VOIDING DYSFUNCTION

EVERYTHING YOU NEED TO KNOW

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He was the first man that Fermina Daza heard urinate. She heard him on their wedding night, while she lay prostrate with seasickness in the stateroom on the ship that was carrying them to France, and the sound of his stallion's stream seemed so potent, so replete with authority, that it increased her terror of the devastation to come. That memory often returned to her as the years weakened the stream, for she never could resign herself to his wetting the rim of the toilet bowl each time he used it. Dr. Urbino tried to convince her, with arguments readily understandable to anyone who wished to understand them, that the mishap was not repeated every day through carelessness on his part, as she insisted, but because of organic reasons: as a young man his stream was so defined and so direct that when he was at school he won contests for marksmanship in filling bottles, but with the ravages of age it was not only decreasing, it was also becoming oblique and scattered, and had at last turned into a fantastic fountain, impossible to control despite his many efforts to direct it. He would say: "The toilet must have been invented by someone who knew nothing about men." He contributed to domestic peace with a quotidian act that was more humiliating than humble: he wiped the rim of the bowl with toilet paper each time he used it. She knew, but never said anything as long as the ammoniac fumes were not too strong in the bathroom, and then she proclaimed, as if she had uncovered a crime: "This stinks like a rabbit hutch." On the eve of old age this physical difficulty inspired Dr. Urbino with the ultimate solution: he urinated sitting down, as she did, which kept the bowl clean and him in a state of grace.

Gabriel Garcia Marquez
Love in the Time of Cholera

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Introduction

The **upper urinary tract** consists of the **kidneys** and **ureters**, as opposed to the **lower urinary tract**, which consists of the **bladder** and **urethra**. While the upper urinary tract functions to **produce** and **conduct** urine, the lower urinary tract serves to provide **storage** and **emptying** of urine.

Voiding dysfunction is a broad term applicable to any situation in which the storage and/or emptying functions go awry, resulting in a variety of symptoms called ***l*ower *u*rinary *t*ract *s*ymptoms (LUTS).** Many people, both male and female, are afflicted with lower urinary tract symptoms. Although LUTS tend to increase with the aging process, they are by no means isolated to the elderly population, and can occur in children as well as young and middle-aged adults. These symptoms run the gamut from failure of storage, known as **urinary incontinence**, to failure of emptying, known as **urinary retention**. Between these two extremes, there are many possibilities, broadly classified into **irritative** and **obstructive** lower urinary tract symptoms.

Irritative LUTS consist of the following:

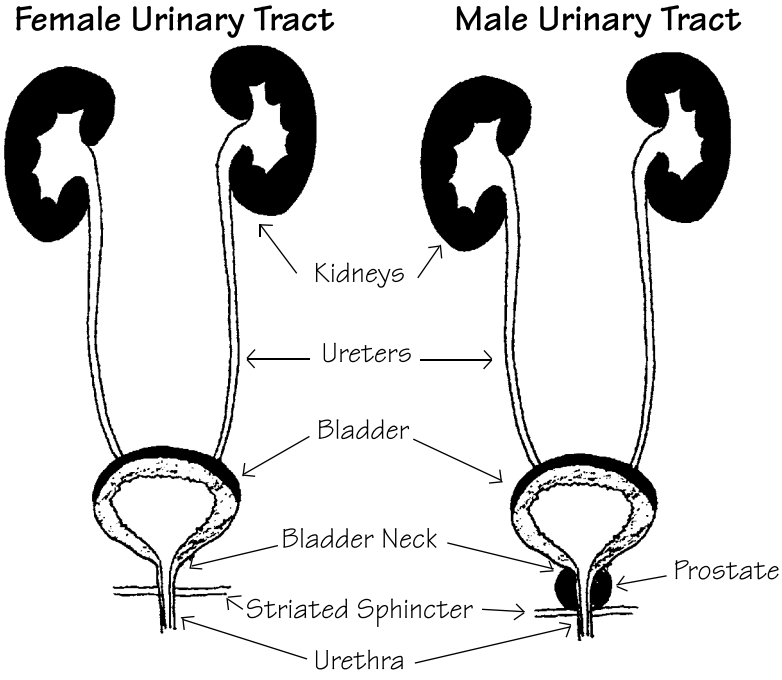
- **frequency** – urinating much more often than normal
- **nocturia** – awakening from sleep to urinate
- **urgency** – the sudden and strong desire to urinate
- **precipitancy** – the need to get to the toilet in a hurry
- **urgency incontinence** – the sudden and strong desire to urinate with an inability to get to the toilet in time to prevent leakage

Obstructive LUTS consist of the following:

- **hesitancy** – a stream that is slow to start
- **weak stream** – a stream that lacks force
- **narrow caliber stream** – a thin stream
- **intermittency** – a stream that starts and stops
- **straining** – the need to use abdominal muscles to generate a stream
- **prolonged emptying time** – excessive voiding time
- **incomplete emptying** – the sensation of partial fullness in the bladder after completion of urination

Basic Anatomy of the Urinary Tract

To better understand lower urinary tract dysfunction, it is important to have a basic understanding of normal urinary tract anatomy and function. The **kidneys** are paired organs that constantly filter blood, removing liquid waste in the form of urine. Urine flows down the **ureters**, thin tubes that connect the kidneys to the urinary bladder. The **bladder** is a balloon-like, muscular organ that functions to store and empty urine. The **urethra** is a thin tube that conveys urine from the bladder out of the body. The **sphincters** are muscles that surround the urethra and function to pinch the urethra closed during urinary storage and allow the urethra to open during emptying. The **bladder neck sphincter** is located at the junction of the bladder and urethra. The **striated sphincter** is located just beyond the prostate gland in men and in the mid-urethra in women. The **prostate gland** is part of the male reproductive system, functioning to produce a component of the semen that provides nutrition and motility for sperm. The prostate completely surrounds the urethra and is located between the bladder neck and striated sphincters. The **pelvic floor muscles** are hammock-like muscles that provide support for the pelvic organs, including the bladder and urethra.



Basic Physiology of the Urinary Tract

The lower urinary tract is able to store and empty urine successfully by virtue of certain properties of the bladder and urethra:

- **Capacity**—The average adult has a bladder that typically holds about 12 ounces before the urgent need to urinate arises. If the bladder does not have adequate capacity, storage problems will result.
- **Elasticity**—The bladder is stretchy and compliant, meaning that as volume increases during storage there is minimal increase in bladder pressure. Low-pressure storage is essential for avoiding urinary leakage.
- **Sensation**— Bladder nerves allow us to feel an increasing sense of urgency as volume increases. Impaired sensation will result in us never getting the signal that we need to urinate.
- **Contractility**—After feeling the urge to urinate, our bladders are able to squeeze (contract), increasing bladder pressure sufficiently in order to expel urine out of the bladder. If our ability to contract our bladder is impaired, then we are unable to empty properly.
- **Timing**— A bladder contraction must occur on a timely basis: if the bladder squeezes prematurely "without its owner's permission", then we can perceive sudden urgency, a need to run to the bathroom at an inopportune time, and perhaps urinary leakage.
- **Position**—Our lower urinary tract is maintained in proper position by virtue of certain muscles and supporting structures that create a floor below the bladder and urethra and anchor the bladder and urethra to the pelvic side walls. Defects in support to the lower urinary tract in females often occur after childbirth and can result in a range of LUTS ranging from incontinence to obstructive symptoms.
- **Sphincters**—The bladder neck and striated sphincters function to keep the urethra pinched closed during storage and allow the urethra to open during emptying. If they do not function properly, incontinence will result. If they fail to relax at the time that we desire to urinate, obstructive symptoms can occur.

