Urethrography: Technique, anatomy and pathology - a pictorial review.

<table>
<thead>
<tr>
<th>Poster No.:</th>
<th>C-1053</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congress:</td>
<td>ECR 2011</td>
</tr>
<tr>
<td>Type:</td>
<td>Educational Exhibit</td>
</tr>
<tr>
<td>Authors:</td>
<td>T. M. Walshe, C. Donagh, A. M. Browne, P. McCarthy; Galway/IE</td>
</tr>
<tr>
<td>Keywords:</td>
<td>Urinary Tract / Bladder, Genital / Reproductive system male, Fluoroscopy</td>
</tr>
<tr>
<td>DOI:</td>
<td>10.1594/ecr2011/C-1053</td>
</tr>
</tbody>
</table>

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

1. To review the process of performing and interpreting urethrography.

2. To review and illustrate normal urethral anatomic structures

3. To describe and illustrate with case examples normal variants and the multiple urethral pathological findings detected on urethrography including:

   - urethral strictures
   - urethral trauma
   - urethral diverticuli
   - urethral filling defects etc.

Background

Conventional retrograde urethrography and micturating cystourethrography remain the imaging modalities of choice for imaging the urethra. Cross-sectional imaging modalities, including ultrasonography, magnetic resonance imaging and computed tomography are useful adjuncts for further evaluating periurethral structures. This poster revises the value of retrograde and antegrade urethrography, the importance of correct technique, knowledge of normal anatomy and various pathologies.

Normal Anatomy: on page 3

Varying from 17.5 to 20cm in length, the male urethra consists of anterior and posterior portions. The anterior urethra extends from the external meatus to the inferior edge of the urogenital diaphragm. The anterior urethra is conventionally divided into the penile (or pendulous) and bulbous parts by the suspensory ligament of the penis at the penoscrotal junction, where there is usually mild angulation of the urethra. The penile portion terminates in the glans penis to form the fossa navicularis (1-1.5 cm long). The proximal portion of the bulbous urethra is dilated, the “sump” of the bulbous urethra; just proximal to the sump, the bulbous urethra assumes a conical shape at the bulbomembranous junction. The anterior urethra has periurethral Littré glands. The Cowper glands are 2 tiny glands that lie either side of the membranous urethra. The ducts of the Cowper glands are 2 cm long and empty into the bulbous urethra. Cowper’s ducts occasionally fill with contrast during urethrography in a normal patient, however filling occurs much more commonly in the presence of urethral strictures. Visualisation of the Littré’s glands
and the prostatic ducts is always abnormal and is associated with chronic inflammation and distal urethral strictures.

The posterior urethra is divided into the prostatic and membranous urethra. The prostatic urethra (~3.5 cm) passes through the prostate slightly anterior to midline. The verumontanum is a 1-cm-long ovoid filling defect seen in the posterior wall of the prostatic urethra. The distal end of the verumontanum marks the proximal boundary of the membranous urethra, (~1 cm long) the portion that passes through the urogenital diaphragm. This is also the region of the external sphincter of the urethra. The distal boundary of the membranous urethra (the bulbomembranous junction) is the cone of the bulb urethra. Identification of the bulbomembranous junction on a retrograde urethrogram is very important for assessing urethral disease as well as for planning urologic procedures. When the posterior urethra is optimally opacified and the verumontanum is visible, the bulbomembranous junction can be identified 1-1.5 cm distal to the inferior margin of the verumontanum. When the posterior urethra is suboptimally opacified, the bulbomembranous junction can be arbitrarily localized where an imaginary line connecting the inferior margins of the obturator foramina intersects the urethra.

The much simpler female urethra measures up to 4 cm long and extends from the bladder neck at the urethrovesical junction to the vestibule, where it forms the external meatus between the labia minora. The female urethra is embedded in the anterior wall of the vagina and is lined throughout by many small periurethral glands.

Images for this section:
**Fig. 1:** Normal anatomy of the male urethra (Gray's Anatomy, The anatomical basis of clinical practice, 40th Ed.)
Imaging findings OR Procedure details

Urethrography

**Technique on page ...**

The external meatus is prepared in a standard sterile fashion for the placement of a conventional Foley catheter. In our department an 8 Fr catheter is most commonly used, although catheters up to 18F can be utilised depending on operator preference. The catheter, with both the irrigating syringe and inflating (saline solution) syringe attached, should be flushed before use to eliminate the introduction of air bubbles.

Once the balloon portion of the catheter is seated in the navicular fossa, the balloon is inflated with 1.0-1.5 mL of saline. A penile clamp e.g. Knutsson's clamp was commonly utilised in the past to direct contrast into the external meatus. The use of lubrication containing local anaesthetic is optional, some authors do not recommend its use as it may prevent the balloon from remaining in place for optimal occlusion. The patient is placed in a supine 45° oblique position. Positioning the patient with their leg abducted and knee flexed may help if the area of interest is obscured. The penis should be placed laterally over the proximal thigh with moderate traction. If the patient is not positioned sufficiently oblique, the bulbous urethra will appear foreshortened and will therefore not be adequately evaluated.

Then 20-30mL of 50\% iodinated contrast material is injected under fluoroscopic guidance. Commonly, spasm of the external urethral sphincter will be encountered, which prevents filling of the deep bulbar, membranous, and prostatic urethras. Pre-warming the contrast will help reduce the incidence of spasm. Gentle slow pressure will usually overcome the resistance of the external urethral sphincter. Filling of the Cowper ducts should not be misinterpreted as extravasation. Opacification of the prostatic ducts, Cowper ducts, and periurethral Littré glands is often, but not necessarily, associated with urethral inflammatory and strictures. If the integrity of the urethral mucosal lining is disrupted by increased pressure during contrast material injection, intravasation of contrast material with opacification of the corpora and draining veins may occur.

