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RESEARCH ARTICLE

Neurologic diseases that cause female urinary retention

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Abbreviations used: LS, lumbar spondylosis; DPN, diabetic distal polyneuropathy; MSA, multiple system atrophy; LUT, lower urinary tract; LUTS, lower urinary tract symptoms; OAB, overactive bladder; PVR, post-void residual; CIC, clean, intermittent catheterization; MS, multiple sclerosis

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ABSTRACT

OBJECTIVE: The pathogenesis of female urinary retention is not well known. Hence, we systematically investigated the frequency of diseases that underlie female urinary retention in a urodynamic laboratory.

METHODS: We analyzed data from 450 consecutive female patients. Data registries included the diagnosis, lower urinary tract symptom questionnaires, urodynamic study results, and neurologic exam observations. Complete urinary retention is defined as mean post-void residual (PVR) urine volume > 100 ml with no voluntary void at all; whereas incomplete urinary retention is defined as mean PVR urine volume > 100 ml after voluntary partial void.

RESULTS: Sixty of the 450 female patients visiting our lab (13%) had urinary retention with 4 (6.7%) of these having complete retention and 56 (93.3%) having incomplete retention. The most common underlying disease in these 60 patients was lumbar spondylosis (LS), 38.3% (with 16 patients having LS alone and 7 having LS & diabetic distal polyneuropathy [DPN]), multiple system atrophy (MSA), 18.3%, and DPN, 14.4% (with 2 patients having DPN alone and 7 having LS & DPN), followed by drug-induced retention (*e.g.*, by antidepressants), 8.3%, acute myelitis of possible demyelinating origin, 5.0%, and other etiologies. An underactive detrusor was the major urodynamic findings in those patients.

CONCLUSIONS: The present study revealed that common etiologies for female urinary retention are neurologic, *e.g.*, an underactive detrusor due to MSA, age-related LS, and lifestyle-related DPN. Therefore LS and DPN, both common diseases, should also become major treatment targets in order to maximize patients' quality of life.

Keywords: urinary retention, women, lumbar spondylosis, diabetes, multiple system atrophy

INTRODUCTION

Whereas urinary retention in men over 60 years is often attributed to prostatic hyperplasia, urinary retention in women is rare and has neurologic etiologies in many cases [1]. Detrusor myopathy [2], Fowler's syndrome [3], spina bifida occulta [4], multiple sclerosis [5], sacral herpes [6], meningitis-retention syndrome [7], and multiple system atrophy (MSA) [8] are all conditions that may cause female urinary retention as the sole initial symptom. Recently, however, there is also growing evidence that common neurologic diseases, *e.g.*, lumbar spondylosis (LS, also called lumbar canal stenosis) [9,10] and diabetic polyneuropathy (DPN) [11,12] may cause urinary retention, particularly in middle-aged/elderly women. However, it remains unclear to what extent these neurologic diseases contribute to female urinary retention. To answer this question, we reviewed our urodynamic case records concerning this issue.

MATERIALS AND METHODS

This is a single-center, retrospective study. Inclusion criteria of the patients are as follows: 1) all female patients at a university urodynamic laboratory during a 5-year period, 2) all patients were referred from the neurology, urology, orthopedic surgery, gynecology, or endocrine/metabolic disease departments in order to assess neuro-urological function, 3) all consecutive patients irrespective of their lower urinary tract (LUT) symptoms (LUTS), 4) all patients fulfilled the data registries included the diagnosis; responses to several LUTS questionnaires; urodynamic study results; and neurologic and other examination findings as described below. We had no exclusion criteria. The case records were digitized using File Maker Pro personal computer database software.

LUTS questionnaires

All female patients (and their families) completed questionnaires, *e.g.*, an International Prostate Symptom Score (IPSS, although originally developed for men, we tentatively applied this in women, mainly the voiding LUTS section), an Overactive Bladder (OAB) Symptom Score, and a Neurologic LUTS Questionnaire (both OAB and voiding LUTS) [11]. In addition, a detailed medical history, including questions regarding pelvic surgery, was taken from all patients.

