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Neurological Lower Urinary Tract Dysfunction essential terminology

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Abstract

AIMS: To introduce basic concepts and definitions in the International Continence Society (ICS) Standardisation of Terminology in adult Neurogenic Lower Urinary Tract Dysfunction (NLUTD).

METHODS: Fundamental terminology in the ICS Standardisation of Terminology of Adult NLUTD was identified and summarised.

RESULTS: NLUTD is often associated with impairment of cognitive, motor, sensory and/or autonomic functions. Lesions are categorised into suprapontine, pontine/ suprasacral spinal, sacral spinal, cauda equina/ peripheral nerve or mixed lesions. People affected with neurological disease are also at risk of the conditions seen in the general population, such as benign prostate enlargement. Symptoms of NLUTD include alterations in bladder or urethral sensation and incontinence. Loss of urine can result from incontinence, involuntary passing of urine and factors that impair toilet use, incorporating problems such as impaired cognition urinary incontinence, impaired mobility urinary incontinence and voiding dysregulation. Signs may be discerned by physical examination and recording of a frequency volume chart or bladder diary. Urodynamic observations during filling cystometry may include altered sensations, neurogenic detrusor overactivity and reduced bladder compliance. During pressure flow studies, there may be detrusor underactivity or bladder outlet obstruction (BOO). BOO may be caused by various forms poorly co-ordinated muscle activity in the bladder outlet. Symptoms, signs and urodynamic observations may be useful in diagnosing the presence and specific location of neurological impairment.

CONCLUSIONS: The review provides a succinct summary of symptoms, signs and urodynamic observations as set out in the ICS Standard on Adult NLUTD.

Introduction

Adult neurogenic lower urinary tract dysfunction (NLUTD) refers to abnormal or difficult function of the bladder, urethra (and/or prostate in men) in mature individuals in the context of clinically confirmed relevant neurologic disorder. NLUTD is a key subgroup of people affected by lower urinary tract symptoms (LUTS), due to the severity of their symptoms, and the implications of urinary dysfunction for their wider health. The International Continence Society (ICS) categorises symptoms, signs, urodynamic observations and conditions associated with lower urinary tract dysfunction (LUTD) in relationship to the storage and voiding phases of the micturition cycle. Neurological disease brings additional dimensions to the LUTD as experienced in the lives of affected individuals. The current document is a summary of core terminology in NLUTD for use in the wider context of LUTS in people known to have a neurological disease, or suspected of potentially having one which has not yet been diagnosed.

Methods

Recommendations in the ICS Standard on Adult Neurogenic Lower Urinary Tract Dysfunction [1] were reviewed and summarised. Definitions and key terms are generally transcribed verbatim. In the original document, many of the definitions are accompanied by explanatory or exemplary footnotes which have been adapted or excluded for the current review for the sake of brevity. Readers requiring more detailed information are referred to the full ICS Standard, and other documents produced by the ICS Standardisation Steering Committee.

Neurological control

The nervous system controls many facets that are essential for the normal micturition cycle (storage and voiding). Particularly crucial are cognition (e.g. decision making, anticipation, awareness of environment/ social context, and conscious perception of sensation), motor functions (e.g. mobility, balance and dexterity), sensory nerve activity and autonomic functions (e.g. regulation of the detrusor and sphincter). The neurological functions act together to make sure that both urine storage and voiding reflect timings and contexts appropriately, with full voluntary control (Figure 1).

Neurological diseases are diverse and differ in terms of the parts of the nervous system affected (e.g. the cognitive-predominant effects of dementia) and their behaviour (e.g. progressive, such as multiple sclerosis, or non-progressive, such as spinal cord injury). Thus, neurological disease may have differing

effects on cognitive, sensory, motor and autonomic functions which manifest in the specific NLUTD experienced by the patient. Inevitably, the consequences of neurological disease extend beyond LUTD, and mean that affected patients have a range of issues that influence treatment potential and health risk. Problems with bowel function, sexual and reproductive function, cognition, mobility and blood pressure control are particularly relevant.

In describing the features of an individual patient's dysfunction, clinicians should appreciate the distinction between symptoms, signs and urodynamic observations as set out in the ICS Standardisation of Terminology of Lower Urinary Tract Function [2] (for summary see [3]). A summary of the classification of neurological lesions [1], including the potential clinical and urodynamic features, is given in Figure 2.

