The Transition Toward Opioid-sparing Outpatient Radical Prostatectomy: A Single Institution Experience With Three Contemporary Robotic Approaches

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OBJECTIVE To evaluate for differences in the perioperative and early postoperative outcomes between three different contemporary approaches of robotic radical prostatectomy (RARP), namely Single-Port (SP) Transvesical (TV), SP Extraperitoneal (EP), and Multi-Port (MP) Transperitoneal (TP).

METHODS Retrospective review was performed on 865 consecutive patients with localized prostate cancer who underwent SP-TV, SP-EP, and MP-TP RARP. SP-TV and SP-EP RARP were performed using the purpose-built SP robotic platform. All procedures were performed by a single, experienced robotic surgeon. Demographics, perioperative, and early postoperative data were collected from the prospectively-maintained database. Statistical analysis was performed with descriptive statistics as presented.

RESULTS All SP cases were completed without any need for conversion or additional ports. When compared with MP-TP RARP, both SP-EP and SP-TV RARP were associated with significantly reduced length of stay (median, SP-TV 5.07 vs SP-EP 5.1 vs MP-TP 26.6 hours, $P = < .05$) and with most patients being discharged within 24 hours (SP-TV 92.3% vs SP-EP 84.6% vs MP-TP 30.4%, $P = < .05$). Postoperative analgesia requirements were significantly reduced following SP-TV RARP with 95% did not require opioid analgesia after discharge, as opposed to 77.6% and 12.1% of patients in the SP-EP and MP-TP RARP cohorts, respectively ($P = < .05$). Additionally, SP-TV RARP demonstrated the added benefit of a shorter Foley catheter duration of 4 days with an earlier return of urinary continence.

CONCLUSION The localization of RARP, as facilitated by the SP robotic platform, provided the opportunity for enhanced postoperative recovery resulting in decreased length of admission and postoperative pain, which allowed for increasing adoption of opioid-sparing outpatient prostatectomy. UROLOGY 180: 140–150, 2023. © 2023 Elsevier Inc. All rights reserved.

In recent years, robot-assisted radical prostatectomy (RARP) has been considered a mainstay in the management of localized clinically-significant prostate cancer. Varying surgical access for the procedure has now been introduced, including Transperitoneal (TP), Extraperitoneal (EP), transperineal, and Transvesical (TV). The advent of the TV approach can be credited to the development of a purpose-built Single-Port (SP) surgical platform, which provided the opportunity to reduce the invasiveness of radical prostatectomy (RP) by localizing the procedure within the confines of the bladder wall with minimal interference on the surrounding anatomy.[1,2]

The regionalization of RARP with the SP-TV RARP provided the opportunity for RP to be performed on patients in whom a traditional approach may be complicated, such as those with morbid obesity, previous abdominal surgery, and in patients that may benefit more from regional anesthesia.[3,4] The latter can be facilitated as the technique no longer required the steep Trendelenburg position that was necessary for most other minimally invasive RP.[4] Furthermore, SP-TV RARP also allowed clinicians to consider

Abbreviations: RP, Radical prostatectomy; RARP, Robot-assisted radical prostatectomy; SP, Single-port; MP, Multi-port; TV, Transvesical; EP, Extraperitoneal; TP, Transperitoneal; BMI, Body mass index; CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiologist; PSA, Prostate specific antigen; NCCN, National Comprehensive Cancer Network; LND, Lymph node dissection; EBL, Estimated blood loss; LOS, Length of stay; IQR, Interquartile range; PSM, Positive surgical margin

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other focal surgical management options for localized prostate cancer in selected patients, such as partial prostatectomy, as recently introduced in our institution.[5]

With the expanded role of RARP and with newer techniques still maintaining comparable oncological outcomes, current focus can be geared toward refining early postoperative recovery and functional outcomes. Hence, the primary objective of this present study was to evaluate for any changes in the perioperative and early postoperative outcomes with the continuing technical evolution from Multi-Port (MP) TP RARP to the SP-EP and SP-TV RARP.