Urodynamic studies

After voluntary voiding, transurethral catheterization was performed to measure post-void residual (PVR) urine volume. Complete urinary retention is defined as mean PVR urine volume > 100 ml with no voluntary void at all; whereas incomplete urinary retention is defined as PVR urine volume > 100 ml after a voluntary void in the laboratory, at the clinic, or at home when clean, intermittent catheterization (CIC) is performed. A double-lumen 8F catheter was inserted into the urethra. A rectal balloon catheter was inserted into the anus. A concentric needle electrode was inserted into the external anal sphincter muscle. We performed medium-fill (50 ml/min.) electromyography (EMG)-cystometry with pressure-flow analysis using two computers (Urovision, Lifetech Inc, Houston, TX, USA; Neuropack M2, Nihon Kohden Inc, Tokyo, Japan) [13]. The filling phase parameters included first-sensation volume, bladder capacity, and detrusor overactivity. The voiding phase parameters included outlet obstruction and detrusor contractility. Outlet obstruction was designated as the Schäfer's obstruction grade 3 or more (although originally developed for men, we tentatively applied this figure in women). Low maximum Watts Factor (< 10 watts/m^2) or weak/very weak on the Schäfer nomogram is defined as underactive (weak) detrusor (although originally developed for men, we tentatively applied this figure in women). We also analyzed the motor unit potential of the sphincter muscles [14].

Neurologic and other examinations

All patients underwent a neurologic examination, which included testing for gait disturbance, motor weakness, deep tendon reflexes of the lower extremities, and sensation in the lower half of the body, including the perineal area. All patients underwent blood chemistry and urine analysis. Diagnostic criteria of major neurologic diseases that might cause female urinary retention are as follows. LS is diagnosed when the patients have 1) neurologic cauda equina syndrome, *e.g.*, intermittent claudication, saddle anesthesia/pain (radiculopathy), etc., 2) imaging of spinal canal narrowing more than 70% by axial images of lumbar magnetic resonance imaging (MRI) scan that is performed in all cases, including severe central protrusion but mild neurologic symptoms, and 3) excluding other causes of cauda equina syndrome, *e.g.*, spinal cord tumor, sacral herpes, myelomeningocele, etc. DPN is diagnosed when the patients have 1) neurologic distal polyneuropathy, *e.g.*, globe and stocking type numbness/pain with decreased/absent deep tendon reflexes, 2) neurophysiologic distal polyneuropathy, *e.g.*, prolonged distal latency and/or slowed motor/sensory conduction velocity in the extremities by a neve conduction study that is performed in all cases, 3) a history of treated/untreated diabetes with abnormal hemoglobin A1C by a blood test that is performed in all cases, and 4) excluding other causes of distal neuropathy, *e.g.*, alcohol intoxication, drug abuse, chronic inflammatory demyelinating polyneuropathy, Charcot- Marie- Tooth diseases, etc. MSA is diagnosed when the patients have 1) autonomic failure involving urinary incontinence (inability to control the release of urine from the bladder, with erectile dysfunction in males) or an orthostatic decrease of blood pressure within 3 min of standing by at least 30 mm Hg systolic or 15 mm Hg diastolic, and 2) poorly levodopa-responsive parkinsonism or a cerebellar syndrome. We also performed brain MRI scan and single photon emission computed tomography (SPECT) scan in all suggestive patients to ascertain clinical diagnosis of MSA, and ^{123}I-metaiodo-benzylguanidine (MIBG) myocardial scintigraphy in order to exclude Parkinson's disease from MSA-P. All patients gave informed consent before participating in the study.

RESULTS

We had 450 female patients in our urodynamic laboratory. The frequency of urinary retention was 13% (60/450 patients), including 4 patients (6.7%) with complete retention and 56 patients (93.3%) with in complete retention (**Fig. 1**).

