MODULE 9: URINARY INCONTINENCE

KEYWORDS: Urodynamics, urgency incontinence, stress incontinence, urinary sphincter, urinalysis

LEARNING OBJECTIVES

At the end of this clerkship, the medical student will be able to:

1. Identify and name the major anatomic features of the bladder and urethra in the male and female
2. Define incontinence
3. List the symptoms and signs of the various types of incontinence; stress, urge, overflow, mixed and total
4. Describe the epidemiological features of incontinence
5. List the risk factors for incontinence
6. List the important components of the history when interviewing a patient with incontinence
7. List the important components of the physical exam of a patient with incontinence
8. Summarize the laboratory and urodynamic tests, if any, that should be ordered in a patient with incontinence
9. List the indications for treatment of incontinence
10. List the nonsurgical treatment options for stress and urge incontinence, describe their side effects, and outline the mechanisms by which they work
11. Briefly describe the surgical treatment options for stress and urge incontinence

NORMAL URINATION

Urination may seem straightforward in concept, but it is actually a complex phenomenon, which, even today, is poorly understood. In general, the urinary tract needs to perform two separate processes: 1) store urine (bladder filling and storage) and 2) empty urine (micturition). To properly perform these two functions, 3 major

Figure 1: The normal urinary tract showing the relationship between bladder, sphincter and urethra

anatomic components are needed: a bladder, an outlet or sphincter, and a conduit (urethra) as outlined in Figure 1.

To store urine, the bladder must accommodate increasing volumes of urine and maintain a low filling pressure. To do this, the normal bladder detrusor muscle relaxes as it fills with urine, keeping pressure/volume or compliance low. This relationship is shown graphically in Figure 2. Good high bladder compliance is due to both the elastic and the viscoelastic properties of the normal bladder wall. The bladder outlet must also remain closed at rest to prevent leakage. Finally, there must also be no involuntary bladder contractions. To empty, there is a lowering of outlet

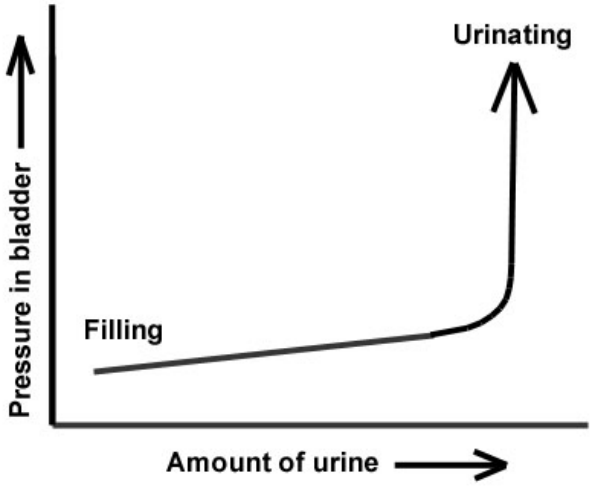

Figure 2. The pressure-volume relationship in the normal bladder. As the bladder fills, the pressure rises very little until the stretch limit had been reached, at which time contraction of the bladder heralds urination

resistance at the level of the urinary sphincter. In addition, there must be a coordinated contraction of the bladder smooth muscle of adequate duration and magnitude. Finally, there can be no anatomic obstruction for normal emptying to occur.

The nervous system also modulates the normal bladder response to filling. As the bladder fills, spinal and sympathetic reflexes are evoked that: 1) stimulate alpha-adrenergic mediated contraction of the bladder neck to promote storage and 2) inhibit bladder contractions through inhibitory beta-adrenergic effects on the bladder body smooth musculature. Such neural control helps explain why adults (unlike small children) can “hold on” to urine despite the “need” to void. To help keep the outlet closed during storage, the striated muscle within the urethra contracts as the bladder fills. In addition, there are important contributions from the passive properties of the normal supple urethra that forms a “mucosal seal” which increases resistance to the flow of urine.

At some point, bladder filling produces a sensation of distension that leads to voluntary voiding. The bladder outlet or sphincter relaxes, followed by coordinated contraction of the bladder smooth musculature mediated through pelvic parasympathetic nerves. Although bladder emptying is largely a spinal

parasympathetic reflex, the actual organization center for urination is in the pons and is referred to as the pontine micturition center and includes ascending and descending spinal cord pathways. Thus normal voiding is a complex process and can occur voluntarily or involuntarily.

