SCANDINAVIAN JOURNAL OF UROLOGY
2021, VOL. 55, NO. 4, 324–330
https://doi.org/10.1080/21681805.2021.1893380

ARTICLE

Patient related factors affecting in-hospital costs of a TURP procedure

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ABSTRACT

Introduction: Treatment costs of lower urinary tract symptoms secondary to benign prostatic enlargement (BPE) are a substantial economic burden that will continue to increase in the future as a result of the ageing male population and increasing health awareness. The true costs for surgical interventions against BPE have been difficult to quantify as treatment costs strongly depend on the performance setting and may also vary among different healthcare systems, regions and institutions. The purpose of this study was to disclose the in-hospital costs and main expense items associated with a transurethral resection of the prostate (TURP).
Methods: A cohort of men subjected to TURP due to BPE was analysed during a 3-year period (2017–2019). All in-hospital expenses were registered using an electronic spreadsheet. Patient background and perioperative variables were registered using retrospective chart reviews.
Results: A total of 122 men were available for final analysis. Of these, 70 men were operated on due to bothersome LUTS and 52 men due to urinary retention. The mean and median (inter quartile range) cost per patient was €4025 and €3702 (2961 – 4390), respectively. The main drivers of total cost were length of stay, the surgical procedure and anaesthesia related costs. Factors associated with increasing total cost per patient were increasing age, prostate volume, presence of urinary retention, occurrence of complications, increasing catheter time and length of stay.
Conclusion: The main factor that influences total cost for an elective TURP procedure is the occurrence of postoperative complications. Our findings firmly underscore the indispensability to employ every possible means to avoid and prevent complications of any kind.

ARTICLE HISTORY
Received 1 September 2020
Revised 14 January 2021
Accepted 16 February 2021

KEYWORDS
TURP; postoperative complications; costs; predictors; urinary retention

Introduction

The indications for and incidence of surgical intervention for benign prostatic enlargement (BPE) have changed during the last three decades due to the increasing prevalence of pharmacological therapies. Data from the National Board of Health and Welfare in Sweden clearly show a continuing decrease in the frequency of surgical interventions for BPE with almost 7500 transurethral resections of the prostate (TURP) performed in 1998 and 3900 performed in 2018. There is also a considerable variation in treatment strategies within the country [1]. The emergence of minimally invasive techniques to treat BPE and the prioritisation of urological cancer care have perhaps contributed to this variation.

The complete removal of obstructive hyperplastic prostatic tissue can only be achieved using surgical methods, for example a TURP. It has previously been shown, by us and by others, that TURP is an effective intervention with a low comorbidity and with excellent clinical outcomes [2–5]. The major guidelines strongly recommend TURP in patients with lower urinary tract symptoms (LUTS) refractory to pharmacological treatment or the presence of BPE complications for example urinary retention [6,7].

Treatment costs of lower urinary tract symptoms (LUTS) secondary to BPE are a substantial economic burden and it is certainly reasonable to believe that these costs will continue to increase in the future as a result of the ageing male population and probably also increasing health awareness. The estimated annual treatment costs for BPE in 2003 in Europe were €858 per patient, three quarters of which concerned medication costs [8]. The true costs for surgical interventions against BPE have been difficult to quantify as treatment costs strongly depend on the performance setting and can also vary among different healthcare systems, regions and institutions. According to Statistics Sweden the mean cost for an elective TURP procedure was 38,616 SEK (€3829) in 2017 [9]. This figure is based on an economic evaluation of all TURP procedures carried out in Sweden during that year, excluding the 5% most expensive treatments, for the purposes of reimbursement.

The Swedish Council on Health Technology Assessment conducted a systematic literature review in 2011 on benign prostatic enlargement with obstruction [10]. The review identified areas in need of further research regarding the healthcare economics of BPE therapy. Specifically, studies on detailed in-hospital expenses were sought for.

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The purpose of this study was to disclose an economic evaluation of in-hospital costs associated with a TURP procedure as well as to determine the predictors of differences in total cost.

