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Urodynamic Findings in Patients with Diabetes Mellitus and Lower Urinary Tract Symptoms

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Chung DE[1]*, Najari BB[2], Lee RK[2], Chughtai BC[2], Kaplan SA[3] and Te AE[2]

[1]Deptartment of Urology, Columbia University Medical Center, USA

[2]Department of Urology, Weill Cornell Medical College, New York

[3]Department of Urology, Icahn School of Medicine, Egypt

***Corresponding author:** Doreen E Chung, MD, FRCSC, Assistant Professor, Department of Urology, Columbia University Medical Center, 161 Fort Washington Avenue, New York, USA, Tel: 212-305-0144; Email: dec2154@cumc.columbia.edu

Abstract

Objective: To characterize urodynamic (UDS) findings in North American patients with diabetes mellitus (DM) and lower urinary tract symptoms (LUTS) from a contemporary cohort.

Methods: A multi-center UDS database (1997-2010) of 3663 records was analyzed for patients with DM. Statistical analysis used Fisher's exact and Mann-Whitney U tests.

Results: 257 patients were identified: 173 men and 84 women.74 patients had insulin-dependent DM (IDDM) and 183 patients noninsulin-dependent DM (NIDDM). Mean age was 70±12 years. The most common diagnosis in all patients was detrusor overactivity (71%). In women, common presenting complaints were frequency (n= 47, 56%), urgency (n=45, 54%), and stress incontinence (SUI) (n=37, 44%). Presenting symptoms in men were frequency (n= 99, 57%), nocturia in (n=83, 48%), and urgency (n=78, 45%). 9(11%) women and 40(23%) men presented in retention. Detrusor underactivity (DU) was present in 26% of patients, including 22% of men and 31% of women (p=0.142). A high proportion of females had both SUI and DU(17%) who 10.4% of men had BOO with DU. Bladder capacity was significantly higher in patients with IDDM (445 vs. 394 mL, p=0.035).

Conclusion: In this contemporary series of patients with DM and LUTS from the United States, the most common diagnosis was Do.26% of patients were found to have coexisting DU. Adding DO to the definition of diabetic cystopathy should be considered and these findings suggest it is important to consider UDS in patients with DM and persistent voiding complaints, particularly prior to surgery.

Keywords: Diabetes mellitus; Urodynamic; Diabetes mellitus; Urinary incontinence

Abbreviations: DM: Diabetes Mellitus; LUTS: Lower Urinary Tract Symptoms; DO: Detrusor Overactivity

Introduction

The prevalence of diabetes mellitus (DM) has been increasing in the United States. In 2012, 9.3% of Americans had a diagnosis of DM and in that age 65 and older the prevalence of diabetes was 25.9% [1]. Classic diabetic cystopathy is described as decreased bladder sensation, increased bladder capacity, impaired detrusor contractility, and incomplete bladder emptying [2,3]. Data are conflicting, regarding urodynamic findings in patients with diabetes mellitus and very few studies are available from North America.

Kaplan et al. reviewed the studies of 182 male and female patients with lower urinary tract symptoms (LUTS) and DM and found that 23% had urodynamic findings consistent with diabetic cystopathy [4] but that this was not the most common urodynamic diagnosis. Lee et al. examined the urodynamic studies of 86 type 2 diabetic women in Taiwan and classified 34.9% as having detrusor underactivity (DU), [5] 14% as having detrusor overactivity (DO), 12.8% as having bladder outlet obstruction (BOO), and 34.8% normal bladder function. In contrast, Changxiae, et al. reported that 95% of 1640 diabetic females in Dujiangyan Province in China demonstrated diabetic cystopathy [6]. There is also emerging evidence that overactive bladder symptoms and detrusor overactivity are prevalent in patients with DM [4,5].

We sought to characterize urodynamic findings in patients with DM and lower urinary tract symptoms (LUTS) in a contemporary North American population.

