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Cost Analysis of Prostate Artery Embolization (PAE) and Transurethral Resection of the Prostate (TURP) in the Treatment of Benign Prostatic Hyperplasia

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Abstract

Purpose Prostatic arterial embolization (PAE) has emerged as a minimally invasive alternative to TURP; however, there are limited cost comparisons reported. The purpose of this study was to compare in-hospital direct costs of elective PAE and TURP in a hospital setting.

Materials and Methods Institutional Review Board-approved retrospective review was performed on patients undergoing PAE and TURP from January to December 2014. Inclusion criteria included male patients greater than 40 years of age who presented for ambulatory TURP or PAE with no history of prior surgical intervention for BPH. Direct costs were categorized into the following categories: nursing and operating room or interventional room staffing, operating room or interventional supply costs, anesthesia supplies, anesthesia staffing, hospital room cost, radiology, and laboratory costs. Additionally, length of stay was evaluated for both groups.

Results The mean patient age for the TURP ($n = 86$) and PAE ($n = 70$) cohorts was 71.3 and 64.4 years, respectively ($p < 0.0001$). Intra-procedural supplies for PAE were significantly more costly than TURP (\$1472.77 vs \$1080.84, $p < 0.0001$). When including anesthesia

supplies and nursing/staffing, costs were significantly more expensive for TURP than PAE (\$2153.64 vs \$1667.10 $p < 0.0001$). The average length of stay for the TURP group was longer at 1.38 versus 0.125 days for the PAE group. Total in-hospital costs for the TURP group (\$5338.31, SD \$3521.17) were significantly higher than for PAE (\$1678.14, SD \$442.0, $p < 0.0001$).

Conclusions When compared to TURP, PAE was associated with significantly lower direct in-hospital costs and shorter hospital stay.

Keywords Prostate artery embolization (PAE) · Cost · TURP · BPH

Introduction

Benign prostatic hyperplasia (BPH) is the most common benign neoplasm in the male population, estimated to affect nearly 50% of men above the age of 60, and nearly 90% of men by the age of 85 [1]. Lower urinary tract symptoms (LUTS) from BPH affect more than 15 million men in the USA, with annual healthcare costs of more than \$3 billion [2]. BPH can have a significant effect on quality of life (QOL) due to urinary symptoms such as urgency, frequency, nocturia, incomplete voiding, weak stream, and straining. Treatment options have traditionally included watchful waiting, oral medications such as alpha-1 blockers and 5-alpha-reductase inhibitors, and surgical management, such as transurethral resection of the prostate (TURP) [1].

TURP is the gold-standard intervention for patients with BPH caused by a prostate less than or equal to 80 mL in volume, who cannot tolerate or who are refractory to medical therapy. In patients with prostate volume greater than 80–100 mL, open prostatectomy is recommended treatment

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for BPH [1]. Prostatic arterial embolization (PAE) has emerged as a minimally invasive therapy for symptomatic patients due to enlarged prostates, and as an alternative to TURP with fewer complications and shorter recovery time, with data supporting mid- and long-term outcomes [3–6]. As PAE is a minimally invasive outpatient procedure, there may be differences in cost associated with each procedure. The purpose of this study was to compare in-hospital direct costs of elective PAE and TURP in a hospital setting.

Materials and Methods

An Institutional Review Board (IRB)-approved chart review was performed of patients who underwent PAE and TURP from January 2014 to December 2014 in the departments of Interventional Radiology and Urology, respectively. The study was compliant with the Health Insurance Portability and Accountability Act. International classification of diseases and related problems (ICD-9) codes were used to identify patients with BPH who underwent elective ambulatory TURP or PAE. Seventy consecutive patients with LUTS from BPH underwent PAE by a single board-certified interventional radiologist. Eighty-six consecutive patients with BPH underwent TURP by one of four board-certified urologists. Patients were not randomized, as this study is a retrospective review of procedures already performed at the time of data collection. Financial data were provided by the departments of Urology and Interventional Radiology for the respective procedures and related in-hospital expenses in the form of Current Procedural Terminology (CPT) codes.

Patients included in the analysis were at least 40 years of age who presented for ambulatory TURP or PAE with no history of prior surgical intervention for BPH. Patients admitted to the hospital for a medical reason other than BPH who then went on to receive a TURP were excluded.