MATERIALS AND METHODS

A retrospective review was performed on all patients who underwent RARP between January 2015 and March 2023. All consecutive patients with localized prostate cancer treated with SP-TV and SP-EP were included in our analysis and compared with patients managed with MP-TP RARP. All procedures were completed by a single experienced robotic surgeon (J.K.) using the DaVinci robotic surgical system (Intuitive Surgical Inc, Sunnyvale, CA) with techniques as described previously.[1,2,6,7] Data were collected from the prospectively maintained, Institutional Review Board (IRB)-approved database.

In both SP-EP and TV approaches, patients were positioned in a supine position. All of the double-articulating instruments, camera, and the Remotely Operated Suction Irrigation system (Vascular Technology Inc [VTI], Nashua, NH), were passed through a multichannel cannula of the purpose-built SP Access Port (Intuitive Surgical Inc) through a single incision. In contrast, patients who underwent MP-TP RARP were positioned in a steep Trendelenburg position with five separate surgical ports. The use of a surgical drain was based on the surgeon's preference and/or intraoperative factors.

The surgical technique for SP-TV RARP was initially described by Kaouk et al, which involved direct percutaneous access into the bladder via a midline suprapubic incision (Fig. 1).

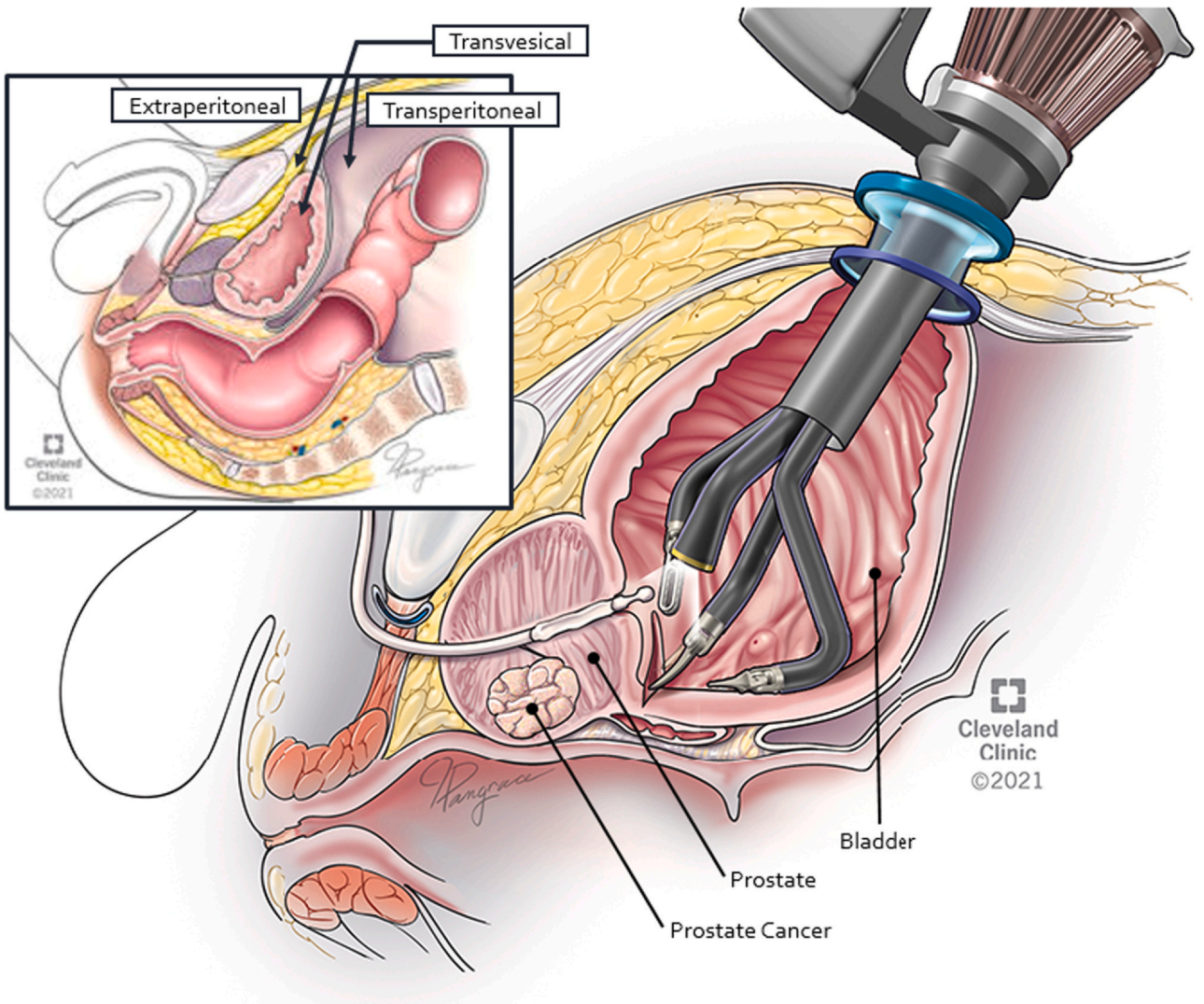

Figure 1. Three different approaches of robotic radical prostatectomy (RARP) included in this present study, namely Multi-Port Transperitoneal, Single-Port (SP) Extraperitoneal, and SP Transvesical (TV) RARP. A detailed intraoperative approach for SP-TV RARP was displayed in-large. (Color version available online.)

Following robot docking and subsequent entry, dissections were commenced posteriorly down to the vas deferens and seminal vesicles. After the posterior plane was established, dissections were progressed laterally to ligate the vascular pedicles and the dorsal venous complex. After apical dissection and transection of the urethra, the prostatectomy specimen was removed from the bladder into the chamber of the SP Access Kit without undocking the robot. Vesicourethral anastomosis was then completed entirely from within the bladder using two unidirectional barbed sutures that run continuously in a clockwise and anticlockwise directions from the posterior aspect of the bladder neck.[1,2]