Methods

The study was conducted according to the guidelines of economic submissions set out by Drummond and Jefferson [11]. Ethical approval was granted by the University of Gothenburg (Dnr 2020-02647).

Financial data

Hospital expense data from in-patient care expenses from the Department of Urology at the Hospital of Skaraborg, Skövde, Sweden from January 2017 until December 2019, was gathered. The data were generated by the electronic hospital accounts management system and presented in an Excel® file format. Data include items such as patient age, length of hospital stay, specific costs for anaesthesia, laboratory testing, pathology reports, medication use, treating staff, interventional equipment and the cost for occupying a hospital bed. The calculations of the expenses from interventions and surgical facilities were based on average personnel costs per minute, fixed charges for room costs, and proportionate devaluation of equipment.

Procedural costs for TURP included professional charges of the urologist, costs for operation facilities (technical staff, premises and equipment), medical supplies required for TURP (e.g. resection loop, irrigation solution, tissue evacuation system), costs for anaesthesia (anaesthesiology staff and medical supplies) and histological tissue examination.

Costs for the inpatient stay included the doctor's professional charges, servicing by nursing specialists, medical supplies (e.g. irrigation solutions and wound care), medications, laboratory services, administration and accommodation (housekeeping, catering and premises). The latter was based on fixed sums calculated by the accounts department.

The Diagnoses Codes of N40.9 (Benign Prostatic Hyperplasia) and R33.9 (Urinary retention,) in The International Classification of Diseases, 10th revision (ICD 10), were used for the search in combination with the surgical procedure TURP (operation code KED22).

Tariffs were recorded as the amounts from the National Board of Health and Welfare in Sweden based on diagnosis related groups (DRG). DRG is a statistical system, used in several European countries to assign for example any in-patient stay into groups for the purpose of payment and reimbursement. In Sweden, separate tariffs were identified for patients with/without minor comorbidity and for patients with major comorbidities. In this study a complete dataset including all patients with a first hospitalisation for the DRG code of N05N was obtained.

We included all costs occurring during the period of stay of in-patient care for a TURP procedure including any peri- or postoperative complications occurring during in-hospital care. All total expenses were divided by the number of participants in the cohort in order to calculate mean values per patient for each expense item. Median and quartile ranges were used to describe the distribution of specific costs for those participants who utilised that particular expense item. Costs of outpatient visits, emergency department visits, readmissions to the urology ward and visits to general practice were not included in this study.

The costs are reported in Swedish Krona (SEK) and were converted to Euros (€), as a more widely used currency, based on the exchange rate as of 11 January 2021 (1 SEK = 0.099€). All costs exclude value added tax.

Participants

Inclusion criteria were as follows: all men operated with a TURP due to bothersome LUTS, refractory to pharmacological treatment, or due to urinary retention requiring either an indwelling catheter or clean intermittent self-catheterisation (CISC). Exclusion criteria were as follows: men with a previous TURP, transurethral incision of the prostate (TUIP) or transurethral microwave thermotherapy (TUMT). Men with known prostate cancer were also excluded as were men that had undergone open adenoma enucleation of the prostate.

The following participant variables were collected: age, BMI (Body Mass Index), ASA (American Society of Anaesthesiologists) grade, transrectal ultrasound volume of the prostate (TRUS), prostate specific antigen level (PSA), international prostate symptom score (IPSS), including the bother score question, and urodynamic parameters such as peak urinary flow rate (Q_{max}) and post-void residual urine (PVR). The presence of an indwelling catheter or the use of CISC was also noted. The TRUS volume of the prostate gland was calculated adopting the prolate ellipse volume method (height × length × width × π/6) using bk ultrasound 5000 (BK Medical, Herlev, Denmark). The PVR was measured by a PadScan HD 5® (Caresono Technology Co., Dandong, China).

The following perioperative variables were extracted: anaesthesia type, duration of surgery, resection weight, postoperative catheter drainage time and patient length of stay. Length of stay was calculated from the time of operation end until the time from discharge from hospital. Postoperative complications were defined and categorised according to the Clavien-Dindo (CD) system [12,13]. Postoperative urinary retention requiring re-catheterisation at discharge from hospital was defined as a CD grade I complication.

