

Voiding dysfunction: definitions

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'Lower urinary tract symptoms' is a term that describes symptoms related to both the storage and emptying phases of the micturition cycle. Storage symptoms include urinary frequency urgency, urge incontinence, nocturia, dysuria and other kinds of pain emanating from the bladder or urethra. Emptying symptoms consist of hesitancy, straining to void, difficulty starting, diminished stream, a feeling of incomplete bladder emptying and urinary retention. In both sexes, the etiology of lower urinary tract symptoms is multifactorial, and symptoms are a poor indicator of underlying pathophysiology. In men, lower urinary tract symptoms are most often attributed to prostatic obstruction, but only approximately two-thirds of men with lower urinary tract symptoms meet the accepted diagnostic criteria for obstruction. Approximately half have detrusor overactivity and a smaller number have impaired detrusor contractility, sensory urgency, sphincteric incontinence, polyuria or nocturnal polyuria. In women, lower urinary tract symptoms are often considered to result from hormonal abnormalities, childbirth, aging, or previous surgery, but the multifactorial underlying pathophysiology is similar to that seen in men, except for a much lower incidence of urethral obstruction and a high incidence of sphincteric incontinence. Treatment typically begins with empiric, conservative therapies aimed at resolving detrusor instability or bladder outlet obstruction. However, although either or both of these etiologies may exist in the individual with lower urinary tract symptoms, treatment may fail as a result of another cause. We believe that treatment based on the pathophysiology of the symptoms will lead to better outcomes than treatment based on symptoms alone.

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Abbreviations

LUTS lower urinary tract symptoms
NBCi nocturnal bladder capacity index

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Introduction

'If the only tool you have is a hammer, then everything looks like a nail.'

It has long been said that the lower urinary tract has a limited means of expressing its own pathology. Historically, these symptoms have been described as irritative and obstructive in nature, because it was (erroneously) believed that the former were caused by inflammatory conditions and the latter by urethral obstruction. In fact, no such correlation exists between symptoms and pathophysiology, and it is now generally accepted that the symptoms be categorized according to when they occur in the micturition cycle – the storage or emptying phase. 'Lower urinary tract symptoms' (LUTS) is the term used to describe all types of voiding dysfunction. Storage symptoms (formerly called irritative symptoms) include urinary frequency urgency, urge incontinence, and nocturia. Emptying symptoms (formerly called obstructive symptoms) consist of hesitancy, straining to void, difficulty starting, diminished stream, a feeling of incomplete bladder emptying and urinary retention. Dysuria and certain kinds of pain thought to emanate from the bladder or urethra do not fit into either category. In both sexes, the etiology of LUTS is multifactorial and symptoms are a poor indicator of underlying pathophysiology. In men, LUTS are most often attributed to prostatic obstruction, but only approximately two-thirds of men with LUTS meet the accepted diagnostic criteria for obstruction. Approximately half have detrusor overactivity and a smaller number have impaired detrusor contractility, sensory urgency, sphincteric incontinence, polyuria or nocturnal polyuria. In women, LUTS are often considered to result from hormonal abnormalities, childbirth, aging, or previous surgery, but the multifactorial underlying pathophysiology is similar to that seen in men except for a much lower incidence of urethral obstruction and a high incidence of sphincteric incontinence.

In clinical practice, it appears that most patients with LUTS are treated empirically according to an algorithm based primarily on symptoms. The aim of such therapy is usually directed at eradicating infection, or treating overactive bladder, sphincteric incontinence or prostatic obstruction. Although it appears that in most patients the symptoms improve, in many they do not or the improvement is short lived. Treatment may fail because of the wrong diagnosis, a lack of effective therapy or poor patient compliance. We believe that treatment is most effective when it is based on a clear understanding of the

underlying pathophysiology. This, in turn, depends on using LUTS not as a shortcut to diagnosis, but rather as clues to direct further diagnostic evaluation aimed at discerning the underlying cause. The use of voiding diaries and pad tests (when incontinence is present) coupled with urodynamics, cystoscopy and other diagnostic modalities (videourodynamics when available) provides the most direct means to an accurate diagnosis.

