

The effect of complete transurethral resection of the prostate on symptoms, quality of life, and voiding function improvement

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Introduction Transurethral resection of the prostate (TURP) still remains the most popular surgical treatment for patients with lower urinary tract symptoms. However, in some patients, the improvement of symptoms after TURP is insufficient. The aim of our study was to evaluate the impact of the resected prostate tissue weight (RPTW) on the improvement of symptoms (IPSS), quality of life (QoL), and voiding function after TURP.

Material and methods The study included 89 men who had undergone TURP in our institution. IPSS, QoL, post-voiding residual urine volume (PVR) and Qmax were recorded before the operation and six months after TURP. The total prostate volume (TPV) and transition zone volume (TZV) were measured before the operation by transrectal ultrasound. The impact of RPTW, RPTW/TZV ratio, and RPTW/TPV ratio were analyzed according to the efficacy of TURP.

Results The mean Qmax after TURP increased by 10.15 mL/s, IPSS decreased by 16.7 points, QoL increased by 3.57 points, and PVR decreased by 95.3 mL. According to Qmax, the treatment was effective in 74.2%, according to IPSS, in 91%, and according to QoL, in 74.2% of patients. The ROC analysis demonstrated that RPTW/TZV and RPTW/TPV ratios were the most significant predictors of obtaining favorable results. Survival analysis (life table) shows that in order to achieve 50% improvement on Qmax, QoL, and IPSS, more than 30–35% of TPV and more than 60% of the TZV should be removed.

Conclusions The efficacy of the TURP at short term follow-up depends on the completeness of the resection.

Key Words: effectiveness ↔ LUTS ↔ resected tissue weight ↔ TURP

INTRODUCTION

Transurethral resection of the prostate (TURP) is an effective treatment modality for lower urinary tract symptoms (LUTS) secondary to a benign obstruction of the prostate (BOP) [1]. However, in some patients, the improvement of symptoms after TURP is insufficient [2, 3]. Therefore, studies have been conducted to detect parameters that can predict outcomes after the intervention. According to several studies, one of such parameters could be resected tissue weight or the ratio of the resected tissue weight with prostate volume [2, 4, 5]. Currently, the standard TURP

technique recommends a complete resection of all adenomatous tissue; however, the duration of the operation and the amount of the tissue removed are directly associated with intraoperative and early postoperative complications [6]. A few studies have found no significant correlation between the resected tissue weight and symptom improvement, and the authors postulated that a complete resection might not be essential [5, 7]. Other techniques for the treatment of LUTS caused by BOP – such as transurethral needle ablation, interstitial laser coagulation or vaporization – do not aim to completely remove the adenoma, but instead rely on tissue slough-

ing or shrinkage at varying degrees. The outcomes of these treatment modalities are acceptable for the patients [8]. For these reasons, the hypothesis of a limited resection has recently gained popularity. Despite the generally accepted principles of the surgical technique, there is no consensus on how much tissue should be resected or how complete the TURP should be. The aim of this study was to evaluate the impact of the resected tissue weight and the resected tissue ratio with transition and total prostate volume on the improvement of symptoms, the quality of life, and voiding function after transurethral resection of the prostate (TURP).

MATERIAL AND METHODS

This prospective case series study included 89 patients with LUTS and histologically confirmed BPH, who underwent TURP. Ethics Committee of the hospital approved this study. The inclusion criteria were age 45–85 years, IPSS ≥ 13 , Qmax ≤ 15 mL/s, post-voiding residual volume (PVR) of ≤ 300 mL, and a prostate biopsy to confirm benign disease, when prostate specific antigen (PSA) was >4 ng/mL, as well as a signed consent form. The exclusion criteria were a previous operation of the bladder, prostate, or urethra; urethral stricture; Qmax of >15 mL/s; IPSS of <13 ; prostate or bladder cancer; bladder stones, and chronic urinary tract infection. The standard protocol was used for the pre- and postoperative examinations. Examinations of the patients before their operations included PSA, IPSS, QoL, Qmax, PVR, total prostate volume (TPV), and transition zone volume (TZV). Transrectal ultrasound (TRUS) was used for the total estimation of the prostate and its zones. TURP was performed using standard 24 or 26 French resectoscopes with either an intermittent or a continued flow according to the technique of a complete