Demographic and baseline clinical variables analyzed included age, race, body mass index, Charlson Comorbidity Index (CCI), American Society of Anesthesiologists (ASA) score, prostate volume, preoperative Prostate Specific Antigen (PSA) level, prostate biopsy results, as well as prostate cancer risk stratification in accordance to the National Comprehensive Cancer Network (NCCN).[8] Decision to proceed with lymph node dissection was based on the Briganti nomogram.[9] Intraoperative variables included the three aforementioned surgical approaches, operative time, estimated blood loss, and evidence of any intraoperative complication, including but not limited to additional port, conversion, or other complications. Histopathology data were collected from in-house pathology reports and presented based on the Gleason Grades and TNM staging by the American Joint Committee on Cancer (AJCC).[10]

With regards to postoperative care, length of inpatient stay (LOS), inpatient analgesia requirement and those prescribed on discharge, Foley catheter duration, as well as 90-day postoperative complication and readmission rates were evaluated. Postoperative complications were categorized using the Clavien-Dindo classification system with major and minor complications defined as those of grades ≥3 and ≤2, respectively.[11] At our institution, patients were classified into different encounter types, namely outpatient (in patients with LOS < 8 hours), extended recovery (most commonly involving overnight admission but with a total LOS ≤ 24 hours), as well as overnight or multi-night inpatient admissions. Given the variability, we have introduced a separate variable evaluating patients with less than 24 hours of admission following the completion of the three surgical approaches.

Statistical analysis was performed using IBM SPSS version 29.0. Categorical variables were presented as absolute and relative percent frequencies, while continuous variables were presented as the median and interquartile range (IQR). Chi-square and *t* test were used to analyze categorical and continuous variables, respectively, with a *P*-value of < .05 considered statistically significant.

