Comparison between complication rates of laser prostatectomy electrocautery transurethral resection of the prostate: A population-based study

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Abstract

Introduction: We compare the complication rates and length of stay (LOS) of laser transurethral resection of the prostate (L-TURP) versus electrocautery transurethral resection of the prostate (E-TURP) in a population-based cohort. L-TURP has shown enhanced intraoperative safety and equivalent efficacy relative to E-TURP in several high volume centres.

Methods: Relying on the Florida Datafile as part of the Healthcare Cost and Utilization Project State Inpatient Databases (SID) between 2006 and 2008, we identified 8066 men with benign prostate hyperplasia who underwent L-TURP or E-TURP. Chi-square and Mann-Whitney tests were used to compare baseline characteristics. A multivariable linear regression model was used to analyze the effect of L-TURP versus E-TURP on complication rates and LOS.

Results: Overall complication rates did not differ significantly for L-TURP compared to E-TURP in univariable (8.8 vs. 7.4%, $p = 0.1$) and multivariable analyses (odds ratio [OR]: 1.06, confidence interval [CI]: 0.85-1.32, $p = 0.6$). Individuals undergoing E-TURP were less likely to experience a LOS in excess of 1 day (46.2 vs. 59.7%, $p < 0.001$). A lower risk to experience a LOS in excess of 1 day was confirmed for patients undergoing L-TURP after a multivariable linear regression model (OR: 0.37, CI: 0.23-0.58, $p < 0.001$), but not for a LOS in excess of 2 days (OR: 0.96, CI: 0.83-1.10, $p = 0.2$).

Conclusions: Patient characteristics and perioperative safety were similar for L-TURP and E-TURP patients. However, LOS patterns demonstrated a modest benefit for L-TURP compared to E-TURP patients.

Introduction

Laser transurethral resection of the prostate (L-TURP) represents a treatment modality for patients with benign prostatic hyperplasia (BPH). Comparatively lower morbidity and lesser invasiveness allow the safe use of L-TURP in elderly patients with multiple comorbidities.[1-3] These advantages contribute to the increased usage of this L-TURP relative to electrocautery transurethral resection of the prostate (E-TURP).[4-6] To date several randomized trials assessed various outcomes comparing L-TURP to E-TURP.[7-15] The potential limitation of these reports is their origin; surgeons had extensive expertise with L-TURP and patients came from centres of excellence, and not part of everyday clinical practice at community centres. Moreover, these expert surgeons operated at high-volume centres. The reported outcomes may differ substantially from outcomes of L-TURP in the community setting. To date, no large-scale study covered the perioperative complications of L-TURP relative to E-TURP in a population-based study. Based on these potentially important limitations, we examined perioperative complications for both procedures in a large contemporary inpatient data file in the state of Florida.

Methods

Data and study population

We relied on the Florida Inpatient Datafile as part of the Healthcare Cost and Utilization Project State Inpatient

Databases (SID) between 2006 and 2008.[16] The latter captures 100% of hospital discharges in the inpatient setting in a given year. Data collection at the participating institutions represents a mandatory process and is performed by trained professional coders. The data are routinely audited for errors.[16]

Diagnostic and procedural codes were based on the International Classification of Diseases, 9th Revision, Clinical Modification (ICD–9–CM). First, patients who underwent E-TURP (ICD–9–CM code 60.29) and L-TURP (ICD–9–CM code 60.21) were identified from 2006 to 2008. Subsequently, patients with a primary diagnosis of BPH (ICD–9–CM 600.xx) were abstracted for a total of 8451 patients. Exclusions consisted of those with a diagnosis of prostate cancer (n = 244), a concomitant E-TURP and L-TURP code at hospitalization (n = 129), as well as those younger than 40 (n = 12).[17] This resulted in 8066 men.

Covariates

Patient characteristics included age (continuously coded), race (Caucasian, African-American, Hispanic, and Other), primary source of payer (private, Medicare, other insurance types), and comorbidities. The latter was quantified using the Charlson-comorbidity index-modified algorithm.[18] For the purpose of descriptives, the comorbidity score was classified as 0, 1, and ≥2. Encrypted surgeon and hospital identifiers allowed the calculation of surgeon and hospital volume. Surgeon volume was calculated using the number of TURP or laser prostatectomy performed by each of the participating surgeons during each of the calendar year of the study. Similarly, hospital volume was calculated using the number of E-TURP or L-TURP performed by each of the participating hospitals during each of the calendar year of the study. Subsequently, the annual surgeon volume was categorized into 3 equal groups: 1 to 5 cases per year (low), 6 to 13 cases per year (medium), and ≥14 cases per year (high). Similarly, the annual hospital volume was categorized into 3 equal groups: 1 to 19 cases per year (low), 20 to 40 cases per year (medium), and ≥41 cases per year (high).

