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Detrusor underactivity is the main reason for persistent symptoms after transurethral resection of the prostate

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ABSTRACT

Introduction: Transurethral resection of the prostate has been considered the gold standard for surgical management of benign prostatic enlargement. Despite its high success rate, a percentage of patients (20%–40%) do not improve afterward. Our purpose is to determine the underlying lower urinary tract dysfunction of patients with persistent symptoms after transurethral resection of the prostate (TURP).

Material and methods: We queried our prospectively maintained database to identify male patients with lack of symptoms improvement after TURP for benign condition. Patients with neurological condition and prostate cancer were excluded.

Evaluation included symptoms assessment, prostate volume, uroflowmetry, maximum cystometric capacity, bladder compliance, detrusor overactivity and urodynamic stress urinary incontinence. We considered obstruction if *Bladder Outlet Obstruction Index* (BOOI) $\geq$ 40, no obstruction if BOOI $<$ 20. We considered detrusor underactivity if *Bladder Contractility Index* (BCI) $<$ 100.

Results: 219 patients had complete urodynamic study. Complete data were obtained from 107 patients, the mean (SD) age was 65.6 (8.2) years. Median (IQR) prostatic volume was 40 (31)cc. After surgery, storage symptoms were the most prevalent (73.8% of the patients). Urodynamic findings were: detrusor underactivity in 75 of 107 patients (70.1%), detrusor overactivity in 54 (50.5%), obstruction in 26 (24.3%).

The only correlation found was between the pre-surgery voided volume in uroflowmetry and detrusor overactivity in the urodynamic study (rho: −0.28, p = 0.033). No difference regarding Qmax before and after TURP was observed in the detrusor underactivity group (p = 0.481). Unfavorable outcome after previous prostate surgery might be explained by detrusor underactivity rather than obstruction.

Conclusions: The most common persistent symptoms after TURP are storage, and the most common urodynamic finding is detrusor underactivity. In this scenario urodynamic study is advisable.

1. Introduction

Transurethral resection of the prostate (TURP) has been considered the gold standard method for surgical management of benign prostatic enlargement (BPE) for years [1]. TURP improves voiding and storage symptoms [2], however the improvement is generally greater for voiding symptoms [3].

Despite the surgery is associated with a high success rate, a number of patients do not improve after TURP [4]. A high percentage of patients (20%–40%) suffer from persistent storage symptoms such as nocturia, urgency, and frequency after relief of obstruction [5].

In real-life setting, persistence of symptoms leads us to rule out the persistence of obstruction. Sometimes the decision is to perform a second TURP. The constant annual rate of reoperation, varies from 1% to 2%, with an incidence at 8 years follow up of 7.4% [6].

Despite the trend to perform a second TURP, different causes other than obstruction have been identified in urodynamic study. Urodynamic findings include persistent bladder outflow obstruction (BOO), detrusor underactivity, detrusor overactivity or urgency [7].

Considering that incidence of BPE increases with age [8] an increase in reoperations due to persistence of symptoms could be expected. So, it

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would be helpful to know the causes of persistent symptoms to prevent unnecessary redo-surgery with potential adverse events [1].

The purpose of the present study was to determine the underlying lower urinary tract dysfunction of patients with persistent symptoms after TURP.

2. Material and methods

We queried our prospectively maintained urodynamic studies database to identify male patients with persistence of lower urinary tract symptoms (LUTS) after TURP, between 2000 and 2020.

The study was conducted according to the Declaration of Helsinki, ethics committee approval was obtained (registration number 2021-128-1).

Inclusion criteria was lack of storage or voiding symptoms improvement after one TURP. Only TURP surgeries to relief benign prostatic obstruction were considered to minimize potential surgical procedure bias.

Exclusion criteria were: any history of neurological disorder, patients who underwent TUR for prostate cancer, and time lapse between TURP and urodynamic study greater than 5 years.

Presence of LUTS, medical history of diabetes, prostate volume (estimated by transabdominal ultrasound) and uroflowmetry with postvoid residual volume measurement were registered before TURP. Surgery was offered to patients presenting complaints of LUTS that did not relief with pharmacological treatment or showed deterioration of symptoms.

After surgery, the presence of persistent LUTS was recorded, along with the patient's age at the time of surgery and the time elapsed between TURP and the urodynamic study.