adenoma resection, down to the surgical capsule. The resected tissue was weighed in the operative theatre after the resection was completed. Follow-up was arranged six months after TURP, and included IPSS, QoL, Qmax, TRUS and PVR investigations. The endpoint of the study was an evaluation of the treatment efficacy using pre/postoperative changes to IPSS, QoL, and Qmax. The cut-off of the efficacy of the operation was defined as 50% improvement of each evaluated parameter or decrease in IPSS (≥ 10 points), increase in Qmax (≥ 10 mL/s), and improvement of QoL (≥ 3 points). All postoperative results were categorized as excellent, good, fair, or none. Treatment was considered effective when the postoperative results were excellent (all three parameters improved more than the defined cut-off), good (improvement in two of the three parameters), and ineffective – when the results were fair (improvement in one of the three parameters), or none (all three parameters did not reach the cut-off level). The weight of the resected prostate tissue (RPTW), RPTW/TZV ratio, and RPTW/TPV ratio were analyzed with regard to the endpoint of the study, i.e. effective or ineffective treatment results. The statistical analysis was performed using the t test and the chi-squared test. The ROC curves were used to analyze the impact of intra operative parameters on treatment efficacy. Survival analysis (life tables) was performed to detect the cut-off and prognostic values of each parameter for predicting postoperative results. SPSS 21.0 for Windows (Statistical Package for Social Sciences, Chicago, Illinois, USA) was used to perform the statistical analysis. Differences were considered significant at $P < 0.05$.

RESULTS

In total, 89 patients were involved in this prospective case report study. The patients' preoperative data

Table 1. Preoperative objective parameters and their difference at six months after transurethral resection of the prostate

	Preoperative n=89			Postoperative n=89			Difference Δ (%)	95% CI	p
	Mean	Range	SD	Mean	Range	SD			
Age (years)	68.6	45–84	7.76	–	–	–	–	–	–
TPV (mL)	47.21	18.3–113.3	19.20	–	–	–	–	–	–
TZV (mL)	26.46	5–74.5	14.57	–	–	–	–	–	–
IPSS	22.38	13–34	5.47	5.62	0–23	4.58	16.76 (74.9)	15.36–18.05	<0.001
QoL score	4.65	3–6	0.98	1.08	0–5	1.06	3.59 (77.2)	3.27–3.88	<0.001
PVR (mL)	127.1	10–300	76.5	31.78	0–250	32.9	95.32 (75)	8.41–11.89	<0.001
Qmax (mL/s)	8.5	3–15	2.64	18.7	6.2–45.3	7.81	10.2 (120)	78.45–112.1	<0.001

TPV – Total Prostate Volume, TZV – Transition Zone Volume, IPSS – International Prostate Symptoms Score, QoL – Quality of Life, PVR – Post Void Residual volume, Qmax – maximal urinary flow rate

are shown in Table 1. Moderate symptoms (up to 18 IPSS points) were observed in 30.2% and severe (19 and more IPSS points) symptoms in 69.8% of the patients. All the evaluated parameters (Qmax, QoL, PVR, and IPSS) changed significantly at 6 months after TURP (Table 1). The difference between pre- and postoperative data varied from 75% (IPSS and PVR) to 120% (Qmax). The treatment was effective according to Qmax (improvement >50% or ≥ 10 mL/s) in 74.2% of the patients, according to IPSS (improvement >50% or ≥ 10 points) in 91%, and according to QoL (improvement >50% or ≥ 3 points) in 74.2% of the patients. According to our definition of efficacy, the treatment was effective in 74.2% (excellent – 71.9% and good – 2.2%) of the patients, while in 25.8% (fair – 6.7% and ineffective – 19.1%) of the patients TURP was ineffective 6 months after the operation. The mean RTW was 23.6 gr. (SD ± 14.43 , range 5–66). The mean RPTW/TPV ratio was 0.48 (SD ± 0.17 , range 0.13–0.89),

and the mean RPTW/TZV ratio was 0.91 (SD ± 0.29 , range 0.42–1.98). The mean TPV at the 6 month follow-up was 25.8 mL (SD ± 15.44). A very strong correlation between RPTW and the difference of TPV before and after TURP was found ($r = 0.869$, $p < 0.001$). All pre- and intraoperative parameters were evaluated with respect to the treatment efficacy. The decrease in PVR was similar between the groups, and therefore, an increase in Qmax and QoL, as well as the reduction in the IPSS score, were significantly higher when TURP was effective (Table 2). There was no difference in RPTW, but the resected tissue ratio with TZV and TPV was higher when the treatment was effective (Table 2). The ROC curve analysis was performed for each of the intraoperative parameters to evaluate their influence on treatment outcomes. The most significant predictors for obtaining favorable results were RPTW/TZV and RPTW/TPV ratios. The data is shown in Table 3 and Figure 1. Survival analysis (life tables) shows