Endpoints

Relying on ICD–9 diagnostic and procedure codes, complications that occurred during hospitalization were captured. Clinically relevant complications were identified, and were categorized as follows: cardiac, respiratory, vascular, hematuria, infections, hyponatremia (TUR syndrome) and hydronephrosis (Appendix 1).[19,20] Complications were selected only if they were not present at the time of admission. Furthermore, blood transfusions and length of stay (LOS) were also examined. The latter was dichotomized as ≤1 versus >1 days and ≤2 versus >2 days.

Statistical analysis

Chi-square and Mann-Whitney tests were used to assess the statistical significance of proportions and median, respectively. Primary endpoints were overall complication, blood transfusion, and prolonged LOS. In sub-analyses, individual complication groups were examined. A multivariable generalized linear regression model was used to examine the effect of E-TURP versus L-TURP on complications. This allowed adjusting for the nested effect of physician and hospitals, as well as other covariates. All analyses were performed using the R project for Statistical Computing version 2.15.2 and the SPSS version 19.0. A two-sided statistical significance level was set at $p < 0.05$.

Results

Baseline descriptives

Overall 6777 TURPs and 1289 L-TURP for BPH were identified between 2006 and 2008 (Table 1). The mean age was 73.1 years (median 74). Patients treated with L-TURP were older (74.7 vs. 72.8 years, $p < 0.001$), harbored a higher number of comorbidities at hospitalization (CCI ≥2: 8.1% vs. 6.4%, $p < 0.018$) and were less likely to be privately insured (13.0 vs. 17.4%, $p < 0.05$).

Univariable complication rates

Overall, 616 (7.6%) patients experienced at least 1 complication during hospitalization (Table 2). Overall complications were similar for L-TURP (8.8 vs. 7.4%, $p < 0.1$) and E-TURP. Similarly, the rates of hamaturia (3.0 vs. 3.3%, $p = 0.7$), transfusion (3.2 vs. 3.3%, $p = 0.8$), cardiac-related (0.6 vs. <0.1%, $p = 0.4$) and all other specific complications (all $p > 0.1$) occurred similarly frequent in both groups, with the exception of infectious complications which were reported more frequently after L-TURP (1.2 vs. 0.5%, $p = 0.005$). Median LOS for L-TURP patient was statistically significantly shorter (1 vs. 2 days, $p < 0.001$). However, a hospital stay longer than 2 days was more frequent in the L-TURP group (31 vs. 28%, $p < 0.001$).

Multivariable analyses

Patients who underwent L-TURP were equally likely to experience any complication type (odds ratio [OR]: 1.06, confidence interval [CI]: 0.85-1.32, $p > 0.6$) relative to their E-TURP-treated counterparts (Table 3). A LOS in excess of 1 day (OR: 0.37, CI: 0.23-0.58, $p < 0.001$) was less with L-TURP than with E-TURP. Conversely, a LOS in excess of 2 days was equally likely after each procedure (OR: 0.96, CI: 0.83–1.10, $p = 0.2$).

Table 1. Patients characteristics according to procedure

Variable	Overall	E-TURP	L-TURP	*p* value
No. patients (%)	8066 (100)	6777 (84.0)	1289 (16.0)	–
Age, years				<0.001
Mean (median)	73.1 (74)	72.8 (73)	74.7 (76)	
IQR	67-80	67-79	69-81	
Race				<0.001
White	6439 (79.8)	5426 (80.1)	1013 (78.6)	
Hispanic	787 (9.8)	649 (9.6)	138 (10.7)	
Black	518 (6.4)	461 (6.8)	57 (4.4)	
Other	322 (4.0)	241 (3.6)	81 (6.3)	
Surgeon volume/year				<0.001
1-5	2694 (33.4)	1963 (29.0)	731 (56.7)	
6-13	2694 (33.4)	2391 (35.3)	303 (23.5)	
≥14	2694 (33.2)	2423 (35.8)	255 (19.5)	
Hospital volume/year				<0.001
1-19	2742 (34.0)	2252 (33.2)	490 (38.0)	
20-40	2673 (33.1)	2297 (33.9)	376 (29.2)	
≥41	2651 (32.9)	2228 (32.9)	423 (32.8)	
Payer				0.001
Medicare/Medicaid	6461 (80.1)	5385 (79.5)	1076 (83.5)	
Private	1346 (16.7)	1179 (17.4)	167 (13.0)	
Other	259 (3.2)	213 (3.1)	46 (3.6)	
Comorbidity score				0.018
0	5355 (66.4)	4539 (67.0)	817 (63.4)	
1	2173 (26.9)	1805 (26.6)	368 (28.5)	
≥2	538 (6.7)	434 (6.4)	104 (8.1)	

