Travel characteristics and outcomes for patients seeking HoLEP

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Introduction: *Holmium laser enucleation of the prostate (HoLEP) is an effective but underutilized option for the surgical management of benign prostatic hyperplasia (BPH). With low adoption, questions arise surrounding patients access to care. It is unclear whether patients undergoing HoLEP are local or specifically seek care from afar. We looked to determine the proportion of patients who traveled out-of-state for HoLEP treatment and the impact of travel on peri and postoperative metrics.*
Materials and methods: *We performed a retrospective cohort study evaluating patients that underwent HoLEP at a single institution from 2007-2019. Patient demographic, perioperative data, postoperative outcomes, travel distance and income data were compared between those who traveled and did not travel out-of-state for care.*
Results: *From 2007-2019, 1565 patients underwent HoLEP at our institution. The mean age was 70.0 years, average body mass index (BMI) of 27.9 kg/m2, and 91.6% identified as Caucasian; 44.2% of patients traveled from out-of-state for HoLEP care, traveling a median of 597 miles. Patients who came from out-of-state had larger prostates (p = 0.005) and worse preoperative International Prostate Symptom Score (IPSS) total and bother scores (p = 0.002). There was no difference in immediate, 30 or 90 day complications rates. In- and out-of-state patients had similar postoperative urinary and functional outcomes.*
Conclusions: *A large proportion of patients specifically seek out HoLEP and travel out-of-state for care. The reasons are likely multifactorial –including advanced disease, lack of local care and healthcare consumerism. These results have implications both for those currently providing HoLEP as a treatment option as well as those motivated to start a HoLEP practice.*

Key Words: holmium laser enucleation of the prostate, access to care, benign prostatic hyperplasia, voiding dysfunction

Introduction

Holmium laser enucleation of the prostate (HoLEP) is a well-established and effective technique for the surgical management of benign prostatic hyperplasia (BPH). HoLEP is size independent and has particular benefits in treating patients with large glands and those on anticoagulation.[1-3] Despite its advantages and recommendations within guidelines, HoLEP has suffered from low adoption rates.[4,5] Although there has been an increase in the number of physicians offering HoLEP over the past decade, it still encompasses a small proportion of total BPH surgical care.[6]

There has been little research into the specific patient population that ultimately undergo HoLEP. With low utilization and adoption, and therefore lower availability

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for patients, care access is an obvious concern. Novel procedures frequently cluster at high volume centers, which impacts access to care.[7] Similarly, complex urologic care has trended toward regionalization – forcing patients to travel greater distances.[8,9] The true impact of travel distance on surgical care and outcomes is unknown – as many variables require consideration. Longer travel distance may correspond to increased risk for complications or suboptimal outcomes if patient travel is due to advanced disease or lack of local care. Alternatively, patients who seek centers of excellence may be uniquely motivated to treat their disease and be primed for superior outcomes. Interestingly, BPH has typically not been an area in which patients have had to travel outside of their health care region to find care, as some of the standard treatment options are ubiquitous amongst urologists.[10] Therefore, understanding the population of patients that travel for BPH care and their surgical outcomes is valuable.

In the expanding landscape of BPH procedures, HoLEP represents an effective but scarce treatment option. For those patients that undergo this procedure, it is unclear what proportion travel for care, and how this travel is related to specific patient factors as well as outcomes. Our institution is a high volume HoLEP center, performing > 150 cases per year. To better address these knowledge gaps, we retrospectively evaluated our BPH database to determine what proportion of patients traveled from out-of-state for care and compared their peri and postoperative outcomes. We hypothesize that a large percentage of patients seek care from afar, have more advanced BPH disease and worse postoperative outcomes.

Material and methods

We performed a retrospective cohort review of all patients who underwent HoLEP at our institution from 2007-2019 using our institutional review board approved database. All procedures were performed by or under the direct supervision of two physicians. Our technique for HoLEP has previously been described.[11] All patients on blood thinners were asked to hold anticoagulation when possible except for aspirin. After HoLEP they were advised to restart anticoagulation 3-5 days postoperatively.