Intervention

Monopolar TURP was performed under spinal or general anaesthesia by 14 urological surgeons, including eight residents in training. A 26 Charrière resectoscope was used with a standard tungsten wire loop and electrolyte free sorbitol-mannitol 3% solution (Braun, Kronberg, Germany). Diathermy using an Erbe V10 300 generator (Tubingen, Germany) was set at 180 W for cutting and 80 W for coagulation modes (dry cut).

Postoperatively, a 22 Ch three-way catheter was inserted into the bladder and irrigation was commenced with normal saline solution. A trial without a catheter (TWOC) was, as a rule, initiated on the first postoperative day and the patient was encouraged to void. If this trial failed up to a maximum of two attempts during the following days the patient was sent home with an indwelling catheter and with instructions of TWOC given to the GPs office.

Statistical methods

Data were collected in Excel® 2011 and statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS®) version 22 (SPSS Inc., IBM Corp., Armonk, NY, USA) and *R* Statistical Software (Version 3.6.1; Foundation for Statistical Computing, Vienna, Austria). A *p*-value < 0.05 was considered statistically significant.

To explore the association between pre-, perioperative variables with the total cost per patient uni- and multivariable linear regression were conducted. Since the distribution of the total cost is right skewed, a log transformation was applied before the analysis, in order to satisfy the assumptions regarding normal distribution and equal variances in the regression analyses. After the model fitting, the estimated parameters were back-transformed in order to be easier to interpret. For continuous variables, it means that for each one unit increase in the predictor variable the total cost changes by the factor estimate, while for categorical variables the total cost changes by the accompanying factor estimate in respect to the base level. To explore the association of postoperative variables (catheter time, length of stay and complications) with total cost per patient univariable linear regression analyses were performed. Missing values of the pre-operative variables which were included in the regression analyses were imputed by means of a single imputation method, where the missing values of a specific variable were replaced by predictions from regression models based on the other pre-operative variables and PSA.

Table 1. Patient background and perioperative variables ($n = 122$).

	Missing	Median	IQR	Range
Age	*0/122*	72	67–76	48–87
BMI (kg/m^2)	*3/122*	26.8	24.5–28.4	16.3–44.7
Prostate volume (cm^3)	*1/122*	42	35–55	17–92
PSA (ng/ml)	*11/122*	2.2	0.9–4.1	0.16–12
IPSS (0-35)*	*13/70*	19	15–24	4–35
Bother score (0-6)*	*15/70*	4	3–5	1–6
Q_{max} (ml/s)*	*24/70*	7.4	4.9–11.3	1.1–30.1
PVR (ml)*	*7/70*	156	70–226	0–500
Operation time (min)	*32/122*	62	45–79	12–157
Resection weight (g)	*16/122*	18	12–28	4–69
Catheter time (hours)	*0/97*	20	16–22	9–216
LoS (days)	*0/122*	1	1–2	1–12
		n	%	
Urinary retention		52	42.6	
Catheterised		34	27.9	
CISC		18	14.7	
ASA grade	1	29	23.8	
	2	58	47.5	
	3	35	28.7	
Anesthaesia type	Spinal	92	75.4	
	General	30	24.6	
Clavien-Dindo grade	0	84	68.8	
	1	23	18.9	
	2	8	6.6	
	3a	5	4.1	
	3b	1	0.8	
	4a	1	0.8	

BMI: body mass index; PSA: prostate specific antigen; IPSS: international prostate symptom score; Q_{max}: maximum urinary flow rate; PVR: post-void residual volume of urine; LoS: length of hospital stay; CISC: clean intermittent self-catheterisation; ASA: American Society of Anaesthesiology.
*IPSS, bother score, Q_{max} and PVR registered from LUTS patients only.

