Feasibility and safety of same-day discharge following single-port robotic-assisted laparoscopic prostatectomy

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Abstract

Purpose The standard discharge pathway following robotic-assisted laparoscopic prostatectomy (RALP) involves overnight hospital admission. Models for same-day discharge (SDD) have been explored for multiport RALP, however, less is known regarding SDD for single-port RALP, especially in terms of patient experience.

Methods Patient enrollment, based on preoperative determination of potential SDD eligibility, commenced March 2020 and ended March 2021. Day-of-surgery criteria were utilized to determine which enrolled patients underwent SDD. Differences in preoperative characteristics and perioperative outcomes between patients undergoing SDD and patients undergoing standard discharge were evaluated. A prospectively administered questionnaire was designed to characterize patient-centered factors informing SDD perception.

Results Fifteen patients underwent SDD and 36 underwent standard discharge. Overall mean ± SD age and BMI were 63.6 ± 7.0 years and 29.7 ± 4.4 kg/m², respectively. Mean operative time was shorter in the SDD cohort than the standard discharge cohort (188 min vs 217 min, \( p = 0.011 \)). A higher proportion of cases that underwent SDD were performed using the Retzius-sparing approach, 80% (12/15) vs 33% (12/36) in the standard discharge cohort (\( p = 0.005 \)). Rates of 90 day complication (\( p = 0.343 \)), 90 day readmission (\( p = 0.144 \)), and 90 day emergency department visits (\( p = 0.343 \)) rates were all not significantly different between cohorts. Of questionnaire respondents undergoing standard discharge, 32% (8/25) cited pain as a reason for not undergoing SDD.

Conclusions With comparable outcomes to the standard discharge pathway, SDD is safe and effective in single-port RALP. Post-operative pain and perceptions of distance are implicated as patient-centered barriers to SDD; proactive pain management and patient education strategies may facilitate SDD.

Keywords Prostatectomy · Patient discharge · Outcomes research

Abbreviations

Abbreviation | Description |
--- | --- |
RARP | Robot-assisted radical prostatectomy |
SDD | Same day discharge |
SP | Single-port |
MP | MultiPort |
EP | Extraperitoneal |

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RS  Retzius sparing
TP  Transperitoneal
LND  Lymph node dissection
BMI  Body mass index
ASA™  American society of anesthesiologists™

Background

In 2018, the da Vinci® Single Port (SP) platform (Intuitive Surgical, Sunnyvale, CA) was approved by the United States Food and Drug Administration for usage in urologic surgery. SP robotic-assisted laparoscopic prostatectomy (RALP) minimizes invasiveness while maintaining efficacy in terms of oncologic outcomes, as compared to the conventional multiport (MP) system [1, 2]. Additionally, it has been demonstrated that SP-RALP is associated with higher rates of same-day discharge (SDD) than MP-RALP [3].

Same-day discharge (SDD) protocols reduce healthcare costs without compromising perioperative outcomes in several surgical disciplines [4, 5]. Recently, SDD became an important consideration due to the risk of iatrogenic COVID-19 exposure and conservation of strained hospital resources [6].

SDD protocols for MP-RALP have been shown to be safe and effective [7, 8]. Wilson et al. previously validated the feasibility of an outpatient protocol for extraperitoneal (EP) SP-RALP [9]. Another retrospective study conducted at the same institution concluded that increased OR time and post-operative narcotic administration were factors significantly associated with increased likelihood of inpatient care following EP SP-RALP [10].

The Retzius-sparing (RS) [11] and transperitoneal (TP) approaches have not been evaluated fully in terms of SDD following SP-RALP. This study represents our experiences with a prospective implementation of our institution’s SDD protocol designed for all three approaches to SP-RALP: RS, EP, and TP. Additionally, we characterize patient reported outcomes and perceptions regarding SDD in a prospectively administered questionnaire.

