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Population-based Comparative Effectiveness of Transurethral Resection of the Prostate and Laser Therapies for Benign Prostatic Hyperplasia

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Abstract

Introduction—As the American population ages, benign prostatic hyperplasia (BPH) and its associated lower urinary tract symptoms (LUTS) have become increasingly important causes of chronic morbidity. We assessed the comparative effectiveness of two common forms of surgical therapy, transurethral resection of the prostate (TURP) and laser therapies for BPH.

Methods—Using patient level discharge data and revisit files from the Agency for Healthcare Research and Quality, we evaluated a cohort of patients who underwent TURP or laser therapy for BPH in 2005 in California. Short-term outcomes (in-hospital complications, length of stay, 30-day readmission, 30-day repeat surgery, 30-day emergency room visits) were compared between the therapies through regression analysis. Long-term retreatment (defined as absence of secondary procedures for BPH or complications of therapy) was assessed with survival analysis. Analyses were adjusted for medical comorbidity, race, age, and insurance status.

Results—From 11,645 discharges, mean length of stay was shorter for laser patients versus TURP [0.70 versus 2.03 days respectively, ($p < 0.0001$)]. 30-day revisits occurred in 16% of laser patients and 17.7% of TURP patients ($p = 0.0338$). Retreatment rates at 4 years were 8.3% for TURP and 12.8% for laser ($p < 0.0001$). After adjustment, TURP patients were 37% less likely to require repeat therapy than laser patients (HR 0.64; $p < 0.0001$).

Conclusions—Laser procedures and TURP both provide effective management of BPH/LUTS. Laser procedures are associated with less need for hospitalization than TURP, but appear to involve a tradeoff in long term efficacy.

Keywords

Prostatic Hyperplasia; Comparative Effectiveness Research; Surgery; Transurethral resection of prostate

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Introduction

As the American population ages, benign prostatic hyperplasia (BPH) and its associated lower urinary tract symptoms (LUTS) become increasingly important causes of chronic morbidity. To confront the morbidity of symptomatic BPH, new therapies have been developed and promulgated into practice. These minimally invasive surgical therapies (MIST) provide benefits over traditional surgery that may increase the efficiency of surgical care for men with BPH. However, little long term data exist about the efficacy and complications of these new therapies compared to the gold standard of transurethral resection of the prostate (TURP).

One such MIST is laser therapy. Laser therapies are increasingly marketed as replacements for TURP. Published improvements of laser therapy over traditional TURP include lower blood loss,^{1, 2} shorter hospital stays,³ ability to treat larger glands,^{4, 5} and elimination of the risk of TUR syndrome.⁶ Despite these advantages, few studies document long term outcomes with laser therapy. Those that do are single institution studies, and may not reflect the experience of patients outside select centers with greater technological expertise.

In this study, we compare the effectiveness of TURP and laser therapies for BPH in real world settings. We hypothesize that laser therapies will be associated with shorter stays and fewer 30 day complications, while TURP and laser therapies will have equal long-term durability.

Methods

Study Cohort

Using data from the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality (AHRQ), we evaluated a cohort of patients, 40 years of age and older, who had surgical therapy for BPH in 2005 with follow up through 2009. BPH was defined by International Classification of Disease (ICD-9) diagnosis codes. We excluded patients who had genitourinary cancers or surgical therapy in 2004. Using ICD-9 codes and Current Procedure and Terminology (CPT) codes, we identified patients with TURP and laser prostatectomy procedures within hospitals and ambulatory surgical centers. HCUP provides an all payor discharge level collection of hospitalizations (State Inpatient Database, SID),⁷ outpatient surgeries (State Ambulatory Surgery Database, SASD),⁸ and emergency room visits (State Emergency Department Database, SEDD)⁹ from participating states. We used California SID, SASD, and SEDD data since information on inpatient surgery, outpatient surgery (both hospital based and from freestanding ambulatory surgical centers),¹⁰ and emergency room visits were available from this source. We then used AHRQ revisit files to create linkages at the patient level across inpatient, ambulatory surgical, and emergency department practice settings and years.¹¹ Revisit files link patients across the data sets based on date of birth, gender, and an encrypted patient identifier. The revisit file provides information about the time from one event to another, while keeping the actual date of a service encrypted. A limitation of the revisit files is they only provide data on patients within an individual state. Thus, any patient care that takes place across state lines cannot be tracked with this data. Therefore, California's unique population distribution, with few population centers near other states, provides an advantage when using the revisit files. Through use of the revisit files, we were able to follow our cohort of surgically treated patients for both short and long-term outcomes.

