Post prostatectomy Incontinence:
- Male sphincteric anatomy
- Male bulbourethral sling

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Urology Grand Rounds

Questions

1. What keeps a man dry after RRP?
2. What’s the difference between the external urethral sphincter, striated urethral sphincter, rhabdosphincter, periurethral striated sphincter?
3. What is the UG diaphragm? Where is it?
4. How do you spare puboprostatic ligaments?
5. What is the male sling and how does it work?
6. What factors can I modify to improve the continence of my patient?
An unfortunate scenario:

- Healthy 53 male, no medical problems presents w/ PSA 9.0ng/l. Biopsy reveals adenocarcinoma. Radical Retropubic prostatectomy performed, no complications, catheter comes out w/o problems BUT he never regains continence. He’s wearing a thick diaper and asks “why did this happen?”

PPI - incidence

- <1% following TURP
- Stress incontinence 2.5-87% following RRP
- Total incontinence: 0-11.7% following RRP
- Up to 40% persistent long-term UI post RRP
- Reporting method influences rates
- “centres of excellence” 5-20%
Incidence of Incontinence after Radical Prostatectomy

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<th># of Patients</th>
<th>% Incontinence</th>
<th>Definition</th>
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<td>Zincke et al</td>
<td>1728</td>
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<td>Fowler et al</td>
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<td>Litwin et al</td>
<td>98</td>
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Fowler et al. -Medicare survey *Urology 1995*

- 757 men surveyed
- 63% said they were incontinent
- 6% had undergone surgery for it
- 31% wore pads, diaper or used clamp
- 41% said they drip urine every day
Post RRP incontinence - incidence

80,000 RRP performed in USA 2003

- Definition dependent
- Evaluation dependent
  - How long was f/u
- Method dependent
  - Retrospective vs prospective
  - Surgeon reporting vs pt survey

Evaluation - pad weights

- Need objective evidence
- w/o pad weights, evaluation is totally SUBJECTIVE
- Pts w/ 100cc or 1000cc/day loss may both use 5 pads...their expected outcomes totally different
- Need to weigh pads!!
classification

- Sphincter dysfunction
  - Up to 75% of PPI (CU VIII)
- Bladder dysfunction
  - Pre-op detrusor instability
  - ? Denervation of bladder
- Overflow incontinence
  - Anastomotic stricture

Evaluation - summary

Postprostatectomy Incontinence

Intrinsic Sphincteric Deficiency (History, VLPP)

Mixed Bladder Dysfunction and ISD (Address Bladder First)

Bladder Dysfunction Instability Loss of Compliance
Precipitating Factors - patient variables

- Prior TURP, radiation
- Advancing age
- Excess blood loss
- Comorbid disease (DM, CVD)
- Neurologic disease
- Impaired mobility
- Cognitive impairment

Surgical techniques to avoid PPI

- Difficult to summarize
- For every study that supports a particular technique, another study refutes it
- Fact: several key maneuvers responsible for maintaining continence post RRP
  - e.g., sure you spared bladder neck perfectly but you may have damaged the sphincter when the urethra was divided!!
nerve sparing

- O’Donnel and Finan (J U 98) published continence rates following RRP
  - Continence 94% vs 70% (nerve sparing vs non nerve sparing)
  - Concluded that preservation pelvic nerves have major role in continence
  - However, unclear whether preservation of nerves or just careful dissection around sphincter responsible

Nerve sparing

- Hollabaugh et al (Urology 1998)
  - ext sphincter innervated by pelvic (ANS) and pudendal (somatic) nerves
  - Stated 3 factors may damage these continence nerves
    - Passing a clamp below DVC, above urethra
    - Placement of sutures at 5 and 7 o’clock
    - Deep dissection of SV’s
Nerve sparing

- Nerve sparing RRP may decrease time to continence but final continence rates not improved
  - Wei et al (J U 2000)
  - Hollabaugh et al (Urology 1998)

Surgical technique- nerve sparing

- Steiner JU 91
  - No statistical difference in continence rates based on NVB preservation
    - Continence rates were identical in impotent and potent men
  - Concluded that anatomic factors and meticulous dissection at apex responsible for maintaining urinary control, NOT preservation of pelvic nerves
Nerve sparing:

- “Still unclear exact innervation of ext. urethral sphincter” (JU 1995)

- Licht et al: prospective analysis 206 pts undergoing RRP w/ preservation BN
  - Found no impact on continence BUT...
  - **Lower incidence of bladder neck contracture**

- Lowe compared bladder neck preservation to bladder neck resection
  - Concluded bladder neck preservation is feasible in context of good cancer operation but continence rates did NOT improve but **did shorten duration of incontinence**
**preservation of puboprostatic ligaments**

- Pyramidal fascia extending from prostate to undersurface of pubic symphysis
- Poore et al (Urology 98)
  - Reported earlier return of continence using PPL sparing approach
    - 6.5 vs 12wks

**preservation of puboprostatic ligaments**

- It’s still divided silly!!!
- Relative sparing: ligation is closer to prostate
- This leaves portion of PPL under symphysis intact
- IMPORTANT FOR ANTERIOR support of urethra and function of Rhabdosphincter (see later)
“Considering how close the urinary sphincter is to prostate, it’s not surprising that it’s function will sometimes be affected”

“God did not mean for us to remove this organ w/o serious sequelae”

Continence

- Requires urethral pressure > bladder pressure
- Need compliant bladder free of invol contractions
- In absence of voiding dysfunction, complex interplay of striated muscle, smooth muscle, nerves, neuromediators, support structures that is still not entirely understood.
Confusion with terminology

Nomenclature of Urinary Sphincters  
Hinmans Atlas of Urosurgical Anatomy '93 p373

- **Smooth muscle sphincters**
  - Preprostatic Sphincter
    - Involuntary sphincter, vesical neck sphincter, prostatic smooth muscle sphincter, internal sphincter
  - Passive Prostatic Sphincter
    - Passive sphincter, passive smooth sphincter

- **Striated muscle sphincters**
  - Prostatomembranous striated sphincter
    - Prostatic striated sphincter
      - External striated sphincter, striped compressor of prostatic urethra, compressor prostatae, sphincter urethrae prostaticae
    - Membraneous urethral sphincter
      - External sphincter, external voluntary sphincter, distal intrinsic urethral sphincter, intrinsic external sphincter, intramural external sphincter

- **Periurethral striated sphincter (pubococcygeus)**
  - External intrinsic striated urethral sphincter, distal intrinsic striated urethral sphincter, extrinsic periurethral musculature, periurethral striated muscle, periurethral levator ani muscle
zones of continence – Turner Warwick

1. Proximal (internal) Urethral Sphincter
   - BN, SM, prostate, prostatic urethra to veru
   - Arranged circular fashion
   - Removed at Rad P

2. Distal (external) Urethral Sphincter
   - Veru to proximal bulb (perineal membrane)
   1. Rhabdosphincter (s.m. & skel)
   2. Extrinsic skeletal (levators)
   3. Supporting fascia
   4. Urethral mucosal infoldings

Distal urethral sphincter

- Sphincter responsible for continence post RRP
- 1. rhabdosphincter (prostatomembranous striated urethra)
  - Smooth and skeletal muscle
  - Slow twitch fibers
  - Resist fatigue and likely responsible for passive continence
- 2. periurethral striated sphincter (pelvic floor)
  - Fast twitch
  - They fatigue
  - Voluntary continence
- Exact innervation unknown
- Generally agreed that both autonomic (pelvic n.) and somatic (pudendal n.) innervation involved
Distal urethral sphincter

Male urinary continence zones

Myers Urol clinics 2001

- Superior sphincter-vesical neck
- Inferior sphincter-sphinctoric urethra
  - External striated component
  - Internal smooth muscle and elastic tissue component
- Levator ani: puboanal-is-puboperinealis complex
  - Forms UG hiatus flanks membranous urethra
Absence of a Urogenital Diaphragm

- Concept of a plate of muscle b/t the pubic rami is FALSE
- MRI images of prostate, external sphincter and bulb show NO evidence of a urogenital diaphragm (Dorschner JU 1999)
- The plates of muscle just distal to apex are in fact levators
The “urogenital diaphragm”, external urethral sphincter and radical prostatectomy.  