Diagnosing lower urinary tract symptoms

We believe that the best way to treat a problem is to understand it. LUTS are the means by which the lower urinary tract expresses its own pathology, but the symptoms themselves present only a murky view of the pathophysiology, and to understand it, diagnostic studies are necessary. Each symptom deserves individual attention in order to diagnose the underlying cause. Some physicians consider a voiding diary and pad test not helpful or too time consuming. Others do not use them because they do not think patients will do them properly. Diaries afford the opportunity to view individual symptoms in real time. Groutz *et al.* [1•] reported on the use of voiding diaries and pad tests for assessing LUTS and showed that, for clinical purposes, 24 h diaries and pad tests are reliable and reproducible. As a research tool, 48 and 72 h compilations are even more reliable, but the patients were not nearly as compliant as they were with 24 h diaries. The report by Groutz *et al.* [1•] supports the use of both voiding diaries and pad tests in everyday clinical practice. The patient-based questionnaire is another useful tool for assessing LUTS. Lemack *et al.* [2•] reported on a group of 119 men and women with mild Parkinson's disease and LUTS using a patient questionnaire to assess the bother and the prevalence of LUTS. They concluded that LUTS was common in early Parkinson's disease, and suggested that earlier treatment should be considered to halt symptomatic progression of the symptoms before an 'end stage' is reached.

Voiding diaries, pad tests and patient questionnaires are especially useful to evaluate treatment outcomes. Groutz *et al.* [3•] recently introduced a new outcome score, which incorporates in a user-friendly format three validated popular instruments (24 h micturition diary, 24 h pad test and patient questionnaire) for incontinence. The relationship between objective evaluation and subjective symptoms is known to be vague. Some patients say they are cured, yet objective testing shows they are still wet; others say they are still wet in their day to day lives, yet objective testing shows they are cured. Any assessment, then, must take these factors into account. However, gross classification into cure, improvement and failure may fail to reflect the real clinical status accurately. Strict criteria for cure and failure and a detailed differentiation between various degrees of

improvement (i.e. good, fair and poor response), as suggested by the new response score, may therefore provide a more meaningful tool to assess outcome results.

Storage symptoms

Nocturia

Nocturia refers to the simple notion of urinating during the night and a more complex idea of involving some sort of excess. Most men and women who are awakened twice or more a night to void consider it to be a very bothersome condition, especially when it results in incontinence [4,5•,6,7,8•]. It is especially bothersome when associated with nocturnal incontinence [9•]. Weiss and Blaivas [10•] suggested three broad categories of pathophysiology that account for nocturia: nocturnal polyuria, low nocturnal bladder capacity and mixed (nocturnal polyuria and low nocturnal bladder capacity). This classification was later supported by Homma *et al.* [11•]. Although the overactive bladder or bladder outlet obstruction can be the cause of nocturia there are many other non-urological causes that must be considered. These include such things as diabetes mellitus, diabetes insipidus, sleep apnea, congestive heart failure, polydipsia, and venous insufficiency.

In order to classify nocturia properly it is necessary for the patient to complete a 24 h micturition diary. Twenty-four hour diaries have been shown to be reproducible and as reliable as longer diaries (48–72 h) to diagnose different voiding dysfunctions [1•]. Several definitions of nocturnal polyuria have been proposed but none has been universally accepted. Weiss and Blaivas [10•] suggested the use of a nocturnal polyuria index (nocturnal urine volume/24 h urine volume). They defined nocturnal polyuria as a nocturnal polyuria index greater than 35%. Other suggested definitions include a nocturnal urinary volume greater than 6.4 ml/kg or greater than 0.9 ml/min.

In order to quantify nocturnal bladder capacity, two other terms were introduced by Weiss and Blaivas [10•], the nocturia index and the nocturnal bladder capacity index (NBCi). The nocturia index is simply the nocturnal urinary volume divided by the functional bladder capacity. Obviously, whenever nocturnal urinary volume exceeds functional bladder capacity, nocturia (or enuresis) ensues. The NBCi is an index derived from the other measurements. In simple terms (or at least as simple as we can make this), the greater the NBCi, the more that nocturia is attributed to diminished nocturnal bladder capacity and nocturnal sensory urge disorders compared with daytime bladder capacities. Kawauchi *et al.* [12•] also demonstrated that nocturnal urinary volume and nocturnal bladder capacity are significant determinants of nocturnal urinary frequency.

Overactive bladder (urgency, frequency, urge incontinence)

It is easy to be confused with the term 'overactive bladder' itself because different authors use it differently. Urinary urgency and frequency is often used interchangeably with the term 'overactive bladder'. Some use it to describe urgency and frequency whereas others use it also to describe urge incontinence. Abrams and Wein [13••] introduced the following definition for the overactive bladder: 'the overactive bladder is a medical condition referring to the symptoms of frequency and urgency, with or without urge incontinence, when appearing in the absence of local and pathologic or metabolic factors that would account for these symptoms'. This definition, of course, leaves us with no words to describe patients who do have pathological or metabolic factors; for example, the symptomatic patient with benign prostatic hyperplasia and overactive bladder. In the report by Abrams and Wein [13••], the authors distinguished three groups of people with overactive bladder: those with frequency and urgency; those with frequency, urgency and urge incontinence; and those who have mixed incontinence.