URINARY INCONTINENCE

The number of individuals with incontinence among our increasingly geriatric population is staggering. In the US alone, there are an estimated 17 million men and women with bladder problems who cost the health care system an estimated $30 billion annually to manage. Urinary incontinence affects up to 1/3 of adults and 1/2 of nursing home residents. Patients may not report incontinence to their doctors due to embarrassment or misconceptions regarding treatment. Since incontinence is often treatable, it behooves health care professionals to identify patients who might benefit from treatment. Since the treatment of incontinence varies depending on the etiology, the aim of evaluation is to identify the etiology. As outlined in Table 1, incontinence occurs because of problems with the bladder or the sphincter or both. Common causes of bladder initiated incontinence include stroke, spinal cord injury, multiple sclerosis, spina bifida, bladder infection or inflammation. Common causes of incontinence due to sphincter issues include postpartum (or age-related) pelvic floor laxity and urethral hypermobility, neurogenic sphincter failure (Parkinson's, multiple sclerosis) and post-surgical injury (Transurethral Resection of the Prostate (TURP), radical prostatectomy). Less common causes of incontinence include urinary fistulae or ectopic ureteral orifices. Although Vesicovaginal fistulae, secondary to traumatic or prolonged labor, do not occur commonly in the US, they are a serious health problem in less developed countries and are the most common cause of continuous incontinence. Incontinence may also occur due to non-urologic causes that are usually reversible when the underlying problem is treated (Table 2).

Table 1. Symptoms and Associated Anatomical Abnormalities with Incontinence

CLINICAL SYMPTOM	FAILURE TO STORE	FAILURE TO EMPTY
Incontinence		
Urge	**Overactive bladder** **Decreased bladder compliance (fibrosis)**	
Stress	**Intrinsic sphincter deficiency** **Pelvic floor laxity** **Neuropathic sphincter**	
Overflow		**Acontractile bladder** **Prostatic, urethral obstruction** **Dyssynergic sphincter**
Total	**Neuropathic sphincter** **Sphincterotomy**	

TABLE 2: Causes Of Transient Incontinence

CAUSE	COMMENT
Delirium	Incontinence may be due to delirium and stops when acute delirium resolves.
Infection	Symptomatic infection may produce urge incontinence.
Atrophic vaginitis	Vaginitis may cause the same symptoms as an infection.
Pharmacologic	
• Sedatives	Alcohol and long-acting benzodiazepines may cause confusion and incontinence as a result.
• Diuretics	A brisk diuresis may overwhelm the bladder's capacity and cause uninhibited detrusor contractions, resulting in urge incontinence.
• Anticholinergics	Nonprescription and prescription medications can have anticholinergic properties. Side effects of anticholinergics include urinary retention, frequency and overflow incontinence.
• alpha-adrenergics	Bladder neck and proximal sphincter tone is increased by alpha adrenergic agonists producing urinary retention, particularly with an enlarged prostate gland.
• alpha-antagonists	Bladder neck and proximal sphincter tone is decreased with alpha adrenergic antagonists. Women treated for hypertension may develop or exacerbate stress incontinence.
Psychological	Depression may be associated with incontinence.
Excessive urine production	Excessive intake, diabetes, hypercalcemia, congestive heart failure and peripheral edema can cause polyuria and incontinence.
Restricted mobility	Incontinence may be precipitated or worsened if the patient cannot get to a toilet quickly enough.
Stool impaction	Impacted stool can lead to urge or overflow urinary incontinence and fecal incontinence.

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Failure to Store or Empty-Bladder Dysfunction

Bladder dysfunction causes urge or overflow incontinence. Urge incontinence occurs when bladder pressure overcomes sphincter mechanism. Elevated bladder or detrusor

pressure tends to open the bladder neck and urethra. An elevation in bladder pressure may occur from intermittent bladder contractions (detrusor over activity) or because of an incremental rise in pressure as bladder volume increases (poor compliance). Detrusor over activity may be idiopathic or it may be associated with a neurologic disease (detrusor over activity of neurogenic origin). Detrusor over activity is common in children as well as in the elderly and may be associated with bladder outlet obstruction. Poor bladder compliance results from loss of the visicoelastic features of the bladder or because of a change in neuroregulation. The patient with urge incontinence may appreciate a sudden sensation to void but is then unable to suppress it fully. In severe cases, the patient may not be aware of the sensation of needing to void until they are actually leaking. The amount of leakage in patients with urge incontinence is variable, depending on the patient's ability to suppress the contraction. Patients with urge incontinence will often have frequency and nocturia in addition to urgency and urge incontinence. They may also have nocturnal enuresis. The "overactive bladder" is a newer term that describes patients with frequency and urgency with or without urge incontinence.