Patient demographic data, number of comorbidities, prior medication management, prior BPH treatment, catheter status, PSA, prostate volume, preoperative urinary parameters, preoperative quality of life data, operative time, enucleation time, morcellation time, catheterization time, pathology, postoperative urinary parameters, functional results and postoperative quality of life data were compiled. Patients in preoperative urinary retention were excluded from evaluations of preoperative urinary voiding parameters. Quality of life scores were measured using the International Prostate Symptom Score (IPSS). Incontinence was defined as any degree of self-reported leakage by the patient, either with stress maneuvers or unprovoked leakage. Complications were graded using the Clavien-Dindo classification system and identified at time of surgery (immediate), within 30 days and between 30-90 days postoperatively. Patient reported home zip code data was used to compute geodetic distance between their county of residence and treatment site. Income data was obtained from US census median household income data stratified by zip code for 2006-2010.[12] Patients from out of country were excluded from distance or income analysis.

Patients from in-state and out-of-state underwent a similar work up, which included an office visit, cystoscopy, prostate volume measurement (either trans-rectal ultrasound (TRUS) or calculated from cross-sectional pelvic imaging), and uroflowmetry. Urodynamics were performed as clinically indicated. Out-of-state patients typically had this work up over a shorter period while in-state patients may have accomplished this work up over multiple visits. Treatment options were discussed with all patients depending on their symptoms profile, bother, and prostate size. Options discussed included conservative management, medical therapy, transurethral resection of the prostate, HoLEP, simple prostatectomy and available minimally invasive surgical treatments. Out-of-state patients were encouraged to stay in state 48 hours after surgery. There were no special considerations made between time from consultation to surgery in either group. All patients were offered a follow up visit at our institution 3 months after surgery.

Statistical analysis was performed using SPSS statistical software. Descriptive statistics were reported for continuous and categorical data. The Chi-squared test, Students t test, and Mann-Whitney U were used for comparison of proportions, means, and non-parametric data, respectively.

Results

Patient characteristics

Our study sample consisted of 1,565 patients who underwent HoLEP at our institution from 2007 to 2019. The mean age was 70.0 years, average body mass index (BMI) of 27.9 kg/m^2, and 91.6% identified as Caucasian. Slightly less than half of the patients, 691 (44.2%), came from out-of-state for care. From this cohort, 32 patients (4.6%) were international. Approximately 33% of the

study sample had no comorbid conditions while 14.2% had 3 or more – the in-state cohort had a statistically significant higher proportion of comorbidities (p = 0.002). Interestingly, 12.1% of patients in our sample held a doctoral degree. Out-of-state patients presented with significantly larger prostate volumes, 92 g vs. 82.8 g (p = 0.014). Also, they presented with worse preoperative IPSS total and bother score (p = 0.005, p = 0.002). Out-of-state patients were more likely to be on 5-alpha reductase inhibitors (5-ARI) at time of surgery, 32.1% vs. 25.9% (p = 0.006). In-state patients had higher rates of anticoagulation/antiplatelet use, 45.7% vs. 37.4% (p = 0.001). There was no statistically significant difference between in- and out-of-state patients in terms of alpha blocker therapy, prior BPH procedures or catheter status. Table 1 highlights baseline patient characteristics.

Operative data and outcomes

Out-of-state patients had greater tissue resected during HoLEP, 57 g vs. 51 g (p = 0.001). There was no difference between in- and out-of-state patients in