Materials & Methods

A prospectively managed multi-institutional urodynamics (UDS) database (1997-2010) of 3663 records was retrospectively reviewed and analyzed for patients presenting with DM and LUTS. UDS were performed using Laborie (Toronto, on) equipment. Procedures followed the recommendation of the International Continence Society (ICS) Good Urodynamics Practice standards [7-9].

Patients under went multichannel videourodynamic evaluation. Bladder pressure was monitored using a dual lumen 7F catheter, inserted into the bladder. Abdominal pressure was recorded using a standard rectal balloon catheter. Slow-fill cystometry was performed at 15-30 ml/min with 30% diatrizoate maglumine. Videourodynamic findings were first interpreted by an experienced urologist then reviewed retrospectively for confirmation. Diagnoses, also confirmed retrospectively, were made at time of UDS.

Definitions were consistent with those by the ICS [8]. BOO in men was classified according to ICS nomogram. In women, BOO was defined, by criteria set out by Blaivas and Groutz, as Qmax ≤ 12 ml/s with Pdet ≥ 20 cm H2O, obvious radiographic evidence of BOO in the presence of a sustained detrusor contraction of at least 20 cm H_2O, or inability to void with transurethral catheter in place despite sustained detrusor contraction of at least 20 cm H_2O [10,11]. DO was characterized by involuntary detrusor contractions during filling. Definition of overactive bladder (OAB) was the presence of storage symptoms, urgency with or without urgency incontinence, usually with frequency and nocturia. DU was defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within a normal time span. DU in men was also determined using Schafer's pressure-flow nomogram [12,13]. Patients who did not have appreciable contraction during voiding phase of UDS were considered to have a contractile detrusor.

All patients underwent detailed history (including standardized voiding questionnaire)and physical examination. Clinical parameters within the database included demographics, past medical and surgical history, voiding symptoms, and medications (including anti hyperglycemic agents). Duplicate studies on a single patient were excluded. Also excluded were patients who had a history of neurologic diagnosis (such as multiple sclerosis or stroke) or major pelvic surgery that might affect voiding function, such as abdominoperineal resection.

Statistical analysis was performed using the Fisher's exact and Mann-Whitney U tests. All analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC).

Results

Studies from 257 diabetic patients were analyzed and included 84(32.7%) females and 173(67.3%) males. Mean age of all patients was 69.6±11.5 years. For males mean age was71.2±10.7years and mean age of female patients was younger at 66.1±12.5 years. 74(28.8%) patients had insulin-dependent diabetes mellitus (IDDM) and 183(71.2%) patients had noninsulin-dependent diabetes (NIDDM). Regarding Comorbidities, 25 (29.8%) women had a history of hysterectomy. 51 (19.8%) patients

reported a history of coronary artery disease including 38 (21.9%) male and 13 (15.4%) female patients. 19 (7.3%) had undergone CABG (16 male, 3 female).

	Total	Men	Women	P-value
No. Patients	257	173	84	
Age (years)	70 ± 12	71 ± 11	66 ± 13	0.002
Type of DM				0.002
IDDM	74 (29%)	39 (23%)	35 (42%)	
NIDDM	183 (71%)	134 (77%)	49 (58%)	

Table 1: Patient Characteristics.

Urodynamics findings for the overall cohort of patients subdivided by gender, are presented in Table 2. For all diabetic patients, the most common diagnosis was DO (71%). DU was present in 26% of patients, including 22% of men and 31% of women (p=0.142). No differences were seen in proportion of patients diagnosed with impaired bladder sensation (18% males vs. 21% females, p=0.415) or a contractile detrusor (2% males vs. 4% females, p=0.427).

Urodynamic Diagnosis	All (N=257)	Men (N=173)	Women (N=84)	P-value
Detrusor Overactivity (DO)	183 (71%)	122 (68%)	51 (61%)	0.001
Bladder Outlet Obstruction (BOO)	128 (50%)	118 (66%)	10 (12%)	<0.001
DO + BOO	93 (36%)	85 (48%)	8 (9.5%)	<0.001
SUI	53 (21%)	11(6%)	42 (50%)	<0.001
Detrusor Underactivity (DU)	66 (26%)	40 (22%)	26 (31%)	0.142
SUI + DU	14 (5%)	0 (0%)	14 (17%)	<0.001
BOO + DU	20 (8%)	18 (10%)	2 (2%)	<0.001
Impaired Bladder Sensation	50 (19%)	32 (18%)	18 (21%)	0.415
A contractile Detrusor	7 (3%)	3 (2%)	4 (5%)	0.427

Table 2: Urodynamics Findings in Patients with DM and LUTS Grouped by Gender.