Outcomes

Peri-operative outcomes of laser therapy and TURP were examined. These short-term outcomes included length of stay from the initial procedure, complications during the initial

ambulatory surgery center or hospital stay, additional ambulatory surgical procedures within 30 days of the initial surgery or hospital discharge, visits to emergency rooms within 30 days of surgery or hospital discharge, and readmission to a hospital within 30 days of surgery or hospital discharge. Length of stay was assessed directly from HCUP records. Possible complications during and after the initial surgery were ascertained using AHRQ's published Patient Safety Indicators.¹² 30-day readmission, repeat surgery, and emergency room visits were assessed from use of the revisit files linked to inpatient, ambulatory surgery, and emergency room data files. Indicator variables were created for these variables.

Our primary outcome was the long term efficacy of surgical therapy for BPH; assessed by receipt of repeat surgical therapy. To provide a broad selection of possible secondary therapies, we included procedures for BPH, and for possible complications of therapy such as anti-incontinence or stricture procedures. For privacy protection, the HCUP database doesn't contain the 'real date' for procedures or hospitalizations. Thus for patients who experienced a repeat surgery the time from initial surgery to repeat surgery was calculated using the revisit files. For patients who did not have repeat surgery, we calculated maximum follow up time based on the month and year of the initial procedure through the final date of the data (12/31/2009).

Exploratory Variables

Procedures were classified as TURP and laser therapy. Due to ICD-9 and CPT coding, all types of laser therapies (contact vaporization, non-contact vaporization, and enucleation) are included as laser therapy. Patient comorbidities were assessed from ICD-9 codes found on the discharge record from surgery, and enhanced by examining data for hospitalizations for 1 year prior to the surgery discharge. Comorbidity coding was performed by applying the methods of Elixhauser, et al.¹³ Patient demographics were based on the record from the index surgical procedure. Patient race was categorized as White, Black, Hispanic, and other. Patient age was categorized into 5-year age ranges (<50, 50 to 54, 55 to 59, 60 to 64, 65 to 69, 70 to 74, 75 to 79, and 80+). Payor status was categorized as commercial insurance, Medicare, Medicaid/self-pay, other.

Statistical Analysis

Differences in length of stay between the TURP and laser therapy groups were compared by linear regression analysis. Logistic regression analysis was used to assess for differences between treatments in hospital readmissions, repeat ambulatory surgery visits, emergency room visits, and complications. Each peri-operative outcome was assessed in individual models without confounding variables and then controlling for differences in comorbidity, race, age, and payor status between the types of therapy. Because service setting (inpatient versus outpatient) can influence coding of comorbidity and complication data, we reexamined the results stratified by location of the initial surgery. These results were also adjusted for patient characteristics.

Efficacy of surgical therapy for BPH was assessed using survival analysis techniques. The outcome variable was the composite measure of retreatment, with the explanatory variable being TURP or laser therapy. Initially, Kaplan-Meier analysis was performed. Due to differences in patient populations in the TURP and laser therapy groups, Cox proportional hazard models were fit to control for differences in the populations by race, age, and payor status.

All analyses were conducted with SAS version 9.2. This study had approval from the Institutional Review Board of Washington University in Saint Louis. P values of < 0.05 were considered statistically significant.

Results

The final cohort included 11,645 men treated with surgical therapy in 2005, 8675 TURP and 2970 laser therapy. Laser therapy patients had fewer comorbidities than TURP patients (42% no comorbidity versus 32%; $p < 0.001$). Fewer Black and Hispanic patients were treated with laser therapy compared to Whites ($p < 0.001$). Laser therapy was performed in the outpatient setting 68% of the time compared to only 21% for TURP ($p < 0.001$).

With the exception of LOS, short-term outcomes were similar between TURP and laser therapy (**Table 1**). The median LOS was 0.70 days for laser therapy (95% CI 0.62 to 0.78) and 2.03 days (95% CI 1.96 to 2.10) for TURP. Post-procedure complications occurred in 7.9% of laser patients and 13.2% of TURP patients (OR 1.79; 95% CI 1.54 to 2.07). After adjustment for patient characteristics, there was no longer a significant difference in complications between the therapies (OR 1.15; 95% CI 0.97 to 1.37). 30-day revisits (hospitalization, ambulatory surgery, or emergency room) were also not different between the therapies. 16% of laser patients had a 30-day revisit compared to 17.7% of TURP patients (30 day-revisit TURP vs laser crude $p = 0.0338$; adjusted $p = 0.4105$). In adjusted analysis, no differences were found in the use of repeat outpatient surgery, emergency room visits, or inpatient hospitalizations between the groups.

