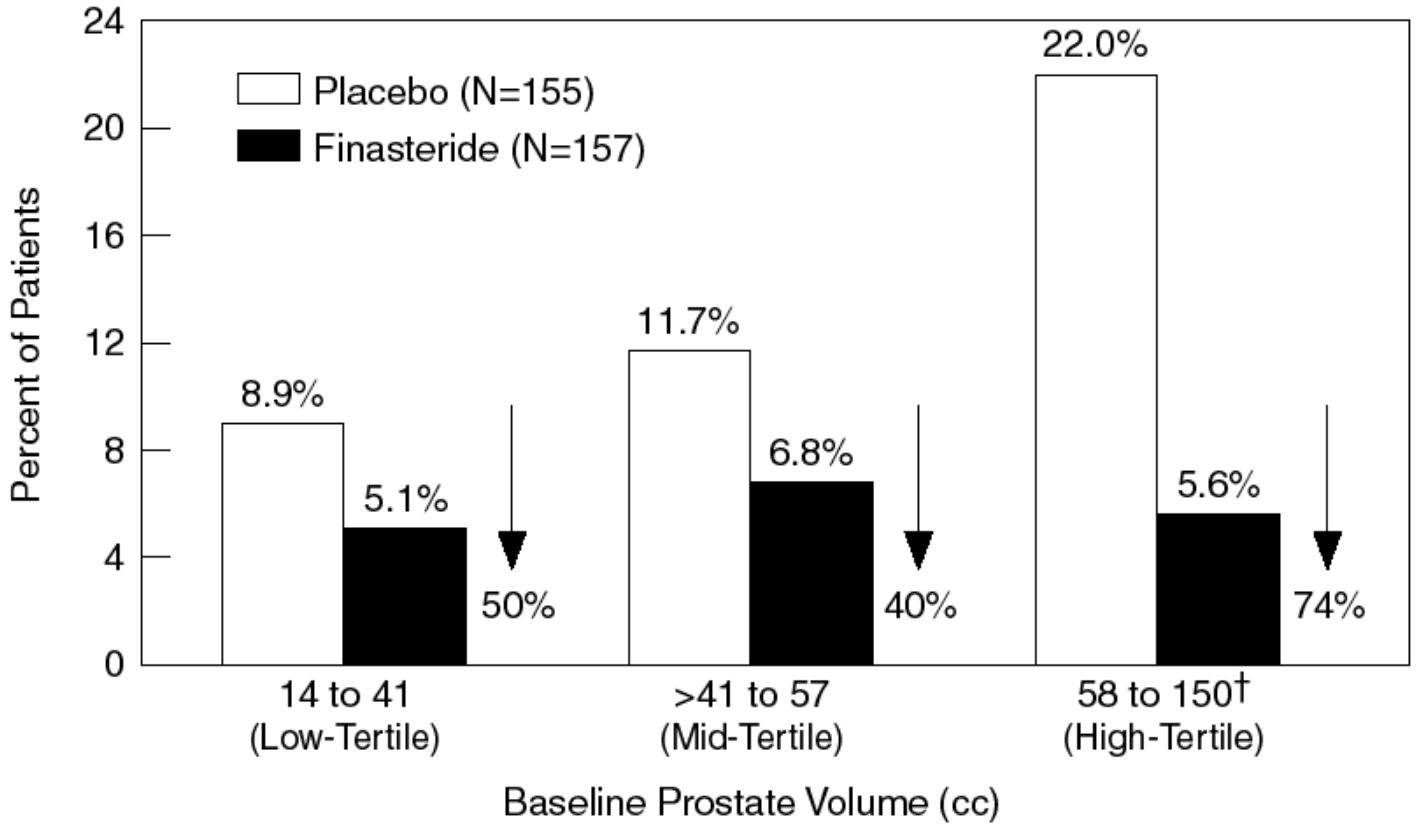
BPH Pharmacotherapy

- 5 alpha reductase inhibitors:
  - Reduce rate of Acute Urinary Retention
  - Decrease rate of surgery over 6 years
  - Work best in larger prostates
  - Decrease size by 25%
  - Decrease PSA by 50%
  - Slower onset of action than alpha blockers

Incidence of Acute Urinary Retention at Year 4 by Baseline Prostate Volume Tertile



= Reduction in risk over 4 years (Life Table Analysis)