Men were more likely than women to be diagnosed with BOO (66% vs. 12%, p<0.001). They were also more likely to be diagnosed with the combination of the combination of BOO with DU (10.4% vs. 2.4%,p <0.001) and the combination of DO and BOO (48% vs. 9.5%,p<0.001). Similarly, women were more likely than men to be diagnosed with SUI (50% vs. 6%, p<0.001) and the combination of SUI and DU (17% vs. 0%, p<0.001).

In women, the most common presenting complaints were frequency (n=47, 56%), urgency (n=45, 54%), and SUI (n=37, 44%). In men, the most common presenting symptoms were frequency (n=99, 57%), nocturia (n=83, 48%), and urgency (n=78, 45%). For all patients the most common symptoms were frequency (n=146, 56.8%), urgency (n=123, 47.9%), and nocturia (n=110, 42.8%). 9 women (11%) and 40 men (23%) were in urinary retention prior to UDS. 68 (81.0%) females and 79 (45.7%) males presented with urgency incontinence (UUI).

Tables 3 & 4 display urodynamics parameters grouped according to gender and type of diabetes. Between patients with IDDM and NIDDMno significant differences were seen in Qmax (14mL/s IDDMvs. 14 mL/sNIDDM, p=0.889), PVR (46 mL IDDMvs. 45 mLNIDDM, p=0.275),

Parameter	All (N=257)	Men (N=173)	Women (N=84)	P-value
First Sensation (mL)	185 ± 130	194 ± 139	166 ± 104	0.078
Capacity Volume (mL)	410 ± 227	425 ± 242	378 ± 191	0.337
Qmax (mL/second)	15 ± 15	13 ± 16	18 ± 13	0.002
Pdet at Qmax (cm H2O)	48 ± 31	57 ± 31	28 ± 18	<0.001
PVR	46 ± 109	48 ± 111	43 ± 104	0.609

Table 3: Urodynamic Parameters Grouped by Sex.

Parameter	All (N=257)	IDDM (N = 74)	NIDDM (N=183)	P-value
First Sensation (mL)	185 ± 130	189 ± 108	183 ± 137	0.465
Capacity Volume (mL)	410 ± 227	445 ± 211	394 ± 232	0.035
Qmax (mL/second)	15 ± 15	14 ± 12	14 ± 16	0.889
Pdet at Qmax (cm H2O)	48 ± 31	41 ± 25	51 ± 33	0.078
PVR (mL)	46 ± 109	45 ± 114	47 ± 108	0.275

Table 4: Urodynamics Parameters Grouped by type of Diabetes.

Discussion

The prevalence of diabetic cystopathy in patients with DM ranges in studies between 25 – 95% [4-6]. Part of this variation may be accounted for by the fact that while most experts agree on the qualitative criteria for diabetic cystopathy (decreased bladder sensation, increased bladder capacity, and impaired detrusor contractility, and incomplete bladder emptying), the exact quantitative urodynamic parameters that confine this phenomenon are not consistent in the literature[4,14,15].

The pathophysiology of diabetic bladder dysfunction is thought to be multifactorial, related to myogenic, neuronal, urothelial and urethral alterations [16]. Although progression to cystopathy is thought to be related to the duration of diabetes, animal studies suggest changes to bladder function begin to occur soon after its onset. This is seen in animal models in which osmotic polyuria during early diabetes results in bladder remodeling and increased contractility resulting in early bladder hypertrophy and commonly symptoms of detrusor overactivity [17,18]. Over time, prolonged hyperglycemia results in oxidative stress, likely contributing to bladder decomposition and symptoms of diabetic cystopathy.