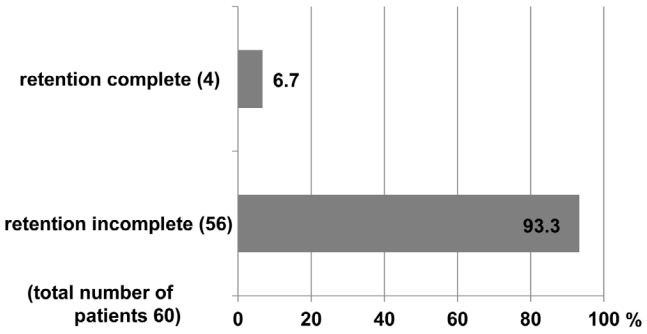

Figure 1. Female urinary retention: complete and incomplete. Complete retention, unable to void at all; Incomplete retention, able to void voluntarily but leave large post-void residuals.

Twenty-three of the 60 patients (38.3%) had LS, including 16 with LS alone (26.7%) and 7 with LS & DPN (11.1%). After LS, the most common underlying diseases were MSA, 11 (18.3%) and DPN, 9 (15.0%), including the 7 with LS & DPN (11.1%) and 2 with DPN alone (3.3%), followed by drug-induced (*i.e.*, by antidepressants, anticholinergics) symptoms, 5 (8.3%), acute myelitis of possible demyelinating origin, 3

(5.0%), meningitis-retention syndrome, multiple sclerosis spinal form, spinocerebellar ataxia and sacral herpes zoster, 2 (3.3%), respectively, and other etiologies, 8 (13.3%) (**Fig. 2**). In the present study, 10% (most of other etiologies, 13.3%) of patients were considered to have idiopathic (with no apparent etiologies). No opiate use was noted in our cohort.

A majority of patients with female urinary retention had both storage and voiding symptoms, and IPSS, OABSS, and a Neurologic LUTS Questionnaire could not differentiate the major disease groups (MSA, LS, LS & DPN, DPN) (data not shown). Patients with DPN did not always report sensation of residuals and other voiding symptoms, as expected by the larger PVR urine volume described as follows. Urodynamic findings in the major disease groups (MSA, LS, LS & DPN, DPN) that cause female urinary retention are shown in **Table 1**, and complete retention was found only in DPN in our cohort. Overall, the major urodynamic abnormality was an underactive detrusor, which was observed in 72.7% of MSA cases, 33.3% of LS, 57.1% of LS & DPN and 50.0% of DPN indicating that an underactive detrusor was the most prominent in MSA. We could not analyze patients who were unable to void at the urodynamic test. The PVR urine volume was the largest in DPN (390 ml; normal < 30 ml). First-sensation volume and bladder capacity were also the largest in DPN (314 ml; normal, 100–300 ml). The incidence of detrusor overactivity in LS & DPN (42.9%) was less than those in MSA (63.6%) and LS (46.7%). The incidence of neurogenic change in the sphincter EMG was 75.0% in MSA, 57.1% in LS, 75.0% in LS & DPN and 0% in DPN. None revealed outlet obstruction. None revealed decelerating bursts in the sphincter EMG [3] in our study cohort.

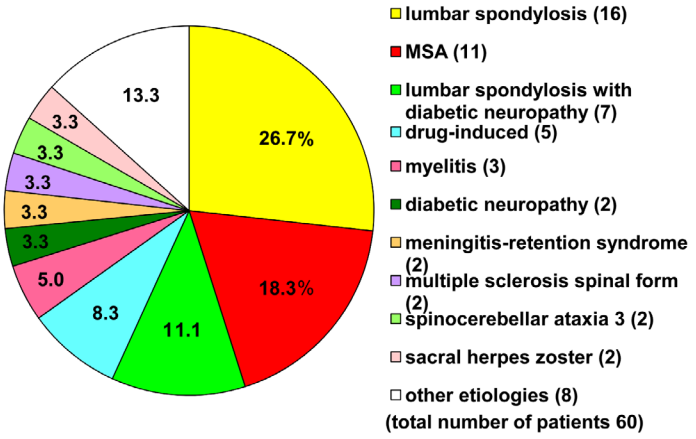

Figure 2. Etiologies of female urinary retention. MSA, multiple system atrophy.