Revised Nov 2008

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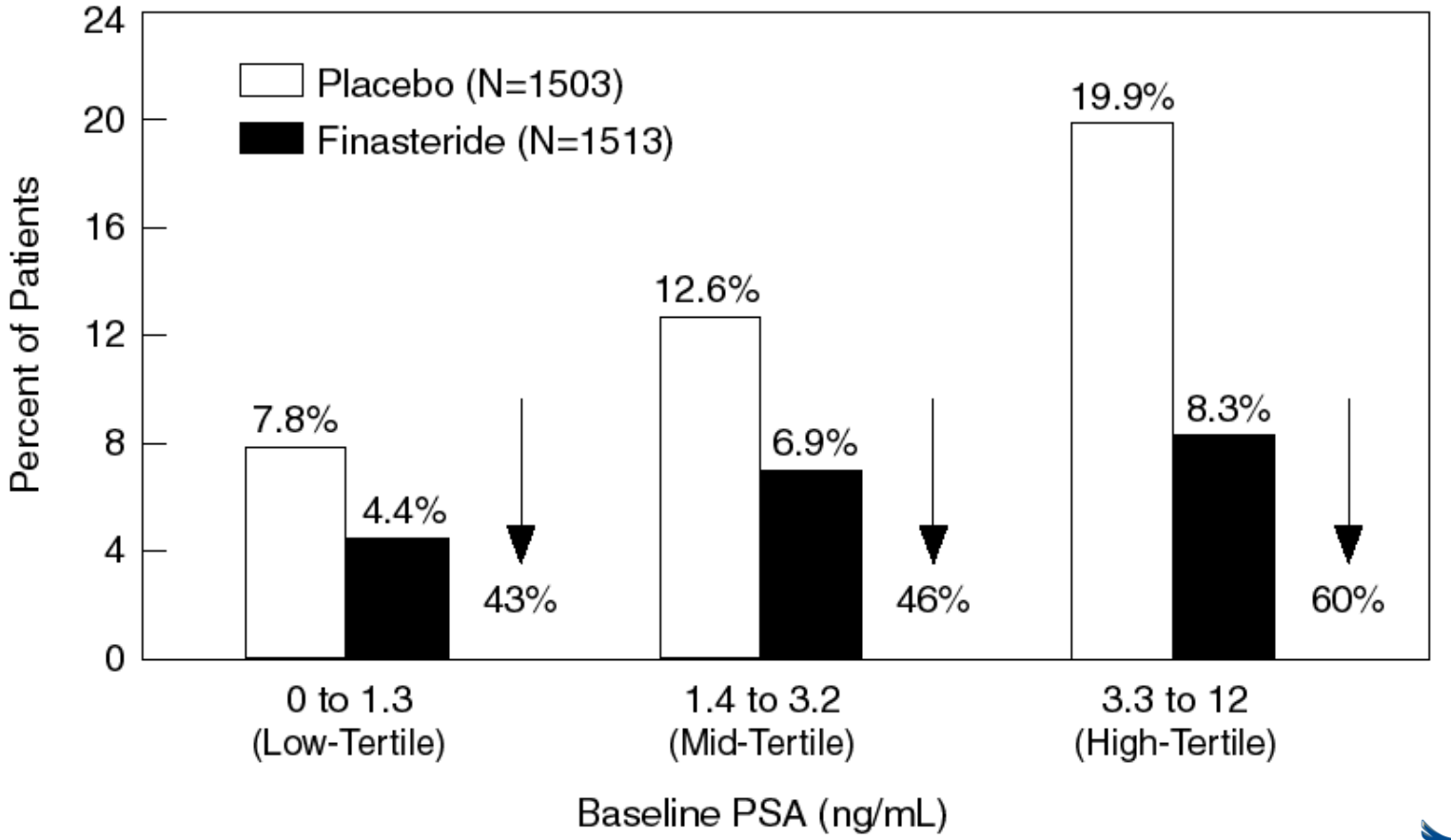
Incidence of BPH-Related Surgery at Year 4 by Baseline PSA Tertile



= Reduction in risk over 4 years (Life Table Analysis)

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BPH Pharmacology

- 5 Alpha reductase inhibitors
  - Side Effects
    - Erectile Dysfunction <5%
    - Decreased libido <4%
    - Decreased Volume Ejaculate < 3%
    - Gynecomastia <1%

BPH Pharmacotherapy

- Combination of Alpha Blockers and 5 Alpha reductase inhibitors
  - Long and short of it is:
    - IF prostate small and PSA low
      - Use alpha blocker
    - IF prostate large and PSA high
      - Use Combo

BPH and Surgery

- Surgical Options
  - "Minimally invasive therapy"
    - Injections – eg. Botox™, alcohol
    - Photodynamic therapy (PTD)
    - Microwave heat treatment
    - High Intensity Frequency Ultrasound (HIFU)
    - Needle ablation / radio-wave treatment
    - Electrovaporization of prostate
  - **Green light Laser therapy**
  - **Transurethral resection (TURP)**
  - **Open prostatectomy**

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BPH and Surgery

- Indications for surgery
  - Symptoms refractory to medical therapy
  - Recurrent UTI
  - Urinary Retention
  - Recurrent Hematuria
  - Renal Impairment
  - Bladder Calculi

