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ORIGINAL ARTICLE

Safety and feasibility of outpatient robot-assisted radical prostatectomy

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Abstract
Since its inception, robot-assisted radical prostatectomy (RARP) has developed into a familiar surgical modality with improved perioperative outcomes including decreased hospital stay for localized prostate cancer patients. Experience with outpatient RARP has been reported as early as 2010. In this study, we evaluate the safety and feasibility of outpatient RARP by comparing perioperative outcomes between patients undergoing outpatient RARP to patients discharged on the day following surgery. This is a single-institution retrospective cohort study. Patients with localized disease who underwent RARP without pelvic lymph node dissection from September 2017 to January 2018 were included. *T* tests and Chi-squared analysis were used to compare demographic and perioperative characteristics of patients who were discharged on the same day of surgery (outpatient RARP) to patients discharged on the day after surgery (inpatient RARP). Of the 51 patients included in the study, 26 underwent outpatient RARP while 25 underwent inpatient RARP. There was no significant difference in mean age (61.4 vs 65.8 years, $p=0.05$), BMI (27.1 vs 28.3 kg/m^2, $p=0.35$), ethnicity, tobacco use (8 vs 15%, $p=0.41$), PSA (8.7 vs 8.4 ng/dL, $p=0.77$), biopsy Gleason score distribution, prostate size (51.8 vs 57.7 cc, $p=0.26$) or preoperative hemoglobin (14.3 vs 13.4 g/dL, $p=0.06$), respectively. There was no significant difference between operative time (95.3 vs 101 min, $p=0.16$), EBL (52.8 vs 66.5 cc, $p=0.08$), postoperative change in hemoglobin (-1 vs -1.1 g/dL, $p=0.62$), pathologic stage distribution or complication rate (4 vs 8%, $p=0.58$) between patients who underwent outpatient vs inpatient RARP, respectively. Outpatient RARP offers similar or improved perioperative outcomes when compared to inpatient RARP. We advocate outpatient RARP as a safe and feasible alternative to inpatient RARP for appropriately selected prostate cancer patients. Furthermore, we introduce an outpatient model that can be applied to other institutions seeking to implement outpatient RARP.

Keywords Robotic prostatectomy · Outpatient robotic surgery · Prostate cancer · Outpatient prostatectomy · Robot-assisted radical prostatectomy · Safety of robotic surgery

Introduction

The increasing utilization of robot-assisted radical prostatectomy (RARP) for treatment of localized prostate cancer has made it both a familiar and popular surgical modality among contemporary urologists. The opportunity and maintenance cost of a robotic surgical system, rising healthcare costs and improved safety with robotic surgery have all encouraged this traditionally inpatient surgery to transition to outpatient surgery. Optimizing efficiency while reducing costs, however, must not occur at the expense of patient safety, oncologic compromise or perioperative morbidity.

Experience with outpatient RARP has been reported at other healthcare organizations. Martin and colleagues showed that extraperitoneal RARP is both safe and feasible [1]. Furthermore, other investigators used surveys to demonstrate that outpatient RARP does not negatively impact patient satisfaction [2]. Outpatient RARP has not yet been widely adopted as there are insufficient data demonstrating its safety and feasibility.

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In this study, we describe our institutional experience with outpatient RARP and present our outpatient RARP model, which we hope can be introduced to other institutions seeking to incorporate this surgical modality into their hospitals.

Methods

Patient selection

This is a single-institution retrospective cohort study. Patients who underwent RARP without pelvic lymph node dissection from September 2017 to January 2018 for localized prostate cancer were included in the study. One of three urologists was the primary surgeon during each RARP and an additional urologist was the assistant surgeon. All surgeons were board certified and had each performed over 150 RARPs in the past. Two additional urologists reviewed patient charts and separated the subjects into two categories: outpatient RARP (patients who were discharged on postoperative day 0) and inpatient RARP (patients who were discharged on postoperative day 1). All patients had an American Society of Anesthesiologists (ASA) classification of 2 or lower. All patients had localized prostate cancer determined by preoperative staging workup, were counseled on the possibility of outpatient surgery and lived within 30 miles of the hospital. Patients were excluded if there was a concomitant procedure performed (e.g. lysis of adhesions, hernia repair, pelvic lymph node dissection, bladder neck reconstruction) or if there were any intraoperative surgical or anesthetic complications.

Outpatient RARP protocol

All patients were informed and agreed to the possibility of outpatient RARP at the time of their perioperative evaluation. On the day of surgery, all patients proposed to undergo outpatient RARP were administered preoperative analgesics (15 mg meloxicam orally or 1 g acetaminophen intravenously) and anti-emetics (4 mg ondansetron orally or 4 mg dexamethasone) intravenously. Bowel prep was omitted to minimize risk of postoperative ileus. All patients arrived with a companion who was aware that the patient would be discharged on the day of surgery. During the surgical briefing, all operative staff were made aware of the same-day discharge. The anesthesia team was advised to use short-acting anesthetics and myorelaxant reversal agents to facilitate more expeditious emergence from anesthesia.

