Research Article

Initial Study of Urodynamic Profile in Evaluating Lower Urinary Tract Problems: A Single Center Experience

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Abstract

Urodynamic testing is crucial for evaluating lower urinary tract (LUT) and other urological conditions related to bladder and urethral function. This study aims to profile LUT problems in our center to target specific diagnostic and treatment strategies. This descriptive and retrospective study utilized secondary data from 324 patients who underwent urodynamic evaluation in the Department of Urology, Persahabatan National Hospital, between February 2022 and May 2023. Among patients with suspected benign prostatic hyperplasia (BPH), over half (52.7%) presented with reduced bladder capacity, with 40.2% showing detrusor overactivity (DO) and 37.5% displaying detrusor underactivity (DU). More than half (59.2%) of urinary retention patients suffered from DU with small bladder capacity (43.7%) and low bladder compliance (32.4%). Similarly, in the overactive bladder (OAB) group, 54.5% had reduced bladder capacity, which was also predominant (56.0%) in the urodynamic stress urinary incontinence (USI) group. Among patients suspected of having neurogenic bladder, 73.3% had DU, 48.9% had small blaSadder capacity, and 40% exhibited bladder atony. Furthermore, among the five pediatric patients assessed, three had a small bladder capacity, low compliance, and DU. These findings underscore the significance of urodynamic testing, which can contribute to better evidence-based treatment in managing LUT dysfunction.
Keywords: *urodynamic, lower urinary tract symptoms, urinary retention, detrusor underactivity.*

Profil Urodinamik pada Pasien dengan Keluhan Saluran Kemih Bagian Bawah: Studi Pendahuluan di Satu Rumah Sakit

Abstrak

Pengujian urodinamik sangat penting untuk mengevaluasi saluran kemih bagian bawah dan kondisi urologi lainnya yang berkaitan dengan fungsi kandung kemih dan uretra. Penelitian ini bertujuan untuk membuat profil permasalahan saluran kemih bagian bawah sebagai dasar dalam menentukan strategi diagnostik dan pengobatan yang spesifik. Penelitian ini merupakan penelitian retrospektif deskriptif menggunakan data sekunder dari 324 pasien yang menjalani pemeriksaan urodinamik di Departemen Urologi, RSUPN Persahabatan, pada bulan Februari 2022 hingga Mei 2023. Di antara pasien yang diduga mengalami benign prostatic hyperplasia (BPH), lebih dari separuh (52,7%) mengalami penurunan kapasitas kandung kemih kecil, dengan 40,2% menunjukkan detrusor overactivity (DO) dan 37,5% menunjukkan detrusor underactivity (DU). Lebih dari separuh (59,2%) pasien retensi urin menderita DU dengan kapasitas kandung kemih kecil (43,7%) dan compliance kandung kemih rendah (32,4%). Demikian pula, pada kelompok overactive bladder (OAB), 54,5% memiliki kapasitas kandung kemih kecil, yang juga dominan (56,0%) pada kelompok inkontinensia urin stres urodinamik (USI). Di antara pasien yang dicurigai menderita kandung kemih neurogenik, 73,3% memiliki DU, 48,9% memiliki kapasitas kandung kemih kecil, dan 40% menunjukkan atonia kandung kemih. Sedangkan, di antara lima pasien anak yang diperiksa, tiga diantaranya memiliki kapasitas kandung kemih kecil, compliance kandung kemih rendah, dan DU. Temuan ini menggarisbawahi pentingnya pengujian urodinamik, yang dapat berkontribusi pada pengobatan berbasis bukti yang lebih baik dalam manajemen permasalahan saluran kemih bagian bawah.
Kata kunci: *urodinamik, keluhan saluran kemih bagian bawah, retensi urin, detrusor underactivity.*

Introduction

The urodynamic test is an essential diagnostic tool for evaluating the lower urinary tract, providing valuable insights into bladder function and related urological conditions. Urodynamic testing involves measuring and analyzing several bladder and urethral function parameters, such as cystometry and uroflowmetry. Cystometry assesses bladder filling and emptying by measuring intravesical pressure and urine flow rates, and uroflowmetry measures rate and pattern. Meanwhile, pressure-flow studies evaluate the relationship between detrusor pressure and urine flow during voiding.[1]