Results

A total of 122 men were available for final analysis. Of these, 70 men underwent a TURP procedure due to bothersome LUTS and 52 men due to urinary retention. The urinary retention group comprised 34 men with an indwelling catheter and 18 men using CISC. The background and perioperative variables are presented in Table 1. The majority of men (69%) did not have any postoperative complications during hospital stay. Most complications were of mild to moderate nature (CD grade I and II) whereas major complications (CD grade 3a or above) occurred in seven men (5.7%). Ninety-seven men (80%) were catheter free at discharge from the hospital. The remaining men were discharged with a catheter and a scheduled TWOC at general practice two weeks later.

The costs categorised into specific expense items are shown in Table 2. The mean cost per patient undergoing a

Table 2. Cost breakdown for in-hospital expenses arising from a TURP procedure ($n = 122$).

Expense item	Missing	Sum of costs	Mean cost per patient*	Median cost per patient	IQR	Range
In-patient care	None	1,268,038	10,394	6433	4924–12,866	1887–59,092
Start cost	None	68,501	561	543	543–683	396–1247
Surgical procedure	None	1,705,066	13,976	12,812	10,463–15,936	4557–58,694
Medications	None	20,143	165	94	58–137	17–2615
Recovery unit	1/122	1,073,790	8802	3992	3101–17,374	1646–28,339
Anaesthesia	1/122	612,878	5024	4751	3683–5951	544–32,147
Pathology	36/122	60,508	496	566	566–566	555–2532
Chemistry lab	None	8886	73	77	67–164	8–717
Microbiol lab	None	16,899	139	137	137–140	134–1685
Transfusion lab	None	29,621	243	298	297–298	122–10,893
Physiology lab	None	9967	82	170	170–257	170–4388
Radiology	None	27,085	222	1430	1081–3104	421–10,178
Other	None	48,600	398	N/A	N/A	N/A
Total		**4,949,983**	**40,574**	**37,343**	**29,852–44,260**	**14,891–182,935**

Costs are presented in Swedish Krona (SEK) where 1 SEK = 0.099 Euro (€) as of 11 Jan 2021.
IQR: Inter Quartile Range.
*Mean cost per patient = costs extrapolated for the entire cohort ($n = 122$).
Median, IQR and Range values are for patients with registered expenses only (valid cases).

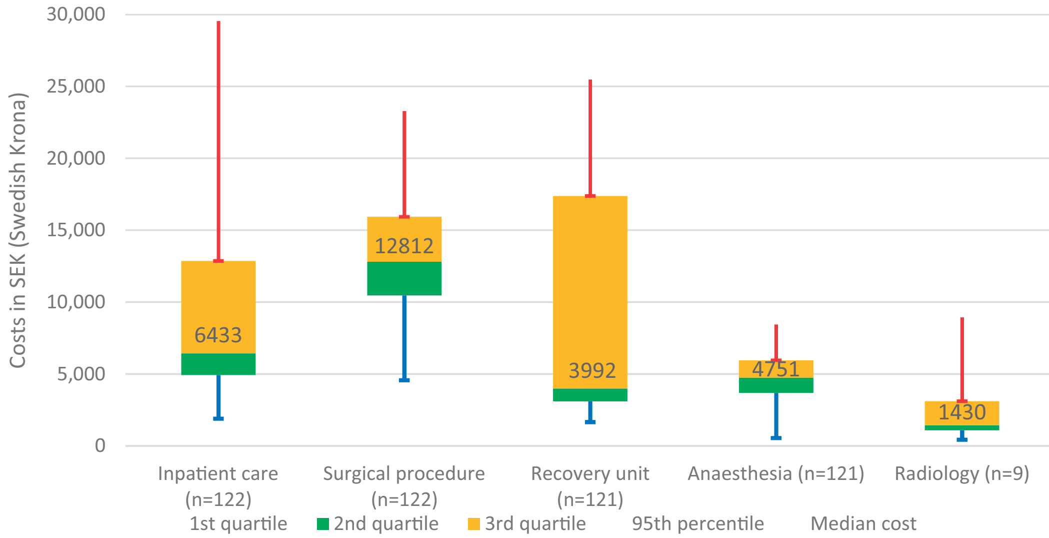

Figure 1. Box plot diagram of main expense items presented as median values and IQR. The top 5% of costs are excluded.