IQR: interquartile range; E-TURP: electrocautery transuretral resection of the prostate; L-TURP: laser transuretral resection of the prostate.

Table 2. Rates of in-hospital complications and length of stay according to procedure

Complications	Overall	E-TURP	L-TURP	*p value*
No. patients (%)	8066 (100)	6777 (84.0)	1289 (16.0)	–
Overall	616 (7.6)	503 (7.4)	113 (8.8)	0.1
Hematuria	248 (3.1)	206 (3.0)	42 (3.3)	0.7
Transfusion	262 (3.2)	219 (3.2)	43 (3.3)	0.8
Infection	53 (0.7)	37 (0.5)	16 (1.2)	0.005
Hyponatremia	53 (0.7)	* (0.7)	*(<1.0)	0.1
Pulmonary	53 (0.7)	* (0.7)	*(<1.0)	0.9
Cardiac	38 (0.5)	* (0.4)	*(<1.0)	0.4
Retention	30 (0.4)	* (0.3)	*(<1.0)	0.036
Vascular	* (0.1)	* (0.1)	0 (0)	0.8
LOS mean (median) **IQR**	2.49 (2) 1-3	2.45 (2) 1-3	2.71 (1) 1-3	<0.001
LOS >1 day	4640 (57.5)	4044 (59.7)	596 (46.2)	<0.001
LOS >2 days	2219 (27.5)	1818 (26.8)	401 (31.1)	0.002

IQR: interquartile range; E-TURP: electrocautery transuretral resection of the prostate; L-TURP: laser transuretral resection of the prostate; LOS: length of stay. *Cell-counts of n < 11 were masked due to confidentiality reasons according to Healthcare Cost and Utilization Project National Inpatient Sample (HCUP) guidelines.

Discussion

The objective of this study was to compare the perioperative complications of patients treated with either L-TURP or TURP from 2006 to 2008 in Florida. The characteristics of L-TURP patients were not meaningfully different than those treated with E-TURP (Table 1). A comorbidity index of 1 and ≥2 accounted for 27% and 6% of L-TURP patients and 29% and 8% of E-TURP patients, respectively. These characteristics indicate that despite statistically significant differences, very little clinical difference distinguishes L-TURP patients from E-TURP patients.

Contrary to our expectations, we did not observe a truly larger proportion of older and sicker individuals undergoing L-TURP. This finding implies that urologic surgeons who use L-TURP do not apply this procedure in a highly selective manner. However, due to the nature of the database, we had no information on perioperative anticoagulation status or patients characteristics regarding prostate size, voiding symptoms or the amount of ablated tissue. This lack of information prevented us from analyzing whether patients undergoing L-TURP possibly had larger prostates or underwent the procedure with concomitant anticoagulation therapy.

Surgeon characteristics represent the second important finding. We observed that most (57%) L-TURPs were performed by surgeons with low surgical volume (1-5 cases per year). Conversely, only 30% of E-TURPs we performed by low volume surgeons. We also noted that 38% and 29% of L-TURPs were performed in low or medium volume centres, respectively, and 33% were done in high volume institutions. E-TURPs were distributed more equally among centres with low, medium and high volume institutions. Such differences may have affected the assessment of LOS >1 day in the multivariable adjustment. Notwithstanding, surgical volume did not reach statistical significance in that model. Of note, our definitions of hospital and surgeon volume are based on the cases performed by each of the participating

Table 3. Multivariable generalized linear regression for complications and length of stay

