Urethral Stricture Disease: Contemporary Management

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March 3, 2004

Stricture Disease - Outline

⇒ Applied Anatomy
⇒ Evaluation
⇒ Bulbous Urethral Stricture
  ⇩ Short-segment
  ⇩ Long-segment
⇒ Penile Urethral Stricture
⇒ Posterior Urethral Distraction
Penis: Blood Supply

- Branch of deep internal pudendal artery
- Dual circulation of the urethra
- Urethral mobilization

Fasciocutaneous Blood Supply

- Superficial external pudendal artery
- Dartos skin island flap mobilization
Urethral Strictures

- Scar of urethral epithelium or underlying corpus spongiosum(spongiosis)

- Etiology:
  - Staddle trauma
  - Inflammatory (BXO, GU)
  - Pelvic fracture (disruption)
  - ? Congenital

- Determine: Length, location, depth/density of spongiosis

Urethral Imaging

- Retrograde Urethrography
- Voiding cystourethrogram
- Cystoscopy
  - Flexible/ped’s scopes

- Ultrasound
- MRI
Urethral Stricture

Treatment

Management (Dilation/DVIU) --- CURE (Reconstruction)

? Abandon the reconstructive ladder

Case 1: Short segment bulbous urethral stricture

⇒ 2cm bulbous urethral stricture
Short Bulbous Urethral Stricture

- Treatment Options (<2cm):
  1. Direct Vision Internal Urethrotomy (DVIU)
  2. Urolume Endoprosthesis
  3. Reconstruction – Stricture Excision & Primary Anastomosis (EPA)

Direct Vision Internal Urethrotomy (DVIU)

- Considered standard treatment
- Incision/ablation of stricture transurethrally (12 o’clock position)
- Healing by secondary intention
- Complications:
  - UTI/Fever (10%)
  - Hematuria/hematoma (6%)
  - Erectile Dysfunction (<1%)
  - Chordee
**Long Term Success: DVIU**

- 27% long-term success rate
- No effect of prolonged catheterization

**Direct Vision Urethrotomy**

- Poor long-term success
- Multiple urethrotomies do not achieve cure
- Reserved for short bulbous urethral strictures with minimal associated spongiofibrosis
- Not completely benign
Applied Anatomy: The Urethra

- Structural layers
- 3 segments
- Lumen course
- Boundaries

Uroleum Endoprosthesis

- Superalloy braided mesh cylinder
- Indication: Bulbous urethral stricture (<3cm)
- Implanted post DVIU/dilation
- Epithelialization: 6-12 months
**Urolume: Contraindications**

1. Meatal or penile urethral stricture
2. Inability to incise/dilate >26Fr
3. Active UTI
4. Future instrumentation
5. Strictures at external sphincter
6. Perineal fistula
7. Children
8. Prior urethroplasty with skin transfer
9. Posterior urethral disruption

**Urolume: Outcomes**

- North American Urolume Study (N=175)
- Decrease in symptom score
- Increase in peak flow
- 23% required multiple stents
- 26% stricture recurrence
- Complications:
  - Post-void dribbling
  - Hematuria
  - Erectile pain
Urolume: Final Thoughts

- Urethral reconstruction after Urolume:
  - Complete urethral excision and circumferential reconstruction

  Indication: Patients older than 55 years with co-existing medical conditions

Reconstruction - Excision & Primary Anastomosis

- Short-segment bulbous urethral strictures (1-4 cm)
- General rule:
  - Strictures closest to membranous urethra more amenable
- Avoid instrumentation 3 months prior to evaluation/reconstruction
  - Suprapubic catheter diversion
Exaggerated Lithotomy Position

- Inquire hip/back problems
- “Trial” of positioning in office
- 15% rate transient peroneal neurapraxia

Jordan perineal bookwalter
EPA: Exposure of Bulbous Urethra

- Lambda shaped perineal incision
- Division of ischiocavernosus muscle

EPA: Exposure of the Bulb

- Complete urethral mobilization (as far as penoskeletal junction)
- Development of intracranial space
Excision & Primary Anastomosis