Urodynamic studies were performed following the ICS Good Urodynamic Practice Standards [9]. Filling cystometry and pressure flow study was done with a transurethral 8-Fr double-lumen catheter in the micturition position preferred by the patient. Uroflowmetry parameters registered were Qmax (maximum flow rate), voided volume and post-void residual volume (PVR) before and after TURP. Urodynamic parameters collected after surgery were, maximum cystometric capacity (MCC), bladder compliance, detrusor overactivity, patterns of detrusor overactivity (phasic or terminal), volume at first involuntary detrusor contraction, maximum detrusor pressure at involuntary detrusor contraction (PdetICmax), presence of stress urinary incontinence (SUI), *Bladder Outlet Obstruction Index* (BOOI) and *Bladder Contractility Index* (BCI). We considered obstruction if BOOI $\geq$ 40, no obstruction if BOOI $<$ 20, the remainder were considered indeterminate. We considered detrusor underactivity if BCI $<$ 100.

Statistics: The Kolmogorov–Smirnov test was used to assess whether the data conformed to a normal distribution. Mean and standard deviation (SD) were used for continuous variables that meet normality, median and interquartile range (IQR) in non-normality. For categorical variables, number (n) and percentage (%) were used. The Wilcoxon signed-rank test was used to compare non-normally distributed data between two groups. For correlations between data, Spearman or Chi-square correlations were used depending on the type of variable. Spearman's rank correlation coefficients (r) were then interpreted following the guidelines proposed by Fowler et al. [10] as follows, 0–0.19 (very weak), 0.20–0.39 (weak), 0.40–0.59 (moderate), 0.60–0.79 (strong), and $>$ 0.80 (very strong). McNemar test was used to compare change in percentage of symptoms. Statistical calculations were done using SPSS version 28.0 (SPSS, Chicago, IL, USA).

3. Results

219 patients underwent urodynamic study after TURP. After revision 112 patients were excluded due to: lack of preoperative data (patients referred from another hospital, 22), hemodialysis (no diuresis, 4), neurogenic bladder (35), TURP for prostate cancer (20), TURP done more than 5 years before urodynamic study (21) and more than one TURP (10) (Fig. 1). Complete data were obtained from 107 patients. Mean (SD) age was 65.6 (8.2) years and 25% of the patients were diabetics. Median (IQR) prostatic volume was 40 (31)cc and median time (IQR) since TURP until urodynamic study was 24 (47) months. Prior to surgery, all patients (100%) presented with voiding symptoms (intermittency, weak stream and straining), while 54.2% exhibited storage symptoms (frequency, urgency and nocturia). Following surgery, voiding symptoms were reported by 46.7% of patients, and storage symptoms by 73.4%, and stress urinary incontinence (SUI) by 19% (Table 1). Patients complained that surgery had not resolved their symptoms. Some patients expressed dissatisfaction, reporting unresolved symptoms, with a subset being more affected by the predominance of storage-related issues.

No differences regarding uroflowmetry before and after TURP were observed (Table 2).

The most common urodynamic finding was detrusor underactivity (DUA) which was present in 75 of 107 patients (70.1%). Other urodynamic findings were detrusor overactivity in 54 (50.5%), bladder outflow obstruction in 26 (24.3%), low compliance in 27 (25.7%) and stress urinary incontinence in 6 (5.6%). Detrusor overactivity was phasic in 37 (68.5%.) Some patients had more than one urodynamic finding, the most frequent combination was coexistence detrusor overactivity and underactivity in 32.7% patients, (Table 3). The mean (SD) for MCC was 293.5 (126.5) ml, and for BCI was 85.8 (29.4). Median (IQR) for compliance was 34 (40) ml/cmH_2O and for BOOI was 21 (35). No significant difference was observed for diabetes between those patients with detrusor underactivity and those without.

The causes of BOO were identified as urethral stricture in 8 patients (4 managed with dilatation, 2 with urethroplasty, and 2 declined treatment), dysfunctional voiding in 4 patients, and bladder neck stricture in 6 (5 underwent repeat TUR, while 1 refused treatment) and remaining 8 declined further diagnostic evaluation.

No correlation was found between free uroflowmetry parameters before TURP and urodynamic findings. Only a weak negative relationship between detrusor overactivity and voided volume was found (rho: −0.28, p = 0.033).