NLUTD symptoms

People with NLUTD may describe storage, voiding and post voiding symptoms consistent with the definitions used for the general population [2, 3]. Sometimes, a patient may not express that a symptom is present, so it is appropriate to discuss with the caregiver as well when establishing the presenting complaint. Storage symptoms may converge in **Neurogenic Overactive Bladder, which is a symptom syndrome characterized by urgency, with or without urgency urinary incontinence, usually with increased daytime frequency and nocturia in the setting of a clinically relevant neurologic disorder with at least partially preserved sensation.**

Bladder and urethral sensation

Neurologically healthy people are intermittently aware of bladder sensations related to filling and voiding, and urethral sensation with voiding. Someone with NLUTD may describe alterations, for example;

Increased bladder sensation: the desire to void during bladder filling occurs earlier or is more persistent to that previous experienced. Reduced: the definite desire to void occurs later to that previously experienced despite an awareness that the bladder is filling. Absent: the individual reports no sensation of bladder filling or desire to void. Such patients may have a significant post voiding residual in the bladder, without any sensation of incomplete emptying.

Non-specific bladder awareness: the individual reports no specific bladder sensation, but may perceive, for example, abdominal fullness, vegetative symptoms, urethral sensations or spasticity as bladder filling awareness or a sign of bladder fullness. This may indicate that the usual sensory nerve pathways are not communicating centrally. Instead anatomical routes which do not usually contribute to everyday sensations may be intact and functional.

In addition, some people report they are unable to feel flow of urine along the urethra. They may report that they can only discern whether bladder emptying is finished by looking, or listening for the splash of urine in the toilet to stop.

Loss of urine

Mature CNS regulation ensures storage (detrusor relaxation with outlet contraction) and the transition to voiding (detrusor contraction with outlet relaxation) is under voluntary control. Various situations in NLUTD may lead to a loss of urine;

1. Incontinence; categorised into stress urinary incontinence, urgency incontinence and mixed urinary incontinence, and reflecting LUT dysfunction. Definitions used in NLUTD are the same as those used in the general population.
2. Involuntary passing of urine; no LUT abnormality is necessarily present, but instead the voiding reflex may activate at times not consciously initiated by the patient. This may be during occasions generally considered socially inappropriate. It may reflect a dysfunction in the cerebrum, e.g. a stroke or dementia. Abnormal voiding reflexes, or disinhibition, may result in the person passing urine without voluntary control.
3. Factors that impair toilet use, such as immobility, cognitive disability, and decreased motivation.

Thus, some additional incontinence definitions are standardised in NLUTD;

- **Impaired cognition urinary incontinence is periodic urinary incontinence that the individual with cognitive impairment reports to have occurred without being aware of it.**
- **Impaired mobility urinary incontinence is inability to reach the toilet on time for voiding because of physical or medical disability.** This inability includes (any combination of) the individual's physical as well as social causes or reasons. Other signs or symptoms of LUTD should not be present, or should be reported by the professional (as primary or as accessory) (eg,

“Urgency urinary incontinence” with “mobility impairment”; or “Mobility impairment urinary incontinence” with “stress urinary incontinence

- **Voiding dysregulation** is urination in situations which are generally regarded as socially inappropriate, such as while still fully dressed, or in a public setting away from toilet facilities.
- **Involuntary voiding** is both a symptom and a diagnosis of sporadic bladder emptying when awake, without intention to void. Usually the voiding reflex is preserved, and there is only lack of proper inhibition of the voiding reflex. If that happens when asleep it is called Acquired Enuresis.
- **Enuresis** is intermittent incontinence that occurs during periods of sleep. Enuresis is considered different from urgency urinary incontinence. Confirming the precise underlying mechanism(s) is often not possible in routine clinical practice.
- **Continuous (urinary) incontinence**: complaint of continuous involuntary loss of urine.

Signs

NLUTD evaluation incorporates the examination used for the general population, since people with neurological disease are the same risk of ageing-related and other changes as any other person.