Methods

Patient population

With Institutional Review Board approval, we began accruing data on the feasibility of our planned SDD program for SP-RALP in January 2020. Beginning March 2020, SDD was offered to eligible patients undergoing SP-RALP at our institution. The last patient in our cohort was enrolled in December 2020. Surgeons utilized three approaches to SP-RALP – RS, EP, and TP. Eligibility was determined during the preoperative clinic visit by the treating surgeon and criteria employed are defined below. A total of 51 patients were enrolled, of which 15 patients underwent SDD and 36 patients underwent standard discharge (defined as a length of stay > 1 night).

Surgical technique

SP-RALP was performed using the da Vinci® SP platform. The collinear single-entry apparatus enables RALP to be performed through a single 2.5 cm cannula. All surgeries utilized the Hasson technique to place the periumbilical SP trocar. Our institution’s approach to TP and RS SP-RALP have been previously described [12–14]. EP SP-RALP is performed with the same general steps as the TP approach, except the seminal vesicles and vas deferens were dissected anteriorly. Approach was determined by surgeon discretion and based on clinical factors including body habitus, prior abdominal/pelvic surgery, and patient tolerance of Trendelenberg positioning. There were 2 treating surgeons, both of whom are fellowship-trained and had been performing SP RALP for 1 year prior to enrolling patients in the study.

Standard pelvic lymph node dissection (LND) was performed in 46/51 cases. The decision to perform LND was not informed by SDD.

Enrollment

Consecutive patients were enrolled in our study from March 2020 to March 2021 based on the following characteristics which informed treating surgeons’ preoperative determination of potential SDD: patient interest in potential SDD, available transportation for day of surgery, and available caretaker for the initial 24-h post-operative period. In the post-operative setting, the following criteria were used to determine actual SDD: patient ability to tolerate food and liquid without nausea, patient ability to ambulate with oral pain medications, and patient amenability to SDD.

Same day discharge protocol

Our SDD protocol was approved by our department leadership and our Patient Safety & Quality Improvement coordinators. SDD was offered to first- and second-start surgeons. All patients received subcutaneous local anesthetic and were instructed to utilize over-the-counter medications for first-line pain control. Patients endorsing severe pain were
prescribed either hydrocodone or oxycodone and were instructed to utilize these medications only in cases of severe pain. Patients had a Foley catheter in place for 5–10 days after surgery. Post-operative office visits occurred at the time of catheter removal, 4–6 weeks post-operatively, and then 12 weeks post-operatively. The post-operative discharge pathway was identical for all patients.

Questionnaire

Following discharge, all patients in our series were administered a 3-question survey instrument regarding outcomes and opinions on SDD. Responses were collected over the phone and data was stored in a secured REDCap version 9 database (Vanderbilt University, Nashville, TN) [15]. Responses were collected an average of 18 days after surgery. Questions addressed reasons why the patient did not undergo SDD and patient perception of SDD in hindsight.

Outcomes

Preoperative patient and tumor characteristics, intraoperative characteristics, perioperative outcomes, recovery metrics, and questionnaire responses were recorded. Preoperative information included patient age, body-mass index (BMI), straight-line distance between patient’s home United States Postal Service zone improvement plan (ZIP) code and our institution’s ZIP Code, American Society of Anesthesiologists™ (ASA™) classification, prior abdominal/pelvic surgery, initial prostate-specific antigen (PSA) level, and biopsy Gleason grade group.

Intraoperative and post-operative variables included first-start surgery, operative time, estimated blood-loss, and Clavien-Dindo complication ≥ 2 within 90 Days [16]. Readmission and emergency department visits within a 90-day post-operative time period were assessed. Administration of narcotic pain medication and post-operative morphine milligram equivalents (MME)—calculated from documented post-anesthesia care unit and inpatient floor usage—were recorded for all cases.

Lymph node yield, prostate size, and pathologic Gleason grade group were recorded for all patients. Questionnaire responses were characterized into themes. Reasons why SDD eligible patients elected to undergo standard discharge included pain, distance from our institution, fatigue, second-start surgery, and medical contraindication (e.g., need for post-op inpatient dialysis).