No differences regarding uroflowmetry before and after TURP were observed (Table 2). When patients were divided into two groups – those with DUA and those without – Qmax in patients with DUA was similar before and after surgery (10.7 ml/s and 10.2 ml/s, respectively; p = 0.481). However, in patients without DUA, Qmax significantly improved after surgery (7.9 ml/s and 16.1 ml/s, respectively; p = 0.048).

We did not find a significant relationship between LUTS and urodynamic findings, except for the presence of urgency and detrusor overactivity (p = 0.018), and stress urinary incontinence (symptom) and urodynamic SUI (p = 0.002).

All 75 patients diagnosed with DUA were provided with detailed information about their condition, behavioral advice and pharmacological option to address their most bothersome symptoms. Of these, 36 patients were satisfied with information alone and declined further treatment, 9 were treated with alpha-blockers, 7 with mirabegron, 7 with a combination of alpha-blockers and anticholinergics, 5 with anticholinergics alone, 2 with an indwelling catheter, and 1 with clean intermittent catheterization. In 8 patients, all treatments failed, and symptoms persisted. Patients presenting with storage symptoms were managed with anticholinergics, mirabegron or a combination of both.

4. Discussion

Despite the good results described with TURP, persistence of LUTS has been observed in up to 40% of patients after surgery [5], the most common are storage symptoms. In this study, 73.8% of patients referred to UDS for persistent LUTS presented storage symptoms. Male LUTS impair quality of life (QoL), and the most bothersome are storage symptoms [11]. We found that preoperative uroflowmetry correlated

