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Population based trends in the surgical treatment of benign prostatic hyperplasia

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Abstract

Purpose—Laser prostatectomy has increased in popularity over the last decade. However, traditional transurethral resection of the prostate (TURP) remains common. In an effort to understand decisions surrounding use of laser prostatectomy versus TURP, we evaluated trends in transurethral surgery for benign prostatic hyperplasia (BPH) in an all payer dataset, focusing on patient and provider factors that are associated with receipt of laser prostatectomy.

Methods—Using the State Inpatient and Ambulatory Surgery Databases for Florida, we identified subjects undergoing laser prostatectomy or TURP (2001 to 2009). We calculated rates of surgery over time, stratified by procedure type. We used multilevel regression to examine patient (age, race, level of comorbidity) and provider (surgeon volume) factors associated with receipt of laser prostatectomy versus TURP.

Results—While the overall rates of transurethral surgery remained stable ($p=0.227$) over the study period, use of laser prostatectomy rose 400% (from 25 to 114 procedures per 100,000 men, $p<0.001$), replacing about half of all TURPs. Patients were less likely to undergo laser prostatectomy if they were older (OR 0.65, 95% CI 0.61–0.70) and less healthy (OR 0.48, 95% CI 0.45–0.51). While these factors were predictive of surgery type, the majority of the variation in laser prostatectomy use (69%) was explained by the urologist a patient saw.

Conclusions—Laser prostatectomy utilization has increased over the last decade at the expense of TURP, driven largely by provider effects. However, the elderly and more infirm patients are the least likely to receive it, raising concerns about underuse in this population.

Introduction

Benign prostatic hyperplasia (BPH) is the most common benign neoplasm in men.¹ Its prevalence increases with age, such that more than three out of four men over age 70 suffer from lower urinary tract symptoms (LUTS) secondary to BPH.² The economic impact of BPH is substantial, with costs exceeding \$3 billion annually.³ As the United States' population ages, the public health burden of BPH will only grow.⁴ Understanding how care is currently delivered for this highly prevalent disease will help with identifying opportunities to improve efficiency of care in the future.

The surgical treatment of BPH has been dominated by transurethral resection of the prostate (TURP) for many decades. TURP is indeed the first minimally invasive treatment of BPH

and provides excellent long-term outcomes. However, as technology has evolved, the surgical management of BPH has changed over the last decade, with laser prostatectomy increasing in popularity after the introduction of green light laser vaporization in 2000.^{5,6} Based on the available limited comparative effectiveness data, laser prostatectomy may have several advantages, including shorter hospital stay, shorter catheterization time, lower risk of clot retention, and no risk for transurethral resection (TUR) syndrome.^{7–9} In fact, a recent study did report favorable outcomes after laser prostatectomy even in men who underwent surgery while on anticoagulation.¹⁰ While most of these studies are limited by the lack of long-term follow-up, the reported advantages may make laser prostatectomy particularly well-suited for elderly men with significant comorbidity. However, despite the potential advantages of laser prostatectomy, TURP has remained the most common procedure performed among the elderly.⁶

In an effort to understand decisions surrounding use of laser prostatectomy versus TURP, we evaluated recent trends in transurethral surgery for BPH in an all payer dataset, focusing on patient and provider factors that are associated with receipt of laser prostatectomy.

Methods

Database and Subjects

We used the Florida files from the Healthcare Cost and Utilization Project's State Ambulatory Surgery Database (SASD) and State Inpatient Database (SID). These capture 100% of the outpatient and inpatient discharges in a given year, respectively. We chose Florida for two reasons. First, it is one of the larger and more ethnically diverse states participating in the Healthcare Cost and Utilization Project. Second, it captures discharges from a variety of practice locations, including freestanding ambulatory surgery centers. We abstracted all discharges for TURP [Current Procedural Terminology (CPT) codes 52601, 52612, 52614, 52620, 52630, International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code 60.29] and laser prostatectomy (CPT codes 52647, 52648, 52649, ICD-9-CM code 60.21) between 2001 and 2009 (n=96,134). We excluded patients with a diagnosis of prostate cancer (n=11,768) and with a code for both TURP and laser prostatectomy (n=410). We also excluded men younger than 40 years (n=100), because they are unlikely to have BPH.¹¹