Table 1. Urodynamic findings in major neurologic diseases that cause urinary retention in women.

Diseases	Age (years)	Retention complete	Post-void residual (ml)	First sensation volume (ml)	Bladder capacity volume (ml)	Detrusor overactivity (%)	Low compliance detrusor (%)	Underactive detrusor (%)	Neurogenic change in sphincter EMG (%)
Multiple system atrophy (n =11)	67.4 (57–74)	0/11	164	134	286	63.6	9.1	72.7	75.0
Lumbar spondylosis (n = 16)	71.7 (58–82)	0/16	220	149	368	46.7	6.7	33.3	57.1
Lumbar spondylosis + diabetic polyneuropathy (n = 7)	71.1 (63–77)	0/7	222	149	361	42.9	0	57.1	75.0
Diabetic polyneuropathy (n = 2)	70.5 (64–77)	1/2	390	314	505	50	0	50.0	0

EMG, electromyography; Detrusor overactivity, detrusor overactivity during bladder filling; Underactive detrusor, underactive detrusor during voiding

DISCUSSION

Female urinary retention is still a challenging symptom for neuro-urologists to interpret; the differential diagnoses include multiple sclerosis [5], sacral herpes [6], meningitis-retention syndrome [7], and MSA [8]. More recently, age-related LS [9,10] and lifestyle-related DPN [11,12] have been added to this list [14,15,16]. However, it remains unclear to what extent these neurologic diseases contribute to female urinary retention. To the best of our knowledge, this is the first detailed study to show the frequency of female urinary retention at a urodynamic laboratory. We found the following: the most common etiologies for female urinary retention were neurologic, *e.g.*, LS (LS alone 26.7%, LS & DPN 11.1%), MSA (18.3%), and DPN (DPN alone 3.3%, LS & DPN 11.1%).

Among neurologic diseases, MSA was the second most common diagnosis, while in another study, MSA was the most common (19.0%) [11]. MSA is a degenerative disease characterized by glial cytoplasmic inclusions in the brain [8]. Neuroimaging shows a pontine cross sign and putaminal slit sign [8]. Clinically, MSA shows any combination of autonomic, cerebellar and extra-pyramidal symptoms. Autonomic

symptoms appear as postural hypotension and pelvic organ dysfunction, and bladder dysfunction is the most common (90–100%) [14]. Bladder dysfunction in typical cases is a combination of urinary urgency/frequency caused by detrusor overactivity, and large PVR, caused by detrusor underactivity, with or without detrusor–sphincter dyssynergia. The former (overactivity) presumably reflects lesions in the bladder inhibitory areas (the basal ganglia, the cerebellum and the prefrontal cortex, etc.), while the latter (underactivity) presumably reflects lesions in the bladder facilitatory area (Barrington's nucleus, sacral intermediolateral nucleus, etc.) [14,15]. In our study, underactive detrusor was the most common contributor to MSA while bladder capacity was the least common. This presumably reflects comorbid detrusor overactivity in this disorder. Another urodynamic finding is sphincter EMG abnormality (75% of patients). This finding reflects lesions in the sacral Onuf's nucleus [14,15].