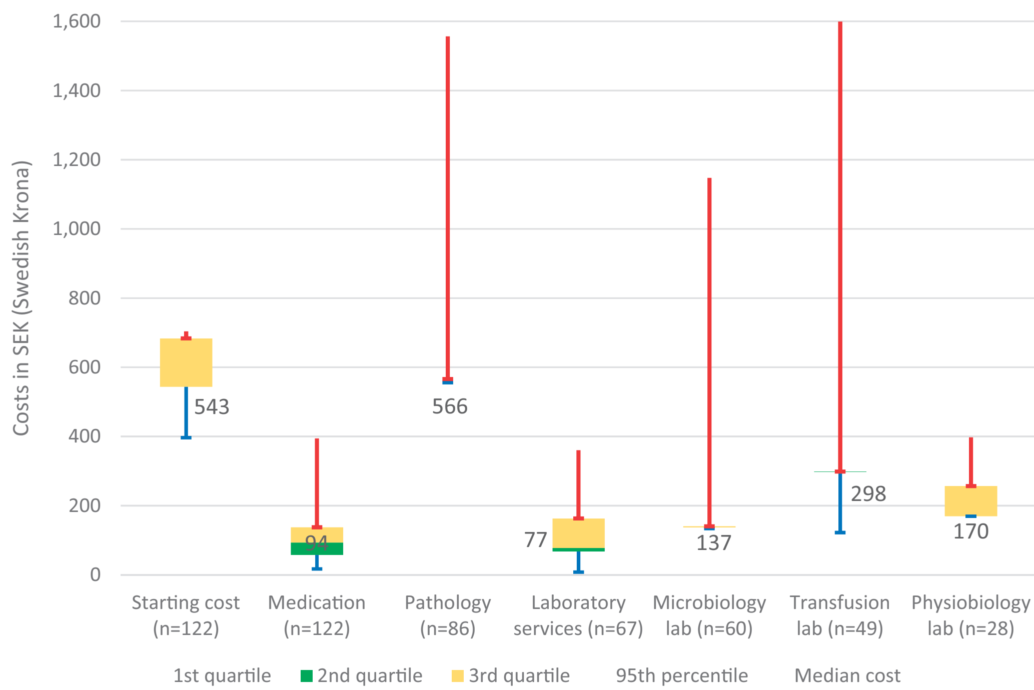

Figure 2. Box plot diagram of other expense items presented as median values and IQR. The top 5% of costs are excluded.

TURP procedure was 40,574 SEK (€4022). The median cost per patient was 37,343 SEK (€3701) (IQR 29,852–44,260 SEK or €2959 – 4388). The main expense items were, in order of median cost per person, surgical procedure, in-patient care, anaesthesia and recovery unit care, respectively. Taken together, these items comprised 94% of the mean total cost per patient. The variation of costs specified for in-patient care and recovery unit were vast and overall, the recovery unit exhibited greater costs than anaesthesia.

The expense item "other" comprised rare occurrences such as admittance to the ICU department and care by an occupational therapist or a physiotherapist. Radiological investigations were exceptional, employed only in nine men. The main expense items are depicted as box plots in Figure 1. Minor expense items are presented in Figure 2. In order of median cost per person, they included costs for histopathological analysis, the starting cost, transfusion lab costs, clinical physiology, microbiology lab costs, medications and, finally, laboratory services. The top 5% of costs for each expense item was excluded from the box plots due to presentation purposes. The overwhelming majority of costs at the transfusion laboratory services were for Group, Save and Cross-match of blood preoperatively. Only four patients (3.3%) required a blood transfusion postoperatively, mirroring the costs for this item. Costs in the microbiology department were mainly due to perioperative urine cultures and in a few cases due to blood cultures in cases of suspected septicaemia. In all, six patients (4.9%) were treated

Table 3. Univariable simple linear regression analysis of explanatory variables with total cost.