TURP – Gold Standard

- TURP – Transurethral Resection of prostate
  - Electrocautery resection of of prostatic tissue
  - Endoscopic
  - Pt stay is usually 1 night

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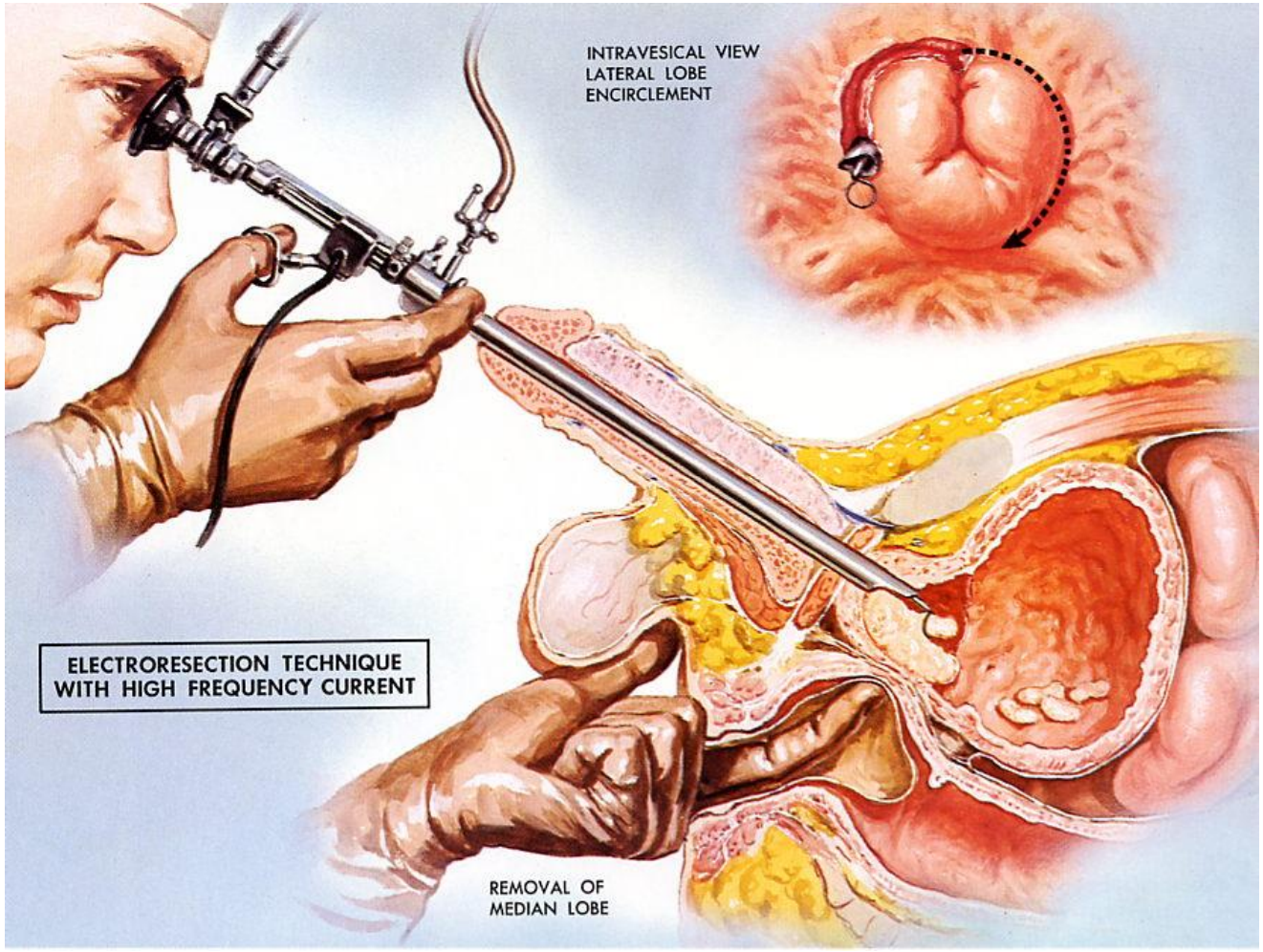
TURP