LS was the most common causative disease, while in one study LS was the fourth most common (5%) [9]. In another report [16], (lumbar) disc disease was the most common (25.6%). LS is an age-related disease based on osteoporosis. Recent studies suggest that estrogen receptor alpha and collagen type I alpha 1 gene polymorphisms are related with female osteoporosis [17]. Since LS is common in the elderly, it is difficult to determine to what extent LS contributes to urinary retention. However, some cases are accompanied by intermittent claudication and saddle anesthesia, leading to complete cauda equina syndrome including LUTS. LUTS occurs in 50–70% of LS patients [18]. The prevalence depends on spinal canal narrowing, *e.g.*, 70% canal narrowing (30% left) for urinary retention [9], and a 5- [19] to 8-mm [20] canal for LUTS. The cauda equina contains pre-ganglionic autonomic fibers connecting to the detrusor and somatic fibers to the sphincter. Common urodynamic abnormalities in LS are a low-compliance detrusor and an underactive detrusor. Low-compliance detrusor was noted in 3% and underactive detrusor in 30–57% in the present study. It is worth mentioning that if the protrusion is central within the dural canal, LS can present with urinary retention alone without typical cauda equina syndrome [9,21].

DPN was the third most common in our findings, while in one study DPN is the fourth most common (5%) [9]. In another report [16], DPN is the second most common (25%). Type 2 diabetes is a common lifestyle disease [22]. DPN occurs in up to 50% of patients with diabetes [22]. DPN commonly involves postganglionic, small-fiber bladder neuropathy, which often parallels somatic neuropathy and duration of diabetes [11]. Focal axonal swelling/degeneration [23] and decreased cholinergic fibers in the bladder wall [24] underlie this condition. The pathogenesis includes altered metabolism of glucose and polyol, ischemia-reperfusion due to over-distention and vasculopathy, superoxide-induced free-radical formation, and impaired axonal transport of nerve growth factor [25]. Common urodynamic abnormalities in DPN are impaired bladder sensation and an underactive detrusor [11]. Impaired bladder sensation (first sensation volume 314 ml) was most prominent in DPN in the present study. Large PVR might progress insidiously, since DPN patients do not always have sensation of residuals and other voiding symptoms.

Limitations of this study include that we could not analyze patients who were unable to void at the urodynamic test. Therefore, the true incidence of underactive detrusor might be larger. Limitations of this study also include the small number of subjects and the possibility of selection bias limiting the generalizability of the findings. For example, there were no cases of obstruction-related or post-operative urinary retention. Referral from gynecology department is limited in our hospital, which might have affected the results in our study. Regarding other causative etiologies, stroke was not included in the present study: this is because urinary retention is extremely rare in stroke except for the acute 'brain shock' phase [26]. Multiple sclerosis (MS) was not included in the present study: this might be due to a selection bias that the frequency of MS in Asian countries including Japan is lower than European countries, although bladder dysfunction is a common feature in MS [27]. Similarly, spinal traumatic injury was not included in the present study: since our urodynamic laboratory belongs to a university hospital, and spinal cord injured patients might be referred to the specific center for spinal cord injury, although bladder dysfunction is a very common feature in spinal cord injury [28].

An underactive detrusor and large PVR (more than 100 ml) may lead to infection, kidney dysfunction, and significantly affect the quality of life in female patients. In our patients, treatment options include management of underlying diseases if possible, *e.g.*, laminectomy for LS and blood glucose lowering for DPN. However, if these treatments fail, or are not indicated, it is recommended to start CIC [29,30]. If repeated CIC is difficult to perform because of concurrent detrusor overactivity, CIC twice during the daytime and the use of an Intermittent Self Balloon Catheter (DIB International, Co.) during the night-time is a regimen that can be recommended by caregivers [29,30].

In conclusion, the present study revealed that common etiologies for female urinary retention were neurologic, *e.g.*, an underactive detrusor due to MSA, age-related LS, and lifestyle-related DPN. Therefore, LS and DPN, both common neurologic diseases, should also become major treatment targets in order to maximize patients' quality of life.

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None.

Author contributions

HN has a role in acquisition of data, analysis and interpretation of data. RS has a role in study concept and design, acquisition of subjects and/or data, analysis and interpretation of data, and preparation of manuscript. MS, FT, HT, MY, OT, MK, YT, YA, TO, TY, TY, TU, HS and YS have a role in acquisition of data.

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