RESULTS

A total of 865 patients were included in our analysis, which consisted of 190, 255, and 420 patients managed with SP-TV, SP-EP, and MP-TP RARP, respectively. A comparison of baseline demographic and clinical variables was presented in Table 1. Of note, patients who underwent SP-TV RARP were found to have a significantly smaller prostate volume on preoperative evaluation (median, SP-TV 35 vs SP-EP 41.3 vs MP-TP 40 mL, $P = < .05$). Despite CCI scores being comparable across the three groups ($P = .667$), history of previous abdominal surgery was more common in the SP-TV cohort (SP-TV 51.6% vs SP-EP 33.3 vs MP-TP 31%, $P = < .05$).

With regards to intraoperative parameters, both SP-EP and SP-TV groups were found to have significantly less intraoperative blood loss (median, SP-TV 72.5 vs SP-EP 150 vs MP-TP 200 mL, $P = < .05$) and were less likely to have any surgical drain tube inserted (SP-TV 0.5% vs SP-EP 0.8% vs MP-TP 96.4%, $P = < .05$). No extra ports nor conversion were required for the two approaches, as opposed to the 11 patients who had additional ports in the MP-TP cohort. The rates of nerve-sparing procedures were comparable between the three approaches ($P = .086$), unlike lymph node dissection which was significantly less common in SP-TV RARP (SP-TV 28.9% vs SP-EP 96.9% vs MP-TP 90.7%, $P = < .05$). Nevertheless, the total operating time was still comparatively faster for MP-TP RARP (median, SP-TV 197 vs SP-EP 193 vs MP-TP 178 minutes, $P = < .05$).

LOS was significantly shorter following the two SP approaches (median, SP-TV 5.07 vs SP-EP 5.1 vs MP-TP 26.6 hours, $P = < .05$). These corresponded to 92.3%, 84.6%, and 30.5% of the patients who underwent SP-TV, SP-EP, and MP-TP RARP being discharged within 24 hours, respectively ($P = < .05$). When evaluated based on the encounter types, SP-TV RARP was noted to have the highest proportion of outpatient encounters (SP-TV 78.6% vs SP-EP 69.3% vs MP-TP 2.1%, $P = < .05$). For the purpose of our analysis, 22 SP-TV RARP patients with planned inpatient admissions were excluded. Based on the remaining patients, we identified 34 patients who were admitted overnight despite the initial plan for outpatient procedure. The reasons for such change included patient preference and social reasons ($n = 15$), pain management ($n = 5$), overnight monitoring for postoperative oliguria ($n = 3$), hematuria ($n = 3$), bladder spasm ($n = 2$), underlying von Willebrand's disease ($n = 1$), monitoring for new-onset dizziness ($n = 1$), cardiac-related issue including tachycardia and atrial fibrillation ($n = 3$), and intraoperative complication ($n = 1$). The latter was only identified in one patient throughout the whole series. The case was a small enterotomy on a 69-year-old patient during SP-TV RARP, which necessitated suture repair with the assistance of the General Surgery team. The patient was noted to have multiple previous abdominal surgeries, including total colectomy with ileostomy for ulcerative colitis, as well as cholecystectomy. He had an uneventful recovery and was discharged on postoperative day 3 without any clinical sequelae.

As reported in Table 1, inpatient analgesia and opioid requirements were significantly reduced following SP-TV (Analgesia-free during admission, SP-TV 34.7% vs SP-EP 30.2% vs MP-TP 2.1% $P = < .05$; Opioid-free during admission, SP-TV 58.4% vs SP-EP 54.5% vs MP-TP 13.6%, $P = < .05$). A similar trend was observed for analgesia prescribed on discharge, especially with a significant proportion of patients who had SP-TV RARP were not discharged on any opioids (SP-TV 94.7% vs SP-EP 77.6% vs MP-TP 12.1%, $P = < .05$). Despite these differences, the pain scores on discharge were similar between the three groups ($P = .359$).