Urodynamic tests as an objective tool to assess lower urinary tract symptoms (LUTS) have shown a sensitivity of 82%, 69% and 51% with a specificity of 57%, 60%, and 66% for diagnosing several types of incontinence ranging from stress urinary incontinence (SUI), urge incontinence, and mixed incontinence, respectively.[2] In both male and female patients, standard urodynamic testing can help prioritize the management of multiple coexisting pathologies and clarify ambiguous diagnoses, aiding in surgical decision-making. Furthermore, LUTS and urinary incontinence (UI) as the most common symptoms in patients should be differentiated by the cause of the problem, such as bladder outlet obstruction (BOO), detrusor underactivity (DU), detrusor overactivity (DO), and urodynamic stress incontinence (USI).[3]

While urodynamic studies have been extensively investigated in various populations worldwide, there is a scarcity of research specifically focused on the urodynamic profile in Indonesia. Understanding LUTS's urodynamic characteristics and prevalence in the Indonesian population is crucial for developing targeted diagnostic and treatment strategies. Several studies in Indonesia showed that patients who underwent urodynamics testing demonstrated superiority when diagnosing the patients and choosing the right treatment.[1–3] Overall, this study aims to address and provide valuable insights into the urodynamic profile in Indonesia by elucidating and promoting evidence-based approaches to lower urinary tract dysfunction within the Indonesian population in general.

Methods

This descriptive-retrospective study used secondary data from medical records of patients who underwent urodynamic evaluation in the Department of Urology, Persahabatan National Hospital, from February 2022 to May 2023. We extracted the patient's demographics and characteristics from the patient's medical record, including age, sex, body mass index, clinical diagnosis of patients before the procedure, and urodynamic results during the filling and voiding phases. The pre-urodynamic diagnosis was made using history taking, physical examination and other examinations. The diagnosis was categorized into six groups, including LUTS, urinary retention, OAB, USI, neurogenic bladder, and pediatric voiding dysfunction for patients under 18 years old. This study has been approved by the ethics committee of the Faculty of Medicine, University of Indonesia - dr. Cipto Mangunkusumo Hospital, with ethics approval number KET-1395/ UN2.F1/ETIK/PPM.00.02/2023.

This study will report urodynamic findings from the filling (storage) and voiding phases. Bladder capacity was divided into two groups. Low bladder capacity was defined when the capacity is under 300 ml.[4] Detrusor overactivity was determined based on urodynamic observation from the International Continence Society (ICS) as an involuntary detrusor contraction during the filling phase at any time before permission to void being given. UI was defined as the complaint of involuntary urine loss and was proven by objective findings of urine loss as a sign. On the other hand, USI, based on the symptoms, is a complaint of urine loss during coughing, sneezing, or physical exertion. Diagnosis of USI is noted during urodynamics when involuntary leakage of urine was found during the secondary raising of intravesical pressure due to increased abdominal pressure. DO incontinence is an involuntary leakage of urine raised from detrusor overactivity and urgency before leakage was found in patients with the sensation.[5]

In the voiding phase, BOO was defined as an abnormal urinary flow noted on pressure flow study during increasing detrusor pressure, resulting from anatomical obstruction such as stricture, previous incontinence surgery, cystocele, and urethral diverticulum. BOO have different categorization in female and male patients. In men, BOO was categorized into obstructed (>40), unobstructed (<20), or equivocal (20−40) groups using the bladder outlet obstruction index (BOOI) from ICS. However, in women, bladder outlet obstruction for females (BOOIf) was calculated using the formula (PdetQmax – 2.2xQmax) and categorized into three different groups by their probability of BOO, specifically <0 (<10% probability of BOO), >5 (50% probability of BOO), >18 (90% probability of BOO). DU was defined as poor bladder emptying due to

inadequate detrusor pressure or short contraction time.[3,4] All of the data collected from this study were analyzed using IBM SPSS version 21.0.

Results

Data from the medical records included 324 patients who underwent urodynamics testing in Persahabatan National Hospital during the study period. The subjects' characteristics were detailed in subgroups of age, sex, body mass index, and pre-urodynamic diagnosis. Two-thirds of the samples were men (66.7%), most likely to be adults (53.4%), followed by the geriatric (45.1%) age group and pediatric with only five patients. The median age of the samples was 62 (10-89) years. Samples had an abnormal age distribution and, therefore, were described in the median. The patient's BMI was most likely in normoweight (47.6%), followed by overweight and obese in second and third place. The most common pre-diagnosis before urodynamics was LUTS due to benign prostatic hyperplasia (BPH) (34.9%) and urinary retention (21.9%) in the second place.