- **Nerves**—The seemingly "simple" act of emptying our bladder is actually a highly complex event, requiring an intact nervous system that allows sensation of bladder filling, and contraction of the bladder muscle along with synchronous and coordinated relaxation of the sphincter muscles. In certain neurological disorders, such as spinal cord injury and multiple sclerosis, uncoordinated voiding results in high bladder pressures and obstructive symptoms. The bladder, the bladder neck, and the striated sphincter each essentially have a unique nerve responsible for its function, and because of the important relationship of the nervous system to lower urinary tract functioning, almost any neurological process can cause voiding dysfunction.

A Simplified Way Of Thinking about Voiding Dysfunction

Keeping in mind three basic principles can help explain most voiding dysfunction:

Principle # 1
Voiding dysfunction can be divided into problems of **storage** and problems of **emptying**. However, it is possible to have both problems at the same time—for example, when the bladder becomes over-distended because of emptying issues, urine may overflow, thus creating storage issues.

Principle # 2
Causes of voiding dysfunction can be divided into problems of **bladder origin,** problems of **urethral origin,** and problems of **non-bladder, non-urethral origin**. For example, a bladder that does not contract adequately, or alternatively, a urethra obstructed by an enlarged prostate gland, may cause obstructive LUTS.

Principle # 3
Lower urinary tract function has everything to do with the physics of **pressure**. Emptying will always occur when the pressure in the bladder is greater than the pressure in the urethra. Storage will always occur when the pressure in the bladder is less than the pressure in the urethra.

Causes of LUTS

Urethral Causes

- **Prostate gland enlargement or cancer** causing urethral obstruction
- **Scar tissue** in the urethra causing obstruction (urethral stricture)
- **Dropped bladder (cystocele)** in females causing urethral obstruction
- **Failure to relax the urethral sphincter muscles** causing urethral obstruction
- **Lax urethral support or poor urethral sphincter function** due to factors including: childbirth, vaginal or pelvic surgery, pelvic trauma, radiation, or neurological conditions causing incontinence

Bladder Causes

- **Bladder irritation** caused by bladder infections, bladder stones, bladder cancer, interstitial cystitis, etc.
- **Bladder over-activity:** Defined as a bladder that "squeezes without its owner's permission" that can occur as a consequence of obstruction from prostate enlargement in men or a cystocele in women, although in many cases occurs without any underlying cause.
- **Small anatomical bladder capacity** that can be a condition that one is born with or can be acquired on the basis of scarring, radiation, etc.
- **Hyper-sensitive bladder:** People have varying degrees of sensitivity to touch, pain, temperature, etc., and those with heightened bladder sensitivity tend to feel full with low volumes and develop LUTS.
- **Learned voiding dysfunction:** A condition in which the bladder is capable of storing a normal volume, but because of a learned bad habit of excessive focus on the bladder, the initial sensation of fullness is responded to by seeking a bathroom.
- **Bladder under-activity (Impaired bladder contractility):** As a consequence of the bladder not squeezing properly, residual urine remains in the bladder, giving rise to LUTS since the bladder is always partially filled.
- **Extrinsic pressure on the bladder:** The urgency that occurs as a result of the bladder being full can also occur if the bladder is pushed upon by adjacent structures. This is a nearly universal occurrence in pregnancy and is often seen with uterine fibroids or rectal fullness due to gas or constipation, although it can be caused by any pelvic mass.

Non-Urethral, Non-Bladder Causes

- **Excessive fluid intake:** The intake of large volumes of fluids, particularly beverages containing caffeine (coffee, tea, cola, and chocolate) can lead to excessive urinary frequency and other irritative LUTS. There is a prevalent misconception that 8-10 glasses of water per day are necessary for good health. Although water is important for many bodily functions and to prevent dehydration, excessive fluid intake can have serious consequences including, for example, electrolyte imbalance. My advice is to drink in accordance with your thirst just as you would sleep in accordance with your fatigue level.
- **Diuretics** are commonly prescribed medications that cause the kidneys to increase urine production, resulting in LUTS.
- **Anxiety and stress:** The bladder is a convenient outlet for stress and some people "channel" their anxiety to this organ, resulting in LUTS.
- **Physiologic nocturnal diuresis:** Urine production is often increased during sleeping hours. Often, the urine volume produced in the 8 sleeping hours is similar to that produced in the 16 awake hours. This phenomenon occurs more frequently as we age. This situation can be amenable to management with a synthetic hormone, ***DDAVP (Vasopressin),*** which works by reducing production of urine by the kidneys.
- **Poor sleeping habits**: Some people urinate at night simply because they are sleeping poorly, not because they have urinary urgency.
- **Obstructive sleep apnea:** Sleep apnea is a well-recognized cause of nocturia.
- **Peripheral edema:** Edema is fluid in the soft tissues (usually the ankles) that tends to accumulate with gravity over the course of the day. Upon assuming the recumbent position when sleeping, this fluid returns to the circulation, causing the kidneys to increase urine production.
- **Neurological causes:** Any neurological disease can have a profound effect on the bladder, giving rise to significant LUTS. Included are stroke, multiple sclerosis, spinal cord injury, Parkinson's disease, etc.
- **Systemic diseases:** Diabetes mellitus, diabetes insipidus, kidney insufficiency, and congestive heart failure are just a few examples of diseases that can increase urine volume and thus give rise to LUTS.

The Prostate

The prostate is an organ of the male reproductive system that functions to produce prostate fluid, a milky liquid that serves as a nutrient vehicle for sperm. Similar to the breast, the prostate consists of numerous glands that produce this fluid and ducts that convey the fluid into the urethra. At the time of the male climax, the smooth muscle within the prostate squeezes and forces the fluid out of the glands through the prostate ducts into the urethra, where it mixes with secretions from the other male reproductive organs to form the semen. The prostate gland completely surrounds the urethra, enabling its many ducts to drain into the urethra. However, this necessary anatomical relationship between the prostate and the urethra can potentially be the source of many troubles for the aging male.

The term applied to prostate enlargement is **Benign Prostatic Hyperplasia (BPH).** BPH is considered to be one of the most common diseases of aging men and can be associated with bothersome lower urinary tract symptoms (LUTS) that affect quality of life by interfering with normal daily activities and sleep patterns. The complaints of patients with BPH are typically urinary frequency, urgency, nocturia, weakened and intermittent stream, and the sensation of incomplete bladder emptying. The relationship between BPH and LUTS is complex because not all men with BPH develop LUTS, and LUTS are neither specific to nor exclusive to BPH. It is important to identify other conditions that can mimic BPH, including urinary tract infections, prostate cancer, urethral stricture, and impaired bladder contractility.