Table 2. Differences between parameters according to the effectiveness of the treatment

Parameter	Ineffective treatment, n=23					Effective treatment, n=66					p	95% CI Lower/Upper
	Preoperative		Post-operative		Δ	Preoperative		Post-operative		Δ		
	mean	SD	mean	SD		mean	SD	mean	SD			
Qmax	9.9	2.81	10.9	3.22	1	8.07	2.43	21.42	7.07	13.3	<0.0001	-15.34 / -9.35
QoL	4.4	1.03	1.8	1.3	2.6	4.7	0.96	0.83	0.85	3.9	<0.0001	-1.94 / -0.66
IPSS	21.5	5.6	8.43	6.26	13.1	22.6	5.5	4.65	3.4	17.97	0.001	-7.79 / -1.97
PVR	122.3	81.2	36.3	53.1	85.9	128.7	75.3	30.21	22.4	98.5	0.519	-51.16 / 26.01
	Ineffective treatment, n=23				Effective treatment, n=66				p	95% CI Lower/Upper		
	Mean		SD		Mean		SD					
TZV	26.63		15.3		26.41		14.4		0.95	-6.8 / 7.27		
TPV	50.01		20.97		46.13		18.9		0.41	-5.4 / 13.24		
RPTW	20.43		12.28		24.7		15.04		0.22	-11.2 / 2.66		
RPTW/TZV	0.76		0.21		0.96		0.29		0.004	-0.33 / -0.06		
RPTW/TPV	0.388		0.147		0.51		0.17		0.003	-0.2 / -0.04		

TPV – Total Prostate Volume, TZV – Transition Zone Volume, IPSS – International Prostate Symptoms Score, QoL – Quality of Life, PVR – Post Void Residual volume, Qmax – maximal urinary flow rate, TZV – transition zone volume, TPV – total prostate volume, RPTW – resected prostate tissue weight, RPTW/TZV – ratio of the resected prostate tissue weight and transition zone volume, RPTW/TPV – ratio of the resected prostate tissue weight and total prostate volume

Table 3. ROC curve analysis for the influence of intra-operative parameters on the evaluated parameters and overall effectiveness

	RPTW			RPTW/TZV			RPTW/TPV		
	Area	p	95% CI	Area	p	95% CI	Area	p	95% CI
Qmax	0.572	0.303	0.435–0.71	0.691	0.007	0.569–0.813	0.699	0.005	0.578–0.82
IPSS	0.758	0.017	0.56–0.955	0.764	0.014	0.613–0.915	0.850	0.001	0.743–0.96
QoL	0.572	0.303	0.435–0.71	0.691	0.007	0.569–0.813	0.699	0.005	0.578–0.82
Overall effectiveness	0.572	0.303	0.435–0.71	0.691	0.007	0.569–0.813	0.699	0.005	0.578–0.82

IPSS – International Prostate Symptoms Score, QoL – Quality of Life, Qmax – maximal urinary flow rate, RPTW – resected prostate tissue weight, RPTW/TZV – ratio of the resected prostate tissue weight and the transition zone volume, RPTW/TPV – ratio of the resected prostate tissue weight and the total prostate volume, Area – area under the curve

that in order to achieve 50% improvement in Qmax, QoL, and IPSS (Table 4), more than 30–35% of all prostate tissue (the cut-off value of the RPTW/TPV ratio was 0.30–0.35) and more than 60% of the transition zone tissue (the cut-off value of RPTW/TZV ratio was 0.60) should be removed.