The urodynamic data summarized in Table 2 reveal key findings among patients pre-diagnosed with LUTS due to BPH. Among the 112 subjects, 52.7% had reduced bladder capacity, 40.2% demonstrated DO, and 37.5% showed DU. Additionally, nearly one-third of these subjects exhibited low bladder compliance (31.3%) and BOO (26.8%). Only two subjects presented with mixed intravesical obstruction and DU in the LUTS cohort.

Of 71 subjects with urinary retention, over half (59.2%) had DU with small bladder capacity (43.7%), low compliance (32.4%) and bladder atony (28.2%). A small portion of the patients with urinary retention also have DO incontinence (19.7%), DO (18.3%), detrusor sphincter dyssynergia (DSD) (15.5%), BOO (12.7%), and USI (9.9%).

In subjects with OAB, the majority exhibited small bladder capacity (54.5%), followed by similar proportions with DU (37.9%) and DO (36.4%). Two subjects with a pre-diagnosis of OAB showed USI. Among 25 subjects with USI confirmed by urodynamics, the most common findings were small bladder capacity (56.0%), USI (44%), and DU (44%). Meanwhile, 45 subjects with a preliminary diagnosis of a neurogenic bladder had urodynamic findings that confirmed the diagnosis, with 73.3% DU, 48.9% with small bladder capacity, and 40% bladder atony. The pediatric voiding dysfunction group included five subjects with pre-urodynamic diagnoses: LUTS (1), OAB (1), USI (1), and neurogenic bladder (2). The youngest age of the pediatric patient was 10 years old, and the oldest was 16 years old. The pediatric patients ranged from 10 to 16 years old. Urodynamic results indicated that three patients were recorded as having small bladder capacity (3/5), low compliance (3/5), and DU (3/5).

Table 1. Characteristics of Study Sample

Characteristics	n (%)
Gender	
Male	216 (66.7)
Female	108 (33.3)
Age Group (years old)	
Pediatric (<18)	5 (1.5)
Adult (18-64)	173 (53.4)
Geriatric (>64)	146 (45.1)
Median Age	62 (10−89)
Body Mass Index	
Underweight (<18.5)	30 (9.3)
Normoweight (18.5−22.9)	154 (47.6)
Overweight (23.0−24.9)	73 (22.5)
Obese (>25.0)	67 (20.6)
Pre-Urodynamic Diagnosis	
LUTS due to BPH	112 (34.6)
Urinary Retention	71 (21.9)
SIU	25 (7.6)
OAB	66 (20.7)
Pediatric	5 (1.5)
Neurogenic Bladder	45 (13.7)

Table 2. Comparisons of Post-urodynamic Diagnosis with Pre-urodynamic Diagnosis

Pre-urodynamic Diagnosis	Post-urodynamic Diagnosis										
	Patients	Small Bladder Capacity n (%)	Low Bladder Compliance n (%)	DO n (%)	DO Incontinence n (%)	Stress Incontinence n (%)	BOO n (%)	DU n (%)	Bladder Atony n (%)	DSD n (%)	Mixed BOO + DU n (%)
LUTS	112	59 (52.7)	35 (31.3)	45 (40.2)	12 (10.7)	4 (3.6)	30 (26.8)	42 (37.5)	8 (7.1)	4 (3.6)	2 (1.8)
Urinary retention	71	31 (43.7)	23 (32.4)	13 (18.3)	14 (19.7)	7 (9.9)	9 (12.7)	42 (59.2)	20 (28.2)	11 (15.5)	0
Overactive Bladder	66	36 (54.5)	9 (13.6)	24 (36.4)	11 (16.7)	2 (3.0)	8 (12.1)	25 (37.9)	11 (16.7)	15 (22.7)	0
SUI	25	14 (56.0)	8 (32)	6 (24.0)	4 (16.0)	11 (44.0)	0	11 (44.0)	8 (32.0)	7 (28.0)	0
Neurogenic Bladder	45	22 (48.9)	17 (37.8)	14 (31.1)	10 (22.2)	4 (8.9)	5 (11.1)	33 (73.3)	18 (40.0)	9 (20.0)	0
Pediatric	5	3 (60.0)	3 (60.0)	0	0	1 (20.0)	0	3 (60.0)	3 (60.0)	1 (20.0)	0
Total	324	165	95	102	51	29	52	156	68	47	47