Identification of covariates

We obtained patient-level data [age, race (white, African American, Hispanic, versus other), primary payer (private, Medicare, versus other), and discharge diagnoses] from SASD and SID. Comorbidity was measured using Deyo's clinical comorbidity index for administrative databases.¹² We calculated a patient's socioeconomic status at the zip code level using methods described by Diez Roux.¹³ Surgeons were identified using the encrypted surgeon identifiers from SASD and SID. Surgeon volume, a physician-level factor, was measured by counting the total number of transurethral procedures for BPH (TURP and laser prostatectomy) per year for each surgeon. We then categorized yearly surgeon volume into low (1–3 cases), medium (4–14 cases), or high (15–179 cases) based on terciles of transurethral surgery cases for BPH.

Statistical analyses

To examine use of transurethral surgery for BPH over time, we calculated population based rates for each year and procedure (TURP and laser prostatectomy). For these rates, the numerator was the total number of TURP and laser prostatectomy procedures performed in a year and the denominator was the census population estimate for male residents 40 years old or older for that year for the state of Florida. We then adjusted these rates for age using direct standardization.¹⁴ Time trends in adjusted rates were assessed with Poisson regression.

Our primary outcome was receipt of laser prostatectomy versus TURP. We used the chi squared test to assess bivariate associations of patient, surgeon, and regional factors with undergoing laser prostatectomy. We fit a series of logistic random-intercept models to identify factors associated with receipt of laser prostatectomy. These models allowed us to account for the nested structure of our data (i.e. patients nested within physicians) while adjusting for physician and regional characteristics.¹⁵ We first examined the association of age and comorbidity with receipt of laser prostatectomy, controlling for year. To understand the impact of confounding, we added covariates (race, regional socioeconomic status, surgeon volume) in a step-wise fashion. We examined whether payer type would explain some of the associations of age and comorbidity with receipt of laser prostatectomy by adding primary payer to the models. In order to evaluate the extent to which the treating physician explains the type of surgery a patient gets, we calculated the physician intraclass correlation coefficient in these logistic random-intercept models.¹⁵ To illustrate our findings, we calculated predicted probabilities of receiving laser prostatectomy from logistic regression models. In order to examine whether differential coding of comorbidity within the inpatient (SID) and outpatient (SASD) datasets affected our results, we performed sensitivity analyses stratified by location of service.

We performed all analyses using Stata version 12SE. All tests were 2-tailed and we set the probability of a Type 1 error at 0.05 or less. The University of Michigan Medical School Institutional Review Board exempted this study from review in accordance with the Code of Federal Regulations Title 45, subpart A, section 46.101, paragraph b, subparagraph 4.

Results

Between 2001 and 2009, we found 54,399 TURP and 29,457 laser prostatectomy procedures. Over the study period, age-adjusted laser prostatectomy rates increased more than 4-fold from 25 to 114 per 100,000 ($p < 0.001$) while the overall transurethral surgery rate for BPH remained stable (248 per 100,000 in 2001 vs. 233 per 100,000 in 2009, $p = 0.227$, Figure 1).

The results of bivariable analyses are summarized in Table 1. Use of laser prostatectomy was inversely related to age and comorbid illness (Table 1). In multivariable analyses, the odds of laser prostatectomy decreased with increasing age [odds ratio (OR) 0.75 for age 65–79, OR 0.65 for age 80, Table 2]. These estimates remained unchanged after adjusting for potential confounders such as race, socioeconomic status, and surgeon volume. The effect of age was partially explained by primary payer type, because adding primary payer type to the

model attenuated the association of age with receipt of laser prostatectomy (Table 2). Patients with greater comorbidity had about half the odds of receiving a laser prostatectomy compared to patients with no comorbidity. These results did not change significantly after adjusting for potential confounders (Table 2). Figure 2 illustrates the relationship between age, comorbidity, and predicted probability of receiving laser prostatectomy.

There was a lag in adoption of laser prostatectomy among men with more comorbidity (Figure 2B). While the adjusted probability to undergo laser prostatectomy in 2004 was 36% for men with no comorbidity, it took until 2007 until men with high comorbidity had a similar probability (Figure 2B).