	Overall comparison			LOS >2 days			LOS >1 day		
	OR	95% CI	*p* value	OR	95% CI	*p* value	OR	95 CI	*p* value
Treatment type									
E-TURP	Ref.			Ref.			Ref.		
L-TURP	1.06	0.85-1.32	0.6	1.26	0.87-1.82	0.2	0.37	0.23-0.58	<0.001
Age	1.04	1.03-1.05	<0.001	1.04	1.03-1.05	<0.001	1.03	1.02-1.04	<0.001
Year of procedure	1.72	1.55-1.92	<0.001	0.96	0.83-1.11	0.6	0.91	0.60-1.38	0.6
Insurance									
Medicare/Medicaid	Ref.			Ref.			Ref.		
Private	1.25	0.94-1.66	0.5	1.16	0.99-1.36	0.07	1.10	0.89-1.35	0.4
Other	0.94	0.55-1.62	0.8	0.79	0.29-2.14	0.6	1.10	0.31-3.87	0.9
Race									
White	Ref.			Ref.			Ref.		
Hispanic	0.76	0.53-1.1	0.1	2.34	1.44-3.81	0.001	1.51	0.82-2.78	0.2
Black	1.34	0.94-1.90	0.1	1.71	1.04-2.81	0.035	2.23	1.51-3.31	<0.001
Others	0.85	0.52-1.40	0.5	1.66	1.11-2.49	0.014	1.16	0.87-1.55	0.3
Surgical volume (cont.)	0.98	0.96-0.99	0.011	0.99	0.97-1.00	0.044	0.96	0.83-1.10	0.6
				0.77	0.72-0.83	<0.001	0.77	0.72-0.83	<0.001
Hospital volume (cont.)	1.00	0.99-1.00	0.2	1.00	99-1.00	0.2	1.00	0.99-1.01	0.8
				0.83	0.77-0.90	<0.001	0.83	0.77-0.90	<0.001
				0.84	0.77-0.90	<0.001	0.84	0.77-0.90	<0.001
Comorbidity									
0	Ref.			Ref.			Ref.		
1	0.92	0.72-1.15	0.5	1.01	0.79-1.29	0.9	1.04	0.95-1.14	0.4
≥2	0.94	0.55-1.62	0.8	1.35	0.87-2.10	0.2	1.75	1.39-2.20	<0.001

E-TURP: electrocautery transuretral resection of the prostate; L-TURP: laser transuretral resection of the prostate; OR: odds ratio; CI: confidence interval; LOS: length of stay; Cont: continuously coded.

hospitals and surgeons. For descriptive purposes, hospital and surgeon volume were both categorized into tertiles (e.g., 3 equal groups). In consequence, the low- intermediate- and high-volume definitions are specific to the current database and not represent other absolute volume thresholds. For example, our definition of high volume includes surgeons performing more than 1 procedure per month and hospitals performing less than 1 procedure per week. Taken together, the relatively low volume thresholds indicate that L-TURPs performed in the state of Florida are not restricted to individuals whose practice profiles exclusively or even predominantly focus on L-TURPs. Instead it appears that most clinicians who perform L-TURPs use this procedure less than once a week. A similar pattern was found for hospital volume where most L-TURPs were performed at centres where less than 1 L-TURP was performed each week. It is possible that these observations are related to the inherent characteristics of the procedure. For example, operating time of L-TURP may be longer than for E-TURP. Moreover, the expertise required for some L-TURP techniques (such as laser enucleation of the prostate) might be greater. Finally, the learning curve might not applicable for E-TURP in most cases, but may be steep and lengthy for the relatively novel L-TURP.[21] Since our database relied solely on an inpatient sample, L-TURPs performed in the outpatient setting could not be captured, which may have significantly underestimated the surgical volume associated with that approach.

The complication rates and their distribution represent the third important finding of this report. The differences between overall complication rates after E-TURP or L-TURP are neither clinically meaningful nor statistically significant. The lack of statistical significance was confirmed in multivariable analyses adjusted for clustering among surgeons and hospitals. The same finding applied to separate analyses that focused on specific complication rates. We did, however, identify a statistically significant difference regarding postoperative retention. The retention rate was slightly higher for L-TURP in univariable analyses. Multivariable analyses were not possible due to insufficient number of events. This observation is surprising, especially in light of reports suggesting better tolerability and less morbidity of L-TURP relative to E-TURP,[4,7,8] However, in a recent meta-analysis, Ahyai and colleagues demonstrated comparable perioperative comorbidity after minimally invasive surgical therapies for BPH (including several ablative L-TURP procedures as well as bipolar TURP) compared E-TURP.[22] Moreover, our results suggest that surgeon familiarity with the procedure (surgical volume OR: 0.98, $p = 0.011$) might be a better

determinant of overall complication rates instead of procedure type (OR: 1.06, $p = 0.6$). Furthermore, we did not find any differences with respect to the rate of hyponatremia. This may seem unexpected since L-TURP uses a saline solution allowing it to avoid this complication. This finding might be explained by a low number of events in both L-TURP and E-TURP, which failed to reach statistical significance. Also, it is possible to develop postoperative hyponatremia secondary to medication or pulmonary, cardiac and hepatic conditions, all of which could explain the low frequency of hyponatremia after L-TURP.