Statistical analysis

For univariable analysis, Fisher’s exact test was used for categorical variables and Wilcoxon rank-sum test was used for continuous variables to evaluate differences in preoperative characteristics and perioperative outcomes between patients undergoing SDD and patients undergoing standard discharge. Statistical significance was defined as a two-tailed p value of <0.05. All analyses were performed using R version 3.5.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of 51 patients enrolled in our study as SDD eligible, 15 patients actually underwent SDD. All evaluated preoperative patient characteristics are described in Table 1; none were significantly different between the SDD and standard discharge cohorts. There were no intraoperative complications, aborted procedures, or procedural conversions. Patients who underwent standard discharge had a length of stay of either 1 or 2 days. Overall mean ± SD age and BMI were 63.6 ± 7.0 years and 29.7 ± 4.4 kg/m², respectively. Overall median (IQR) straight line distance between patients’ home ZIP code and our institution’s ZIP code was 30.0 (9.1–96.4) miles and was not significantly different between cohorts (p = 0.444). No differences were observed between cohorts in terms of biopsy Gleason grade group (p = 0.775). Overall median (IQR) prostate size was 39.2 (32.5–54.5) grams, and prostate size was not significantly different between cohorts (p = 0.134).

Perioperative outcomes are described in Table 2. Operative time and utilization of both TP and RS approaches were all significantly different between the SDD and standard discharge cohorts. Mean operative time was shorter in the SDD cohort than the standard discharge cohort (188 vs 217 min, p = 0.011). A higher proportion of cases that underwent SDD were performed using the RS approach—80% (12/15) vs 33% (12/36), respectively (p = 0.005), and a higher proportion of cases that underwent standard discharge were performed using the TP approach—56% (20/36) vs 20% (3/15), respectively (p = 0.030).

Lymph node dissection was performed in 90% (46/51) cases and performance rates were not significantly different between cohorts (p = 0.624). Overall mean ± SD lymph node yield was 4.3 ± 3.2 lymph nodes and was not significantly different between cohorts (p = 0.283). Nodal invasion was observed in 1 case.

In the SDD cohort, 20% (3/15) patients were readmitted within 90 days. In the standard discharge cohort, 6% (2/36) patients were readmitted. Readmission rates were not statistically significant between cohorts (p = 0.144). In terms of emergency department visits within 90 days, rates were 20% (3/15) and 8% (3/36) for the SDD and standard discharge cohorts respectively and did not differ significantly (p = 0.343). 3 emergency department visits resulted in readmission. Clavien-Dindo complication ≥ 2 within 90 days
occurred in 20% (3/15) SDD cases and 8% (3/36) standard discharge cases; these rates were not significantly different between groups ($p = 0.343$). Further details are provided in the discussion section.

All patients were offered our prospectively administered questionnaire to assess regret in the SDD cohort and reasons why patients elected against SDD if they underwent standard discharge. Questionnaire responses are presented in Table 2.

### Discussion

We present our implementation of a SDD protocol for patients that underwent SP-RALP at our institution. SDD was prospectively offered to our cohort of 51 SP-RALP patients, who were deemed eligible by treating surgeons during their preoperative visits. We demonstrate that SDD is non-inferior to standard discharge in terms of post-operative pain control, 90-day readmission, and complication rates. Differences between patients undergoing SDD and patients undergoing standard discharge pertain to procedural approach, first-start surgery, and mean operative time. Patients who undergo SDD infrequently experience regret, and patient centered factors preventing SDD in eligible patients include pain and distance.

In terms of preoperative characteristics including age, BMI, history of prior pelvic or abdominal surgery, ASA™ score, and biopsy Gleason grade group, the SDD and standard discharge cohorts were not significantly different. Observed similarity between cohorts is likely a result of our prospective patient selection.

Ninety-day complication, readmission, and emergency department visit rates were all not significantly different between cohorts. This indicates SDD for SP-RALP is safe and feasible. The most prevalent reason for readmission was symptomatic lymphocele, occurring in four (out of five) readmissions; the fifth readmission was caused by bladder spasms. More symptomatic lymphoceles occurred in the SDD group (3/15 cases) versus the standard discharge group (1/36 cases). However, all lymphoceles occurred on post-operative day 10 or later, which suggests that standard discharge (rather than SDD) would not have impacted these readmissions.