TABLE 1. **Descriptive characteristics**

Variable	Overall	In-state	Out-of-state	p value
Number of patients (%)	1565 (100%)	874 (55.8%)	691 (44.2)	
Age, yr (mean, SD)	70.0 (8.3)	70.5 (8.4)	69.4 (8.1)	0.011
BMI, kg/m^2 (mean, SD)	27.9 (5.0)	28.2 (5.0)	27.6 (4.9)	0.240
Race (n,% of total)				0.076
Caucasian	1433 (91.6%)	814 (93.1%)	619 (89.6%)	
Hispanic	24 (1.5%)	12 (1.4%)	12 (1.7%)	
Black	21 (1.3%)	12 (1.4%)	9 (1.3%)	
Asian	29 (1.9%)	11 (1.3%)	18 (2.6%)	
Unknown	58 (3.7%)	25 (2.9%)	33 (4.8%)	
Number of comorbidities (n,%)				0.002
0	517 (33%)	262 (30.0%)	255 (36.9%)	
1	515 (32.9%)	280 (32.0)	235 (34.0%)	
2	311 (19.9%)	191 (21.9%)	120 (17.4%)	
> or = 3	222 (14.2%)	141 (16.1%)	81 (11.7%)	
Alpha blocker, currently taking (n,%)	982 (62.7%)	546 (62.5%)	436 (63.1%)	0.799
5-ARI, currently taking (n,%)	448 (28.6%)	226 (25.9%)	222 (32.1%)	0.006
Anticoagulation/antiplatelet, currently taking (n, %)	657 (42.1%)	399 (45.7%)	258 (37.4%)	0.001
Prior BPH procedure, yes (n,%)	190 (12.2%)	98 (11.2%)	92 (13.4%)	0.198
Catheter status (n,%)				0.329
None	1128 (72.4%)	631 (72.3%)	497 (72.6%)	
SIC	211 (13.5%)	114 (13.1%)	97 (14.2%)	
Indwelling	208 (13.4%)	119 (13.6%)	89 (13.0%)	
Spanner	11 (0.7%)	9 (1.0%)	2 (0.3%)	
MD or PhD, yes (n,%)	189 (12.1%)	103 (11.8%)	86 (12.4%)	0.690
TRUS volume, grams (median, IQR)	87.9 (29.4)	82.8 (63.2)	92 (73.6)	0.014
Preoperative Qmax (median, IQR)	8 (7)	8 (7)	8 (6.5)	0.251
Preoperative PVR (median, IQR)	143 (215)	145 (222)	137 (212)	0.984
Preoperative PSA (median, IQR)	4.7 (5.7)	4.5 (5.6)	4.6 (5.2)	0.247
Preop IPSS (median, IQR)	21 (11)	20 (10)	21 (10)	0.005
Preop IPSS bother (median, IQR)	5 (2)	4 (2)	5 (1)	0.002

SIC = self intermittent catheterization; Spanner = prostatic stent

TABLE 2. **Operative data and outcomes**

Variable	Overall	In-state	Out-of-state	p value
Tissue resected, g (median, IQR)	53 (51)	51 (46)	57 (54)	0.001
Enucleation time, min (median, IQR)	55.1 (45)	56 (44.1)	55 (43.5)	0.838
Morcellation time, min (median, IQR)	11.5 (16)	11.2 (14)	12 (16.4)	0.123
Length of stay, day (median, IQR)	1 (0)	1 (0)	1 (0)	0.241
Duration of catheter (median, IQR)	1 (1)	1 (1)	1 (1)	0.102
Intraop transfusion, yes (n,%)	5 (0.3%)	3 (0.3%)	2 (0.3%)	0.851
Immediate complication, yes (n,%)	79 (5.1%)	49 (5.6%)	30 (4.4%)	0.276
30 day complication, yes (n,%)	127 (8.3%)	80 (9.3%)	47 (7.1%)	0.116
90 day Complication, yes (n,%)	71 (4.7%)	38 (4.4%)	33 (5.0%)	0.580
Prostate cancer on path (n, %)	17 3 (11.1%)	108 (12.4%)	65 (9.4%)	0.065

enucleation time, morcellation time, median length of stay or catheter duration. There was no difference between either group in intraoperative transfusions, immediate, 30, or 90 day complications. Prostate cancer was found in 11.1% of our study sample, with no statistically significant difference between either cohort. Table 2 highlights operative data and outcomes.