The rate of 90-day postoperative complication was relatively low and did not differ significantly following SP-TV, SP-EP, and MP-TP RARP (SP-TV 13.7% vs SP-EP 16.1% vs MP-TP 12.9%, $P = .420$). Major complications were only identified in 1.1%, 6.7%, and 2.9% of the total patients in the three groups, respectively. Similarly, readmission rate was not significantly different between the groups (SP-TV 3.7% vs SP-EP 7.5% vs

Table 1. Baseline, perioperative and early postoperative characteristics of patients who underwent Single-Port (SP) Transvesical (TV) Robot-Assisted Radical Prostatectomy (RARP), SP Extraperitoneal (EP) RARP, and Multi-Port (MP) Transperitoneal (TP) RARP.

	SP Transvesical (SP TV)	SP Extraperitoneal (SP EP)	MP Transperitoneal (MP TP)	*P*-Value
n	190	255	420	
Baseline variables				
Age (y), median (IQR)	63.1 (58.3-68.2)	64 (59.8-68.6)	63 (57.7-67.9)	< .05 SP TV vs SP EP: .708 SP TV vs MP TP: .240 SP EP vs MP TP: < .05
Race, *n* (%)				.278
African American	11 (5.8%)	224 (87.8%)	40 (9.5%)	
Asian	3 (1.6%)	18 (7.1%)	5 (1.2%)	
Caucasian	172 (90.5%)	1 (0.4%)	355 (84.5%)	
Hispanic	1 (0.5%)	0 (0%)	3 (0.7%)	
Others	3 (1.6%)	12 (4.7%)	17 (4%)	
BMI (kg/m^2), median (IQR)	28.5 (25.7-31.3)	28.4 (26-31.2)	28.8 (26.2-32.6)	.062
ASA, *n* (%)				.139
ASA 1	0 (0%)	3 (1.2%)	0 (0%)	
ASA 2	58 (30.5%)	80 (31.4%)	95 (25.2%)	
ASA 3	128 (67.4%)	164 (64.3%)	274 (72.7%)	
ASA 4	3 (1.6%)	8 (3.1%)	8 (2.1%)	
CCI, median (IQR)	4 (3-5)	4 (3-5)	4 (3-5)	.667
Previous abdominal surgery, *n* (%)	98 (51.6%)	85 (33.3%)	130 (31%)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .801
Prostate volume (mL), median (IQR)	35 (27.1-47.3)	41.3 (28.7-59.7)	40 (31-59)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .412
Preoperative PSA (ng/mL), median (IQR)	5.7 (4.5-8.5)	6.5 (5.1-10.2)	6 (4.5-8.8)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: .700 SP EP vs MP TP: .096
Biopsy Gleason Grade Group, *n* (%)				< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Grade Group 1	50 (26.3%)	30 (11.8%)	94 (22.4%)	
Grade Group 2	104 (54.7%)	118 (46.3%)	163 (38.8%)	
Grade Group 3	29 (15.3%)	57 (22.4%)	79 (18.8%)	
Grade Group 4	4 (2.1%)	33 (12.9%)	48 (11.4%)	
Grade Group 5	3 (1.6%)	17 (6.7%)	36 (8.6%)	
Clinical T (cT) stage, *n* (%)				.138
cT1c	176 (92.6%)	218 (85.5%)	328 (86.5%)	

Table 1 (*Continued*)