In an interesting analysis, Swithinbank and Abrams [8•] reported on a group of community dwelling women with LUTS. Their symptoms were measured using the Bristol female lower urinary tract symptoms questionnaire. A total of 61% of the woman had urinary urgency, 46% had urge incontinence, and 15% had urinary frequency (more than eight voids per day). Fifty-six per cent of the women with urge incontinence, 50% of the women with frequency and 37% with urgency perceived their symptoms to be significant problems. The finding that urgency and urge incontinence were so prevalent may be related to the finding of increased detrusor instability with aging. Urinary incontinence (especially at night) was rated as the most troublesome of all the symptoms in this group.

In most other series, incontinence is also rated as the most troublesome of all LUTS. The abrupt desire to void that cannot be aborted defines urge incontinence. Urge incontinence is thought to be caused by involuntary detrusor contractions that are associated with a variety of clinical conditions including urethral obstruction, neurological abnormalities, pelvic organ prolapse and idiopathic causes. Its incidence increases with age, although aging itself has never been shown to cause it [14•].

Most recent attention has focused on the pharmacological treatment of urge incontinence. Current agents work by antagonizing muscarinic anticholinergic receptors. Unfortunately, these agents work on other organ systems that contain cholinergic receptors. This explains the

frequent side-effects many men and women complain of, including dry eyes, constipation, and dry mouth. Newer agents such as tolterodine have a much lower incidence of these side-effects due to the fact that it is 'uroselective' and binds with a greater affinity to cholinergic receptors of the bladder compared with other organ systems [15]. Anticholinergic therapy alone can help alleviate the symptoms of the overactive bladder, but often other treatments must be used. Behavioral therapies have been shown to be beneficial in the treatment of the overactive bladder. Combining anticholinergic therapy with programs that include biofeedback, electrical stimulation and behavioral modification may even improve outcomes. When more conservative measures fail surgical intervention may be warranted. Hassouna *et al.* [16••] demonstrated significant improvements in women with symptoms of overactive bladder utilizing sacral modulation. In their multi-center report, 51 women with refractory urgency and frequency were randomly assigned into a treatment arm and a control arm. The treatment arm showed significant improvements in the number of daily voids, volume per void and the degree of urgency. In a subsequent report, Chartier-Kastler *et al.* [17•] used sacral modulation on nine women with refractory urge incontinence. These women were all candidates for augmentation cystoplasty. With a mean follow-up of 47 months, all had clinically significant improvement in their incontinence. In fact, five were completely dry and all of the women reported subjective improvement [17•].

Emptying symptoms

Emptying symptoms such as difficulty starting, hesitancy, weak stream and a feeling of incomplete bladder emptying, especially in men, is usually thought to be indicative of outlet obstruction. Nevertheless, a significant proportion of men with emptying symptoms do not in fact have outlet obstruction. Kuo [18••] reported on 324 men with LUTS and evaluated them using videourodynamics. The author found that approximately a third of the men did not meet urodynamic criteria for obstruction. The findings in the third of men without obstruction consisted of: normal study (22%), detrusor instability (5%), sensory urgency (15%), impaired detrusor contractility (3%) and poor muscle coordination (55%) [18••].

Conclusion

The term 'voiding dysfunction' is a descriptive one, and the symptoms that define voiding dysfunction account for just about everything that can go wrong in the lower urinary tract. The findings of the studies cited indicate that there is a poor correlation between individual LUTS and underlying etiology. This underscores the importance of understanding the complex relationship between symptoms, pathophysiology and treatment.

Symptoms serve two functions: they alert the physician to exactly what the patient wants treatment for, and they direct the diagnostic evaluation. Understanding pathophysiology is important for (at least) three reasons: it helps direct rational treatment based on alleviating the cause of the symptoms; it helps prognosticate; and it helps to define the subtle differences between patients who may explain differences in therapeutic outcome. Understanding these differences allows physicians to determine why some patients fail and others succeed with the same treatment. Understanding pathophysiology is also interesting in its own right.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

- 1 Groutz A, Blaivas JG, Engleman K, *et al.* Non-invasive outcome measures for urinary incontinence: a multi-center study of voiding diaries and pad tests. *J Urol* 2000; 164:698–701.

A very important paper for future clinical research demonstrating the efficacy of patient questionnaires, pad tests and voiding diaries to assess LUTS. It also provides evidence of the reliability of a shorter (24 h) diary.

- 2 Lemack GE, Dewey RB, Roehrborn CG, *et al.* Questionnaire-based assessment of bladder dysfunction in patients with mild to moderate Parkinson's disease. *Urology* 2000; 56:250–254.