Aging, genetic, and hormonal factors cause the prostate gland to gradually enlarge. The prostate gland typically starts to enlarge at about 40 years of age. The two prerequisites for prostate growth are the presence of the testicles and aging. Men who have been castrated (had their testicles removed) prior to puberty never develop any prostate growth. The prostate gland is about the size of a walnut in early adulthood and can increase to a variable extent, ranging in size from a ping-pong ball to a large navel orange. As the prostate grows (hypertrophies), it may put pressure on the urethra, much as a hand squeezing a garden hose can affect the flow through the hose. Although larger prostates tend to cause more “crimping” than smaller prostates, the relationship is not precise and a small prostate

can, in fact, cause more symptoms than a large prostate, much as a small hand squeezing a garden hose tightly may affect flow more than a larger hand squeezing gently. The factors of concern are precisely where in the prostate the enlargement is and how tight the squeeze is on the urethra. In other words, prostate enlargement in a location immediately adjacent to the urethra will cause more symptoms than prostate enlargement in a more peripheral location. Also, the prostate gland and the urethra contain a generous supply of muscle and, depending upon the tone of the prostate, variable symptoms may result. In fact, the tone of the prostate smooth muscle can change from moment to moment depending upon one's adrenaline level. In situations of high anxiety, adrenaline levels are higher, resulting in tighter prostate and urethral tone. This is known as **dynamic obstruction,** as opposed to s**tatic obstruction,** which is defined as the obstructing, mechanical effect of the enlarged prostate tissue.

Our bodies have an absolutely remarkable ability to adapt to changes, and this ability has been well documented in the lower urinary tract. As the prostate enlarges and causes urethral restriction, the bladder must work harder in order to generate more pressure to get the urine through this restriction. Thus, with prostate obstruction there is loss of bladder compliance, as the bladder becomes more rigid and less stretchy and elastic. The bladder muscle thickens, producing the characteristic ribbed appearance of prominent interlacing muscle fibers known as ***bladder trabeculation*.** This is a situation analogous to what happens to a weight trainer who gets enlargement of the biceps muscle as a response to flexing the arms against the resistance of weights. As the obstruction increases, there can be out pouching of the innermost layer of the bladder through hypertrophied muscle fibers, forming ***bladder diverticula***. As the prostate continues to enlarge, the bladder will continue to compensate. This process of prostate growth and consequent bladder ***compensation*** is slow and gradual, occurring insidiously over the course of many years. However, although prostate growth can continue indefinitely, bladder compensation cannot. The bladder muscle has a limitation on the thickness that can be achieved—once maximized, no further compensation can occur and the bladder can no longer generate pressures great enough to overcome the resistance caused by continued prostate growth. So, initially the bladder compensates, increasing the thickness of its musculature in order to be able to increase voiding pressures. Once the

bladder maximizes its thickness, the process of ***decompensation*** can occur. Untreated, this decompensation progresses with dilatation of the bladder, and at this point, urine tends to be retained in the bladder after voiding, known as ***residual urine,*** setting the stage for recurrent urinary infections and bladder stones. As the bladder musculature gets flabbier and loses tone, there is increasing difficulty in emptying the bladder, which culminates in ***urinary retention,*** an inability to empty the bladder at all. Eventually, the decompensated bladder can back up to the upper urinary tracts, causing swelling of the ureters and kidneys (***hydronephrosis***) and deterioration in kidney function (***renal insufficiency***).

Prostate enlargement can be present without any symptoms whatsoever because of the compensation process, or alternatively, may cause pure obstructive LUTS, pure irritative LUTS, or mixed obstructive and irritative LUTS. Prostate enlargement may also sometimes present with ***acute urinary retention***, in which severe pain accompanies the acute inability to urinate—a situation that often develops without any perception of symptoms prior to the inability to urinate—also explainable on the basis of the compensation process. Prostate enlargement may also sometimes present with ***chronic urinary retention***, in which a long-term obstruction engendering a decompensated bladder produces LUTS (often frequency and incontinence) on the basis of very high residual volumes, sometimes in excess of two liters of urine. Unlike acute urinary retention, chronic urinary retention is painless, as the gradual increasing residual volume over a prolonged time period blunts the sensation of urgency that normally accompanies the filling process.

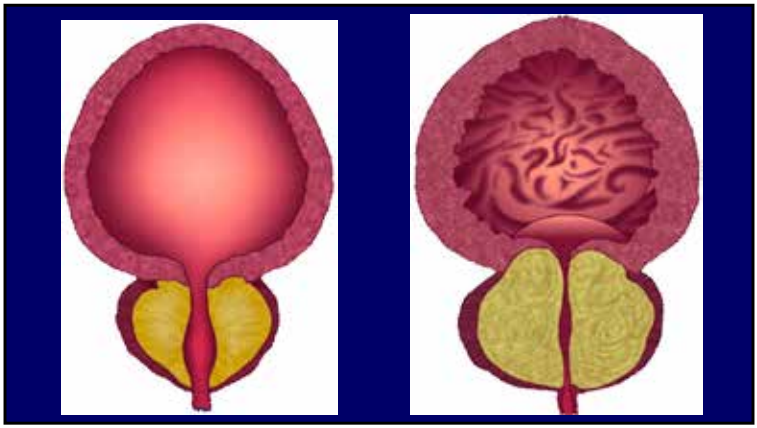
Symptoms due to prostate enlargement may be on the basis of mechanical obstruction of the urethra, compensatory changes of the bladder, or from both. Bladder compensation may induce certain changes including elevated residual urine volumes, urinary infections, bladder stones, bladder diverticula, and bladder over-activity, each of which, in and of themselves, can cause specific lower urinary tract symptoms. Obstructive symptoms caused by prostate enlargement are simple to understand by virtue of the mechanical obstruction created by the enlarged prostate impinging upon the urethra. Irritative symptoms on the basis of prostate enlargement may be caused by such problems as the presence of residual urine, causing urgency and

frequency because the bladder always starts off somewhat full. The presence of residual urine may also be a setup for ***urinary infections*** and ***bladder stones***, which often can manifest with irritative symptoms. The simple presence of a thick, muscular, compensated bladder is enough to create bladder irritability and thus induce irritative symptoms. ***Bladder diverticula*** may occur as part of the compensation process and may become quite large; because they have no muscular backing, they tend to fill up with urine during the voiding process and not empty. They may be a source of residual urine, infections, stones, and irritative symptoms.

The situation is made more complex by other factors that may further modify and affect the lower urinary tract symptoms. ***Anxiety and stress*** increase the secretion of adrenaline, which causes increased prostate and urethral smooth muscle tone that may further compromise urinary outflow. ***Over-zealous drinking*** can make matters worse by placing more demands on an already over-taxed lower urinary tract. ***Medications*** can influence LUTS—particularly water pills (diuretics) that increase urine output, and cold and allergy medications that can decrease bladder contractility and increase prostate and urethral smooth muscle tone to a degree such that urinary retention can occur. The ***slow and insidious nature of prostate enlargement and bladder compensation*** may cause such gradual symptomatic progression that symptoms are barely noticed. The ***often-stoic male personality***, who tends to deny the existence of medical problems, further confounds these issues. The ***ambulatory status*** of the individual can be an important factor—for example, the presence of arthritis of the knees may be a factor that prevents a person with LUTS from getting to the bathroom on a timely basis. ***Bowel status*** can also be an important factor—constipation may allow rectal contents to put pressure on the bladder, further exacerbating obstructive and irritative LUTS. ***Time of day*** can play a profound role with respect to how pronounced symptoms are. Many men report that their nocturnal and first morning voids are the most difficult of the day, with a general easing up of symptoms occurring as the day progresses. Nobody is quite sure how to explain this cyclical phenomenon; I feel that it may be related to the status of the sphincter muscles. Remember that in order to void, synchronous and coordinated contraction of the bladder muscle needs to occur simultaneously with relaxation of the sphincter muscles. The striated sphincter is a skeletal muscle under voluntary control

and during sleep and early AM hours, our skeletal muscles, of which the striated sphincter is included, tend to be somewhat rigid in tone. As difficult as it would be to jump out of bed and start exercising immediately without limbering and warming up, it is equally difficult to relax the striated muscle on an immediate basis, and this may well contribute to the nocturnal and first morning exacerbation in obstructive LUTS.