When stratified by surgical setting, differences were noted between laser therapy and TURP for LOS and post-procedure complications. With restriction to only cases where hospitalization was required, LOS remained shorter for laser patients, (2.17 days; 95% CI 1.94 to 2.38 days laser versus 2.58 days; 95% CI 2.49 to 2.67 days TURP). While post-procedure complications did not differ between TURP and laser patients treated in inpatient settings (adjusted OR 1.01; 95% CI 0.84 to 1.25), in the outpatient setting post-procedure complications were more common with TURP than laser therapy (adjusted OR 1.50; 95% CI 1.08 to 2.09). No differences in revisits were found comparing the two therapies when stratified by location of service.

With a median follow up of 4.49 years (mean = 4.27 years), TURP appeared to be more durable than laser therapy for treatment of BPH. By Kaplan-Meier survival analysis, 91.7% (95% CI 91.06% to 92.23%) of TURP patients were free of repeat surgical therapy at 4 years after their initial BPH surgery compared to 87.2% (95% CI 86.01% to 88.42%) of laser therapy patients (Figure 1; $p < 0.001$). When assessed by Cox proportional hazards regressions modeling, controlling for patient characteristics, TURP patients were 37% less likely to need further surgical intervention compared to laser therapy patients (Table 2; adjusted HR 0.636; 95% CI 0.553 to 0.734 ; $p < 0.001$). For surgeries performed in an inpatient setting, TURP patients were 42% less likely to need further surgical intervention compared to laser patients (adjusted HR 0.578; 95% CI 0.473 to 0.731). For procedures in the outpatient setting, no difference was noted in outcomes between TURP and laser therapy (HR 0.830; 95% CI 0.664 to 1.024).

Discussion

TURP and laser therapies for the prostate are well established surgical treatments for BPH but with different side effect profiles. In the population-based practice explored in this study, we have confirmed that laser therapy has a shorter length of stay than seen with TURP. Peri-operative complications and revisits within 30 days of surgery were similar between the two treatments. Long-term efficacy of the treatments, as defined by surgical retreatment rates, was better for TURP patients compared to laser therapy patients with follow up for 3 to 4 years.

This study provides the first large scale community based exploration of the comparative effectiveness of laser therapy and TURP in the management of men with BPH. Our findings confirm data from prior single institution studies and randomized trials showing the efficacy of laser therapy. The 13% retreatment rate found for laser therapy patients in our study contrasts with recent results published for both laser enucleation and photoselective vaporization procedures. Five year retreatment rates were 5% for laser enucleation therapy in one study,¹⁴ and 1.4% in another.¹⁵ A recent randomized trial found increased need for retreatment in patients receiving TURP compared to photoselective vaporization.³ These results reveal the importance of examining results from general clinical practice compared to only centers with specialized expertise as our population-based analysis captured retreatment at different institutions. Furthermore, no studies in a recent meta-analysis had more than 250 patients,¹⁶ making long-term assessment of relatively rare complications difficult.

With few long-term follow up studies, and most studies of BPH therapy addressing average symptom responses, our study fills an important gap in knowledge regarding the effectiveness of laser therapy compared to TURP. Our study shows that men with BPH can expect good freedom from retreatment with either TURP or laser procedures, and the 13% repeat surgery rate at 4 years among laser patients may underestimate success with current technology. Patients will have few peri-operative complications with either procedure. The 16% to 18% 30-day revisit rate found in our study is consistent with results reported in single institution series and trials.¹⁶ Furthermore, the stratified results reveal important differences between the surgical techniques. More men treated with TURP than laser therapy had a hospital stay after their procedure. While most laser procedures are performed as outpatient surgery, those that become inpatient may be the result of complications during or after surgery, patient comorbidities, or local practice patterns. Conversely, TURP procedures where a patient is able to be discharged on the day of surgery are typically smaller resections with lower risks of bleeding and other complications. Higher revisit rates were found among men treated as inpatients than outpatients, likely reflecting the indications for inpatient management. Overall, these results provide useful information for counseling patients as they make decisions on intervention for BPH.

As we consider the results reported in this study, we recognize that the surgical treatments for BPH are not static. Refinements to both TURP and laser therapies continue to occur. Refinements to TURP include bipolar TURP^{17, 18} and vaporization using bipolar technology and saline irrigation.¹⁹ While uncommonly performed in the United States, holmium laser enucleation of the prostate provides a minimally invasive technique for removal of large prostate glands.^{20, 21} Excellent results have been published with follow up out five years.¹⁴ Laser vaporization technology continues to evolve, with most studies based on lower wattage systems.²² Indeed, the results in this study are likely reflective of treatment with these lower wattage systems. Higher wattage PVP laser systems are now available, and these systems have been reported to increase the efficiency of the vaporization.²³ Long term efficacy studies of these newer higher energy systems are not yet available.