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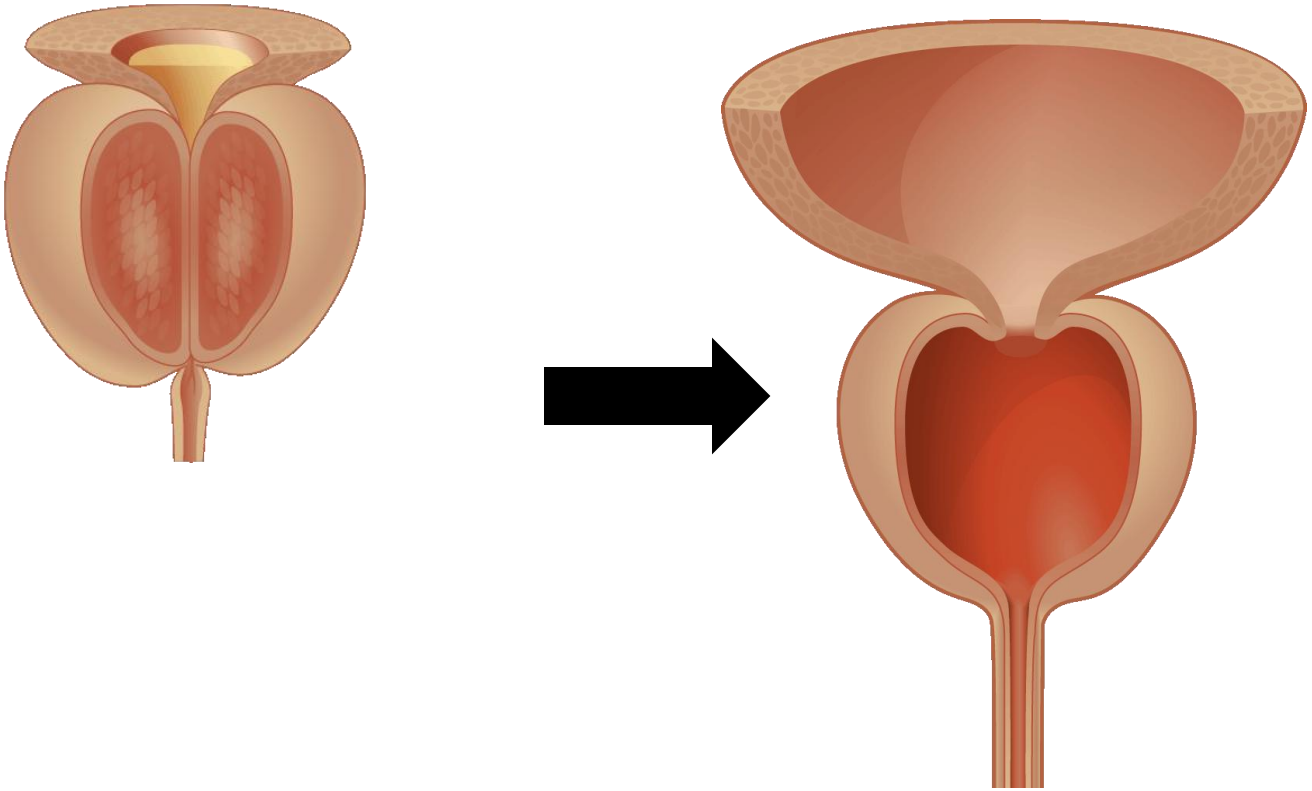
Before and After TURP



BEFORE **AFTER**

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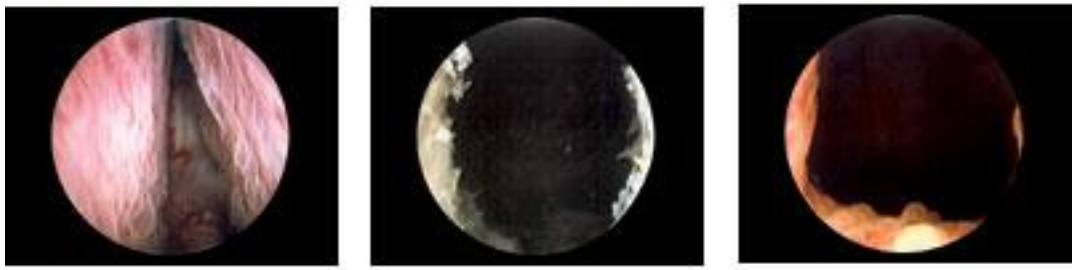
TURP

- Complications
  - Bleeding
  - Perforation
  - TUR Syndrome
    - With prolonged procedure
    - Absorption of hypotonic solution leads to:
      - Hyponatremia, hypervolemia, hypertension, mental confusion, seizures, nausea, vomiting, visual disturbances
      - Occurs in < 2% of cases

Other Surgical Options

- Green light laser

Turp-like cavity with the safety profile of minimally invasive treatments



Pre-Op | Immediate Post-Op | 3 Months Post-Op

Photos courtesy of Mahmood A. Hai, M.D.

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Other Surgical Options

- Open Prostatectomy
  - For LARGE prostates

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Objectives Today

- 1. Anatomy of the lower urinary tract
  - A) Innervation of the bladder
  - B) Normal voiding
- 2. Classify Neurogenic Bladder
- 3. Classify Urinary Incontinence
  - A) Rx for different types of incontinence
- 4. BPH & LUTS

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