Many men with prostate enlargement do not require treatment. However, under certain circumstances, there are compelling reasons to treat this condition. The most common reason to treat BPH is the **presence of lower urinary tract symptoms that are interfering with one's quality of life**. Since the impact of LUTS on the patient's quality of life is highly variable, the patient's perception of the severity of the condition and the degree to which it interferes with his lifestyle or causes embarrassment should be the primary consideration when opting for treatment. **Acute** and **chronic urinary retention, recurrent urinary infections, bladder stones and renal insufficiency mandate treatment.**



Normal Bladder and Prostate

Enlarged Prostate with Compensated Bladder

How are LUTS Evaluated?

Many possible urinary tract problems can produce similar, if not identical, lower urinary tract symptoms as BPH. Examples are the following: prostate cancer, bladder cancer, urethral strictures, urinary infections, bladder stones, impaired bladder contractility, and overactive bladder. The challenge in patients with LUTS is to definitively establish that the symptoms are due to BPH.

The starting point of the evaluation of BPH is a thorough ***history and physical examination.*** The history will attempt to determine the duration and severity as well as prior management of the LUTS. The presence of the following symptoms will be reviewed**:** blood in the urine, difficult urination, painful urination, burning with or after urination, urinary infections, cloudy urine, foul smelling urine, urinary hesitancy, weak quality stream, the need to strain to pass urine, spraying or split stream, intermittent urinary stream, prolonged emptying time, sensation of incomplete emptying, the need to urinate twice or more to empty, post-void dribbling, frequent urinating, urinary urgency, urinary retention, nighttime urinating, difficulty urinating at night but not during day, leakage on way to the toilet, leakage with putting the key in the door to your home, leakage with cold weather, leakage with running water, leakage without awareness, leakage while sleeping, leakage when getting out of the car, leakage with: walking, running, sneezing, coughing, laughing, shouting, stair climbing, lifting, bending, standing, sports, intercourse, orgasm or sitting quietly, continuous leakage, the need to use pads, kidney stones, and/or urethral discharge.

Past medical history, particularly the presence of diabetes and neurological diseases, is essential information. Prior surgical history will be ascertained. A complete discussion of all medications is important because of the profound effect on urinary function that many medications have. Fluid intake patterns, mobility issues, bowel habits, and sexual function all need to be addressed. Family history of BPH or prostate cancer needs to be reviewed.

Physical examination will include examination of the abdomen for the presence of lower abdominal fullness that may be indicative of a bladder that empties poorly. Examination of the lower extremities

will rule out the presence of edema. A thorough examination of the genitalia and DRE (digital rectal exam) is performed. The DRE will demonstrate sphincter tone, the presence of fecal impaction, and enlargement or irregularity of the prostate gland.

Depending on the findings at the time of the history and physical examination, some of the following tests will need to be performed in order to establish the precise diagnosis and enable proper treatment:

Prostate Symptom Score (see Appendix 1) is a symptom-scoring tool used in the initial assessment. Since most patients who seek treatment for BPH do so because symptoms alter quality of life, symptom quantification is of major importance in determining the severity of the problem, the response to treatment, and in detecting symptomatic progression in men managed by watchful waiting. Classification ranges from mild (0 to 7), moderate (8 to 19) or severe (20 to 35).

Urinalysis is a dipstick and microscopic examination of the urine that will test for the presence of sugar in the urine (possibly indicating the presence of diabetes), protein in the urine (possibly indicating kidney disease), and pus cells and bacteria in the urine (often indicative of a urinary tract infection), as well as the presence of blood in the urine (which may indicate an abnormality in the urinary tract).

Urine Culture is a test to see if bacteria are present in the urine, and if so, what particular type of bacteria.

Urinary Cytology is a "PAP smear" of voided urine. A specimen is sent to a laboratory where a pathologist will examine it microscopically. This test can detect early cancers of the bladder and urinary tract and is useful in the evaluation of blood in the urine and irritative LUTS.

PSA is a blood test that can indicate the presence of prostate disease. Because prostate cancer is one of the potential causes of LUTS, PSA together with the digital rectal exam is very beneficial in helping exclude prostate cancer as a diagnosis. However, an elevated PSA is not specific for prostate cancer and can occur on the basis of prostate enlargement alone; in fact, serum PSA measurement has been shown to have a good correlation with prostate size. Refinements in PSA testing including ***PSA velocity*** (change in PSA over time), ***PSA***

density (PSA corrected for the size of the prostate), and the ***free/total PSA ratio*** (the higher the ratio, the greater the chance that the PSA elevation is due to BPH) may help diagnostic specificity.

Creatinine is a blood test that indicates how well the kidneys are functioning. It is particularly useful when a man is in urinary retention to detect whether the kidneys have been adversely affected by the "back up" of urine in the bladder.

Post-void residual volume is the amount of urine remaining in the bladder immediately following urination. The preferred method of determining this volume is via a hand-held ultrasound device known as a bladder scanner, although the measurement can also be obtained by passing a small hollow tube (catheter) into the urinary bladder.

Voiding Diary (see Appendix 2) is a 24 hour record of urination in which the time of urination and the precise volume of urination is recorded by the patient. This is a simple and objective means of documenting the frequency of urination as well as the bladder capacity.

Uroflowmetry is a recording of the force of urinary flow, that simply requires urinating into an electronic device.

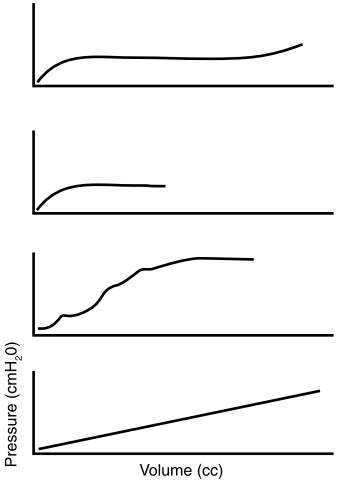
The "normal" uroflow is bell-shaped with the average flow 15 cc/sec and peak flow 25cc/sec.

The abdominal "straining" pattern may be indicative of urinating by straining the abdominal muscles.

The "plateau" pattern is seen with prostate and urethral obstruction, and bladder muscles that are not able to generate satisfactory pressures.