DISCUSSION

TURP aims to resect tissue from the transition zone of the prostate to treat LUTS secondary to BPO. TURP is still regarded as a standard surgical proce-

dure for the treatment of LUTS secondary to BPO in prostates ≤ 80 mL [8]. Despite the growing popularity of pharmacotherapy during the last decades, surgical management of LUTS is still recommended in certain conditions, including the presence of refractory urinary retention, bladder stones, persistent gross hematuria, recurrent urinary tract infection, renal failure secondary to BPO, or ineffective conservative treatment [8, 9], and provides good results. In a recent analysis of 20 contemporary RCTs published between 2005 and 2009 and a maximum follow-up of 5 years, TURP resulted in an improvement of the mean Qmax (162%), a reduction of the mean IPSS (–70%), and a reduction of the mean QoL score (–69%) and mean PVR (–77%) [10]. A study with long-term follow-up also reported a significant decrease in most symptoms and an improvement in the urodynamic parameters after the mean period of 13 years [1], which demonstrated the efficacy of TURP in long-term settings. Generally, the outcome of TURP performed for LUTS is favorable in 78–93% of patients [11]. The results of our study were similar – TURP was effective in 74.2% of patients. However, the description of the effectiveness of TURP was not standardized, and thus, the data could be evaluated critically. According to literature, the best results for the treatment of LUTS were demonstrated after open prostatectomy [12, 13] when up to 97% of the transition zone can be enucleated during the operation [14]. The logical conclusion is that during the TURP, as much tissue as possible should be resected, but data supporting this is insufficient and controversial.

The impact of preoperative parameters on treatment-related functional results or treatment efficacy has been investigated in various prospective randomized studies. Symptom differentiation between overactive bladder and BOP is one of the essential points that can affect postoperative results. In our study, obstructive symptoms were only slightly more expressed than irrigative symptoms (3.3 vs. 3.1 point per IPSS question) which could account for the high ineffective results rate. Using more extended ques-

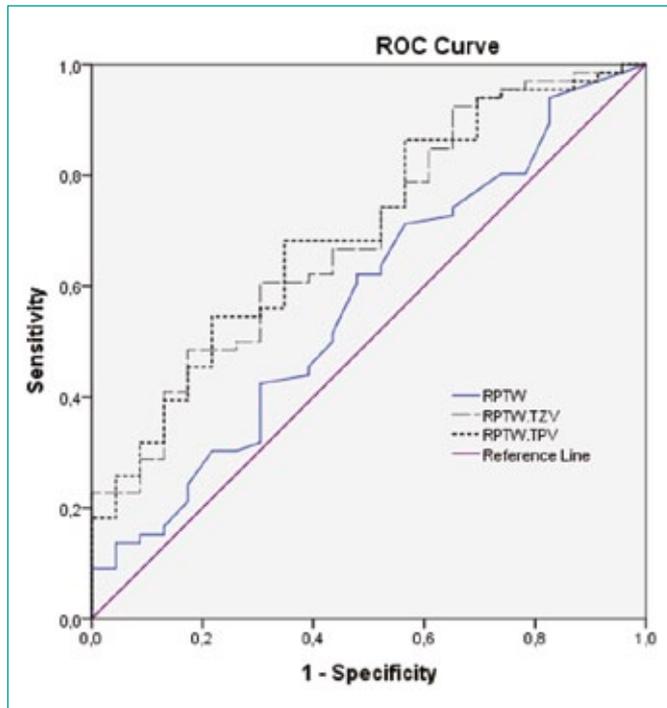


Figure 1. ROC curve analysis for the influence of intra-operative parameters on the evaluated parameters and the overall effectiveness.

RPTW – resected prostate tissue weight: area under the curve – 0.572, $p = 0.303$, RPTW/TZV – ratio of the resected prostate tissue weight and the transition zone volume: area under the curve – 0.691, $p = 0.007$; RPTW/TPV – ratio of the resected prostate tissue weight and the total prostate volume: area under the curve – 0.699, $p = 0.005$

Table 4. Significance of the completeness of the resection on changes in the evaluated parameters

	ΔQ_{max}		$\Delta IPSS$		ΔQoL		Effective Treatment
	$\geq 50\%$ Cut-off/HR	≥ 10 mL/s Cut-off/HR	$\geq 50\%$ Cut-off/HR	≥ 10 score Cut-off/HR	$\geq 50\%$ Cut-off/HR	≥ 3 score Cut-off/HR	Cut-off/HR
RPTW/TPV	0.35/HR 0.7	0.35/HR 2.5	0.35/HR 2.5	0.35/HR 3.4	0.35/HR 3.1	0.3/HR 1.23	0.35/HR 1.6
RPTW/TZV	0.6/HR 0.96	0.7/HR 1.49	0.7/HR 1.5	0.6/HR 1.1	0.6/HR 1.2	0.6/HR 1.4	0.6/HR 1.93

Δ – difference between pre- and post-operative values, IPSS – International Prostate Symptoms Score, QoL – Quality of Life, Qmax – maximal urinary flow rate, RPTW/TZV – ratio of the resected prostate tissue weight and the transition zone volume, RPTW/TPV – ratio of the resected prostate tissue weight and the total prostate volume

tionnaires before the procedure could be helpful with better selection of patients.