Overflow incontinence occurs at extreme bladder volumes or when the bladder volume reaches the limit of the bladder's viscoelastic properties. The loss of urine is driven by an elevation in bladder pressure when overdistended. Overflow incontinence is seen when there is incomplete bladder emptying caused either by obstruction or poor bladder contractility. Obstruction is rare in women but can result from severe pelvic prolapse or following surgery for stress incontinence. Obstruction due to benign prostatic hyperplasia is common in older men. Patients with overflow incontinence will complain of constant dribbling and they may also describe extreme frequency.

Failure to Store or Empty-Outlet Dysfunction

Urethral or outlet related incontinence, or stress incontinence, occurs because of either urethral hypermobility or intrinsic sphincter deficiency (ISD). Incontinence associated with urethral hypermobility has been called anatomic incontinence, since the incontinence is due to malposition of the sphincter unit. Displacement of the hypermobile proximal urethra below the level of the pelvic floor does not allow for the transmission of abdominal pressure to the urethra that normally helps to close the urethra.

ISD was initially felt to occur after failure of one or more operations for stress incontinence. Other causes of ISD include myelodysplasia, trauma, and radiation. Some authors have theorized that all incontinent patients must have an element of ISD in order to actually leak. The patient with stress incontinence will leak urine with any sudden increase in abdominal pressure. In patients with severe ISD the increase in abdominal pressure required to cause leakage is small, and therefore patients may leak urine with minimal activity.

EVALUATION OF INCONTINENCE

The evaluation of the incontinent patient includes a history and a physical, laboratory tests and possibly urodynamic testing. The onset, frequency, severity and pattern of incontinence should be sought, as well as any associated symptoms such as frequency, dysuria, urgency or nocturia. Incontinence may be quantified by asking the patient if he or she wears a pad and how often the pad is changed. Obstructive symptoms, such as a feeling of incomplete emptying, hesitancy, straining or weak stream, may coexist with incontinence, particularly in males and in female patients with previous incontinence procedures, cystoceles or poor detrusor contractility. Female patients should be asked about symptoms of pelvic prolapse, such as recurrent urinary tract infection, a sensation of vaginal fullness or pressure, or the observation of a bulge in the vagina. All incontinent patients should be asked about bowel function and neurologic symptoms. Response to previous treatments, including drugs, should be noted. Important features of the history include previous gynecologic or urologic procedures, neurologic problems and past medical problems. A list of the patient's current medications, including use of over-the-counter medications, should be obtained.

Although the history may define the patient's problem, it may be misleading. Urge incontinence may be triggered by activities such as coughing, so that according to the patient's history, he or she would seem to have stress incontinence. A patient who complains only of urge incontinence may also have stress incontinence. Mixed incontinence is very common, with at least 65% of patients with stress incontinence having associated urgency or urge incontinence.

A complete physical examination is performed with emphasis on a neurologic assessment and the abdominal, pelvic and rectal examination. In females, the condition of the vaginal mucosa and the degree of urethral mobility is determined. Simple pelvic examination with the patient supine is sufficient to determine if the urethra moves with straining or coughing. The degree of movement is not as important as the determination of whether movement occurs. The presence of associated pelvic organ prolapse should be noted as it can contribute to the patient's voiding problems and may have an impact on diagnosis and treatment. A rectal exam in both males and females includes the evaluation of sphincter tone and perineal sensation.

The laboratory assessment of incontinence includes:

- Urinalysis: A urinalysis is performed to determine if there is any evidence of hematuria, pyuria, glucosuria, or proteinuria. This test can check for early signs of systemic disease such as diabetes, kidney disease, urinary tract infections, or to detect blood in the urine. A urine specimen is sent for cytology if there is hematuria and/or irritative voiding symptoms.

- Urine Culture: Infection in the urine is an important indicator of an abnormality. The relatively constant movement of urine from kidneys to ureter to bladder followed by excretion keeps it sterile. Abnormalities that inhibit this constant flow process can lead to stasis and infection. The urine is cultured if there is pyuria or bacteriuria on urinalysis. Infection should be treated prior to further investigations or interventions.

- Bladder Ultrasound: A bladder ultrasound performed after urination is helpful to evaluate the amount of residual urine (post void urine, PVR) remaining and is a quick assessment of the integrity and completeness of urination. A normal PVR is <50 mL and a PVR in excess of 200 mL is very abnormal. A significant PVR may reflect either bladder outlet obstruction or poor bladder contractility. The only way to distinguish outlet obstruction from poor contractility is with urodynamic testing.