Postoperative functional and urinary outcomes

When evaluating the entire cohort, there was a significant improvement in postoperative functional and urinary outcomes. Specifically, median Qmax was 14 (IQR 18) mL/sec, demonstrating a 75% improvement from preoperative levels of 8 mL/sec (IQR 7). Postoperative PVR and PSA were 21 (IQR 51) mL and 0.56 (IQR 3.30) ng/mL for the entire cohort. Reduction in total IPSS and bother were significant, with a median IPSS of 4 (IQR 9) and bother of 0 (IQR 2). When compared to preoperative scores, this amounted to a 17 and 16 point decrease for the in- and out-of-state groups, respectively. Although 40.3% of the total sample endorsed temporary urinary incontinence at 3 months, pad usage was low – with median pad usage of 0 (IQR 1) pads per day. There was no significant difference in postoperative functional and urinary outcomes when stratified by in- and out-of-state groups. Table 3 lists postoperative functional and urinary data.

Approximately 74% of patients returned for postoperative follow up, with a higher proportion of in-state patients returning than out-of-state patients, 83.6% vs. 61.1% (p = 0.001). Median follow up time was 2 months.

TABLE 3. **Postoperative functional and urinary outcomes**

Variable	Overall	In-state	Out-of-state	p value
Follow up, yes (n,%)	1153 (73.7%)	731 (83.6%)	422 (61.1%)	0.001
Months to follow up (median, IQR)	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	0.132
Qmax (median, IQR)	14 (18)	13.65 (18)	15 (19)	0.107
PVR (median, IQR)	21 (51)	20 (49)	21 (57)	0.766
PSA (median, IQR)	0.560 (3.30)	0.6050 (3.50)	0.4850 (2.99)	0.341
IPSS (median, IQR)	4 (9)	4 (9)	4 (9)	0.297
IPSS bother (median, IQR)	0 (2)	0 (2)	0 (2)	0.724
Incontinence, yes (n,%)	509 (40.3%)	323 (40.6%)	186 (39.9%)	0.817
Pads per day (median, IQR)	0 (1)	0 (1)	0 (1)	0.725

TABLE 4. **Distance and income**

Variable	Overall	In-state	Out-of-state	p value
Distance traveled, mi (median, IQR)	118.1 (517.75)	21.3 (59)	597.2 (765)	0.001
Range, mi	0-2912	0-212	171-2912	
Median household income, dollars (median, IQR)	$64,467 ($35,582)	$65,895 ($37,392)	$62,242 ($32,883)	0.014

Distance and income

As expected, those patients who resided in-state traveled shorter distances than those who came from out-of-state. In-state patients traveled a median of 21.3 (IQR 59) miles while out-of-state patients traveling a median of 597.2 (IQR 765) miles (p = 0.001). Regarding median household income, zip code derived proxies of income were different in the two cohorts, with in-state patients having significantly higher income than out-of-state patients (p = 0.014). Table 4 highlights distance and income data.

In- and out-of-state residence over time

From 2007 to 2019, there was a trend toward more patients coming from out-of-state for care although this did not reach statistical significance (p = 0.052). Table 5 shows trends of in- and out-of-state patients receiving HoLEP care at our institution over the study period.

TABLE 5. **Patient location over time**

Year	Overall	In-state	Out-of-state	p value
2007	16	12 (75%)	4 (25%)	0.052
2008	81	51 (63%)	30 (37%)	
2009	85	58 (68%)	27 (32%)	
2010	101	57 (56%)	44 (44%)	
2011	69	42 (61%)	27 (39%)	
2012	91	48 (53%)	43 (47%)	
2013	127	68 (54%)	59 (46%)	
2014	138	78 (57%)	60 (43%)	
2015	163	87 (53%)	76 (47%)	
2016	178	84 (47%)	94 (53%)	
2017	145	76 (53%)	69 (48%)	
2018	157	100 (64%)	57 (46%)	
2019	183	98 (54%)	85 (46%)	

Discussion

HoLEP is an effective yet underutilized modality for the management of BPH.[6,13] Many reports center around its comparison to other modalities or reasons for its low utilization; however, few studies have focused on the characteristics of patients who undergo this procedure. Here we described the geographic distributions of patients who underwent HoLEP and evaluated their peri and postoperative factors and outcomes.

We found that a large proportion of patients travel from out-of-state for BPH surgical care; almost 45% at our institution. These patients had fewer comorbidities than their in-state counterparts, had larger prostates and worse preoperative quality of life metrics. Both in- and out-of-state patients had short hospital stays, with most patients discharging on postoperative day one. There were similarly low rates of postoperative complications among both groups. In-state patients were more likely to follow up for postoperative visits, but the time to follow up was not different in either cohort. Functional and urinary outcomes among both groups were not significantly different.