Filling Cystometry is a test used to assess the function of the bladder during storage (sensation, compliance, capacity, over-activity) by measuring the pressure and volume relationship. After urination, a small catheter is placed in the bladder and the residual volume is

recorded. Next, the bladder is slowly filled with fluid while an electronic device records the volume of fluid instilled and the pressure within the bladder. The first desire to urinate typically occurs at about 3 to 5 ounces, a more urgent desire at about 8 to 10 ounces, and the capacity at about 12 to 15 ounces. The normal bladder is compliant (elastic, stretchy, and accommodating), meaning that the pressure in the bladder when full is not much different from the pressure when the bladder is empty. The normal bladder does not contract (squeeze) until its owner wishes it to do so.



Normal

"Hypersensitive" bladder

"Overactive" bladder *(bladder squeezes without its owner's permission)*

"Poorly compliant" bladder *(significant pressure increase for each increment in volume*

Voiding Cystometry (Pressure-Flow Study) is a test used to distinguish *obstruction* from *impaired bladder contractility (weak bladder)*, both of which can present with the same obstructive LUTS. During voiding, urinary flow rate and bladder pressure are measured and recorded. In general, low flow/low pressure implies impaired contractility and low flow/high pressure implies obstruction.

Pelvic Floor EMG (Electromyography) is a simple test of pelvic floor activity during the filling and voiding phases of urination. Patch electrodes (similar to EKG pads) are placed adjacent to the anal area. Usually, there is *increasing activity* during filling and *relaxation* during the voiding phase.

Imaging There are a variety of methods of obtaining anatomical images of the urinary tract using radiological studies. Ultrasonography of the urinary tract is a painless, radiation-free, absolutely safe means of imaging the upper and lower urinary tracts. It can demonstrate obstruction of the kidneys, kidney abnormalities, kidney stones, residual urine volume, prostate size, bladder wall thickness, the presence of bladder diverticula and bladder stones, as well as other valuable information.

Cystoscopy is a test in a which a tiny, lighted, flexible instrument attached to a camera is inserted to visually inspect the urethra, prostate, and bladder. Anesthetic jelly is placed within the urethra to minimize any discomfort. This is a very helpful test to assess the size and shape of the prostate, trabeculation (visible ruffles and ridges often seen with prostate enlargement and bladder over-activity), diverticula, stones, and tumors of the urinary bladder.

How is BPH treated?

Patients with mild symptoms or even with more severe symptoms that are not bothersome can be managed expectantly (“watchful waiting”) with periodic re-evaluation. The degree to which BPH patients are bothered by LUTS varies greatly among individuals with the same severity of symptoms, although generally there is a direct relationship between symptom severity and interference with quality of life. Treatment options are: watchful waiting, medications, minimally-invasive surgical therapy, and standard surgery.

Table 1 **Treatment options for BPH**

Watchful Waiting

Treatment with Medication

Alpha Blockers

- Hytrin (Terazosin)
- Cardura (Doxazosin)
- Flomax (Tamsulosin)
- Uroxatral (Alfuzosin)
- Rapaflo (Silodosin)

5 Alpha-reductase inhibitors

- Proscar (Finasteride)
- Avodart (Dutasteride)

Combination Therapy (alpha blocker plus 5 alpha-reductase inhibitor)

- Jalyn (Dutasteride & Tamsulosin)

Phytotherapy (use of plant extracts)

Minimally-Invasive Therapy

- Transurethral microwave heat treatments
- Transurethral needle ablation
- UroLift

Surgery

- Transurethral resection of the prostate
- Transurethral incision of the prostate
- Transurethral electrovaporization
- Transurethral laser therapy
- Open prostatectomy

Watchful Waiting

This is the preferred management option for patients with mild LUTS, and is also appropriate for men with more severe symptoms who are not greatly bothered by them. It is not appropriate management for men who have developed a complication of BPH such as urinary retention, recurrent infections, kidney insufficiency, etc. This is careful periodic monitoring, but no active treatment. Monitoring is typically on either a 6-month or annual basis and involves a discussion of symptom changes, a digital rectal exam, urinalysis, PSA, and perhaps a bladder scan to reassess post-void residual volume. When circumstances change, more aggressive therapy can be offered.

Treatment with Medication

The medical treatment of BPH includes alpha blockers, 5 alpha-reductase inhibitors, combination therapy, and phytotherapy (use of plant extracts). These treatments are generally reserved for symptomatic and bothersome LUTS. Although not as effective as surgery, they can provide adequate symptomatic relief.

Alpha blockers include Hytrin (Terazosin), Cardura (Doxazosin), Flomax (Tamsulosin), Uroxatral (Alfuzosin), and Rapaflo (Silodosin). They are all appropriate options for men with LUTS due to BPH. They are more or less equal in effectiveness, with slight differences in adverse effects. This class of medication relaxes prostate and urethral smooth muscle, relieving the "dynamic" element of prostate obstruction due to excessive muscle tone of the prostate. These medications do not change the size of the prostate, which may continue to grow. You should note improvement in LUTS in a relatively short period of time, typically within several weeks. The major adverse effects with alpha blockers are decreased blood pressure upon standing up (othostatic hypotension), dizziness, fatigue, ejaculatory problems, and nasal congestion. Hytrin and Cardura are medications originally formulated for treating high blood pressure. They work by relaxing arterial muscle and similarly will relax the muscle tone of the prostate and bladder neck. These medications can cause ejaculatory disturbances—because of effective prostate and urethral smooth muscle relaxation, semen tends to take the path of least resistance into the bladder. This "retrograde ejaculation" results in absent or decreased ejaculatory volume.

5 Alpha-reductase inhibitors include Proscar (Finasteride) and Avodart (Dutasteride). These medications are used for the treatment of LUTS associated with demonstrable prostate enlargement. They work by decreasing DHT (dihydrotestosterone), a potent male hormone that causes prostate growth. These medications will actually shrink the prostate gland and ultimately stabilize further growth. The decrease in size of the prostate is a gradual process and a trial for at least six months is necessary before symptomatic improvement is noted. This class of medication is not appropriate treatment when LUTS are present in the absence of prostate enlargement. 5 Alpha-reductase inhibitors are less effective than alpha blockers in improving LUTS,

but have the potential of changing the natural history of BPH—men on such medications have a decreased chance of the BPH progressing to cause *urinary retention* and a decreased likelihood of the *need for surgery* for BPH. Patients with symptomatic BPH but without significant bother may be offered such medication to prevent the possibility of acute urinary retention and the potential for BPH-related surgery. These medications need to be used on an indefinite basis and sexually-related adverse effects including decreased libido, erectile dysfunction and decreased ejaculate volume have been described. Finasteride in a lower dosage (Propecia) has been used effectively for the treatment of male pattern baldness.

5 Alpha-reductase inhibitors work by blocking the conversion of testosterone to dihydrotestosterone (DHT), which is the form of testosterone that is active in inducing prostate growth. PSA is generally lowered by 50%, but this does not mask the PSA-based detection of prostate cancer. Studies have demonstrated that this class of medication has the potential of decreasing the incidence of prostate cancer, resulting in a prostate cancer risk reduction of approximately 25%.

Combination Therapy (alpha blocker plus 5 alpha-reductase inhibitor) is appropriate and effective treatment for men with symptomatic LUTS associated with demonstrable prostate enlargement. Combination therapy appears to be more effective in relieving and preventing the progression of LUTS than either individual therapy alone.