This study provides data on men with early Parkinson's and their LUTS. Perhaps treating men with Parkinson's earlier will lead to better outcomes.

- 3 Groutz A, Blaivas JG, Rosenthal JE. A simplified urinary incontinence score for the evaluation of treatment outcomes. *Neurourol Urodyn* 2000; 19:127–135.

A new and easy way to assess outcomes for incontinence.

- 4 Robertson G. Nocturnal polyuria. *BJU Int* 1999; 84 (suppl 1):17–19.

- 5 Blanker MH, Bohnein AM, Groeneveld FP, *et al.* Normal voiding patterns and determinants of increased diurnal and nocturnal voiding frequency in elderly men. *J Urol* 2000; 164:1201–1205.

Data are presented on a large community-based sample on men over 50 years of age. Basically, nocturia is a common complaint and is associated with benign prostatic hyperplasia and aging.

- 6 Fonda D. Nocturia: a disease or normal ageing?. *BJU Int* 1999; 84 (suppl 1):13–15.

- 7 Mattiasson A. Nocturia: current knowledge and future directions. *BJU Int* 1999; 84 (suppl 1):33–35.

- 8 Swithinbank LV, Abrams P. A detailed description, by age, of lower urinary tract symptoms in a group of community-dwelling women. *BJU Int* 2000; 85 (suppl 2):19–24.

The Bristol female lower urinary tract symptoms questionnaire is used in a large community based group of women to assess the symptoms they may have.

- 9 Swithinbank LV, Donovan JL, Rogers CA, *et al.* Nocturnal incontinence in women: a hidden problem. *J Urol* 2000; 164:764–766.

Storage problems are usually the most bothersome of LUTS. Nocturnal incontinence increased in a linear relationship with aging, and when present was considered a troubling symptom.

- 10 Weiss JP, Blaivas JG. Nocturia. *J Urol* 2000; 163:5–12.

This classic paper reviews nocturia as a symptom and a condition. It reviews the published literature on definitions and causes. The authors propose a classification system using measurements obtained in a 24 h diary. This classification system may help to direct treatment based on a specific pathophysiology.

- 11 Homma Y, Yamaguchi O, Kageyama S, *et al.* Nocturia in the adult: classification on the basis of largest voided volume and nocturnal urine production. *J Urol* 2000; 163:777–781.

This paper helps support the classification system proposed by Weiss and Blaivas [10••].

- 12 Kawauchi A, Tanaka Y, Soh J, *et al.* Causes of nocturnal urinary frequency and reasons for its increase with age in healthy older men. *J Urol* 2000; 163:81–84.

This study provides evidence that nocturnal bladder capacity decreases with age. If bladder capacity decreases with age and urine volume stays the same or increases then nocturia should be expected.

- 13 Abrams P, Wein AJ. Introduction: overactive bladder and its treatment. *Urology* 2000; 55:1–2.

A useful definition for the overactive bladder is proposed. I believe the definition proposed will lead to less confusion when describing patients with urgency, frequency or urge incontinence.

- 14 Temml C, Haidinger G, Schmidbauer J, *et al.* Urinary incontinence in both sexes: prevalence rates and impact on quality of life and sexual life. *Neurourol Urodyn* 2000; 19:259–271.

The Bristol female lower urinary tract symptoms questionnaire is used to assess the impact incontinence has on approximately 2500 Austrian women.

- 15 Chancellor M, Freedman S, Mitcheson HD, *et al.* Tolterodine, an effective and well tolerated treatment for urge incontinence and other overactive bladder symptoms. *J Urol* 2000; 163:83–91.

- 16 Hassouna MM, Siegel SW, Lycklama A, *et al.* Sacral modulation in the treatment of urgency-frequency symptoms: a multicenter study on efficacy and safety. *J Urol* 2000; 163:1849–1854.

Sacral modulation is an exciting technology that has a significant effect on many unexplainable symptoms in men and women. This paper demonstrates its usefulness in women with urgency and frequency.

- 17 Chartier-Kastler EJ, Bosch JL, Perrigot M, *et al.* Long-term results of sacral stimulation (S3) for the treatment of neurogenic refractory urge incontinence related to detrusor hyperreflexia. *J Urol* 2000; 164:1476–1480.

Another study demonstrating the effect sacral modulation can have on storage symptoms.

- 18 Kuo HC. Pathophysiology of lower urinary tract symptoms in aged men without bladder outlet obstruction. *Urologia Internationalis* 2000; 64:86–92.

Outlet obstruction is one of many etiologies for LUTS in men. Videourodynamics is a useful diagnostic tool to direct treatment based on the pathophysiology of symptoms.