Intraoperatively, intravenous crystalloid was administered judiciously to keep the patient adequately hydrated. Any intraoperative complication excluded the patient from same-day discharge. Pelvic drains were placed selectively at the surgical team's discretion. At the end of the procedure, the incision sites were infiltrated with up to the weight-based limit of local anesthetic (a 50:50 mixture of 0.25% bupivacaine:1% lidocaine). If meloxicam was not administered preoperatively, 30 mg of intravenous ketorolac was administered at the end of the case.

Each patient was given an oral dose of 5 mg/325 mg of hydrocodone/acetaminophen or oxycodone/acetaminophen 2 h postoperatively. Standard postoperative serum hemoglobin and hematocrit were drawn in the recovery room; patients were ineligible for same-day discharge if there was a decrease of > 1.9 g/dL in postoperative serum hemoglobin. If there was a decrease in serum hemoglobin of up to 1.9 g/dL, the patient was eligible for same-day discharge only if the subsequent hemoglobin was within 0.5 g/dL of the previous value. No intravenous pain medication was administered in the recovery room. Discharge criteria included urine output of > 1 mL/kg/h for 2 h, ability to ambulate without assistance, ability to tolerate a clear liquid diet and patient desire/satisfaction with discharge on the same day of surgery. If placed intraoperatively, pelvic drains were removed prior to discharge as per the surgeon's discretion. A total of five patients were discharged with a pelvic drain. Patients who were discharged with pelvic drains had them removed within 1 week during their postoperative visits. All patients were contacted within 16 h of surgery to assess for possible early complications.

Statistical analysis

Patient charts were retrospectively reviewed and subjects were categorized into either outpatient RARP (discharged on postoperative day 0) or inpatient RARP (discharged on postoperative day 1). Clinicopathologic data (age, basal metabolic index [BMI], ASA classification, ethnicity, history of prior abdominal surgery, history of tobacco use, prevalence of diabetes, PSA, biopsy Gleason score, prostate volume and preoperative serum hemoglobin) were compared between the two groups. Intraoperative outcomes (operative time [OT], estimated blood loss [EBL], transfusion rate) and postoperative outcomes (postoperative serum hemoglobin, change in serum hemoglobin, final pathologic stage, positive margin rate and complication rate) were also compared between groups. *T* tests were used to compare numerical variables and Chi-squared tests were used to compare categorical variables.

Results

A total of 51 patients underwent RARP from September 2017 to January 2018. There were no concomitant procedures performed (lysis of adhesions, pelvic lymph node

dissection, hernia repair, bladder neck reconstruction). There were no intraoperative surgical or anesthetic complications. A total of 26 patients underwent inpatient RARP while 25 patients underwent outpatient RARP. Baseline demographic data are compared in Table 1. Mean age was 65.8 years in the inpatient group and 61.4 years in the outpatient group ($p=0.05$). Mean BMI was 28.3 kg/m^2 in the inpatient group and 27.1 kg/m^2 in the outpatient group ($p=0.35$). There was a significantly higher proportion of subjects with ASA score of II in the outpatient group compared to the inpatient group (48 vs 19%, respectively, $p=0.03$). There was no significant ethnic disparity noted (46% Caucasian in inpatient RARP vs 56% in outpatient RARP, $p=0.48$). Five patients underwent a prior abdominal operation; three were from the outpatient group while two were from the inpatient group. None of the patients required an intraoperative adhesiolysis. Six patients were smokers, four from the inpatient group and two from the outpatient group ($p=0.41$). There were seven patients with diabetes in the inpatient group and four in the outpatient group ($p=0.34$). Mean PSA was 8.4 ng/mL in the inpatient group and 8.7 ng/mL in the outpatient group ($p=0.77$). Gleason score distribution, prostate volume and preoperative hemoglobin were similar between groups.

Intraoperative and postoperative characteristics of study subjects can be found in Table 2. There was no significant difference in operative time or EBL between the study groups. No patients underwent conversion to open surgery or received blood products intraoperatively. Postoperative serum hemoglobin was significantly higher in the outpatient group compared to the inpatient group (13.2 vs 12.3 g/dL, $p=0.02$). However, there was no significant difference in change between pre- and postoperative serum hemoglobin among study groups ($p=0.62$).