Phytotherapy
These agents, derived from plant sources, have been used extensively on a worldwide basis for the treatment of LUTS. However, the disparities in the raw products, variations in extraction techniques, and lack of identity of the active component all impinge on the ability of the manufacturers to ensure product potency and product-to-product consistency. Despite their widespread usage, the mechanisms of action, effectiveness, and safety of these agents have not been well established. The most popular agent is ***Saw Palmetto*** (***Serenoa repens)***.

Minimally-Invasive Therapies

Thermal-based therapies
The principle of thermal-based therapies is heating the prostate to high temperatures, causing coagulation necrosis (destruction) of prostate tissue, and thus alleviation of the prostatic obstruction. Means of achieving the high temperatures are via a variety of energy sources, including microwaves, radio frequency waves, high-intensity ultrasound, hot water, and laser. In general, trans-urethral heat treatment is more effective than medical therapy but less effective than surgery in relieving LUTS. One advantage of these techniques is that they can be performed in the office under local anesthesia with sedation, versus surgery, which requires an operating room in the hospital, and general or regional anesthesia.

UroLift
UroLift is a new minimally invasive means of treating prostate obstruction by placing implants within the prostate under cystoscopy guidance that compress the obstructing prostate tissue. It results in opening the urethra so that the prostate no longer blocks the outflow of urine while leaving the prostate intact and does not use cutting, heating or removal of prostate tissue. Its advantages are less bleeding and preservation of erectile and ejaculatory function. It is not applicable to all men with prostate enlargement but is appropriate for certain prostate anatomies and sizes.

Surgery

Patients who have developed serious complications of BPH, such as acute urinary retention, renal insufficiency, recurrent urinary infections, recurrent urinary bleeding, large bladder diverticula, or bladder stones, are best treated with surgery. Surgery may be an appropriate initial choice of treatment if warranted by very bothersome symptoms. The choice of surgical approach (open versus cystoscopic) and energy source (electrocautery versus laser) are technical decisions based upon the size of the prostate, the urologist's judgment, and the patient's health. Most patients will have tried medical therapy before considering surgery.

Transurethral resection of the prostate (TURP)
This is a time tested procedure to alleviate obstructive LUTS. Under general or regional anesthesia, the inner portion of the prostate is removed (resected) using a cystoscopic approach via the urethra, with no external incision. An electric cutting loop is moved through the prostate under direct visual guidance, removing the obstructing component of the prostate in piecemeal fashion, and leaving behind the remaining normal prostate tissue. At the end of the procedure, all of the prostate "chips" are irrigated out of the bladder and submitted for pathological examination. TURP usually entails a 24-hour stay in the hospital and use of a catheter for several days. In general, this procedure will result in marked improvement of obstructive LUTS, and ultimate improvement or resolution of irritative LUTS in 65% of men. Potential adverse effects include a small risk of urinary incontinence and erectile dysfunction, and a 90% chance of retrograde ejaculation. A small percent of men can develop scar tissue in the bladder neck (bladder neck contracture) or scar tissue in the urethra (urethral stricture).

Transurethral incision of the prostate (TUIP)
This is an outpatient cystoscopic procedure limited to relatively smaller prostates in which several cuts are made into the prostate using a cautery knife, alleviating the obstruction by "springing open" the prostate. In the properly selected patient, this can be a simple and very effective technique that has the advantage of a reduced risk of retrograde ejaculation as compared to TURP.

Transurethral electrovaporization of the prostate
In this procedure, a roller ball electrode under cystoscopic control is used to vaporize obstructing prostatic tissue, without actually removing any tissue. Similar to a TURP, it requires anesthesia and a catheter. Irritative LUTS, burning with urination, and urinary retention appear to occur more commonly after this procedure as compared with TURP.

Laser therapy
Laser energy can be used to cause destruction of the obstructing prostate tissue (***transurethral laser coagulation***), vaporization of tissue (***transurethral laser vaporization***), or resection of tissue (***transurethral laser resection/enucleation***). The GreenLight PVP laser procedure (Photoselective Vaporization of the Prostate) combines the

effectiveness of TURP, the surgical "gold standard", with the safety and ease of minimally invasive heat treatments. The GreenLight PVP laser procedure uses a very high powered laser to vaporize prostate tissue. Most patients return home a few hours after the procedure and can return to normal activities within days.

Robotic prostatectomy
This is a surgical technique in which the obstructing part of the prostate is removed via a tiny incision in the lower abdomen using robotic technology. This procedure is reserved for considerably enlarged prostates in which less invasive procedures would not be considerations because of the size of the prostate gland. The enlarged prostate can be thought of as a navel orange with the "fruit" of the orange representing the obstructing adenoma (benign growth of prostate tissue) and the "rind" representing the compressed prostate capsule. Just as a tissue plane exists between the fruity part of the orange and the rind, a distinct surgical plane exists between the adenoma and the capsule. Prostatectomy involves opening the prostate capsule, entering this surgical plane, removing the adenoma, and repairing the capsule. Prostatectomy usually entails an overnight stay in the hospital and the temporary use of a catheter. In the properly selected patient, this can be a simple, rapid, and very effective technique in alleviating LUTS due to a very enlarged prostate.

Management of the complications of BPH

Acute Urinary Retention
The patient in acute urinary retention usually presents to the office or emergency room in dire straits, with severe urgency and lower abdominal pain due to a distended urinary bladder. He will require a urethral catheter to provide drainage to the bladder. Catheters are hollow tubes that can be used on a temporary or permanent basis. Consideration for permanent catheter usage is generally reserved for high-risk BPH patients, particularly medically-compromised men in urinary retention who are too fragile to undergo a surgical procedure to alleviate the BPH and have failed to respond to medical therapy.

Chronic Urinary Retention
Long-term obstruction can result in an over-stretched, flabby "decompensated" bladder. The resultant LUTS, often frequency and

urinary incontinence, are on the basis of very high residual volumes, sometimes in excess of two liters of urine. As distinguished from acute urinary retention, chronic urinary retention is painless, as the gradual increasing residual volume over a prolonged time period blunts the sensation of urgency. Patients with chronic retention are often discovered on the basis of the aforementioned symptoms, but often incidentally when imaging studies reveal massive bladder distension and swelling of the ureters and kidneys (hydronephrosis), or laboratory studies demonstrate renal insufficiency. The initial management is the placement of a urethral catheter to drain the bladder and hopefully allow resolution of the hydronephrosis and renal insufficiency. Unfortunately, normal bladder contractility may never come back, and after sufficient time allowed for catheter decompression of the urinary tract, urodynamics will need to be performed to assess bladder contractility and the possible need for surgery to provide a benefit. If the bladder contractility is impaired, there is no benefit to providing surgical relief of the obstruction and other management options need to be pursued. One such option is the use of a catheter. Methods of use include ***intermittent catheterization, an indwelling urethral catheter, or an indwelling suprapubic tube***. Intermittent catheterization is a technique in which patients are taught to catheterize themselves several times per day as a means of completely emptying the urinary bladder. An indwelling urethral catheter is a catheter positioned in the urinary bladder via the urethra that remains in place indefinitely as a means of keeping the bladder empty. In general, long-term use of an indwelling catheter is unsatisfactory due to side effects that may include infections, stone formation, and bladder irritability. An indwelling suprapubic tube is an alternative means of keeping the bladder empty via a catheter placed through the lower abdominal wall into the urinary bladder. A suprapubic tube tends to have less side effects than a catheter placed through the urethra. In general, indwelling urethral and suprapubic tubes need to be changed every 4-6 weeks or so.