- Anatomic study of 50 RRP
- Striated sphincter is a cylinder of muscle surrounding membranous urethra extending from perineal membrane to prostate and extending over part of ant. Fibromuscular stroma.
- “the urogenital diaphragm is a myth”
- Striated external sphincter was found in ligated material from DVC. This can significantly damage the external sphincter.
Innervation of lower urinary tract

1. pelvic nerves S2-4, excite bladder, relax urethra
2. lumbar sympathetic nerves inhibit bladder, excite urethra
3. pudendal nerves excite ext. urethral sphincter

What keeps a man dry after RRP?
Male Urethral Sphincteric Anatomy and Radical Prostatectomy

- Male Urethral Sphincteric Anatomy and Radical Prostatectomy
  Uro Clinics NA 1991

- Practical Anatomy pertinent to Radical Retropubic Prostatectomy
  AUAU 1994

Membranous urethra

- The functional unit of urethra is from veru to bulb
- We see it during RRP!
- It’s a bad name...
- Nothing membranous about it
- Myers would call it the “sphincteric urethra”
Membranous urethra

Robert P. Myers

Membranous urethra
Concept of “functional urethral length”

- Membranous urethras vary in length
- With a short membranous urethra, < latitude in point of transection
- Transection too distal to apex results in short “functional length”

Urinary Continence After Radical Retropubic Prostatectomy: Relationship with Membranous Urethral Length on Preoperative Endorectal Magnetic Resonance Imaging Scardino: J U 2002

- Coronal MRI image
- Distance b/t prostatic apex to penile bulb
- >12mm had better continence
- Concluded that pre-op determination of memb. urethral length may help guide choice of treatment
**Striated urethral sphincter “rhabdosphincter”**

- Membranous urethra w/ it’s external sphincter (rhabdosphincter) extends from perineal membrane to anterior portion of prostate.

- Striated urethral sphincter gets thicker and becomes more important for continence as you move distally.
**Rhabdosphincter**

- The Rhabdosphincter is the external striated urethral sphincter (surrounds membranous urethra)
- Forms a horseshoe configuration around the membranous urethra (controversial)

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**How do men stay dry after RRP?**

- External striated urethral sphincter (rhabdosphincter)
  - Slow twitch striated fibers (involuntary)
  - Provide sustained tone and PASSIVE continence
- Periurethral striated muscle (pelvic floor)
  - Fast twitch fibers (voluntary)
  - Contract rapidly & forcefully for short duration
  - Voluntary or active continence
Contraction of rhabdosphincter causes draws sphincter complex UPWARDS

Note close relation to pubo-urethral ligaments

Prostate shape: “Donuts and Croissants”

Note diversity of shapes and sizes
Upper row: apical notch...makes apical dissection tricky
- Donut vs croissant
InVance™: Male Bulbourethral Sling

- For mild to moderate stress urinary incontinence
- Option for men who are not candidates for AUS

Based on compression of bulbous urethra
- Uses bone screws to anchor mesh across bulbous urethra
- Pull it tight and use retrograde flow to set the tension
**Patient Selection**

- **Degree of Incontinence**
  - **MILD**
    - 1 pad/day
  - **MODERATE**
    - 2-3 pads/day
  - **SEVERE**
    - 3+ pads/day

- **Management**
  - Male Sling
  - Bulking Agents
  - AMS Sphincter 800
  - Double Cuff AUS

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**InVance™: Male Bulbourethral Sling**

- **Good candidates**
  - Limited manual dexterity
  - Limited mental capacity
  - Refusal of AUS or other surgery

- **Poor candidates**
  - Severe UI
  - Previously implanted AUS
  - Previous radiation treatments
Bone screw placement

- 6 bone screws
- Anterior limit
  - Pubic symphysis
- Posterior limit
  - Pubic ramus @ level of bulbar urethra
  - Above ischial tuberosity

Incision

- Palpate catheter
- 4-6 cm midline perineal incision starting at inferior edge of scrotum
Dissection

- Dissection is directed laterally to expose inferior pubic rami from the symphysis to the ischial tuberosity bilaterally.