Contemporary studies examining the urodynamics findings in patients with DM for the most part originate in Asia and may represent a population quite different than that in North America. In this contemporary series of patients, the most common urodynamic diagnosis observed was detrusor overactivity. These findings support previous observations that detrusor overactivity and urgency incontinence are highly prevalent in patients with DM.

Danforth, et al. used data from over 71,000 women enrolled in the Nurse's Health Study I and II noted an increased prevalence of urinary incontinence in women with type 2 DM, even when controlled for other factors known to contribute to incontinence (odds ratio (OR) 1.2, 95 % confidence interval 1–1.3). This appeared to be true only for urgency incontinence, with no increased association for stress or mixed incontinence [19]. The mechanism for OAB in diabetic patients is thought to be secondary to both central and peripheral mechanisms [20].

The observed rate of DO in diabetic patients undergoing UDS is variable across studies but is seldom low. In a previous North American study, with patients evaluated prior to 1995, Kaplan et al. observed that 55% of 182 men and women with DM had detrusor hyperreflexia during urodynamics [4]. Yamaguchi et al. reviewed the records of 84 Japanese patients with diabetic cystopathy and found that 42% of patients had concomitant detrusor overactivity [20]. Kepapci et al. performed urodynamics on 54 Turkish men and women with type 2 DM and observed a much lower rate of detrusor overactivity of 31%.

Multiple studies have been published regarding DO and diabetes specifically in women. In this study cohort, 61% of diabetic women had DO on urodynamics. This rate is higher than that in other studies. Lee et al. studied the urodynamics of 86 women with diabetes and observed that 14% had DO. Changxiao et al. performed urodynamics on 1640 diabetic females in China and diagnosed DO in 56%.

The reported rate of DU in diabetic patients is also highly variable. In Changxiao et al. diabetic female population the rate of DU observed was substantially higher at 56% vs. our observed rate of 26%. In a series of 52 Indian men with DM and LUTS, DU was seen in 78.8% [21]. In Taiwanese females with DM, Lee et al. observed a rate of 35% [5] Part of this variation in prevalence may be a consequence of the fact that there is not a precise widely-accepted definition of detrusor underactivity [22], particularly in women.

Significantly higher bladder capacity was seen in patients with IDDM (445 mL IDDMvs. 394 mLNIDDM, p=0.035).Very little data exists in the literature regarding differences in urodynamic findings between patients with IDDM and NIDDM. Changxiao, et al. did evaluate for

differences between patients with Type 1 vs. Type 2 diabetes and did not find any differences in prevalence of LUTS or urodynamic diagnoses [6].

Of note, a high proportion of females in this study suffered from both SUI and DU (17%). Similarly 10.4% of men in the study population had BOO in combination with DU and 48% demonstrated BOO with DO. Based on these observations, it may be important to consider urodynamic testing on diabetic female patients with SUI and diabetic male patients with BPH and lower urinary tract symptoms prior to surgical treatment.

Limitations of this study include its retrospective nature, lack of a control group, and the fact that patients were selected to undergo urodynamics based on presentation to a voiding dysfunction clinic. Other limitations are those inherent in urodynamic testing. Urodynamics is not always able to replicate normal voiding and symptoms. For example patients often exhibit a urethral reflex during intubated flow where the sphincter does not completely relax during voiding [23]. More information on patient diabetes characteristics would also have been helpful. Nonetheless, this is one of the only studies from 21st century North America examining urodynamic parameters in patients with diabetes.

Conclusions

In this contemporary series of patients with DM and LUTS from the United States DO was the most common urodynamic diagnosis. Adding DO to the definition of diabetic cystopathy should be considered. The rates of BOO in men and SUI in women do not differ from expected rates in patients without DM, but it is not uncommon for patients with DM to have coexisting DU along with these diagnoses. Patients with IDDM demonstrated increased bladder capacity compared to patients with NIDDM. Based on these findings it is important to consider urodynamic testing in patients with DM with persistent voiding complaints in particular prior to surgical intervention.

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