Renal insufficiency

Renal insufficiency is an impairment of kidney function that can occur as a result of the prostate obstruction. Laboratory tests will typically indicate an elevation of the serum creatinine. The initial management is the placement of an indwelling urethral catheter to drain the bladder and hopefully allow resolution of the renal insufficiency.

It is not uncommon to observe a ***post-obstructive diuresis*** after catheter placement, a situation where the kidneys, after relief of the obstruction, compensate by producing a tremendous volume of urine in a short period of time. If the creatinine does not return to normal levels, a consultation with a nephrologist (kidney specialist) is often in order. It is possible to have chronic renal insufficiency as a long-term complication of BPH, to the extent that kidney function is so impaired that dialysis may be required.

Recurrent urinary infection
Infections, often due to elevated residual urine volumes, need to be managed with appropriate antibiotics prior to embarking on the management of the prostatic obstruction. Recurrent infections can also be contributed to from bladder calculi, bladder diverticula, or from prostatitis (an infection of the prostate).

Recurrent bleeding
As BPH progresses, the blood supply to the prostate becomes greater. These engorged blood vessels of the prostate, coupled with straining to urinate and turbulent, high-pressure voiding, can induce bleeding (gross hematuria). Administration of 5 Alpha-reductase inhibitors, including Proscar (Finasteride) and Avodart (Dutasteride) have been very effective at stemming bleeding of prostatic origin, in addition to decreasing the volume of the prostate gland. If these medications fail to improve chronic bleeding, surgery is certainly indicated.

Large bladder diverticula
As the BPH process progresses, the innermost layer of the bladder (mucosa) can extrude beyond hypertrophied muscle fibers, forming bladder diverticula. These can vary in size from tiny, inconsequential diverticula to huge diverticula, actually larger in size than the urinary bladder. A large diverticulum will fill with urine, but will fail to empty properly, because of the lack of muscular backing to it. Large diverticula will also often require surgical excision in addition to the surgery to reduce outlet obstruction, in order to improve voiding dynamics. If surgery is not an option, or if the diverticulum is not that large, simple manual pressure over the diverticulum at the time of voiding is sometimes sufficient to provide adequate drainage, with the caveat that the prostate obstruction needs to be properly managed.

Bladder stones
Bladder stones occur as a consequence of elevated residual urine volumes. They can be solitary or multiple, smooth or jagged, tiny or large, and of variable chemical composition. They can cause bleeding, infections, and irritative LUTS. They often can be treated with cystoscopic laser technology in order to break the stones into fragments that can be irrigated out of the bladder and/or passed through the urethra. On occasion, a bladder stone can be so large or so hard that it cannot be treated effectively with laser and will require open surgical removal, coupled with management of the prostate obstruction.

Bladder over-activity
A bladder can become overactive as a result of obstruction due to an enlarged prostate, among other reasons. As the prostate enlarges and causes urethral restriction, the bladder must work harder in order to generate more pressure to get the urine through this restriction. Thus, with prostate obstruction there is loss of compliance, as the bladder becomes more rigid and less stretchy and elastic. The bladder muscle thickens, producing the characteristic ribbed appearance of prominent interlacing muscle fibers known as bladder trabeculation. Irritative LUTS can occur, manifesting with any or all of the following symptoms: urgency, precipitancy, frequency, nocturia, and urgency incontinence. Conservative recommendations to combat these symptoms include ***fluid moderation, timed voiding, pelvic floor muscle exercises, and medications.***

Fluid moderation entails limiting fluid intake in an effort to help lessen some of these symptoms. This will not always be possible, but any restriction in fluid intake will decrease the volume of urine output. Caffeine and alcohol increase urinary output so it is best to limit intake of these beverages. Caffeine is present in tea, coffee, cola, and chocolate. Additionally, many foods—particularly fruits and vegetables—have a generous amount of hidden water content, so moderation applies best here as well.

Timed voiding entails purposeful and defensive voiding by the clock and not your own sense of urgency in an effort to keep the bladder as empty as possible. By emptying the bladder before a “critical” volume is reached, the LUTS can be controlled. Voiding on a two-hour basis

is usually effective, although the specific timetable has to be tailored to the individual. Such "preemptive" voiding has been proven to be a very useful technique insofar as voluntary urinary frequency is more desirable than involuntary incontinence.

Contracting the pelvic floor muscles (pubococcygeus or levator ani muscle) at the time of perceived urgency can be useful in preemptively abolishing an unwanted bladder contraction and thus eliminating or decreasing the sense of urgency and frequency. You must first learn awareness of these muscles and after this step is achieved, exercise them to increase their strength. This is not the muscle of the abdominal wall (rectus), nor the muscle of the buttocks (gluteals). A simple means of identifying these muscles for males is to start urinating and when about half completed, to attempt to abruptly stop the stream. The pelvic floor muscles are the ones responsible for stopping the stream. Once you are fully aware of the location and nature of these muscles, you can then exercise them at times when you are not urinating. These exercises can be done in various positions such as lying down, sitting, or standing. Gradually, the strength and tone of the pelvic floor muscles will increase. Attend closely to those activities and events that trigger the LUTS. By actively squeezing the pelvic floor muscles just before and during these activities, the LUTS can often be improved.

There are a variety of bladder relaxant medications that are useful to suppress bladder overactivity. It may take several trials of different medications or combinations of medications to achieve optimal results. ***Detrol LA (Tolterodine), Ditropan XL (Oxybutynin), Oxytrol (transdermal oxybutynin), Sanctura (Trospium), Enablex (Darifenacin), Vesicare (Solifenacin), Gelnique (Oxybutynin) and Toviaz (Festoterodine)*** are effective.

Myrbetriq (Mirabegron) is the newest medication in the group and has a unique mechanism of action.

Neurogenic Voiding Dysfunction

This refers to voiding dysfunction caused by any neurological process or disease. Remember that the seemingly "simple" act of emptying our bladder is actually a highly complex event, requiring an intact nervous

system that allows sensation of bladder filling, and contraction of the bladder muscle along with synchronous and coordinated relaxation of the sphincter muscles. Space constraints will limit the this section to a brief review of the most common neurogenic voiding dysfunctions.

Multiple Sclerosis (MS)

MS is caused by focal inflammatory lesions scattered throughout the nervous system, leading to a variety of neurological signs and symptoms. Some type of voiding dysfunction is seen in nearly all patients during the course of MS. In fact, many patients with MS actually present with lower urinary tract symptoms even before the diagnosis of MS is entertained. The most common voiding dysfunction is bladder over-activity causing irritative LUTS, which occurs in 50-90% of patients. Many MS patients will also demonstrate lack of coordination between the bladder muscle and the striated sphincter resulting in high bladder pressures and obstructive LUTS. Impaired bladder contractility is seen in 20-30% of patients. A not uncommon pattern is the combined finding of bladder over-activity with impaired contractility.