When stratifying the analyses by location of service, laser prostatectomy patients represented only 9% of the inpatients. Patients who underwent laser prostatectomy in the inpatient setting were significantly older and had a significantly higher comorbidity index than those in the outpatient setting (supplemental table 1). In sensitivity analyses limited to the outpatient (SASD) file, older patients and patients with greater comorbidity were again less likely to undergo a laser prostatectomy (supplemental table 2). However, in sensitivity analyses limited to the inpatient (SID) file, older patients with greater comorbidity were more likely to undergo laser prostatectomy (supplemental table 3).

While patient factors were important, the majority (69%) of the variation in receipt of laser prostatectomy was explained by the surgeon rather than the patient, based on 3,156 surgeons in the models. This estimate did not change after including age, comorbidity, surgeon volume, and other possible confounders into the models. This implies that neither the age and comorbidity composition of a physician's patient panel nor his surgical volume explain the physician-level variation in receipt of laser prostatectomy. Rather, other unmeasured factors appear to account for a physician's use or non-use of laser prostatectomy.

Discussion

We found that rates of transurethral surgery decreased slightly, while laser prostatectomy replaced 50% of TURPs over the study period (Figure 1). Laser substitution occurred preferentially among younger and healthier patients. However, unmeasured physician factors explained the majority of the variance in undergoing laser prostatectomy versus TURP, implying who you see is a major determinant of which type of surgery you get.

Among Medicare beneficiaries, rates of minimally invasive therapy for BPH increased between 2002 and 2005 while TURP rates decreased.⁶ Nevertheless, TURP remained the most common procedure for BPH in the elderly in this time period,⁶ which is in line with our findings from an all payer dataset. We explored factors associated with receipt of laser prostatectomy and found younger and healthier patients to be more likely to receive this new procedure. Some of the association of younger age with receipt of laser prostatectomy was explained by payer type. Medicare beneficiaries may be less likely than younger patients to receive more expensive new technologies, especially early in the adoption process. In addition, older patients may be more hesitant to accept treatment with a newer, less well established technology.

Patients with greater comorbidity were also less likely to undergo laser prostatectomy. Laser prostatectomy was primarily performed in an outpatient or ambulatory surgery setting,⁶ a setting less appropriate for patients with greater comorbidity.¹⁶ In order to assess whether location of services affected our results, we performed sensitivity analyses stratified by location of service. Our main findings were confirmed in the analyses limited to the outpatient setting. Although findings in the inpatient setting were limited by the small number of laser prostatectomies performed in this setting, decision making may differ among the older and less healthy inpatients. Within this subset of patients, greater age and comorbidity were associated with increased odds of undergoing laser prostatectomy. Some of these significantly more infirm inpatients may indeed not have been suitable candidates for a TURP, making laser prostatectomy the only feasible procedure.

However, the majority of the variance in undergoing laser prostatectomy versus TURP was explained by unmeasured physician factors. Therefore, in managing BPH, physicians' practice styles play a very important role in procedure selection as previously shown for other conditions.^{17–20}

Our study has several limitations. Although the use of administrative data allowed us to obtain a 100% sample of all inpatient and outpatient procedures performed in Florida over the study period, we were unable to elicit which type of laser or TURP equipment was used for a specific procedure. Even though surgeons utilize the more specific CPT codes when billing in both outpatient and inpatient settings, this detailed information is only retained in the outpatient files. For the inpatient files, the final claims will only include the less specific ICD-9-CM codes. For example, the ICD-9-CM code 60.21 denotes a laser induced prostatectomy in SID, which may be a greenlight laser evaporation, laser coagulation, or holmium laser enucleation. Therefore, we are not able to describe differential trends in use of these laser procedures, but it appears unlikely that lack of these procedural details biased our results. We could not examine trends in the use of transurethral microwave thermotherapy (TUMT) and transurethral needle ablation (TUNA) of the prostate, because the SASD and SID databases do not reliably capture these office based procedures.⁶ However, TUMT and TUNA offer less durable results,^{21,22} so a clinical decision for a patient with symptomatic LUTS first involves the decision for an operative versus office based procedure and then secondarily a decision for or against laser prostatectomy. Therefore, a comparison of laser prostatectomy and TURP more accurately reflects the real clinical decision-making process. In addition, we did not have access to clinical information such as symptom severity or amount of irritative symptoms. Elderly patients may have had more irritative symptoms than younger patients.²³ This could have dissuaded some physicians from offering laser prostatectomy, which has been shown to have more irritative side effects than TURP postoperatively.²⁴ Moreover, our measure of comorbidity was based on claims data, although we used a well described and accepted algorithm which reflects mortality.¹² However, given the inherent limitations of claims data, the findings regarding comorbidity should be viewed as hypothesis generating. Because the SASD and SID databases contain encrypted physician identifiers and do not provide physician-level data, we were not able to assess the importance of specific factors such as physician age or training in determining practice style.