DO: detrusor overactivity; BOO: bladder outlet obstruction; DSD: detrussor sphincter dyssinergia; DU: detrussor underactivity

Discussion

Urodynamic studies serve various purposes according to the American Urological Association (AUA) and the Society for Urodynamics, Female Pelvic Medicine, and Urogenital Reconstruction (SUFU). These include identifying LUTS, predicting its impact on upper urinary tract dysfunction, assessing treatment outcomes, and evaluating cases of treatment failure. Standard urodynamic testing is particularly valuable when the diagnosis is unclear, surgical interventions are being considered, multiple coexisting pathologies are present, or complex urological issues exist. In female patients, common diagnoses for incontinence encompass DO, USI, mixed urinary incontinence (MUI), BOO, and DU. Similar diagnoses can be observed in male patients, with DO often associate with benign prostatic obstruction and other causes of BOO and USI frequently linked to radical prostatectomy. Urodynamic testing plays a crucial role in diagnosing and managing these conditions, including loss of compliance, functional BOO (such as DSD), and their prevalence in patients with spinal cord injury or multiple sclerosis. During urodynamic testing, careful consideration of factors such as pressure transmission, detection of physiological fluctuations, appropriate filling rates, and addressing external interferences is necessary to ensure accurate and reliable results. By effectively managing these factors, the integrity and reliability of urodynamic testing can be upheld.[3]

Studies about urodynamics have always been challenging among urologists; the prevalence and characteristics differ in each country and region. Using a guideline from the ICS as a standardized protocol for urodynamics, we performed urodynamic examination based on its indication data collected from history taking, physical examination including neurological examination in high-risk patients, bladder diary, uroflowmetry, cystometry and pressure flow study (PFS).[4]

There are some previous studies about the urodynamics profile in Indonesia. One study from Yunanto et al[6] profiled urodynamic characteristics in dr. Cipto Mangunkusumo General Hospital, Jakarta, concluded that urodynamics has a better role in diagnosing patients with mixed components. The follow-up study from Soedarman et al,[5] at the same study location, post-urodynamics diagnosis was differentiated into filling and voiding problems, and it was stated that determining the filling and voiding problem could improve personalized, tailored treatment for patients with various LUT problems.

The present study was conducted at a different center in the same city, with data collected from the beginning of urodynamic procurement. Most patients were male, spanning an age range from pediatric to geriatric, with a median age of 62 years. Due to the limited number of pediatric cases, pediatric voiding dysfunction in this study was not analyzed as a separate subgroup of clinical diagnosis based on post-urodynamic results.

The most common clinical diagnoses in this study were LUTS and urinary retention, consistent with previous study.[5,6] Post-urodynamic findings revealed that the most frequent diagnosis was small bladder capacity (52.7%), followed by DO (40.2%), DU (37.5%), low bladder compliance (31.3%), and BOO (26.8%). These results indicate that many patients likely experience issues in the filling phase, with reduced bladder capacity potentially resulting from primary causes such as obstruction and neurological conditions, creating

a cycle of bladder impairment that predominantly manifests as frequency and nocturia symptoms.[7-9]

However, among patients with urinary retention—the second most common clinical diagnosis—DU was the most prevalent finding (59.2%), followed by small bladder capacity (43.7%). Similar findings were reported by Guo et al[10], where 73% of men with urinary retention presented with DU, and by Yang et al[11], where 23.1% of women with urinary retention have DU.[11] These results underscore the value of urodynamic evaluation in providing a better understanding of the need for more holistic and thorough treatment for individuals with LUTS and urinary retention. Bladder impairment and contraction disorder should be treated, as well as BOO.