Our group previously described an association between RS approach and symptomatic lymphocele development [13, 14]. Of 3 total 90-day readmissions in the SDD cohort, 2 were caused by lymphoceles following a RS SP-RALP; correlation of RS approach with SDD is likely responsible for the higher, although not significantly different, readmission rate observed in the SDD cohort. We revised our approach to LND during RS SP-RALP to include peritoneal tacking [13, 14]. However, this study preceded our implementation of peritoneal tacking.

Both post-operative MME and the post-operative narcotic administration were not significantly different between cohorts. Neither cohort was part of an enhanced recovery after surgery (ERAS) protocol, and neither cohort received pain blocks at the conclusion of surgery. Aminsharifi et al. observed that post-operative MME was a factor associated with standard discharge and found that the mean MME in their standard discharge cohort was greater than that of

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**Table 1 Preoperative patient characteristics**

| Preoperative characteristics | Total ($n=51$) | Standard discharge ($n=36$) | SDD ($n=15$) | $p$  |
|-----------------------------|---------------|----------------------------|-------------|-----|
| Age in years, mean(SD)      | 63.6 (7.0)    | 64.1 (7.6)                 | 62.3 (5.0)  | 0.325|
| BMI in kg/m$^2$, mean(SD)   | 29.7 (4.4)    | 30.1 (4.6)                 | 28.5 (4.0)  | 0.352|
| Distance to our institution in miles, median(IQR) | 30.0 (9.1–96.4) | 33.8 (15.1–97.6) | 19.1 (4.1–84.5) | 0.444|
| Initial PSA in ng/mL, mean(SD) | 7.6 (4.9)    | 7.5 (4.6)                  | 7.7 (6.1)   | 0.77 |
| Missing, n (%)              | 4 (7.8%)      | 1                          | 3           |     |
| History of prior pelvic or abdominal surgery, n (%) | 9 (17.6%)    | 7 (19.4%)                  | 2 (13.3%)   | 0.709|
| Biopsy gleason grade group, n (%) |            |                           |             |     |
| 1 or 2                      | 30 (58.8%)    | 22 (61.1%)                 | 8 (57.1%)   | 0.775|
| 3                           | 10 (19.6%)    | 6 (16.7%)                  | 4 (28.6%)   |     |
| 4                           | 5 (9.8%)      | 4 (11.1%)                  | 1 (7.1%)    |     |
| 5                           | 5 (9.8%)      | 4 (11.1%)                  | 1 (7.1%)    |     |
| Missing, n (%)              | 1 (2.0%)      | –                          | 1 (7.1%)    |     |
| ASA™ score, n (%)           |               |                            |             |     |
| 2                           | 32 (62.7%)    | 21 (58.3%)                 | 11 (73.3%)  | 0.360|
| 3 or 4                      | 19 (37.3%)    | 15 (41.7%)                 | 4 (26.7%)   |     |

$BMI$ body mass index, $PSA$ prostate specific antigen, $ASA™$ American society of anesthesiologists™
We observed that differences in mean MME were approaching significance, with the SDD cohort being lower than that of the standard discharge cohort (1.1 vs 5.5; \( p = 0.095 \)). In any case, it is likely that variation in institutional policies regarding post-operative pain management and narcotic administration informs differences in post-operative MME. Further multi-institutional research is necessary to contextualize our results.

Consistent with previous literature examining MP-RALP, first-start surgery is significantly associated with SDD while their SDD cohort [10]. We observed that differences in mean MME were approaching significance, with the SDD cohort being lower than that of the standard discharge cohort (1.1 vs 5.5; \( p = 0.095 \)). In any case, it is likely that variation in institutional policies regarding post-operative pain management and narcotic administration informs differences in post-operative MME. Further multi-institutional research is necessary to contextualize our results.