	SP Transvesical (SP TV)	SP Extraperitoneal (SP EP)	MP Transperitoneal (MP TP)	*P*-Value
cT2a	7 (3.7%)	19 (7.5%)	33 (8.7%)	
cT2b	1 (0.5%)	5 (2%)	8 (2.1%)	
cT2c	6 (3.2%)	12 (4.7%)	5 (1.3%)	
cT3a	0 (0%)	0 (0%)	3 (0.8%)	
cT3b	0 (0%)	0 (0%)	2 (0.5%)	
cT4	0 (0%)	1 (0.4%)	0 (0%)	
NCCN Risk Categories, *n* (%)				< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Very low	1 (0.5%)	3 (1.2%)	18 (4.3%)	
Low	37 (19.5%)	22 (8.6%)	59 (14%)	
Intermediate	141 (74.2%)	162 (63.5%)	236 (56.2%)	
High	8 (4.2%)	63 (24.7%)	79 (18.8%)	
Very high	3 (1.6%)	5 (2%)	28 (6.7%)	
Intraoperative parameters				
Operating time (min), median (IQR)	197 (174.3-225)	193 (174-220)	178 (155-203)	< .05 SP TV vs SP EP: .201 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Extra port, *n* (%)	0 (0%)	0 (0%)	11 (2.6%)	< .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Salvage prostatectomy, *n* (%)	0 (0%)	9 (3.5%)	14 (3.3%)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .896
Nerve-sparing procedure, *n* (%)	151 (79.5%)	222 (87.1%)	350 (83.3%)	.086
Unilateral, *n* (%)	20 (13.2%)	36 (16.2%)	38 (10.9%)	
Bilateral, *n* (%)	131 (86.8%)	186 (83.8%)	312 (89.1%)	
Lymph node dissection, *n* (%)	55 (28.9%)	247 (96.9%)	381 (90.7%)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Estimated blood loss (mL), median (IQR)	72.5 (50-100)	150 (90-200)	200 (100-300)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Intraoperative complication, *n* (%)	1 (0.5%)	0 (0%)	0 (0%)	.169
Surgical drain tube (DT), *n* (%)	1 (0.5%)	2 (0.8%)	405 (96.4%)	< .05 SP TV vs SP EP: .749 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05

Table 1 (*Continued*)

	SP Transvesical (SP TV)	SP Extraperitoneal (SP EP)	MP Transperitoneal (MP TP)	*P*-Value
DT duration (d), median (IQR)	4	0	1 (1-2)	
Histopathology				
Specimen weight (g), median (IQR)	42.9 (35.9-52.7)	49.6 (40-67.1)	48 (38.2-62)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .185
Prostatectomy Gleason Grade Group, *n* (%)				< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .409
Grade Group 1	10 (5.3%)	13 (5.1%)	26 (6.9%)	
Grade Group 2	141 (74.2%)	145 (57.3%)	221 (58.9%)	
Grade Group 3	35 (18.4%)	56 (22.1%)	84 (22.4%)	
Grade Group 4	1 (0.5%)	7 (2.8%)	13 (3.5%)	
Grade Group 5	3 (1.6%)	32 (12.6%)	31 (8.3%)	
Positive margin, *n* (%)	44 (23.3%)	72 (28.5%)	119 (28.9%)	.315
Limited (< 3 mm)	35 (18.4%)	32 (12.6%)	55 (13.3%)	
Nonlimited (≥3 mm)	9 (4.7%)	40 (15.8%)	64 (15.5%)	
Pathology T (pT) stage, *n* (%)				.238
pT2	101 (53.4%)	117 (46.1%)	187 (45.6%)	
pT3a	72 (38.1%)	105 (41.3%)	166 (40.5%)	
pT3b	16 (8.5%)	32 (12.6%)	57 (13.9%)	
Pathology N (pN) stage, *n* (%)				< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
pNx	151 (79.9%)	13 (5.1%)	42 (10.5%)	
pN0	38 (20.1%)	225 (88.6%)	340 (84.8%)	
pN1	0 (0%)	16 (6.3%)	19 (4.7%)	
Postoperative care				
Length of stay (h), median (IQR)	5.07 (4-7.8)*	5.1 (3.8-18)	26.6 (23.2-41.1)	< .05 SP TV vs SP EP: .779 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Length of stay < 24 h, *n* (%)	155 (92.3%)*	215 (84.3%)	128 (30.5%)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Encounter types, *n* (%)				< .05 SP TV vs SP EP: .688 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Outpatient	132 (78.6%)*	176 (69.3%)	9 (2.1%)	