Procedural (direct) costs for TURP included operating room (OR) staffing, operating room supplies, anesthesia supplies, and anesthesia staff not including the anesthesiologist. Procedural (direct) costs for PAE included interventional radiology suite staffing and interventional radiology supplies. Radiology supplies included catheters, wires, and contrast were calculated based on an internal database the department maintains for individual procedures. Closure was achieved with manual compression. Staffing cost was based on time worked by staff and hourly salary. Room costs were based on standardized hospital costs at our facility. Sedation for PAE was provided by IR nurses and was included under “interventional radiology staffing.” There were no separate supply charges. Anesthesia supplies refer to the cost of general anesthesia equipment, though does not factor in differing amounts of drugs used during a case.

Additionally, for TURP, there were charges associated with an inpatient or observational room. Finally, the cost of laboratory services and imaging studies during the patient’s stay were also included in the analysis.

Patients were categorized into either the PAE or TURP group. Unpaired *t* tests were used to compare direct costs between PAE and TURP: cost of staffing for operating room (OR) and interventional suite, cost of operating room and interventional suite supplies, cost of anesthesia supplies, cost of anesthesia staffing (not including an anesthesiologist), hospital room cost, cost of post-procedure radiologic studies, and cost of laboratory studies. These costs were further categorized into total procedural costs (OR or IR staffing, OR or IR supplies, anesthesia supplies, and anesthesia staffing). Additionally, the length of stay (LOS) was evaluated for both groups, and total procedural and post-procedural costs for the course of hospitalization were assessed.

Indirect hospital costs such as electricity, housekeeping, security, medical records, and pathology were excluded. Additionally, professional physician fees of the anesthesiologist, radiologist, and urologist were not included in this analysis. A threshold of $p = 0.05$ was used to determine statistical significance. All analyses were conducted using IBM SPSS Statistics (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, version 22.0. Armonk, NY: IBM Corp).

Results

Seventy patients underwent a common femoral artery approach prostatic arterial embolization, and 86 patients underwent transurethral resection of the prostate. There was a significant difference in the average patient age of the PAE and TURP groups (64.4 vs 71.3 years, $p < 0.0001$) (Table 1). The cost of intra-procedural PAE supplies relative to those of TURP was found to be significantly greater (\$1472.77 vs \$1080.84, $p < 0.0001$) (Table 2). There was no cost for anesthesia supplies or staffing for the PAE patients as sedation was provided by a radiology nurse. Therefore, sedation costs are included in the price of IR staffing, accounted for in separate category. Average costs of anesthesia supplies and staffing for TURP were \$508.09 and \$252.71, respectively (Table 2). Total procedural costs including room staffing, room supplies, anesthesia supplies, and anesthesia staffing were lower for PAE relative to TURP: \$1667.10 compared to \$2153.64 ($p < 0.0001$) (Table 1; Fig. 1). PAE patients were all discharged after 3 h of observation in an IR recovery unit per the institution’s standard of care, which does not have an additional charge other than IR staffing. TURP patients were either admitted under observation (a hospital stay less

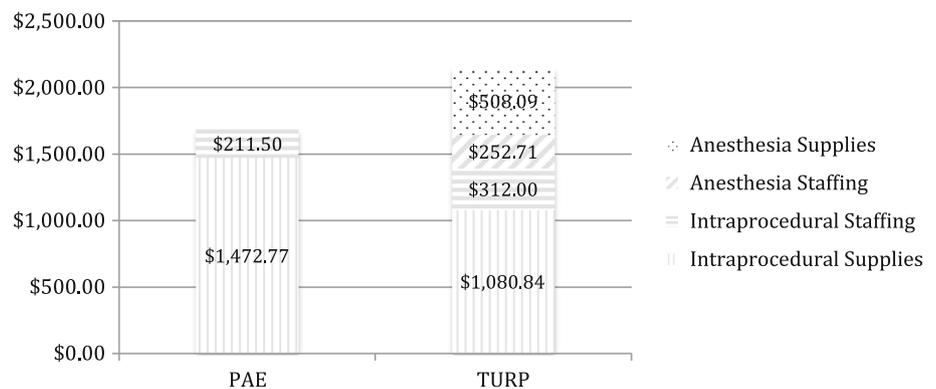
Table 1 Overall outcomes

	PAE		TURP		p value
	Mean	(SD)	Mean	(SD)	
Age (years)	64.39	7.28	71.31	8.68	<0.0001
Total procedural costs	\$1667.10	\$430.47	\$2153.64	\$708.83	<0.0001
Length of stay (days)	0.125	0.00	1.38	1.72	<0.0001
Total cost of LOS	\$1678.14	\$441.99	\$5338.31	\$3521.17	<0.0001