Certain limitations of our study require consideration. First, using administrative data we do not have access to measures of patient symptoms, PSA levels, or prostatic volumes. Patients in the early experience of a surgeon with laser therapy may have been selected for smaller gland size, and thus had shorter hospitalizations and better outcomes than patients with larger glands. Similarly, we cannot define improvements in flow rates, medication use, or PVR measures after therapy. For this reason, we chose to compare peri-operative morbidity and long-term efficacy of the therapies. Second, information on medications is not available for the patients. Thus we cannot determine if surgical therapy eliminated the need for medications, or if patients required medical therapy at a later point. Our data do capture

recurrent surgical treatments for BPH or for complications of therapy, and it is on these measures of long-term efficacy where we have focussed. Third, due to an inability to capture mortality outside of the hospital, we might overestimate the median length of follow up for our cohort, and underestimate the need for repeat treatment at 4 years. Differential results between TURP and laser therapy would only change if survival of patients treated by these modalities was different. Since TURP patients had higher comorbidity burdens, the results are most likely biased to show no difference between the therapies. Finally, the data is obtained at the state level. Thus, if patients cross state lines to receive subsequent care, their care is not recorded. By using California data, we have limited the impact of such border crossings for care.

Conclusions

Laser procedures and TURP both provide effective management of BPH/LUTS. Laser procedures are associated with less need for hospitalization than TURP, but appear to involve a tradeoff in long term efficacy.

Key Definitions for Abbreviations

BPH	Benign Prostatic Hyperplasia
LUTS	Lower Urinary Tract Symptoms
TURP	Transurethral Resection of Prostate
MIST	Minimally Invasive Surgical Therapies
HCUP	Healthcare Cost and Utilization Project
AHRQ	Agency for Healthcare Research and Quality
ICD-9	International Classification of Disease Ninth Edition
CPT	Current Procedure and Terminology
SID	State Inpatient Database
SASD	State Ambulatory Surgery Database
SEDD	State Emergency Department Database

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Figure 1. Time to Surgical Retreatment among TURP and Laser Therapy Patients

TURP appeared to be more durable than laser therapy for treatment of BPH (median follow up of 4.49 years), with 91.7% (95% CI 91.06% to 92.23%) of TURP patients were free of repeat surgical therapy at 4 years after their initial BPH surgery compared to 87.2% (95% CI 86.01% to 88.42%) of laser therapy patients ($p < 0.001$).

Table 1

Short-term outcomes

	Laser	TURP	Crude OR (TURP vs laser)	Adjusted OR (TURP vs laser)
Length of Stay	0.70 (0.62, 0.78)	2.03(1.96, 2.10)		
Post-procedure Complications	234 (7.88%)	1149(13.24%)	1.785 (1.540, 2.068)	1.153 (0.972, 1.369)
30-day Readmissions				
None	2496 (84.04%)	7139 (82.29%)	0.883 (0.789, 0.988)	0.995 (0.870, 1.137)
Outpatient Surgery	72 (2.42%)	130 (1.50%)	0.612 (0.458, 0.819)	0.866 (0.615, 1.220)
ED	277 (9.33%)	909 (10.48%)	1.138 (0.988, 1.311)	1.029 (0.869, 1.218)
Inpatient	125 (4.21%)	497 (5.73%)	1.383 (1.131, 1.690)	1.049 (0.832, 1.322)

Table 2

Cox Proportional Hazards Regression Results for Receipt of Repeat Surgical Therapy TURP versus Laser Treatment

Overall Results	
Crude HR (TURP vs laser)	Adjusted HR (TURP vs laser) (adjusted for comorbidity, race, age group, payor, complications)
0.638 (P<0.0001) 95% CI(0.566,0.723)	0.636 (p<0.0001) 95% CI(0.553,0.734)
Stratified Results	
IN_PATIENT	
Crude HR (TURP vs laser)	Adjusted HR (TURP vs laser) (adjusted for comorbidity, race, age group, payor, complications)
0.616 (P<0.0001) 95% CI(0.509,0.770)	0.578 (p<0.0001) 95% CI(0.473,0.731)
OUT_PATIENT	
Crude HR (TURP vs laser)	Adjusted HR (TURP vs laser) (adjusted for comorbidity, race, age group, payor, complications)
0.798 (P=0.0193) 95% CI(0.660,0.964)	0.830 (p=0.0803) 95% CI(0.664,1.024)