- Complete stricture excision
- Urethral spatulation
- Tension free anastomosis
- SP diversion, stenting catheter
- Closed suction drainage

Results: EPA (Devine Center)

- 198 patients
- Followup >48 months
- Length 1.87 cm (up to 4.5cm)
- 98% cure (no further instrumentation)
- <2% rate of erectile dysfunction
- ~1% UTI, wound infection
EPA: Results

Long-Term Success EPA (> 4 years)

% Success

96% long-term success rate

EPA: Conclusion

- “Gold standard” for short-segment bulbous urethral strictures
  - High success rate
  - Low complication rate
  - Durable
  - No repeat procedures
- Part of more extensive reconstruction
Case 2: Long segment bulbous urethral stricture

- 5 cm bulbous urethral stricture
  - Not a candidate for EPA
  - DVIU has minimal efficacy

Tissue Transfer

- When stricture characteristics preclude primary anastomosis
- Best employed as onlay procedure with aggressive excision of select urethral segments (augmented anastomosis)
- Flap versus graft
  - Recent resurgence of the graft (buccal mucosa)
Graft versus Flap

Graft
- Appropriate graft “bed” required
- Readily available
- Ease of harvest
- Concealed scar/deformity

Flap
- Preserved blood supply - No graft “take” required
- Not always available
- Dissection required
- Local visible scar

Tissue Transfer: Grafts & Flaps

Grafts:
- Buccal mucosa (full thickness)
- FTSG (subdermal)
- STSG (intradermal)
- Bladder epithelial
- Posterior auricular (Wolfe)

Flaps:
- Penile skin island (superficial external pudendal a.)
- Scrotal island (posterior scrotal a.)
The Graft: Principles of “Take”

- Imbibition (48 hours)
- Inosculated (48 hours)
- Vascularized graft bed
- Graft immobilization
- Hemostasis
- Antibiotic prophylaxis

New Concept: Buccal Mucosa Graft

- Resurgence since 1992 (Burger et al.)
- Robust “take” (panlaminar plexus)
- A “wet graft” - well suited to the urethra
- Readily available
- Ease of handling
**Buccal Mucosa Graft: Harvest**

- Buccal Mucosal Graft (BMG):
  - 6 x 2.5 cm each cheek
  - Exaggerated lithotomy *after* harvest complete
  - Close donor sites primarily
  - Clean/Thin graft.
  - Regown/drape before perineal dissection.

**New Concept: Barbagli Procedure (Dorsal Onlay)**

- Fixation of graft dorsally onto corpora
- Urethra sewn open
- Advantages:
  - Graft Fixation = ? better “take.”
  - Preservation of ventral blood supply
  - Decreased incidence of sacculation
  - Decreased stricture recurrence
  - (5% dorsal vs. 14% ventral at 5 yrs)
    - [Mundy, 2001]
Dorsal BMG Onlay: Operative Technique

- Bulbous Urethra mobilized from corporal bodies
- Dorsal urethrotomy into normal (28Fr) urethra
- BMG sutured/quilted to underlying corporal bodies.
- Urethra sewn to graft margins.

Simple Dorsal Urethrotomy & Buccal Mucosal Graft Onlay
Excision With Floor Strip Anastomosis
(Augmented Anastomosis)

Dorsal Onlay - Advantages
Post-Operative Management

- Suction drain adjacent to bulb.
- Voiding trial with contrast at 28 days.
- Routine cystoscopy at 6 months.
- Follow-up:
  - ? Obstructive Symptoms
  - ? Infections

Dorsal BMG Onlay – Success Rates

"Medium-Term" Success Dorsal Onlay

- Barbagli
- Webster
- Mundy
- Jordan
Dorsal BMG Onlay - Conclusion

- BMG properties + Dorsal onlay approach yields excellent results
- Short follow-up: Attrition rate expected with time
- With longer followup will likely become the treatment of choice for long segment bulbous stricture

Tissue Transfer: The Penile Flap

- Penile/preputial most commonly used
- Based on Dartos fascia
- Superficial external pudendal artery
- The skin is the passenger
- Useful when infection or extensive fibrosis present
Penile Skin Island Flap (Quartey)