Accordingly, physical examination must include abdominal, pelvic and perineal examination, and should elicit the following where present;

- Incontinence
- Pelvic organ prolapse
- Pelvic floor muscle function
- Palpable bladder after voiding

Pad testing

A frequency micturition chart, frequency volume chart or bladder diary [2] is needed within the constraints of patient capacity or carer availability. This may be particularly important in NLUTD, where the underlying condition may give rise to an endocrine dysfunction, such as central diabetes insipidus. Physical examination is also used to identify signs which could point towards the localisation of the exact neurological deficits caused by the responsible condition, for example perineal numbness.

Urodynamic observations

Bladder and bladder outlet function both need to be considered for a full understanding of a person's LUT. Since the pathophysiology is complex in NLUTD, and symptoms cannot be relied on for understanding mechanism, urodynamic testing provides a valuable insight into mechanisms and may identify observations that could indicate a risk to the patient's future health.

Filling cystometry

- **Neurogenic detrusor overactivity is characterized by involuntary detrusor contractions during the filling phase which may be spontaneous or provoked in the setting of a clinically relevant neurologic disease. Provoked contraction may be elicited by cough, change of position etc., or by urethral/sphincter to bladder reflex. Neurogenic Detrusor Overactivity Incontinence is incontinence due to involuntary neurogenic detrusor overactivity.**
- **Detrusor Overactivity Leak Point Pressure (DOLPP) is defined as the lowest detrusor pressure rise with detrusor overactivity at which urine leakage first occurs in the absence of voluntary detrusor contraction or increased abdominal pressure.** This is in contrast to Detrusor Leak Point pressure where urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure [2].

Reduced bladder compliance (the relationship between change in bladder volume and change in detrusor pressure [2]) is an important observation (Figure 3) in interpreting the clinical risk for renal function.

In neurogenic LUTD, the cystometric capacity cannot be defined in the same terms as for filling cystometry for the general population. In the absence of sensation, the cystometric capacity is the volume at which the clinician decides to terminate filling. The reason(s) for terminating filling should be defined in the report, for example, high detrusor filling pressure, large infused volume or pain. If there is uncontrollable voiding/bladder emptying, it is the volume at which this begins. In the presence of sphincter incompetence the cystometric capacity may be significantly increased by occlusion of the urethra, for example, by a Foley catheter balloon.

Pressure flow studies

When passing urine, a slow stream may be explained by impaired detrusor contraction, bladder outlet obstruction (BOO) or a combination of both. Potential causes of BOO include;

- **Non-relaxing urethral sphincter**, characterized by a non-relaxing, obstructing urethral sphincter resulting in reduced urine flow.
- **Delayed relaxation of the urethral sphincter**, characterized by impaired and hindered relaxation of the sphincter during voiding attempt resulting in delay of urine flow.
- **Detrusor-Sphincter Dyssynergia (DSD)**, which describes a detrusor contraction concurrent with an involuntary contraction of the urethral and/or periurethral striated muscle. Occasionally flow may be prevented altogether.

DSD is an indicator that the pontine micturition centre is not communicating effectively with the sacral spinal cord, and occurs in people with a suprasacral spinal cord/pontine lesion (SSL). The term should not be used in other forms of NLUTD, and it is not a generally term for BOO in NLUTD.

Other causes of BOO present in the general population, such as benign prostatic obstruction in men, can also be present in people with neurological disease, and videourodynamics may be appropriate to discern the proximal site of BOO.

Impaired detrusor contraction can indicate;

- **Neurogenic detrusor underactivity**; a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span in the setting of a clinically relevant neurologic disorder.
- **Neurogenic acontractile detrusor**; the detrusor cannot be demonstrated to contract during urodynamic studies in the setting of a clinically relevant neurologic lesion (Figure 3).

Balanced bladder emptying is a bladder emptying with physiological detrusor pressure and low residual as perceived by the investigator, and should be defined in the report.

NLUTD clinical diagnoses

- **Spinal Shock Phase** is usually temporary following acute neurologic insult or SCI that is characterized by loss of sensory, motor and reflex activity below the level of injury. NLUTD in Spinal Shock is usually a temporary complete painless urinary retention.
- **Autonomic Dysreflexia** is a syndrome resulting from an upper thoracic or cervical spinal cord injury above T6, elicited by a stimulus in the field of distribution of the autonomous sympathetic nucleus, characterized by unregulated sympathetic function below the lesion and compensatory autonomic responses. It is potentially a medical emergency characterized by hypertension, bradycardia, severe headaches, and flushing above, with pallor below the cord

lesion, and sometimes convulsions. An increase of blood pressure without any other symptoms is called Asymptomatic Autonomic Dysreflexia.