Noteworthy findings were also observed regarding LOS for either procedure. Previous reports suggested that L-TURPs offers the advantage of shorter LOS compared to TURP.[23,24] Our results confirmed that L-TURP is associated with fewer instances of LOS in excess of 1 day, relative to E-TURP. However, no statistically significant difference was recorded when LOS in excess of 2 day was analyzed. This finding implies that L-TURP holds an advantage with respect to LOS when uncomplicated postoperative course occurred. Conversely, in individuals who are at risk of remaining hospitalized for longer periods of time after TURP, the type of TURP makes no difference.

Our findings differ from the previously reported outcomes for L-TURP. For example, in randomized series, from tertiary care centres with a high expertise in L-TURP, lower complication and transfusion rates were reported for L-TURP.[8,9,11,12] Conversely, the current analysis might be more representative of less specialized clinical practice. Moreover, our analyses were adjusted for hospital and surgeons characteristics (clustering).

Study limitations are manifold. First, our data are not prospective and their scope is more limited than those of prospective studies. The data originate from a single state and are thereby less generalizable compared to national registries. Moreover, the study span (2006-2008) might be representative of the increasing popularity of L-TURP. In more contemporary databases different results might be identified due to the continuingly increasing popularity of the L-TURP procedure. Also, low surgeon volume was predominant in the L-TURP group which could have underestimated the advantage of L-TURP over E-TURP, but in our multivariable linear regression model we could not demonstrate the effect ($p > 0.05$) of surgeon volume over LOS >1 day. As demonstrated by Schroeck and colleagues,[5] L-TURP is also done in an outpatient setting and these cases were not accounted for since an inpatient database was used. This could have led to an underestimation of surgeon volume. Last but not least, the diagnostic codes we used to define L-TURP and E-TURP made no distinction between different surgical techniques, such as laser resection, laser enucleation or laser vaporization (Holmium laser enucleation of the prostate, lithium-triborat [Greenlight, AMS] or diode laser). Similarly, E-TURP may also include monopolar or bipolar electrocautery resection of the prostate. Accordingly, the specific laser and electrocautery procedure profiles could not be defined. Nonetheless this report represents the largest retrospective cohort of L-TURP patient to date and is the largest population-based report on perioperative complications experienced by the patients undergoing L-TURP and TURP in a hospital setting.

Conclusion

In a population-based cohort of inpatients treated with L-TURP or E-TURP, patient selection and perioperative safety were similar for both procedures. However, LOS patterns demonstrated a modest benefit for L-TURP compared to E-TURP patients. Those observations should be considered in individual patient counselling and in administrative decision-making.

Competing interests: Larouche, Dr. Becker, Dr. Schiffmann, Dr. Roghmann, Dr. Gandaglia, Dr. Hanna, Dr. Tian, Dr. Perrotte, Dr. Schlomm, Dr. Graefen, Dr. Ahyai, Dr. Karakiewicz and Dr. Sun all declare no competing financial or personal interests. Dr. Trinh has received consultant fees from Intuitive Surgical Inc.

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Appendix 1. ICD-9 codes for postoperative complications

Complication type	ICD-9 codes
Cardiac	410.xx, 402.01, 402.11, 402.91, 428.xx, 427.5, 997.1
Respiratory	518.0, 514, 518.4, 466.xx, 480.xx, 481, 482.xx, 483.xx, 485, 486, 518.5, 518.81, 518.82, 799.1, 997.3
Vascular	415.1, 451.1x, 451.2, 451.81, 451.9, 453.8, 453.9, 997.2, 999.2, 444.22, 444.81, 433.xx, 434.xx, 436, 437.xx
Transfusion	99.04
Hematuria	285.1, 599.7, 599.70, 599.71, 998.1, 998.11
Retention	599.6, 788.2, 788.20, 788.21
Hyponatremia	276.1, 276.6, 276.69
Hydronephrosis	591, 753.29
Urinary infection	590.1, 590.10, 590.11, 590.2, 590.8, 590.80, 590.81, 590.9, 595.0, 595.3, 595.9, 599.0, 995.91, 995.92, 998.02, 998.5, 998.59

ICD: International Classification of Diseases.