An interesting finding in this study is that among patients in the OAB category, only 36.4% had urodynamic results showing DO and 16.7% had DO Incontinence. This aligns with a previous study by Soedarman et al[5], which reported 40% DO and 10% DO incontinence in OAB patients, suggesting thst overdiagnosis may occur in the clinical settings. In this study, the most common urodynamic finding in OAB patients was small bladder capacity (54.5%), followed by an equal number of subjects with DU (37.9%) and DO (36.4%). Contrastingly, a previous study from Yunanto et al[6] revealed that most OAB patients had bladder atony (50%), followed by DU (19%), BOO (16%), a combination of BOO and DU (10%), and only 5% had a normal voiding phase.[6] Furthermore, overdiagnosis in OAB symptoms could be related not only by involuntary bladder contractions but to the bladder capacity. Supporting this, Fan et al,[12] observed that patients with small bladder capacity experience lower tolerance, premature filling sensation, and earlier desire to void in cystometric study. However, in this study, only two pre-diagnosed OAB subjects presented with USI, indicating a relatively low prevalence of MUI compared to previous studies, where over 25% of OAB patients showed USI on urodynamic evaluation.[6] A study by Lin et al[13] also found that only 9% of patients with mixed incontinence had impaired urodynamic results compared to OAB, supporting a higher prevalence of pure OAB over MUI.[13] On the other hand, a lower rate of USI urodynamic findings in OAB patients showed improvement in clinical diagnosis before urodynamics testing, resulting in better outcomes in choosing the right treatment for the patient.

The findings of the current study revealed that among the subjects with USI, a significant proportion exhibited urodynamic diagnoses characterized by a predominant occurrence of small bladder capacity (56.0%), followed by USI (44%), and DU (44%). In comparison, a study by Yunanto et al[6] on USI patients reported that 14% patients had BOO, 30% patients had DU, 54% patients had bladder atony, and 2% patients had a combination of BOO and DU.[6] Notably, our study observed a slightly higher prevalence of DU among USI patients compared to Yunanto et al[6] These results suggest the importance of assessing whether USI patients also have underlying voiding disorders, as this can be crucial for optimizing treatment outcomes. These findings highlight the valuable role of urodynamic examinations in USI patients with concurrent voiding difficulties.

In the suspected neurogenic bladder group, the urodynamic results revealed that 73.3% of patients had detrusor underactivity, 48.9% had small bladder capacity, and 40% had bladder atony. Unlike previous studies, which have not specifically analyzed data from patients with suspected neurogenic bladder, these findings emphasize the importance of urodynamic testing in managing neurogenic bladder. Due to the unreliability of neurogenic bladder symptoms, follow-up urodynamic evaluations are essential as they offer a dependable method to monitor bladder pressures and ensure patient safety. Follow-up urodynamics plays a critical role in managing neurogenic bladder by monitoring treatment responses, ensuring lower urinary tract safety, and identifying patients who require intensified management.[14]

In the pediatric voiding dysfunction group, three out of five subjects were recorded as having small bladder capacity, low compliance, and DU based on urodynamic results. Comparing these results to a study by Yunanto et al[6], it was found that among 60 pediatric patients (6%) with LUTS and urinary retention were attributed to impaired bladder contraction. Specifically, 16.7% of these patients had DU, 25% presented with bladder atony, and another 25% presented with BOO.[6] In contrast, a study by Soedarman et al[5] found that BOO was the leading cause of LUTS in pediatric patients, accounting for 63% of cases.[5] Drzewiecki et al[15] highlight that urodynamic testing has become essential in pediatric cases to effectively manage severe or treatment-resistant urinary tract abnormalities.[15] However, due to the limited

number of the pediatric subjects in this study, specific clinical diagnosis subgroups for pediatric voiding dysfunction were not further analyzed in the post-urodynamic results.

This retrospective study utilized secondary data from medical records, which may introduce biases or incomplete information. Furthermore, the lack of detailed clinical diagnostic judgments and the study's confinement to a single hospital limit its generalizability to a broader population. To address these limitations, future studies employing prospective designs with larger, multi-center sample sizes across diverse patient populations would be valuable for validating and expanding the findings of this study.

Conclusions

At Persahabatan National Hospital, LUTS and urinary retention were the most common diagnoses evaluated with urodynamic testing. In patients with LUTS, bladder impairment related to filling-phase issues and reduced bladder capacity were prevalent, while DU was more commonly observed in urinary retention patients. Given the limited data on pediatric patients, further research with expanded sample sizes in this group is needed. Urodynamic testing plays a critical role in guiding evidence-based treatments for managing LUT dysfunction and provides a foundation for future research.

Conflict of Interest

The author declares no competing interest related to the preparation of this paper.

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