Urinary retention is an inability to properly empty the bladder. Retention may be complete or incomplete;

- **Acute retention of urine is an acute event of painful, palpable or percussable bladder, when the patient is unable to pass any urine when the bladder is full.** Although acute retention is usually thought of as painful, in certain circumstances pain may not be a presenting feature, for example, when due to prolapsed intervertebral disc, post-partum, or after regional anaesthesia such as an epidural anaesthetic. The retention volume should be significantly greater than the expected normal bladder capacity.
- **Chronic retention is a non-painful bladder, which remains palpable or percussable after the patient has passed urine. Such patients may be incontinent.** Chronic retention, excludes transient voiding difficulty, for example, after surgery for stress incontinence, and implies a significant residual urine.

Diagnosing neurological dysfunction

In order to understand the full picture of the neurological deficit, the history may be used to identify features which could localise the site of a problem or suggest the causative condition and its behaviour. Such observations can be helpful to a patient's neurologist in localising areas of deficit. These features are important in defining a patient's condition, since it guides subsequent testing (such as the anatomical sites and scan protocols for MRI). For example, retrograde ejaculation reported by a man who has not had bladder neck or prostate surgery may indicate a neurological deficit in the thoracolumbar spine or related peripheral nerves; this may be accompanied by visualisation of an open bladder neck during videourodynamic filling cystometry. Signs can also help; for example, loss of the anal reflex indicates a lesion affecting the sacral spinal cord or its sensory or motor nerves.

In rare but important cases, urinary dysfunction may present for urological evaluation in a patient with no known neurological background whose ultimate cause may subsequently prove to be a neurological disease. This can occur for example in MS, normal pressure hydrocephalus, multiple system atrophy and early Parkinson's disease [4]. Key symptoms include erectile dysfunction, retrograde ejaculation, enuresis, loss of filling sensation or unexplained stress urinary incontinence [4]. If there is any suspicion that an undiagnosed neurological disease could be present, questioning should enquire about visual

symptoms, back pain, anosmia, bowel dysfunction and incontinence, or memory loss [4]. Specialist evaluation is likely to be needed.

Conclusions

NLUTD is categorised into: suprapontine; pontine/ suprasacral spinal; sacral spinal; cauda equina/ peripheral nerve; mixed lesions. Loss of urine can result from impaired cognition urinary incontinence, impaired mobility urinary incontinence and voiding dysregulation. Urodynamic observations during filling cystometry may include altered sensations, neurogenic detrusor overactivity and reduced bladder compliance. During pressure flow studies, there may be detrusor underactivity or bladder outlet obstruction (BOO). BOO may be caused by various forms poorly co-ordinated muscle activity in the bladder outlet. Symptoms, signs and urodynamic observations may be useful in diagnosing the presence and specific location of neurological impairment.