	Estimate	95% CI	*p* Value	R^2 adjusted
Age	1.01	1.00–1.02	0.009	0.048
BMI	0.98	0.97–1.00	0.068	0.019
TRUS	1.01	1.00–1.01	0.005	0.055
ASA grade (2 vs 1)	1.00	0.84–1.19	0.990	0
ASA grade (3 vs 1)	1.04	0.86–1.25	0.709	
Urinary retention (y/n)	1.21	1.06–1.39	0.006	0.054

BMI: body mass index; TRUS: transrectal ultrasound volume of the prostate; ASA: American Society of Anaesthesiologists; Urinary retention: patients with indwelling catheters or requiring CISC.

Table 4. Univariable simple linear regression analysis of peri- and postoperative variables with total cost.

	Estimate	95% CI	*p* Value	R^2 adjusted
Anaesthesia	0.98	0.84–1.15	0.798	0
Resident involved (yes/no)	1.04	0.90–1.21	0.593	0
Complication (yes/no)	1.49	1.31–1.69	<0.001	**0.228**
Catheter time, continuous	1.01	1.01–1.01	<0.001	**0.387**
Length of stay (2 vs 1)	1.22	1.05–1.41	0.008	**0.313**
Length of stay (>2 vs 1)	1.78	1.53–2.07	<0.001	

with intravenous antibiotics due to febrile urinary tract infections.

In uni- and multivariable analysis of pre- and perioperative variables total cost was significantly positively associated with patient age, prostate volume and the presence of urinary retention preoperatively. In particular, the presence of preoperative urinary retention was found to increase the total cost by 15% (95% CI 1.01–1.32). The adjusted R^2 values were relatively low indicating a modest correlation. The detailed results are presented in Tables 3 and 5. In a univariable analysis total cost was strongly positively associated with the postoperative catheter time, the length of stay and the occurrence of postoperative complications. All these variables exhibited covariance and the main explanatory factor was the occurrence of postoperative complications increasing total costs by 49% (95% CI 1.31–1.69). Results are shown in Table 4.

Residents-in-training were, to a varying degree, involved in 82/122 (67%) of procedures. The individual surgical experience was not elucidated. Following univariate and multivariate analyses, the effect of being operated on by a resident-in-training, as compared to a specialist, on the total cost was not statistically significant, even after adjusting for prostate volume (Estimate 1.13, 95% CI 0.97–1.31, *p*-value 0.111).

Discussion

In this descriptive cohort of 122 men who underwent elective TURP procedures during 2017–2019 the median total cost per patient was 37,343 SEK (€3701). The main expense items, constituting the bulk of total cost, were the surgical procedure, in-patient care, anaesthesia related costs and the recovery unit.

In a cost minimisation analysis from 2018, comparing different targeted drug treatments with TURP, Davis et al. evaluated 1246 men from five European countries and found a considerable variation in the mean cost for a TURP procedure. The operation was cheapest in the UK at €2138 for patients without major comorbidities and most expensive in Germany at €5644 in patients with major comorbidities [14]. A study from Norway in 2006 by Bjerklund Johansen et al. described DRG costs for TURP without and with complications to be €3665 and €4670, respectively [15]. Our results appear to be in line with the findings in these studies.

Table 5. Multivariable linear regression analysis of all explanatory variables with total cost.

	Estimate	95% CI	*p* Value	R^2 adjusted
Age	1.01	1.00–1.02	0.035	**0.140**
BMI	0.98	0.97–1.00	0.049	
TRUS	1.01	1.00–1.01	0.004	
ASA grade (2 vs 1)	1.02	0.86–1.20	0.855	
ASA grade (3 vs 1)	0.96	0.79–1.17	0.688	
Urinary retention	1.15	1.01–1.32	0.035	