Table 2 Intraoperative and postoperative characteristics of inpatient RARP vs outpatient RARP patients

Variable mean (SD)	Inpatient RARP $N=26$	Outpatient RARP $N=25$	p value
Operative time (minutes)	101.0 (13)	95.3 (14.8)	0.16
EBL (cc)	66.5 (27.4)	52.8 (28.4)	0.08
Any transfusion	0	0	N/A
PACU hemoglobin (g/dL)	12.3 (1.4)	13.2 (1.5)	0.02
Change in hemoglobin (from preoperative in g/dL)	− 1.1 (0.9)	− 1.0 (0.6)	0.62
LOS	1.0 (1)	0 (0)	< 0.001

Postoperative oncologic outcomes and complication rates are displayed in Table 3. There was no significant difference in distribution of final pathologic stage between study groups. In the inpatient RARP group, 1 patient had T2a disease, 14 patients had T2b or T2c disease, 9 patients had T3a disease and 2 patients had T3b disease. In the outpatient RARP group, 2 patients had T2a disease, 13 patients had T2b or T2c disease, 9 patients had T3a disease and 1 patient had

Table 1 Demographic data and preoperative tumor characteristics of inpatient RARP vs outpatient RARP patients

Variable mean (SD)	Inpatient RARP $N=26$	Outpatient RARP $N=25$	p value
Age	65.8 (8.2)	61.4 (7.0)	0.05
BMI (kg/m^2)	28.3 (4.3)	27.1 (4.4)	0.35
ASA classification			
I	21 (81%)	13 (52%)	0.03
II	5 (19%)	12 (48%)	
Ethnicity			
White	12 (46%)	14 (56%)	0.48
Non-white	14 (54%)	11 (44%)	
Prior abdominal operation	2 (8%)	3 (12%)	0.61
Tobacco use	4 (15%)	2 (8%)	0.41
Diabetes	7 (27%)	4 (16%)	0.34
iPSA	8.4 (4.6)	8.7 (6.3)	0.77
Biopsy Gleason score			
3 + 3	12 (46%)	15 (60%)	0.76
3 + 4	10 (38%)	7 (28%)	
4 + 3	2 (8%)	1 (4%)	
Higher	2 (8%)	2 (8%)	
TRUS sizing	57.7 (20.6)	51.8 (16.2)	0.26
Preoperative hemoglobin (g/dL)	13.4 (1.4)	14.3 (1.7)	0.06

Table 3 Oncologic outcome and complication rate of inpatient RARP vs outpatient RARP patients

Variable mean (SD)	Inpatient RARP $N=26$ (%)	Outpatient RARP $N=25$ (%)	p value
Final pathologic stage			
T2a	1 (4)	2 (8)	0.88
T2b/c	14 (54)	13 (52)	
T3a	9 (35)	9 (36)	
T3b	2 (8)	1 (4)	
Positive margin rate	8 (31)	6 (24)	0.59
Complication/readmission rate	2 (8)	1 (4)	0.58

T3b disease. There was no significant difference in distribution of pathologic stage between study groups ($p=0.88$). Positive margin rate was 31% in the inpatient RARP group and 24% in the outpatient RARP group ($p=0.59$). Three patients had complications; one patient from the inpatient RARP group had suprapubic pain on postoperative day 3 in the setting of a functioning catheter and was found to have an *E. coli* UTI. Another patient in the inpatient RARP group was seen in the emergency room on postoperative day 5 for fatigue and treated for a Staphylococcal UTI. One subject in the outpatient RARP group was seen in the emergency room on postoperative day 2 and was treated empirically for an *E. coli* UTI. All complications were Clavien–Dindo Grade II.

Discussion

Robotic surgery has become a more prevalent surgical modality and is now the most commonly utilized approach for localized prostate cancer when compared to open or laparoscopic surgery [3]. This is in part due to the improved operative outcomes that robotic prostatectomy can offer [4–6]. As healthcare systems become more comfortable with robotic surgery and medical reimbursement models continue to incentivize efficiency in surgery, there is a drive to develop safe and cost-effective surgical protocols.

We describe our institutional experience with outpatient RARP, an operation that has traditionally required overnight hospitalization. The development of an outpatient RARP model could facilitate the transition of RARP from inpatient to outpatient in the appropriately selected prostate cancer patient. This investigation is a retrospective cohort study demonstrating that outpatient RARP is safe, feasible and has non-inferior oncologic and postoperative outcomes when compared to inpatient RARP. Additionally, it describes an outpatient RARP model, a tool that can be utilized by institutions seeking to initiate outpatient RARP.