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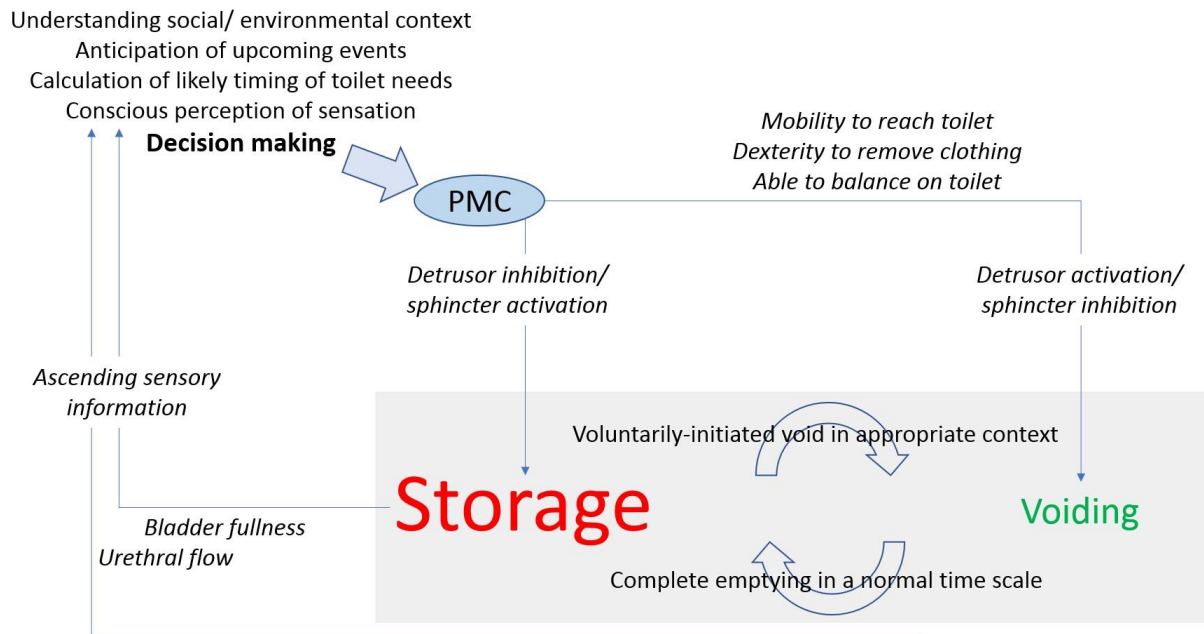


Figure 1. The micturition cycle viewed from the context of the person’s social and environmental context. *PMC= pontine micturition centre.*

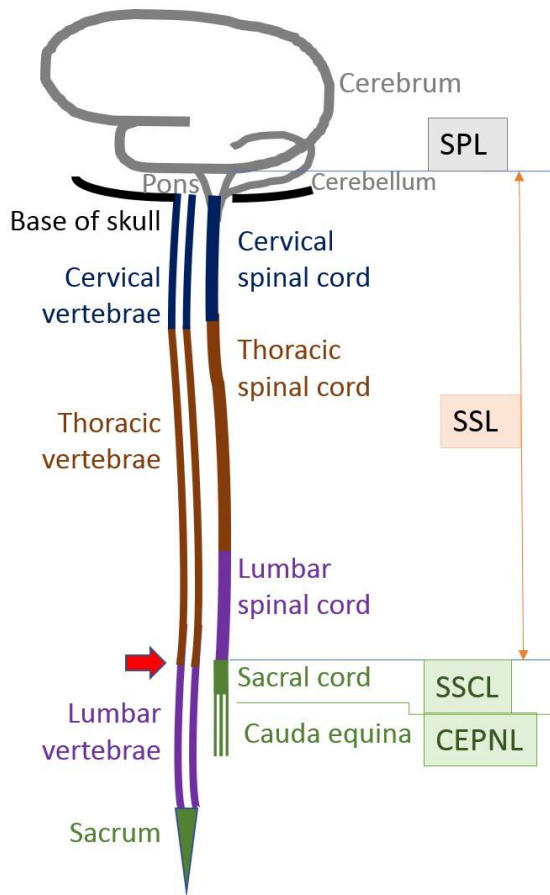


Figure 2. Classification of neurological lesions. **Suprapontine Lesion (SPL)** is a neurological lesion above the pons (forebrain or midbrain). NLUTD in SPL: there is a reflex contraction of the detrusor with impaired cerebral regulation and central inhibition and usually synergistic voiding/bladder emptying. **Suprasacral spinal cord/pontine lesion (SSL)** is a neurological lesion in suprasacral spine and/or pons. NLUTD in SSL: Detrusor overactivity (DO) and DO incontinence are common, with or without detrusor-urethral sphincter dyssynergia (DSD), often resulting in a significant post void residual (PVR) and “high pressure” bladder. **Sacral Spinal Cord Lesion (SSCL)** is a neurological lesion in the sacral spinal cord. NLUTD in SSCL; findings include acontractile detrusor with or without decreased bladder compliance and usually with impaired sphincter activity. **Infrasacral (cauda equina and peripheral nerves) Lesion (CEPNL)** is a neurological lesion affecting the cauda equina and/or peripheral nerves. NLUTD in CEPNL: acontractile detrusor and/or SUI may be present. **Mixed Neuronal Lesion** results from lesions of the neural pathway at different levels of the central nervous system concurrently. Note that in the adult, vertebral levels and spinal cord levels do not lie adjacent. Thus a T12/L1 prolapsed intervertebral disc (classified by its vertebral level) will affect the sacral part of the spinal cord (red arrow).