The investigation of operative parameters is mostly confined to the detection of the removed tissue weight, the duration of the operation, and the values of complications, but they do not estimate the impact on treatment effectiveness [15]. There are only a few studies that have quantified the effect of the amount of the resected tissue or the completeness of the TURP on the outcomes in individuals with LUTS secondary to BOP. Hakenberg et al. suggest that early symptom improvement after TURP will depend on the amount of the tissue removed, but symptomatic improvement after TURP is not primarily dependent on the relative completeness of the resection. Patients with larger prostates and larger RTW tend to gain more symptomatic benefit from TURP than do patients with smaller prostates [4]. Our results showed that RPTW as a single parameter had no impact on the effectiveness of TURP. Indeed, RTPW directly correlates with the transition zone or total prostate volume, but only completeness of the resection (RPTW ratio with TZV >60%, HR 1.91, or RPTW ratio with TPV >35%, HR 1.6) is a significant predictor of the outcome.

A more recent study published by Park et al. did not find any relation between the resected tissue ratio with TZV and clinical improvement after TURP. Patients were stratified into 2 subgroups according to the resection ratio (volume of the resected tissue/TZV) <50% and ≥50%. The authors did not find any significant difference in the improvement of IPSS, Qmax, or QoL scores and PVR after TURP when comparing the investigated groups. The conclusion of this study was that the resection ratio had no effect on post-TURP clinical improvement and that a complete resection of prostate adenoma may not be essential [5]. The interpretation of the data of this study is difficult because in our study, 95% of the patients underwent resection of more than 50% of TZV. Also, attention should be paid to the retrospective study design and the low overall improvement of Qmax, QoL, and IPSS (40%, 46%, and 59%, respectively) comparing our findings or data to other studies [10].

Antunes et al. found that the resection of less than 30% of the prostatic tissue seems to be sufficient to alleviate LUTS related to BPH [7]. The presented study data raises some important unanswered questions, such as how correct the transabdominal measurement of prostate volume is or what was the increase in Qmax and the decrease in PVR – i.e. the markers that are commonly used for the evaluation of outcomes. We think that the author's final message may be misleading, and the results have to be critically analyzed, as the study suffers from some major meth-

odological flaws. We believe that a resection of less than 30% of TPV can be sufficient in selected cases when TZV accounts for the same percentage as TPV. Aagaard et al. in a 10-year follow-up study prospectively assessed the results of total and minimal TURP in 167 patients with obstructive symptoms caused by BPH, and found that a significant relief in symptoms of obstruction and irritation was observed in both groups. Qmax and PVR improvement was also similar between the groups [16]. However, there are no more studies to confirm such long-term results. Why is the discussion about the completeness of TURP interesting in the urological community? In comparison, there is no data indicating that incomplete open prostatectomy might be suggested. We think that the principle of these operations should be the same – to remove all obstructive tissue. It is generally accepted that the duration of the operation and the amount (weight) of the resected tissue are directly associated with an increasing rate of complications. However, recent results on TURP complications reported in the analysis of the contemporary RCTs are not significantly higher in comparison to those observed with other techniques: bleeding requiring blood transfusion – 2%, TURP syndrome – 0.8%, acute urinary retention – 4.5%, clot retention – 4.9%, and urinary tract infection – 4.1% [10, 17]. The duration of the surgery is currently much shorter (mean – 38.5 min), compared with an average of 57 and 62.5 min, respectively, in the past cohort reference studies [15, 18]. On the other hand, there are no randomized studies to compare complication rates after incomplete and complete TURP. We think that if there are limitations related to the duration of the surgery, or an increase in risk because of high co-morbidity, it is better to choose other minimally invasive procedures than to perform an incomplete TURP. Some important messages can be read from this study. The first one is that the resection will not be effective if less than 30% of the TPV and 60% of TZV is removed. The second one is that TURP could be safely stopped if some unexpected difficulties occur and 30% of TPV and 60% of TZV has been resected.

CONCLUSIONS

The efficacy of transurethral resection of the prostate during short-term follow-up depends on the completeness of the resection. An improvement in symptoms, quality of life, and voiding function could be expected when at least 30–35% of the total prostate or 60% of the transitional zone has been removed.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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