The variation in total costs could, to a minor degree, be explained by patient age, prostate volume and preoperative urinary retention. Our multivariable model of predicting total costs could only explain 14% (R^2 adjusted = 0.140) of the cost variation. On the other hand, the postoperative factors of catheter time, length of stay and occurrence of postoperative complications were all strongly associated with increased total cost. For an extra hour, the average patient was catheterised postoperatively, the total cost increased by 1% (370 SEK or €37) and for an extra day the patient occupied a ward bed the total cost increased by 22% (8215 SEK or €814). A patient suffering from any type of postoperative complication had an average increased cost of 49% (18,300 SEK or €1813) as compared to an uncomplicated procedure. Men who suffered from postoperative complications were in general older, had higher ASA grades, longer catheter times and longer periods of hospital stay. It should be pointed out that our sample size was relatively small and, as such, the results obtained by the univariable and multivariable analyses should be interpreted with some caution, as reflected by the wide confidence intervals in our estimates.

An in-depth analysis, regarding the effects of surgical experience on total cost, was not possible due to the fact that residents under the supervision of a urological surgeon carried out a considerable amount of procedures.

The most common postoperative complication was a failed TWOC. This complication, which in our view can be seen as a normal postoperative occurrence, particularly in men with preoperative urinary retention problems, inevitably led to an increased length of stay and, hence, greater costs. A failed TWOC and catheter dependence at discharge from hospital may have been due to a detrusor underactivity that went unrecognised during the preoperative work-up. Invasive urodynamic studies were not routinely used in our patients and, hence, it is impossible to establish whether they suffered from detrusor underactivity. Speculatively, using UDS as a routine prior to subjecting a man to a TURP procedure could be a cost-efficient diagnostic method of filtering out men to the most appropriate treatment pathway. For several years, there has been an ongoing debate as to whether UDS should become standard practice before a TURP [16,17].

This retrospective study, using patient chart reviews, has certain limitations and our findings should therefore be interpreted with some caution. For example, costs of complications occurring after discharge from hospital such as emergency department presentations with acute urinary retention, macroscopic haematuria or septicaemia or visits to the GPs office due to urinary tract infection were not included. Moreover, the costs associated with readmission for any reason is not included in the present series. This needs to be accounted for when comparing different treatment modalities against each another. Furthermore, the true cost of an intervention requires a holistic approach and can be divided into direct costs (of drugs, operations, consultations and complications), indirect costs (lost earnings due to sick leave) and intangible costs (pain and suffering). In this analysis, we have only studied the direct costs.

We did, however, include all costs incurred during the in-hospital stay, including costs of complications after TURP associated with a prolonged length of stay. In addition, we have provided a detailed economic analysis using in-hospital data from the hospital financial department.

A noteworthy finding in our study was that, on average, one TURP procedure was carried out per week during the study period. In all, 14 urological surgeons conducted these procedures. These findings raise important questions as to whether we are surgically treating enough men with problems related to BPE and whether a patient should find it acceptable to be operated by a surgeon merely performing three TURPs per year. Is this amount sufficient to maintain an adequate competence? Should we concentrate TURPs to high volume centres in accordance with the directives governing urological cancer procedures?

The demand for BPE treatment is rising, and this disease is bringing about an increasing burden on what many believes is an already oversubscribed healthcare system in Sweden. Healthcare cost containment is essential and economic considerations should become an inevitable part of clinical practice. Hence, in the present series direct costs involved in a TURP procedure were disclosed but a cost-effectiveness study comparing for example combination pharmacological therapy with TURP was not conducted. In our opinion, it would be interesting to investigate which of the two regimens are most cost-effective over a three-year period and, in fact, such a study is presently under way. Speculatively, pharmacological therapy could have the potential to postpone the need for a TURP but with the possible risk of inflicting more serious complications and as such submitting men with a more advanced BPE for surgery. Previous studies have indicated conflicting results as to whether TURP is the most cost-effective regime, in men with moderate to severe LUTS, as compared to pharmacological treatment, as initial treatment [14,18–20].

Conclusions

The costs associated with a TURP procedure in the present series tally fairly well with those presented by others. Age, prostate volume and preoperative urinary retention are weak predictors for an increased total cost for a TURP. The most important and striking finding was the very strong association between complications and total costs. Our findings firmly underscore the indispensability to employ every possible means to avoid and prevent complications of any kind.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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