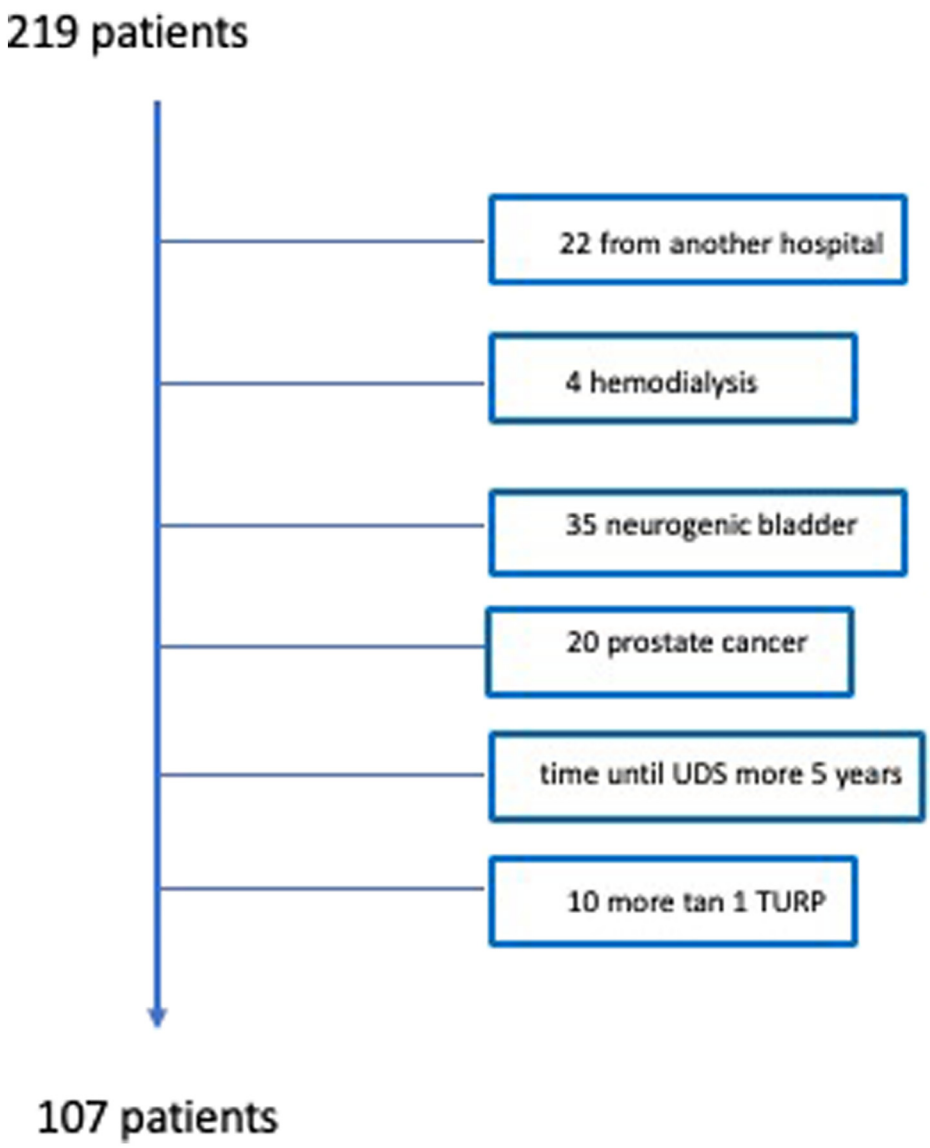

Fig. 1. Flow-chart.

poorly with urodynamic findings, only voided volume showed a weak negative relationship (rho: −0.28) with detrusor overactivity. Voided volume from a representative uroflowmetry may be a good indicator of bladder functional capacity (in the absence of a standard bladder diary). Similar results were found in a study that included 116 patients exploring the association between various preoperative clinical parameters and persistent postoperative storage symptoms after TURP. The authors observed that the storage symptom-positive group had lower functional bladder capacity compared with the storage symptom-negative group [2]. Likewise, a prospective study including 75 patients with pre and postoperative UDS showed that maximum bladder capacity was significantly lower in patients with persistent storage symptoms than those in whom symptoms had resolved [5].

The need for urodynamics in preoperative evaluation remains controversial. EAU Guidelines do not consider pressure/flow studies a routine test prior to prostate surgery for all patients, and give a weak recommendation only for individual patients for specific indications or when further evaluation of the underlying pathophysiology of LUTS is warranted. [12] However, for patients with persistent or recurrent symptoms after TURP, a urodynamic evaluation seems indicated [4,13]. Time from TURP to UDS may be long: our study showed a median time of 24 months. A similar study found a mean of 3.5 years [4]. It seems like a long time for patients with bothersome LUTS. The EAU and AUA guidelines recommend UDS in men who have failed to respond to a TURP. This suggestion is supported by the fact that LUTS are unreliable predictors of bladder outflow obstruction [14]. We observed 46.7% of patients with voiding symptoms and only 24.3% with BOO on UDS. The most prevalent symptom was urgency in 69.1% of patients while the most prevalent urodynamic finding was detrusor underactivity (70.1%). Our data showed that symptoms did not correlate with expected urodynamic findings. In the same way, other studies did not discover correlation between persistent symptoms and urodynamic findings after TURP [4,15].

It is noteworthy that postoperative Qmax showed significant improvement in the group with normal detrusor contraction, whereas there were no significant changes in the group with detrusor underactivity. Lack of changes in Qmax values could potentially serve as an indicator to suspect detrusor underactivity. According to European Guidelines high post void residual volumes can be a consequence of obstruction and/or poor detrusor function. In our cohort, the mean PVR was essentially normal, although 9 patients with BOO and 15 patients with DUA, had PVR volumes greater than 100 ml. Patients with BOO and normal PVR exhibited normal detrusor contraction to compensate bladder voiding.

Table 1
Evolution of symptoms.

N (%)	Pre surgery	Post surgery
Storage	**58 (54.2%)**	**79 (73.8%)**
urgency	44 (41.1%)	74 (69.1%)
nocturia	56 (52.3%)	73 (68.2%)
frequency	43 (40.2%)	72 (67.3%)
urgency + frequency	40 (37.3%)	68 (63.5%)
Voiding	**107 (100%)**	**50 (46.7%)**
Incomplete Emptying	73(68,2%)	43(40,2%)
Intermittency	56(52,3%)	25 (23,4%)
Weak Stream	107 (100%)	49 (45,7%)
Straining	16 (15%)	22 (20,6%)

Table 2
Uroflowmetry before and after TURP.

Uroflowmetry			
	Before surgery	After surgery	p
Qmax (ml/s)	10 (6)[b]	10 (8)[b]	0.55
Voided Volume (ml)	223.9 (124.2)[a]	130 (120)[b]	0.06
Post void Residual Volume (ml)	60 (130)[b]	30 (75)[b]	0.27
Qmax in DUA	10.7	10.2	0.481
Qmax in normoactive	7.9	16.1	0.049

[a] Mean (SD.
[b] Median (IQR).