- Urodynamics: This is the "stethoscope" study in the evaluation of incontinence, infections, neurological or obstructive disorders. Urodynamics is a general term for the study of the storage (compliance) and voiding functions of the urinary bladder and outlet. It is the single best way to rule out lower urinary tract obstruction. For this study, a special Foley catheter is passed into the bladder and electrodes (similar to ECG) are placed on the perineum. The electrodes and the catheter are monitored as the bladder is slowly filled and serial measurements of sphincter activity, bladder and urethral pressure and urinary flow rates are taken. Often, x-ray pictures of the bladder are also taken. This test assesses whether or not there is coordinated voiding. Various disease processes such as multiple sclerosis, Parkinson's, or stroke demonstrate their unique urodynamic tracing. Patients with sacral level spinal cord injury usually elicit detrusor areflexia due to de-enervation of the bladder.

- Cystoscopy is done in incontinent patients to evaluate hematuria, rule out a Vesicovaginal fistula or to investigate the patient with recurrent or persistent urinary tract symptoms. It does not help significantly in the setting of functional causes of the disorder.

TREATMENT OF INCONTINENCE

Urge incontinence

Behavioral treatment: The patient with urge incontinence needs to understand that they leak urine because their bladder contracts with little or no warning. The first line of treatment is timed voiding. Often, reminding patients to void every one to two hours during the day, before they get the urge to void, will result in them staying dry. Other behavioral interventions such as reducing fluid intake, avoiding bladder irritants, or bladder cycling and retraining, where the patient attempts to consciously

delay voiding and to increase the interval between voids, may also treat urge incontinence. Pelvic muscle exercises (Kegel maneuvers) can be used to abort a detrusor contraction provided that the patient gets a warning of needing to void prior to the detrusor contraction starting.

Anticholinergic drug treatment: Anticholinergic medications are the mainstay of medical therapy for urge incontinence. Anticholinergics are also used to decrease bladder pressure in patients with poor bladder compliance. Anticholinergics can be combined with clean intermittent catheterization in patients who have a significant PVR prior to treatment, or in patients who develop retention while on anticholinergics. The side effects of anticholinergics include urinary retention, dry mouth, constipation, nausea, blurred vision, tachycardia, drowsiness and confusion. They are contraindicated in patients with narrow-angle glaucoma.

Surgical treatment: Patients with intractable bladder overactivity may require surgical intervention, consisting of neuromodulation with a sacral nerve stimulator or consideration of various forms of bladder augmentation. Injection of the detrusor muscle with botulinum toxin (Botox) has also been successfully used although this a non FDA-approved use. The primary goal in treating the patient with poor compliance is to treat the high bladder pressure. Complete bladder emptying with clean intermittent catheterization combined with anticholinergics will often lower bladder pressure to a safe range. A combination of anticholinergics and alpha-agonists may be required in some patients. Bladder augmentation may be needed when medical management fails.

Overflow Incontinence

Overflow incontinence is treated by emptying the bladder. If the cause of overflow is obstruction, then relieving the obstruction should lead to improved emptying. Anatomic obstruction in males is from either urethral strictures or prostatic obstruction. Depending on the severity of the urethral stricture the patient may require a urethral dilation, internal urethrotomy or a urethroplasty. Prostatic obstruction may be treated in a variety of ways but transurethral resection of the prostate remains the "gold standard." Overflow incontinence due to sphincter dyssynergia as is found in spinal cord injury patients is best treated with surgical sphincterotomy to create a low pressure, total incontinent state. If a woman is obstructed from previous surgery or from pelvic prolapse, she may benefit from urethrolysis or surgical correction of the prolapse. Clean intermittent catheterization is an option in the obstructed patient who does not want or could not tolerate further surgery. Patients with overflow incontinence due to poor bladder contractility or spinal cord injury are best treated with clean intermittent catheterization. Indwelling catheters are not an optimum treatment for overflow incontinence. All patients with indwelling catheters will have infected urine which predisposes them to bladder calculi and ultimately to squamous cell carcinoma of the bladder. Any foreign object in the bladder can also elevate bladder pressure and produce hydronephrosis, ureteral obstruction, renal stones and eventually renal failure.

Stress Incontinence

The amount of incontinence and how it affects the patient determines the aggressiveness of treatment. The patient who is severely restricted because of severe leakage with minimal movement may not want to try medical therapy but may opt for surgical treatment, whereas the patient who leaks small amounts infrequently may choose conservative treatment.

Pelvic floor exercises (Kegel maneuver) can improve anatomic stress urinary incontinence by augmenting closure of the external urethral sphincter and preventing descent and rotation of the bladder neck and urethra. To benefit from these exercises, women must be taught to do them properly and they must actually do them. Adjuncts to learning pelvic floor exercises include the use of weighted vaginal cones, a perineometer or electrical stimulation. Kegel exercises, however, are not usually as effective as surgical intervention.