Our results raise multiple questions, primarily why such a large proportion of patients travel for HoLEP. Reasons for out-of-state travel are likely multifactorial but factors which may play a primary role include availability of local care, more advanced disease, and healthcare consumerism.

Lack of local care represents the most obvious reason for why such a large proportion of our patients traveled for HoLEP care. The low utilization and adoption of HoLEP across the United States and Canada has been well established. Analysis of a large national quality database has found that HoLEP constitutes only 5% of the BPH procedures performed annually.[14] In 2014, approximately 69% of hospital referral regions were performing either zero or < 10 HoLEPs per year.[6] These numbers illustrate the lack of HoLEP practitioners and limited availability for patients to receive care locally, leaving those with

advanced disease or who specifically desire HoLEP with little choice but to travel for care.

Secondly, based on our findings more advanced disease appeared to be a driver of traveling out-of-state for HoLEP care – with these patients having both significantly larger gland size and higher IPSS scores. The differences in quality of life between the cohorts was small, but given our robust sample size, this difference was statistically significant. The difference in their total scores may not meet the threshold for a meaningful clinical difference; however, the difference in bother scores between the groups, 1, does pass this threshold.[15] We cannot speak to the exact reason for more advanced disease in the out-of-state cohort. This may represent an intertwined issue with lack of local care and subsequent delays in treatment. Alternatively, patients with more advanced disease may be motivated to seek care at centers of excellence and subsequently travel for care. Bother and persistent symptoms are known factors which influence pursuing treatment – as disease burden increases the momentum to seek care also increases.[16] Out-of-state patients may have crossed a burden threshold, which when coupled with a lack of available care, produced a need to travel for BPH surgical care. This finding deserves added attention in future studies.

Outside of lack of local care and advanced disease, health care consumerism may play a role in why patients traveled for care. At its core, healthcare consumerism represents the autonomy of patients to choose who is involved in their care. Where patients choose to seek care is multifaceted but typically heavily influenced by clinician referrals.[17] In our sample, patients from out-of-state traveled hundreds of miles for care – a practice unlikely to be due to clinician referrals and most likely to be self-directed. The motivations behind this are complex and cannot be attributed to a single factor. Patients seeking HoLEP may be better researched consumers and therefore opt to travel large distances for results that they have deemed superior. Interesting, 12% of our study sample held advanced degrees, a MD or PhD. According to 2019 census data on education attainment, approximately 3.5% of the US population holds a professional or doctorate degree.[18] There may be an association between health care providers seeking HoLEP preferentially given the robust data on its outcomes, but this conclusion would require more data to fully support. Although we cannot speak to the influence of this factor, it may be one amongst many that contribute to why patients traveled out-of-state for care.

Institutional reputation cannot be ignored in our discussion of heath care consumerism. Our institution has a national reputation that may influence patients to seek care from afar. This reputation is largely built on word of mouth or patient directed searches, as there are no local, regional, or national marketing campaigns for our institution and HoLEP. We cannot characterize the intention of patients who travel from out-of-state; whether they seek HoLEP specifically or seek the expertise of our center for BPH care. Further evaluation into the reasons that patients seek care at our center may help to better understand the role of healthcare consumerism in HoLEP care.

Despite having to travel out-of-state for surgery, we did not see any differences in postoperative outcomes. These results are consistent within the literature when compared to other specialties and procedures. Patients traveling for colorectal care were found to have similar rates of complication when compared to their local counterparts.[19] For those undergoing cystectomy, surgery at high volume centers was associated with improved outcomes despite increased travel distance.[20] Ultimately, outcomes and complications may be a function of surgical expertise and less influenced by the distance traveled.