- Skin incision to Buck’s fascia
- Elevation of Dartos fascia off Buck’s fascia

Penile Skin Island Flap (Quartey)

- Incision outlining the skin island
- Skin dissected off of Dartos pedicle
Penile Skin Island Flap (Quartey)

- Penile skin island and pedicle freed & mobile
- Can be mobilized to prostatic apex

Case 3: The “Even Longer” Bulbous Urethral Stricture

- 10 cm stricture & multiple past surgeries
  - Penile island flap
  - Versus x2 buccal mucosa grafts
Flap Considerations in Urethral Reconstruction

1. Physical characteristics of the flap:
   - Non-hirsute
   - Thin

2. Flap vasculature:
   - Axial vs Random

3. Mechanics:
   - Dorsal redundancy: Transverse flap
   - Ventral redundancy: Longitudinal (up to 10cm)
   - General redundancy: Circumferential (up to 12-14cm)

Penile Skin Island Flap: Mobilization

- Ventral longitudinal (10cm)
- Circular based ventrally (12-14cm)
**Penile Skin Island: Transposition**

- Flap dissection while supine
- Broad Dartos pedicle
- Plane developed into perineum
- Incision closed

**Perineal Dissection & Stricture Excision**

- Perineal dissection
- Exaggerated lithotomy
- Transection & segment excision
- Dorsal spatulation/calibration
- Develop intracrural space
Augmented Anastomosis: Dorsal Onlay

Dorsal onlay (28 Fr lumen)
Floor strip (ventral) anastomosis
Completed repair

Principles: Augmented Anastomosis

- Excision of obliterated/severely fibrotic segment
- Dorsal spatulation
- Floor strip anastomosis
- Dorsal onlay fashion
Balanitis Xerotica Obliterans (BXO)

- 14% of childhood circumcision specimens
- "Idiopathic"
- Anecdotal cancer risk (in males)
- Histology:
  - Hyperkeratosis, thinned epidermis
  - Homogenization of the dermis
  - Subdermal monocytic infiltrate

Beware of BXO Meatal Stricture

- Meatal obstruction & high voiding pressures
- Extravasation into glands of Littre & microabscesses
- "March" of stricture down the penile urethra
Case 4: Penile urethral stricture

- Inflammatory etiology
- Rarely amenable to EPA
- One-stage versus two-stage reconstruction

Option 1: One-Stage Repair
Longitudinal Skin Island (Orandi) Flap

- Urethrostomy performed (lateral)
- Flap outlined (based on stricture caliber)
- Dartos pedicle mobilized (in proximity)
- Flap anastomosed
Option 1: One-Stage Repair
Longitudinal Skin Island (Orandi) Flap

- Closure of flap & skin
- Postop:
  - SPC, urethral stent
  - Drains, antibiotics (48hrs)
  - Suppress erections
- Complications:
  - Skin loss
  - Fistula
- 88-90% success rate (non-BXO strictures)

Option 2: Staged Urethral Reconstruction

- Indications:
  - Extensive urethral & peri-urethral fibrosis
  - Long segment of obliteration
  - Panurethral stricture
  - Associated fistula
  - Insufficient penile skin/donor tissue
Option 2: Staged Urethral Reconstruction

- Bengt-Johanson (1950’s)
  - 1st Stage - Urethral marsupialization
  - 2nd Stage – Incorporation of adjacent perineal tissue

- Complications:
  - Hair growth
  - Calculi
  - Chronic UTI

- Contemporary: Free graft use

Current Concept: Onlay versus Tubularization

- Stricture segments requiring tissue transfer

![Outcome Graph]

- Avoid tubed grafts & flaps
- Stenosis of tube
Staged Reconstruction:
1st Stage

- Ventral urethroplasty or complete excision
- Spatulate into healthy spongiosum
- Transposition of Dartos

Staged Reconstruction:
1st Stage

- Graft placement
  - Meshed STSG (thigh, buttocks)
  - Buccal mucosa
- Postop bolster
Staged Reconstruction:  
1\textsuperscript{st} Stage