Consistent with previous literature examining MP-RALP, first-start surgery is significantly associated with SDD while

Table 2  Perioperative outcomes and questionnaire results

| Perioperative outcomes                                      | Total  | Standard discharge | SDD   | \( p \) |
|------------------------------------------------------------|--------|--------------------|-------|--------|
| Operative time in minutes, mean(SD)                        | 208.5 (37.0) | 216.9(36.0) | 188.2(31.8) | \textbf{0.011} |
| First start surgery, n (%)                                 | 31 (60.8%) | 16(44.4%)  | 15(100%)   | \textbf{< 0.001} |
| Retzius-sparing, n (%)                                     | 24 (47.1%) | 12(33.3%)  | 12(80.0%)  | \textbf{0.005}  |
| Transperitoneal, n (%)                                      | 23 (45.1%) | 20(55.6%)  | 3(20.0%)   | \textbf{0.030}  |
| Extraperitoneal, n (%)                                     | 4 (7.8%)   | 4(11.1%)   | –         | 0.307             |
| EBL in mL, mean(SD)                                        | 125.6 (69.5) | 138.3(77.3) | 95.0(30.2) | 0.073             |
| Post-operative MME, mean(SD)                               | 4.2 (8.3)  | 5.5(9.4)   | 1.1(2.8)   | 0.095             |
| Prescribed narcotic on inpatient floor, n (%)              | 15 (29.4%) | 13(36.1%)  | 2(13.3%)   | 0.177             |
| Pathological gleason grade group, n (%)                    |         |           |         |        |
| 1 or 2                                                     | 29 (56.9%) | 20(55.6%)  | 9(60.0%)   | \textbf{0.048}  |
| 3                                                          | 13 (25.5%) | 12(33.3%)  | 1(6.7%)    |                   |
| 4                                                          | 4 (7.8%)   | 1(2.8%)    | 3(20.0%)   |                   |
| 5                                                          | 5 (9.8%)   | 3(8.3%)    | 2(13.3%)   |                   |
| Pathological T-stage, n (%)                                |         |           |         |        |
| T2                                                         | 35 (68.6%) | 24(66.7%)  | 11(73.3%)  | 0.205             |
| T3a                                                        | 10 (19.6%) | 6(16.7%)   | 4(26.7%)   |                   |
| T3b                                                        | 6 (11.8%)  | 6(16.7%)   | –         |                   |
| Received LND, n (%)                                        | 46 (90.2%) | 33(91.7%)  | 13(86.7%)  | 0.624             |
| Lymph node yield in subset of patients receiving LND, mean(SD) | 4.3 (3.2) | 4.6(3.3)   | 3.4(2.7)   | 0.283             |
| Prostate size in grams, median(IQR)                        | 39.2 (32.5–54.5) | 41.2(34.1–57.7) | 36.2(30.0–42.1) | 0.134             |
| 90 day readmission, n (%)                                  | 5 (9.8%)   | 2(5.6%)    | 3(20.0%)   | 0.144             |
| 90 day Clavien-Dindo grade II or greater complication, n (%) | 6 (11.8%)  | 3(8.3%)    | 3(20.0%)   | 0.343             |
| 90 day emergency department visit, n (%)                   | 6 (11.8%)  | 3(8.3%)    | 3(20.0%)   | 0.343             |

Questionnaire results

| Reasons for electing to undergo standard discharge despite SDD eligibility | n (%) |
|--------------------------------------------------------------------------|------|
| Pain                                                                     | 8 (32%)|
| Distance                                                                 | 7 (28%)|
| Fatigue                                                                  | 4 (16%)|
| Second-start surgery                                                     | 4 (16%)|
| Medical contraindication                                                 | 2 (8%) |
| Total                                                                    | 25 (100%)|

| Patient perception of SDD in hindsight                                | n (%) |
|------------------------------------------------------------------------|------|
| SDD was the right choice                                               | 14 (93%)|
| I regret undergoing SDD                                                | 1 (7%)  |
| Total                                                                   | 15 (100%)|

| Reasons for SDD regret                                                | n (%) |
|-----------------------------------------------------------------------|------|
| Pain                                                                   | 1 (100%)|
| Total                                                                  | 1 (100%)|

Bold values indicate the statistically significant, defined as a two-tailed \( p \)-value of < 0.05

EBL estimated blood loss, MME morphine milligram equivalents, LND lymph node dissection
distance to institution is not [8]. To offer SDD to the most patients possible, it may be prudent to schedule SDD eligible patients for first-start surgeries, and SDD ineligible patients for second-start surgeries.