A retrograde study is the most appropriate way to evaluate the anterior part of the urethra, and a voiding/micturating study is the most appropriate way to evaluate the posterior part of the urethra; therefore, "dynamic" urethrography represents a synergy of these two imaging techniques. If sufficient contrast flows retrogradely into the bladder, a micturating (antegrade) urethrogram should be performed in order to evaluate the posterior urethra adequately. If a completely obstructing urethral lesion exists, filling of the urinary bladder via a suprapubic catheter or iv contrast administration will be necessary to perform the antegrade evaluation of the urethral lesion.
IMAGING FINDINGS

1. Urethral strictures - Inflammatory strictures associated with gonococcal urethritis are more common and more serious than those associated with nongonococcal urethritis. The typical finding in gonococcal urethral strictures is an irregular urethral narrowing several centimeters long involving mainly the bulbar urethra, associated dilatation of Littre’s glands may be present at urethrography. Periurethral abscesses and urethroperineal fistulas may develop as a consequence of inflammatory strictures.

Traumatic - occur after complete transection injury, and are usually short and solitary.

Iatrogenic- Instrumentation-related strictures usually occur in the bulbomembranous region and, less commonly, at the penoscrotal junction. Strictures of the prostatic posterior urethra (bladder neck contracture) may occur after transurethral resection of prostate or open radical prostatectomy

2. Urethral Trauma

Blunt urethral trauma traditionally has been classified anatomically as either anterior or posterior injury. Posterior urethral injury is usually caused by a crushing force to the pelvis (e.g. from a high impact traffic accident) and occurs in approximately 10% of patients with pelvic fractures, and up to 20% also have associated bladder laceration. Conversely, anterior urethral injury usually results from a straddle pelvic injury and is most often isolated.

Goldman et al proposed a unified classification system for urethral injuries following blunt trauma in 1997 based on the anatomical location of the injury. The new classification system modifies and extends the previously popular Colapinto and McCallum system (type I-III injuries) into five types, with the addition of bladder base injuries (type IV and IVa injuries) and straddle anterior urethral injury (type V injury).

Urethral injury classification

**Type I** injury - produces contusion or laceration but does not involve the full thickness of the urethral wall. There is rupture of the puboprostatic ligaments and the posterior urethra appears intact but may appear elongated

**Type II** injury- the membranous urethra is torn above an intact urogenital diaphragm, which prevents contrast material extravasation from extending into the
perineum, type II occurs in ~ 15% of cases. Partial rupture is implied when some retrograde filling of the bladder is achieved, complete rupture when extravasation occurs and no contrast enters the bladder.

In **type III** on page  injury, the most common urethral injury, the membranous urethra is ruptured but the injury extends into the proximal bulbous urethra because of laceration of the urogenital diaphragm, characterized by contrast material extravasation not only into the pelvic extraperitoneal space but also into the perineum.

**Type IV on page** reveals extraperitoneal periurethral extravasation of contrast at the bladder neck.

Type IVa - extraperitoneal bladder rupture at the base of the bladder that does not extend into the bladder neck.

**Type V on page** - anterior urethral injury - occur most commonly in the bulbar urethra from a "straddle injury" i.e. falling astride a fixed object and can be partial or complete with resulting extravasation into the corpora, type V is usually not associated with a bony injury.

3. **Urethral Filling defects** on page

are uncommon but include calculi, urethral polyps, condylomata acuminata and urethral carcinoma or even more rarely metastatic deposits. Migrant calculi (developing in the kidneys or bladder) are 10 times more common than stones forming de novo in the urethra. Predisposition to primary urethral stone formation results from diverticula and strictures. Urethral carcinoma is rare, occurring 2-5 times more often in women than men. In men, 2/3 arise from the bulbomembranous urethra and are mainly seen on a background of chronic urethral inflammation and/or stricture formation. Squamous cell is found in 75% and transitional cell in 15%.

4. **Urethral diverticulum** on page

has been reported in 1.4% of women with stress urinary incontinence, and is associated with recurrent infection. Currently thought to be acquired and attributed to the rupture of dilated and infected periurethral glands, which results in pseudodiverticulum formation, producing a potential site for urine stasis, infection and stone development and rarely adenocarcinoma development.

5. **Posterior Urethral Valves** on page
The most common congenital cause of lower urinary tract obstruction in male neonates - Posterior urethral valve is diagnosed with micturating cystogram demonstrating bladder neck hypertrophy, dilatation of the posterior urethra proximal to the valve narrowing.

**Images for this section:**

![Image](image-url)

**Fig. 1:** long irregular (gonococcal) stricture on micturating cystogram with proximal urethral dilatation and filling of cowper’s glands.
Fig. 2: long irregular urethral stricture with a periurethral abscess, with opacification of the Littre's glands (white arrow).
Fig. 3: A gonoccal stricture. Note opacification of Littre's glands (red arrow) and Knutsson's clamp
Conclusion

Conventional radiographic contrast studies including retrograde urethrography and micturating cystourethrography are most commonly utilised for imaging of the urethra.

These studies are ideal for delineating abnormalities of the urethral lumen and therefore are commonly chosen as the primary imaging modality for patients with various urethral abnormalities such as trauma, inflammation and stricture.

Meticulous technique, knowledge of normal anatomy and anatomical variants, technical flexibility and experience are crucial to precisely define urethral pathology.

Personal Information

References

4. Pollock H.M. Clinical Urography. 3rd Ed.
5. Gray's Anatomy, The Anatomical basis of clinical practice. 40th Ed.