Table 3
Urodynamic findings and parameters.

DO	SUI	DUA	obstruction	Diagnosis	n (%)
no	no	no	no	Normal	8 (7,5%)
yes	no	no	no	DO	10 (9,3%)
yes	yes	no	no	DO+SUI	2 (1,9%)
yes	yes	yes	no	DO+SUI+DUA	2 (1,9%)
no	yes	no	no	SUI	1 (0,9%)
no	yes	yes	no	SUI+DUA	1 (0,9%)
no	no	yes	no	DUA	33 (30,8%)
no	no	yes	yes	DUA+ Obstruction	6 (5,6%)
no	no	no	yes	Obstruction	4 (3,7%)
yes	no	yes	no	DO+DUA	24 (22,4%)
yes	no	no	yes	DO+Obstruction	7 (6,5%)
yes	no	yes	yes	DO+DUA+Obstruction	9 (8,4%)
Urodynamic finding					
DO					54 (50,5%)
SUI					6 (5,6%)
DUA					75 (70,1%)
Obstruction					26 (24,3%)
Urodynamic parameters				Mean (SD)	
Maximum Cystometric Capacity (ml)				293.5 (126.5)	
BCI				85.8 (29.4)	
Urodynamic parameters				Median (IQR)	
Compliance (ml/cmH_2O)				34 (40)	
BOOI				21 (35)	

DO (detrusor overactivity). DUA (detrusor underactivity)

Although the guidelines recommend to perform UDS in this scenario, it is not unusual that routine clinical practice does not follow them. One real world data study identified a cohort of non-responders after TURP, of which 26% underwent repeated surgery based on urethrocystoscopy findings, and 20% of non-responders still required catheterization [1]. There is a common rationale that the most frequent reason for recurrence of symptoms after TURP is obstruction due to residual adenoma or secondary stricture. In 1994 a retrospective study, including neurogenic and no neurogenic patients, observed that the majority of patients with persistent and recurrent LUTS after TURP did not have urodynamic evidence of obstruction. In fact, impaired detrusor contractility was more frequently associated with retention than was obstruction [4]. In a long term follow-up study with UDS, symptomatic failure was associated principally with detrusor failure rather than obstruction [16].

In our study detrusor underactivity was observed in 70.1% of patients with persistent LUTS after TURP, and only 24.3% were obstructed. This is a significant number of patients with DUA after TURP, higher than other series that ranged between 25% and 36.5% [4,16]. On the other hand, other studies obtained only 3%–4% incidence of DUA [5,15]. A urodynamic definition of DUA has been proposed by the ICS, as low detrusor pressure or short detrusor contraction in combination with a low urine flow rate resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span (a high postvoid residual may be present). However, the main criticism is the lack of consensus on defined urodynamic parameters [17]. In fact, each study used different parameters for defining detrusor underactivity. This could explain the different prevalence found between various studies.

Several studies have focused on the outcomes of patients with DUA after TURP. Most have observed that, for patients with DUA, the efficacy of TURP is limited, and these patients report more postoperative LUTS [6,8,18].

Our study has several limitations, including the absence of validated questionnaires to measure LUTS, limiting a detailed quantification of each specific symptom; the retrospective nature of the preoperative symptoms and the bias of including only those patients who were submitted to UDS for persistent LUTS.

The problem with DUA is the lack of effective pharmacological or specific surgical options [17]. It is recommended to perform UDS to avoid unnecessary surgeries and potential complications in patients with persistent LUTS after the first TURP.

5. Conclusions

The most common persistent symptoms after TURP are storage, and the most common urodynamic finding is detrusor underactivity. In this scenario urodynamic study is advisable. No changes in postoperative Qmax may be suspicious of DUA.

Humans and the ethics approval statement

This study is a review of a prospective database of urodynamic studies and the clinical records of the patients. Ethical approval was obtained from the hospital's ethics committee. The study was conducted according to the Declaration of Helsinki, ethics committee approval was obtained (registration number 2021-128-1).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data associated with the paper are no publicly available but are available from the corresponding author on reasonable request.

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