Our results are novel in that they are the first to describe travel characteristics for patients undergoing HoLEP but also because they may signal a shift in BPH surgical care. TURP remains the most common procedure for surgical BPH care, encompassing almost 60% of the BPH surgeries performed each year.[14] Given the ubiquity of this procedure, patients have traditionally not had to travel great distances for surgical care. An analysis of urologic procedures in the state of Washington notes that only 7% of patients had to travel outside their hospital referral region to undergo TURP.[10] As the landscape of BPH surgical options becomes more varied, we may see patients required to travel to centers of excellence.

Historically, patient travel for complex or novel procedures is not uncommon. Newer procedures often cluster in high volume centers, a consequence of regionalization of care that has been shown to benefit outcomes.[7] Regionalization has been seen in urologic oncology, with radical prostatectomy and cystectomy, and also within endourology for complex procedures.[21,22] With a limited group of surgeons capable of performing HoLEP across the United States, our data may point towards a larger trend of regionalization in HoLEP care.

Our study and data have limitations. This is a retrospective analysis from our prospective database. Our study sample is predominantly Caucasians, who may have fewer barriers to care than African American or Hispanic communities.[23] Therefore, our data may

be enriched by a population with greater ease to travel out-of-state for care. Although we have postulated reasons for such high rates of out-of-state travel, our conclusions should be considered in the frame of the data available. We do not have data on the availability of urologists performing HoLEP in the regions surrounding our institution – discussions on lack of available care were made from the best data available within the literature. Furthermore, there may be factors contributing to out-of-state travel that we may not be able to capture – such as local clinician referral patterns or word of mouth marketing. Similarly, we agree that there are specific factors unique to our geographic region that may influence our results. Our practice is in a location that is frequently visited by out-of-state travelers and has a large community that 'winter' in the region – likely increasing the proportion of patients that seek care from out-of-state. Our institution also has an endourology fellowship which teaches HoLEP, this may provide some unintentional marketing and drive patients to seek care here. Graduates from our fellowship frequently settle out of state, therefore there is little regional competition for those with large glands. Lastly, one can argue that the factors we highlighted may not be as influential as the means to seek care. This argument has merits; however, we found that out-of-state patients had lower median household income than their in-state counterparts when using zip code derived proxies. Therefore, income alone is not necessarily the primary factor for out-of-state travel, although it may be an important piece of the overall story.

The implications of these findings have led to changes in our practice patterns. Many patients contact our department prior to their initial appointment hoping for their work up to be complete during their initial visit – an understandable ask for patients traveling hundreds of miles for consultation. This has required the development of expedited clinical pathways, where patients can have cystoscopy, uroflowmetry and even urodynamics on the same days as their initial visit. Early adoption of telehealth has made the evaluation of out-of-state patients more efficient, given that we can stratify which patients may need a more intensive work up prior to discussions of surgery. These changes may not be replicable by all, but for those with growing HoLEP practices they may provide a helpful model for how to deal with the unique logistical challenges that out-of-state patients pose.

For the surgeon starting a HoLEP practice, this data should be used as a roadmap for what they may face. The availability of urologists capable of performing HoLEP is woefully lacking and for any urologist starting to perform HoLEP, they may experience an influx of patients from both near and far once established. Of course, other factors are at play, such as competing interests from local urologist that may influence referral patterns. Regardless, with such few HoLEP surgeons in the United States and the clear need for advanced BPH care – the tides are in favor of those practitioners that can offer their patients the full scope of BPH surgical procedures. Clinical pathways for patients from afar and flexibility within the workup of patients with advanced BPH should be considered as a HoLEP practice is developed.

Conclusions

In this study, we evaluated travel characteristics for patients undergoing HoLEP. Within our sample, a large proportion of patients came from out-of-state for HoLEP care. These patients had larger glands and worse quality of life scores, but their postoperative metrics were similar to their in-state counterparts. Multiple reasons for out-of-state travel exist, with lack of local care, advanced disease and healthcare consumerism likely playing large roles.

This study adds to the existing knowledge base for HoLEP care and demonstrates a potential implication of low adoption nationally. Patients will seek out HoLEP care and travel long distances for it. Although this does not influence postoperative outcomes, it signals an increase need for more HoLEP practitioners. Until the availability of providers increases, those performing HoLEP should be prepared to offer expedited clinical pathways for patients who travel from afar to limit burden. □

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