Alpha-agonists such as pseudoephedrine (Sudafed) may be used to treat stress incontinence. The bladder neck and proximal urethra have abundant alpha-receptors. Activation of these receptors by alpha-agonists leads to an increase in smooth muscle tone. The usual dose is twice daily, but some women who are incontinent with exercise may benefit from taking an alpha-agonist one hour before exercise. Tricyclic antidepressants, such as imipramine (Tofranil), although not FDA approved for incontinence, have both alpha-agonist and anticholinergic properties which can help with this disorder.

Pessaries are devices inserted into the upper vaginal vault that support the bladder neck and can provide relief to the patient with mild to moderate stress incontinence.

Surgical therapy for stress incontinence is indicated when a patient fails or doesn't want medical therapy. The type of surgical therapy depends on the diagnosis. Patients with anatomic stress incontinence can benefit from a variety of surgical repairs that restore the bladder neck to its normal retropubic position, termed retropubic bladder neck suspensions, or that improve urethral support, such as with the sling procedures. Another group of patients, those with intrinsic sphincter deficiency, usually have a well-supported bladder neck, and so they require a procedure that will close or coapt the proximal urethra. Coaptation may be achieved by injecting a variety of bulking agents into the bladder neck or proximal urethra. Alternatively, a pubovaginal sling, placed at the bladder neck, is the ideal procedure for the patient with both intrinsic sphincter deficiency and anatomic stress incontinence, as it will coapt the proximal urethra and restore the bladder neck to its normal location.

Synthetic, mid-urethral slings are ideal for patients with anatomic stress incontinence who seek surgery with minimal recovery time. In randomized surgical trials for stress incontinence the trans-vaginal tape (TVT) mid urethral sling has been shown to be

comparable to a Burch colposuspenion (a formal retropubic suspension) after 6, 12 and 24 months. The newest sling is a transobturator sling that is placed transversely underneath the mid urethra from one obturator foramina to the other. The advantage of this sling is that the retropubic space is avoided with low risk of bladder, bowel or major vessel injury. To date randomized trials comparing mid urethral or transobturator slings to pubovaginal slings have not been performed. Randomized trials comparing mid urethra slings to transobturator slings are in progress. Series have shown that surgical interventions, although more invasive, are more effective than non-surgical treatments.

Mixed Incontinence

Stress and urge incontinence often coexist. Some clinicians advocate pelvic muscle exercises with the help of biofeedback to treat this combined disorder. Behavioral therapy can result in a reduction in incontinence episodes and a patient perceived improvement. Imipramine may also be beneficial in patients with mixed (stress and urge) incontinence. Seventy percent of patients with combined incontinence (stress and urge) will also obtain relief of urge incontinence after a procedure designed to help stress incontinence. Patients whose urge incontinence does not respond to anticholinergics preoperatively may have a good response to anticholinergics once their stress incontinence is treated.

Total Incontinence

Complete or total incontinence is usually due to surgical or traumatic injury to the sphincter such that there is no control and storage capability. This is best treated with condom catheters to avoid chronic skin irritation and breakdown, or by placement of artificial urinary sphincters. Artificial sphincters are hydraulic devices in which a peri-urethral cuff is filled with saline to maintain continence. Voiding is enabled by deflating the cuff for several minutes. These devices are quite effective in coapting the urethral tissue and recreating the natural sphincter mechanism that maintains continence.

INDICATIONS FOR UROLOGY REFERRAL

The main indication to refer patients with incontinence to urology is failure to respond to medical therapy. Hematuria, recurrent infections or complicated incontinence, such as following radical prostatectomy in a male, should also prompt a referral to urology.

SUMMARY: KEY DIAGNOSTIC SIGNS AND SYMPTOMS OF INCONTINENCE

A Urge Incontinence
  a Symptoms
    - urgency
    - frequency
    - nocturia
    - unable to reach the toilet with urge

B Stress Incontinence
  a Symptoms
    - leakage with physical activity
  b Signs
    - bladder neck mobility
    - positive stress test

C Mixed Incontinence
  a Symptoms
    - urgency
    - frequency
    - nocturia
    - unable to reach the toilet with urge
    - leakage with physical activity
  b Signs
    - bladder neck mobility
    - positive stress test

D Overflow Incontinence
  a Symptoms
    - frequency
    - nocturia
    - urgency
    - leakage with physical activity
  b Signs
    - high post void residual

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