Table 2 Individual costs

	PAE		TURP		p value
	Mean	(SD)	Mean	(SD)	
Intra-procedural supplies	\$1472.77	\$396.15	\$1080.84	\$487.39	<0.0001
Intra-procedural staffing	\$211.50	\$0.00	\$312.00	\$0.00	<0.0001
Anesthesia staffing	\$0.00	\$0.00	\$252.71	\$0.00	<0.0001
Anesthesia supplies	\$0.00	\$0.00	\$508.09	\$261.58	<0.0001
Observational room	\$0.00	\$0.00	\$1510.31	\$1428.69	<0.0001
Inpatient room	\$0.00	\$0.00	\$1194.73	\$2427.71	<0.0001
Imaging costs	\$0.00	\$0.00	\$211.34	\$945.49	<0.0001
Laboratory costs	\$11.04	\$82.29	\$320.98	\$555.25	<0.0001

Fig. 1 Bar graph illustrating differences in total intra-procedural cost between PAE and TURP with subdivisions of individual aggregate costs



than or equal to 23 h) or as an inpatient. The average costs for TURP observation rooms ($n = 54$) and inpatient rooms ($n = 32$) were \$1510.31 and \$1194.73, respectively (Table 2).

The average length of stay was greater for TURP relative to PAE (1.38 and 0.125 days, respectively, $p < 0.0001$). The average total cost of hospitalization was found to be significantly greater for the TURP population compared to the PAE population (\$5338.31 vs \$1678.14, respectively, $p < 0.0001$) (Table 1).

Discussion

Prostate artery embolization is a minimally invasive treatment for lower urinary tract symptoms (LUTS) secondary to BPH. Several studies have shown that PAE is a

safe and effective option in the treatment of BPH, with similar clinical benefits compared to other surgical options in glands of varying sizes [6–8]. As opposed to TURP, there does not appear to be an upper limit of prostate size that can be effectively treated by PAE. Furthermore, PAE is routinely performed as an outpatient procedure and the vast majority of reported complications are minor and self-limited [9].

With increased scrutiny of healthcare spending in the USA, there is growing interest in comparing costs associated with different treatment pathways for the same medical condition. This study evaluated the cost of TURP and PAE in a real-world hospital setting. Direct costs related to PAE were found to be significantly less than TURP. This was due to differences in length of stay, anesthesia, and staffing. Although professional fees were excluded from the analysis, it is thought that the cost discrepancy would

be even greater because TURP involves professional charges from an anesthesiologist as well as the surgeon.

This study is limited by the lack of outcomes data, preventing inclusion of duration of efficacy as part of the analysis. While the duration of improvement is well known for TURP due to multiple longitudinal studies, long-term data for PAE are just beginning to emerge with early reports suggesting duration of efficacy comparable to TURP [8, 10]. However, the rate of re-intervention in the PAE population is still unclear, with at least one study demonstrating approximately 9.2% of patients requiring a repeat procedure due to persistent LUTS [5]. This study only included direct costs and did not include costs related to complications that may be seen as a result of either single procedure. If the cost of managing complications or re-admissions were included, perhaps the TURP arm would be even more costly as the management of these (i.e., incontinence, impotence, bleeding, stricture) can be life-long or life disabling. Additionally, the study did not have patients who required a repeat intervention, TURP or PAE, due to its short-term nature.

Conclusions

Over the past 40 years, it has been the goal of interventional radiologists to achieve the same results as surgeons, but do so in a less invasive manner. However, as healthcare spending continues to skyrocket, there is an increasing emphasis on developing procedures, which are both less invasive and less costly. In this 'real-world' study, PAE was shown to be less expensive than TURP in terms of direct costs. In the future, a more comprehensive cost comparison could be performed that includes physician professional charges, longitudinal efficacy data, and probability simulations to determine complication-related costs.

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Compliance with Ethical Standards

Conflict of interest Sandeep Bagla, John Smirniotopoulos, Julie Orlando, and Rachel Piechowiak have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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