Exposure

- Sharp dissection
- Scott retractor
- Bulbocavernosus muscle left intact
- To minimize bleeding and enhance the compressive effect of the sling, the urethra and all of the structures overlying it are avoided.
**Pubic Ramus**

- Objective is to clear the tissue of the inferior rami from high up in the groove between the corpora and symphysis down to the ischial tuberosity.

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**Bone screw mechanics**
Placing bone screws

Applying mesh
Prospective study for male SUI (94% post RRP)

- 36 pts, mean age 67
- UCLA PCI questionnaire (urinary function section)
- All used >/=2 ppd
- All rated their incontinence as a big problem
Results:

- 24 (67%) pad free
- 5 (14%) 1ppd
- 4 (11%) 2ppd
- 3 (8%) 3ppd

- Overall, 92% improved
- No instances of erosion, infection or prolonged urinary retention
Improved incontinence scores after insertion of male sling

conclusions

- Radical Retropubic prostatectomy results in PPI due to numerous factors
- Difficult to validate preventative techniques
- Our understanding of male sphincteric mechanism is still evolving
Take home messages

1. external striated sphincter (rhabdosphincter) surrounds the membranous urethra and is responsible for keeping a man dry after RRP
2. it’s precise innervation still not understood (type of nerves and location)
3. vital steps in maintaining continence is anatomic transection of DVC and sphincter itself
4. try to preserve as much urethral length as possible

end
Loss of compliance post prostatectomy

urodynamics
Bladder dysfunction

Sphincter dysfunction
**Sphincter dysfunction: injectable therapy**

**What identifies magnitude of problem?**

- Pt description of problem
- # pads/day
- PE/ stress test
- 24hr pad wt
- Standardized clinic pad wt
- Urodynamic test of urethral competence
PE-

- Pad/clamp use
- Skin integrity, dermatitis
- Activity level, q of l
- Radiation therapy

Postprostatectomy Incontinence

- PC (6%)
- DI (4%)
- PC + DI (6%)
- SUI + PC or DI (40%)
- SUI alone (36%)
- NL (8%)
Sphincter dysfunction: male slings

Sphincter dysfunction: AUS
What identifies magnitude of problem?

Assess severity and type of incontinence
- Q of L
- Voiding diary

PE - DRE, neuro
Cysto - contracture, defect, FB, area to inject
UDS - uroflow PVR, CMG, PF, VLPP

Pre operative evaluation

- UDS
  - Loss of compliance (aging, XRT)
  - Detrusor instability (aging, idiopathic)
  - Leak points (??value)
    - Catheter effect, fixed scar
  - Cystourethroscopy
  - Counselling and education
## Practical questions in treatment selection

- How bad is the problem
- How much time has passed since prostatectomy
- What comorbidities exist
  - Residual CaP
  - Further therapies
  - Asso anastomotic contracture
  - Bladder instability
  - Asso urethral stricture

## At what point can one assume no further improvement will take place?

- Predictive features
  - Volume of incontinence
  - Cystoscopic appearance of sphincter
  - UDS
- Rule of thumb: wait one year
Theoretical sling effect on overactive and/or hypertonic detrusor

- Increased severity of uninhibited detrusor contractions
- Poor compliance ($\Delta V/\Delta P$)
  - $\uparrow$ storage pressures wrt upper tracts
    - $>$ hydronephrosis
    - $>>$ renal insufficiency
  - Higher voiding pressures

Patient Selection

**InVance Male Sling**
- Functional Bladder
- Limited Manual Dexterity
- Limited Mental Capacity
- Refusal of AUS

**AMS Sphincter 800**
- Excellent Long-Term Results
- Motivated Patient
contraindications

- Detrusor hyperreflexia or instability if not pharmacologically manageable
- Diminished vesical compliance, decreased or impaired bladder contractility
- Recurrent urethral stricture diseaseable stricure
- Bladder neck contracture
- Bone deformity or severe osteoporosis
- Compromised immune system
- Urinary tract infections
- Previous or active osteomyelitis
- Renal insufficiency and upper or lower urinary tract obstruction