Outpatient minimally invasive radical prostatectomy has been described in the literature. Abboudi and colleagues reported their experience with extraperitoneal laparoscopic radical prostatectomy and noted minimal complications, patient satisfaction ascertained by patient surveys and favorable postoperative outcomes including continence and erectile function [7]. As part of their outpatient surgery protocol, all patients received a TAP (transversus abdominis plane) block with local anesthetic to minimize postoperative pain. In addition, all patients were contacted on the first postoperative day to address any concerns and capture complications. Martin et al. reported a favorable experience in their prospective study of 11 patients undergoing extraperitoneal RARP [1]. Postoperative patient surveys demonstrated patient safety and satisfaction with hospital process, daily care, nursing care, physician care, billing, discharge, pain control, length of stay satisfaction and overall patient satisfaction.

The first prospective cohort study showing safety and feasibility of outpatient RARP was performed in 2016 [2]. Berger and colleagues demonstrated no significant differences in demographic or perioperative outcomes, including operative time, EBL, pathologic stage, positive margin rate or complication rate. In addition, they used validated questionnaires to show family/patient satisfaction with outpatient RARP. Postoperative continence rates were not different between inpatient and outpatient RARP; mean time to continence was 32 days for outpatient RARP compared to 43 days for inpatient RARP ($p=0.09$), exhibiting favorable long-term outcomes.

This study shows that outpatient RARP is not only safe and feasible in the appropriately selected patient but offers non-inferior oncologic and postoperative outcomes. In addition, this is the first known study that introduces a standardized model that can be applied to hospitals seeking to transition to outpatient RARP. As per our model, outpatient RARP can be considered in low-risk prostate cancer patients without severe systemic disease. It is recommended that the patient be counseled prior to discharge about same-day surgery to meet the patient's expectations and encourage patient satisfaction. On the day of surgery, a multidisciplinary approach with communication between the patient/family, surgical staff, nursing staff and anesthesia team is critical to ensure a safe discharge process. Furthermore, postoperative serum hemoglobin checks and recovery room observation are recommended to identify patients who may not be suitable for discharge. The outpatient RARP protocol can be a useful tool in facilitating same-day robotic surgery at other institutions.

This study has several important limitations including its retrospective design and small sample size. The study did not investigate postoperative continence rates or erectile function, as its aim was to evaluate the safety and feasibility

of outpatient RARP with regard to early postoperative outcomes. Larger prospective studies investigating continence rates, erectile function, complication rates and tumor recurrence rates after outpatient RARP are needed to demonstrate its long-term effects compared to inpatient RARP. In our series of 26 patients, only one outpatient RARP patient had a complication. No patients had any complication that was greater than Clavien–Dindo Grade II, demonstrating its safety short term. We chose both EBL and hemoglobin change from surgery to estimate surgical blood loss. We believe that in the setting of no significant EBL difference between groups, change in hemoglobin would not be a significant difference in discharge readiness. However, since EBL is subject to variation, is defined differently according to institution and is still a crude, inaccurate and subjective measurement of surgical blood loss, we chose to include both EBL as well as change in hemoglobin with surgery as measurements of surgical blood loss. We chose to include a hemoglobin cutoff to establish a more objective, definitive and standardized measurement of surgical blood loss that could be more easily applied by practitioners in light of institutional variations in definition of EBL. A postoperative change in hemoglobin of less than 1.9 g/dL was included in the outpatient RARP protocol because a value greater than this has a high positive predictive value for surgical blood loss as evidenced by perioperative literature [8, 9].

Because the main goal of this study was to establish the safety and feasibility of outpatient RARP and introduce a novel model that could be applied to different institutions, a cost analysis was not performed. Calculating institutional cost of overnight hospital stay following RARP can be used to estimate cost savings with outpatient RARP. Lastly, we avoided the utilization of patient questionnaires as they are inherently subjective, can be unreliable and are generally not accepted as metrics for safety and feasibility; instead, we compared exclusively objective data to validate safety and introduced a novel model to demonstrate feasibility. We included only prostate cancer patients who desired to be discharged on the same day as their surgery in the outpatient RARP group. The outpatient RARP protocol was discussed in depth with the outpatient RARP patients preoperatively; any deviation from the expected postoperative outcomes prevented same-day discharge. This approach excluded patients who were dissatisfied with same-day discharge, eliminating the need for patient satisfaction surveys but leading to some selection bias.

Contemporary hospital payment models have driven the development of more cost-effective alternatives to traditional inpatient surgeries. The increasing familiarity with advanced robotic surgical systems has helped transition radical prostatectomy from an inpatient to an outpatient surgery. We demonstrate that outpatient RARP is both safe and feasible for localized prostate cancer; moreover, we introduce a model that can encourage outpatient RARP at other institutions.

Compliance with ethical standards

Conflict of interest Pooya Banapour, Peter Elliott, Ramzi Jabaji, Madhur Merchant, Apurba Pathak, Ashish Parekh and Kirk Tamaddon declare that they have no conflict of interest.

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