In summary, laser prostatectomy utilization has increased over the last decade at the expense of TURP, driven largely by provider effects. Given the potential advantages of laser prostatectomy, our results raise concern about possible underuse of this new technology among the elderly and infirm.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviations

BPH	benign prostatic hyperplasia
CPT	Current Procedural Terminology
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
LUTS	lower urinary tract symptoms
SASD	State Ambulatory Surgery Database
SID	State Inpatient Database
TUMT	transurethral microwave thermotherapy
TUNA	transurethral needle ablation
TURP	transurethral resection of the prostate

References

1. Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *J Urol.* 2005; 173:1256–1261. [PubMed: 15758764]
2. Platz EA, Smit E, Curhan GC, et al. Prevalence of and racial/ethnic variation in lower urinary tract symptoms and noncancer prostate surgery in U.S. men. *Urology.* 2002; 59:877–883. [PubMed: 12031373]
3. Saigal CS, Joyce G. Economic costs of benign prostatic hyperplasia in the private sector. *J Urol.* 2005; 173:1309–1313. [PubMed: 15758787]
4. Taub DA, Wei JT. The economics of benign prostatic hyperplasia and lower urinary tract symptoms in the united states. *Curr Urol Rep.* 2006; 7:272–281. [PubMed: 16930498]
5. Malek, RS. Photoselective KTP Laser Vaporization of Obstructive BPH (PVP). In: Baba, S.; Ono, Y., editors. *Interventional Management of Urological Diseases.* Vol. 8. Tokyo: Springer Japan; 2006. p. 103-122. Available at: <http://www.springerlink.com/content/t0624757428624x3/> [accessed October 10, 2011.]
6. Yu X, Elliott SP, Wilt TJ, et al. Practice patterns in benign prostatic hyperplasia surgical therapy: the dramatic increase in minimally invasive technologies. *J Urol.* 2008; 180:241–245. discussion 245. [PubMed: 18499180]
7. Burke N, Whelan JP, Goeree L, et al. Systematic Review and Meta-analysis of Transurethral Resection of the Prostate Versus Minimally Invasive Procedures for the Treatment of Benign Prostatic Obstruction. *Urology.* 2010; 75:1015–1022. [PubMed: 19854492]
8. Bouchier-Hayes DM. Photoselective vaporization of the prostate towards a new standard. *Prostate Cancer and Prostatic Diseases.* 2007; 10:S10–S14.