Parkinson's Disease (PD)

PD is one of the most common neurological entities causing voiding dysfunction, which occurs in up to 75% of such patients. The usual clinical findings are: muscular rigidity, slow movements, and tremor. Urinary urgency, frequency, and urgency incontinence are the predominant symptoms and are on the basis of bladder over-activity. Obstructive LUTS also occur commonly and are on the basis of failure of the urinary sphincter to relax properly, a manifestation of muscular rigidity.

Diabetes Mellitus (DM)

One of the main consequences of DM is neuropathy, which can affect the lower urinary tract profoundly. Involvement of the lower urinary tract by diabetic neuropathy has been given the term "diabetic cystopathy." The first symptom is usually the impairment of bladder sensation, which results in a gradual increase in the interval between voids. Over time, the condition may progress to the point where the patient voids only once or twice a day, with decreasing awareness of the need to void. Diabetic cystopathy often will cause impaired bladder contractility, giving rise to obstructive lower urinary tract symptoms. Bladder over-activity is not an uncommon finding, causing the symptoms of frequency and urgency.

Cerebral Vascular Accident (CVA)
Also known as a stroke, a CVA occurs when the brain does not receive enough oxygen. It can be caused by occlusion of the arterial supply, hemorrhage (bleeding), or congenital malformations. The most common type of voiding dysfunction occurring after a CVA is bladder over-activity causing irritative LUTS, although about 25% will develop urinary retention due to impaired bladder contractility.

Radical Pelvic Surgery
Voiding dysfunction is a not uncommon occurrence after major pelvic surgery, including abdominal perineal resection of the rectum, radical hysterectomy, and lower anterior resection of the colon. The voiding dysfunction is usually caused by injury or irritation to one or more of the pelvic nerves that provide the nerve supply to the bladder, bladder neck, or striated sphincter. Typically, the voiding dysfunction after radical pelvic surgery will manifest with impaired sensation, impaired bladder contractility, and impaired sphincter function. The voiding dysfunction will often improve with time.

Spinal cord injury (SCI)
During the initial phase of SCI, *spinal shock,* the bladder is unable to contract, causing urinary retention. During the *recovery phase*, the type of voiding dysfunction is based upon the level of the SCI. In general, cervical and thoracic spine injuries will cause bladder over-activity causing irritative LUTS and lack of coordination between the bladder muscle and the striated sphincter causing obstructive LUTS. The pattern of voiding dysfunction after lumbar spine injuries is variable. Most patients after sacral spine injuries will have a bladder muscle that cannot contract properly, causing urinary retention. During the *stable phase*, there is no longer any neurological recovery, and a permanent pattern ensues.

Herniated Disc
The incidence of voiding dysfunction as the result of disc prolapse is in the range of 20%. Depending upon the spinal cord level of the herniated disc and the degree of impingement on the specific nerve, a variety of voiding dysfunctions may develop, ranging from bladder over-activity causing irritative LUTS to impaired bladder contractility causing obstructive LUTS. Lumbar disc prolapse most frequently involves L_4–L_5 and L_5–S_1 intervertebral spaces. The most

common urological finding associated with lumbar disc prolapse is impaired contractility often associated with impaired sensation. Other neurological findings may include saddle anesthesia, bilateral sciatica, and lower back pain.

Appendix 1

International Prostate Symptom Score

1. Incomplete Emptying:
Over the past month, how often have you had the sensation of not emptying your bladder completely after you finished urinating?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

2. Frequency:
Over the past month, how often have you had to urinate again less than two hours after you finished urinating?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

3. Intermittency:
Over the past month, how often have you found you stopped and started again several times when you urinated?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

4. Urgency:
Over the past month, how often have you found it difficult to postpone urination?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

5. Weak Stream:

Over the past month, how often have you had a weak urinary stream?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

6. Straining:

Over the past month, how often have you had to push or strain to begin urination?

0-Not at all
1-Less than one time in five
2-Less than half the time
3-About half the time
4-More than half the time
5-Almost always

7. Nocturia:

Over the past month, how many times did you most typically get up from the time you went to bed at night until the time you got up in the morning?

0-None
1-One time
2-Two times
3-Three times
4-Four times
5-Five or more times

TOTAL SYMPTOM SCORE = SUM OF QUESTIONS 1-7=_____

Score Interpretation:

0-7: Mild Symptoms; 8-19: Moderate Symptoms; 20-35: Severe Symptoms

Quality of life due to urinary symptoms:

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 this?

1-Completely satisfied
2-Mostly satisfied
3-Mixed: about equally satisfied and dissatisfied
4-Mostly dissatisfied
5-Completely dissatisfied
6-Miserable

Appendix 2 VOIDING DIARY

For a 24 hour period, every time that you urinate record the ***time of day*** and the ***volume voided*** by using a measuring cup calibrated in ounces. Please bring this completed diary with you at the time of your next visit.

	Time of Day	Volume voided
void #1		
void #2		
void #3		
void #4		
void #5		
void #6		
void #7		
void #8		
void #9		
void #10		
void #11		
void #12		
void #13		
void #14		
void #15		
void #16		
void #17		
void #18		
void #19		
void #20		

About the Author

Dr. Andrew Siegel earned a medical degree from the Chicago Medical School, Chicago, Illinois, where he was elected to the Alpha Omega Alpha Honor Medical Society.

He completed a two-year residency in general surgery at the North Shore University Hospital, Manhasset, New York, an affiliate of Cornell University School of Medicine. Dr. Siegel then went on to undertake residency training in urology at the University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania. Dr. Siegel completed a fellowship in voiding dysfunction, urodynamics, reconstructive and female urology at the UCLA School of Medicine, Los Angeles, California, under the direction of Dr. Shlomo Raz, prior to joining Bergen Urological Associates.

Dr. Siegel is a diplomate of the American Board of Urology and the National Board of Medical Examiners and is board certified in both Urology and Female Pelvic Medicine & Reconstruction Surgery. He is a member of the American Urological Association, the American Uro-Gynecological Society, the International Continence Society, the Society for Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction, and the Sexual Medical Society of North America.

Dr. Siegel has authored chapters in urology textbooks including *Current Operative Urology* and *Interstitial Cystitis*, and has published articles in numerous professional journals including *Urology, Journal of Urology, Urology Clinics of North America, Postgraduate Medicine, Neuro-Urology and Urodynamics,* and *International Urogynecology Journal.* He has presented papers at professional meetings for many medical societies including the Philadelphia Urological Society, the American Academy of Pediatrics, the American Urological Association, and the American College of Surgeons.

He is a urological surgeon at Hackensack University Medical Center and a Clinical Assistant Professor of Urology at Rutgers New Jersey Medical School. He is a 2016 Castle Connolly *Top Doctor: N.Y. Metro Area* and *Inside Jersey Top Doctor for Women's Health.*

Dr. Siegel has authored the books: *Finding Your Own Fountain of Youth – The Essential Guide to Maximizing Health, Wellness, Fitness & Longevity; Promiscuous Eating: Understanding and Ending Our Self-Destructive Relationship With Food; Male Pelvic Fitness: Optimizing Sexual and Urinary Health;* and *The Kegel Fix: Racharging Female Pelvic, Sexual and Urinary Health.*