Significant differences between the SDD and standard discharge cohorts include proportion receiving a RS SP-RALP and mean case time. Almost all patients who underwent SDD received a RS SP-RALP (12/15 RS, 3/15 TP). Mean operative time for the SDD cohort was approximately 30 min less than that of the standard discharge cohort (188 min vs 217 min, \( p = 0.011 \)). Performance of LND and lymph node yields were not significantly different between the 2 cohorts. Additionally, the proportion of patients endorsing prior pelvic or abdominal surgery was not significantly different between groups and no differences were observed in pathologic T-staging. While median prostate size did not differ significantly between cohorts, patients undergoing standard discharge had a larger median prostate size than patients undergoing SDD (41.2 g vs 36.2 g, \( p = 0.134 \)). We contend that preferential selection of patients with smaller prostates to undergo a RS approach—utilized in 12/15 SDD cases—is the likely driver behind the decreased operative time observed in the SDD cohort.

While mean BMI was not significantly different between cohorts, patients in the SDD cohort had a lower mean BMI than patients in the standard discharge cohort (28.5 kg/m² vs 30.1 kg/m², respectively). Preferential selection of patients with lower BMI for undergoing RS SP-RALP may explain this difference.

Through our questionnaire, we aimed to evaluate patient-centered reasons for not electing to undergo SDD despite preoperative ascertainment of SDD eligibility. Pain was the most prevalent reason provided. Increased post-operative MME has been identified as a factor associated with standard discharge following EP SP-RALP [10]. We contend that pain experienced by patients is a barrier to SDD. Potential non-opioid pain mitigation interventions such as a transversus abdominis plane block may also be considered to facilitate SDD [17]. Additional research is necessary to understand the impact of SDD and ERAS on patient perceptions of postoperative pain in SP-RALP.

Distance was the second most prevalent reason provided by patients for not electing to undergo SDD. Notably, patients reporting distance as a reason for not undergoing SDD did not complain of any pain. Yet, distance between our institution and patients home ZIP codes did not differ between cohorts. This indicates that robust patient education resources are necessary to facilitate SDD.

In terms of patient satisfaction with SDD, we found that 14/15 patients who underwent SDD expressed that it was the right choice. The one patient who regretted SDD cited pain due to a twisted catheter as the cause of regret. While not readmitted, this patient presented to an emergency department on the day of surgery. The patient did not experience any further complications.

**Limitations**

As all SP-RALP cases were performed at a single institution, our study is limited in its generalizability. In our study, SDD was only offered to selected patients as opposed to pre-defined patients. However, patient enrollment did not account for day-of-surgery factors informing SDD, nor did it account for operative factors that may have precluded patients from undergoing SDD altogether. While our study was prospective in nature, randomization was not performed which limits generalizability of our results. In terms of our questionnaire, recall bias may affect our results.

**Conclusions**

Based on our experience with prospective implementation of a SP-RALP SDD protocol, we find that SDD is feasible and not dissimilar to standard discharge in terms of pain control, readmission, and complication rates. SDD presents a unique and timely opportunity to decrease both cost to patient and utilization of strained healthcare resources in eligible patients.

**Author contributions**

SB: Project development, data collection, manuscript writing. CR: Project development, data collection, manuscript editing. AS: Project development, manuscript writing, data collection. JMV: Project development, data analysis. JS: Project development, data collection. JP: Project development, data collection. RSF: Project development, manuscript editing. EHK: Project development, manuscript writing, manuscript editing.

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**Data availability**

The data that support the findings of this study are not openly available due to them containing information that could compromise research participant privacy, and are available from the corresponding author, S.B., upon reasonable request.

**Declarations**

**Conflict of interest**

No conflicts of interest, competing conflicts, or personal financial interests are present for any author.

**Ethical approval**

This study was approved by the Institutional Review Board at the Washington University School of Medicine. Informed consent was obtained from all study participants. All methods were carried out in accordance with the guidelines and regulations set by the Washington University School of Medicine.
Consent for publication  All authors have provided consent for publication.

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