9. Lukacs B, Loeffler J, Bruyère F, et al. Photoselective Vaporization of the Prostate with GreenLight 120-W Laser Compared with Monopolar Transurethral Resection of the Prostate: A Multicenter Randomized Controlled Trial. *European Urology*. 2012 epub ahead of print.
10. Chung DE, Wysock JS, Lee RK, et al. Outcomes and Complications After 532 nm Laser Prostatectomy in Anticoagulated Patients With Benign Prostatic Hyperplasia. *The Journal of Urology*. 2011; 186:977–981. [PubMed: 21791350]
11. Lepor H. Pathophysiology, epidemiology, and natural history of benign prostatic hyperplasia. *Rev Urol*. 2004; 6 (Suppl 9):S3–S10.
12. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992; 45:613–619. [PubMed: 1607900]
13. Diez Roux AV, Merkin SS, Arnett D, et al. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*. 2001; 345:99–106. [PubMed: 11450679]
14. Curtin, LR.; Klein, RJ. Direct standardization (age-adjusted death rates). US Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics; 1995. Available at: ibis.health.state.nm.us/docs/PHStatistics/statnt06rv.pdf
15. Rabe-Hesketh, S.; Skrondal, A. Multilevel and Longitudinal Modeling Using Stata. 2. Stata Press; 2008.
16. Bettelli G. High risk patients in day surgery. *Minerva Anesthesiol*. 2009; 75:259–268. [PubMed: 18946427]
17. Hollenbeck BK, Ye Z, Dunn RL, et al. Provider Treatment Intensity and Outcomes for Patients With Early-Stage Bladder Cancer. *Journal of the National Cancer Institute*. 2009; 101:571–580. [PubMed: 19351919]
18. Hollingsworth JM, Zhang Y, Krein SL, et al. Understanding the variation in treatment intensity among patients with early stage bladder cancer. *Cancer*. 2010; 116:3587–3594. [PubMed: 20564128]
19. Hollingsworth JM, Krein SL, Dunn RL, et al. Understanding Variation in the Adoption of a New Technology in Surgery. *Medical Care*. 2008; 46:366–371. [PubMed: 18362815]
20. Miller DC, Saigal CS, Banerjee M, et al. Diffusion of surgical innovation among patients with kidney cancer. *Cancer*. 2008; 112:1708–1717. [PubMed: 18330868]
21. Hoffman RM, Monga M, Elliot SP, et al. Microwave thermotherapy for benign prostatic hyperplasia. *Cochrane Database Syst Rev*. 2007;CD004135. [PubMed: 17943811]
22. Bouza C, López T, Magro A, et al. Systematic review and meta-analysis of Transurethral Needle Ablation in symptomatic Benign Prostatic Hyperplasia. *BMC Urol*. 2006; 6:14. [PubMed: 16790044]
23. Sarma AV, Wei JT, Jacobson DJ, et al. Comparison of lower urinary tract symptom severity and associated bother between community-dwelling black and white men: the Olmsted County Study of Urinary Symptoms and Health Status and the Flint Men's Health Study. *Urology*. 2003; 61:1086–1091. [PubMed: 12809866]
24. Hoffman RM, MacDonald R, Wilt TJ. Laser prostatectomy for benign prostatic obstruction. *Cochrane Database Syst Rev*. 2004;CD001987. [PubMed: 14973978]

Figure 1.

Population based trends in prostatectomy rates. The increase in laser prostatectomy rates ($p < 0.001$) corresponded with a decrease in TURP rates ($p < 0.001$). Overall transurethral procedure rates **remained stable** ($p = 0.227$).

Figure 2.

Adjusted probability to receive laser prostatectomy by age (panel A) and comorbidity (panel B).

Table 1

Bivariable analysis of patient, provider, and regional factors by procedure type. The percentage of patients in each category is given. SES: regional socioeconomic status

	TURP (n=54,399)	Laser (n= 29,457)	p value
Age			
40–64	17	21	<0.001
65–79	57	57	
>=80	26	22	
Race			
White	82	84	<0.001
African American	6	4	
Hispanic	10	9	
Other	2	3	
Payer			
Medicare	78	74	<0.001
Private	18	23	
Other	4	3	
Clinical comorbidity index ¹²			
0	57	68	<0.001
1	22	21	
2	21	11	
Surgeon volume, tercile			
Low (1–3 cases per year)	5	2	<0.001
Intermediate (4–14 cases per year)	26	16	
High (15–179 cases per year)	69	82	
SES tercile			
Low	34	30	<0.001
Intermediate	33	35	
High	33	35	

Table 2

Association of age and comorbidity with undergoing laser prostatectomy. Odds ratios are given with 95% confidence intervals in parenthesis. SES: regional socioeconomic status

Model	Age 40–64	Age 65–79	Age 80	Comorbidity index 0	Comorbidity index 1	Comorbidity index 2
adjusted for year, race, SES	1.00	0.75 (0.71–0.79)	0.65 (0.61–0.69)	1.00	0.78 (0.74–0.82)	0.47 (0.44–0.50)
adjusted for year, race, SES, surgeon volume	1.00	0.75 (0.71–0.79)	0.65 (0.61–0.70)	1.00	0.78 (0.74–0.82)	0.48 (0.45–0.51)
adjusted for year, race, SES, surgeon volume, primary payer type	1.00	0.84 (0.77–0.90)	0.74 (0.67–0.81)	1.00	0.79 (0.75–0.83)	0.48 (0.45–0.51)