- 6-12 month graft “maturation”
- Voiding per urethrostomy
- 13% elect not to proceed to 2\textsuperscript{nd} stage

Staged Reconstruction:  
2\textsuperscript{nd} Stage

- Incision of neourethra (28Fr)
- Lateral mobilization
**Staged Reconstruction:**
- **2nd Stage**

- Duplay tubularization
- Tunica Dartos flap coverage

**Staged Urethral Reconstruction**
- 82% long-term success rate
- Ensure urethrostomy patency (1st Stage)
- Urethrocystaneous fistula reduced with tunica Dartos flap interposition (<5%)
- Post-void dribbling
- Not a panacea but useful adjunct to complex stricture cases
**Current Concept: BXO & Reconstruction (1998)**

- **One-stage:**
  - Penile island flap onlay

- **Two-stage:**
  - Complete stricture excision
  - Non-genital skin graft

(Mundy, 1998)

- Two stage free-graft urethroplasty using non-genital skin is recommended for BXO

**Posterior Urethral Disruption**

- 4-6% of pelvic fractures
  (Koraitim, 1999)
- MVA (90%)
- Associated vascular injury
- Bulbomembranous junction distraction
Posterior Urethral Distraction

- Mechanism: Rostral displacement

Case 5: Posterior Urethral Disruption (RUG/VCUG)

Overestimation of defect (bladder neck closed)
Posterior Disruption: Antegrade cystoscopy with simultaneous RUG

Posterior Urethral Disruptions

“It is the urologist who will have to share the burden of the ultimate disability with the patient when the thoracic, abdominal & even the orthopedic aspects are probably long forgotten.”

Richard Turner-Warwick, 1977
Posterior Urethral Disruption

- Goal: A patent continent urethra with maintenance of pre traumatic sexual potency
- 75% pre-operative erectile dysfunction

Treatment Options:
1. Open reconstruction (4 months)
2. Delayed endoscopic realignment

Posterior Urethral Reconstruction

- Perineal approach
- Exaggerated lithotomy
- Suprapubic access mandatory
- Exposure of the entire bulbous urethra
- Control proximal blood supply
Posterior Reconstruction:

Develop the Intracurral Space

- Transection at bulb
- Division of triangular ligament
- Retraction of corpora
- Exposure of dorsal vein
- Division of dorsal vein
- Dissection of retropubic tissue

Posterior Reconstruction: Anastomosis

- Resection of fibrosis
- Spatulate apical prostatic urethra
- Seat anastomosis
  "Nestle" urethra
**Posterior Reconstruction: Maneuvers**

- **Infrapubectomy (22-30%)**
- **Corporal rerouting (10-15%)**

**Outcome of Posterior Reconstruction**

- >95% with one stage perineal approach
- 3-5% new erectile dysfunction
- 5% choordae
- 98% long-term success rate
- Failures due to ischemia of corpus spongiosum (internal pudendal artery occlusion)
Current Concept: Vascularity

Selective Revascularization of Posterior Urethral Defects

- Evidence of bilateral internal pudendal artery occlusion
- Revascularization:
  - Increased arterial inflow
  - Re-establish erectile function (with sildenafil)
  - Avoid 1-2% incidence of ischemic urethral obliteration with reconstruction
Delayed Endoscopic Repair

- Quint & Stanisic (1993)
- Suprapubic diversion
- Fluoroscopic incision & resection of fibrosis
- 30% transfusion rate
- 10% rectal perforation
- 68% stricture recurrence

Urethral Stricture Disease: Summary

- DVIU:
  - Poor long-term results
  - Repeat urethrotomies do not cure
- Bulbous Urethral Strictures:
  - EPA is gold standard for short segment strictures
  - Augmented anastomosis with dorsal BMG onlay for segments not amenable to EPA
Urethral Stricture Disease: Summary

- Penile strictures generally require tissue transfer
- BXO strictures:
  - Staged reconstruction
  - Non-genital tissue
- Posterior disruptions successfully reconstructed via a one-stage perineal approach