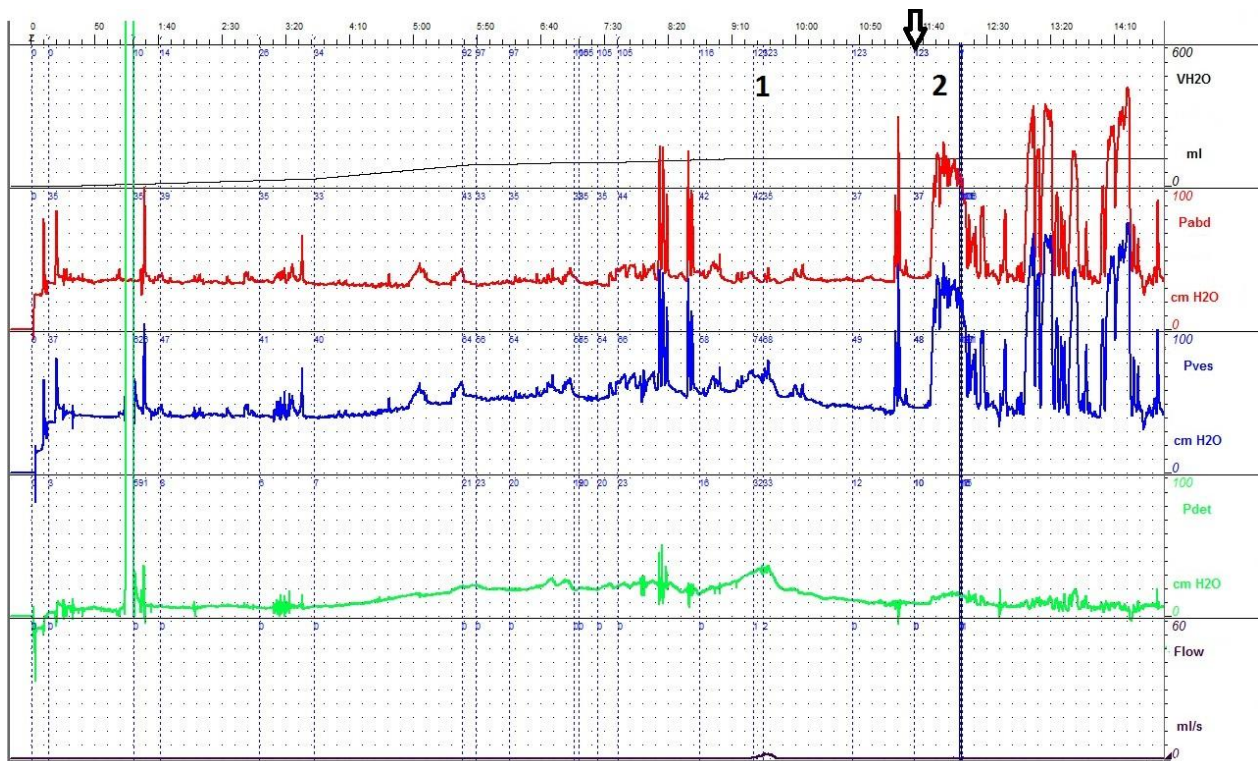


Figure 3; Filling cystometry in a sacral spinal cord lesion (SSCL) showing reduced compliance, as demonstrated by the climbing detrusor pressure (green trace, second from bottom). Detrusor Leak Point Volume (DLPV) is defined as a bladder volume at which first urine leakage occurs (1), either with detrusor overactivity or low compliance. The leakage is seen in the flow trace (black, bottom trace), and the leakage causes the elevated detrusor pressure to dissipate. The arrow indicates permission to void. However, there is no flow generated, and the patient does several Valsalva strains, shown by the substantial pressure rises in both abdominal pressure, and hence bladder pressure (2), signifying neurogenic acontractile detrusor. At time of urodynamics, neurological diagnosis had not previously been suspected, and subsequently he was identified to have multiple system atrophy.