Table 1 (*Continued*)

	SP Transvesical (SP TV)	SP Extraperitoneal (SP EP)	MP Transperitoneal (MP TP)	*P*-Value
Extended recovery	21 (12.5%)*	36 (14.2%)	83 (19.8%)	
Inpatient	15 (8.9%)*	42 (16.5%)	328 (78.1%)	
Analgesia-free during admission, *n* (%)	66 (34.7%)	77 (30.2%)	9 (2.1%)	< .05 SP TV vs SP EP: .310 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Opioid-free during admission, *n* (%)	111 (58.4%)	139 (54.5%)	57 (13.6%)	< .05 SP TV vs SP EP: .411 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Inpatient MME (when applies), median (IQR)	7.5 (3.6-9.3)	7.5 (6.2-9.6)	15 (7.5-24.1)	.274
Pain score at discharge, median (IQR)	3 (1-4)	3 (1-4)	2 (0-4)	.359
Analgesia-free on discharge, *n* (%)	50/190 (26.3%)	62/255 (24.3%)	29/420 (6.9%)	< .05 SP TV vs SP EP: .630 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Opioid-free on discharge, *n* (%)	180/190 (94.7%)	198/255 (77.6%)	51/420 (12.1%)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: < .05
Postoperative complication†, *n* (%)	26 (13.7%)	41 (16.1%)	54 (12.9%)	.420
Clavien-Dindo 1	18 (9.5%)	14 (5.5%)	25 (6%)	
Clavien-Dindo 2	6 (3.2%)	10 (3.9%)	17 (4%)	
Clavien-Dindo 3a	2 (1.1%)	15 (5.9%)	7 (1.7%)	
Clavien-Dindo 3b	0 (0%)	2 (0.8%)	5 (1.2%)	
Readmission, *n* (%)	7 (3.7%)	19 (7.5%)	24 (5.7%)	.314
Foley catheter duration (d), median (IQR)	4 (3 - 6)	7 (7 - 7)	7 (7 - 9)	< .05 SP TV vs SP EP: < .05 SP TV vs MP TP: < .05 SP EP vs MP TP: .063
12-month biochemical recurrence‡	3 (2.8%)	7 (3.9%)	6 (3.3%)	.847

ASA, American Society of Anesthesiologists; BMI, body mass index; CCI, Charlson Comorbidity Index; IQR, interquartile range; MME, Morphine Milligram Equivalent; NCCN, National Comprehensive Cancer Network; PSA, prostate-specific antigen.

* Excluded 22 planned overnight admission patients.

† Postoperative complication within 90 days of surgery.

‡ 12-month biochemical recurrence, defined as two consecutive PSA rise above ≥0.2 ng/mL (for the purpose of our analysis, elevated PSA levels at 6 weeks were excluded).

MP-TP 5.7%, $P = .314$). Foley catheter durations were significantly shorter in patients managed with SP-TV (median, SP-TV 4 vs SP-EP 7 vs MP-TP 7 days, $P = < .05$).

We performed a separate analysis to identify differences between inpatient and outpatient RARP. MP-TP RARP cases were excluded from this analysis given most patients were admitted as inpatient as the standard of care following the procedure. A summary of the baseline clinical and perioperative variables was shown in Supplementary Table 1. The outpatient group consisted of more patients without prior history of abdominal surgery (49.6% vs 37.7%, $P = < .05$). Operating time was faster (median, 192 vs 205.5 minutes, $P = < .05$) and nerve-sparing procedure was more common in the outpatient cohort (87.1% vs 76.3%, $P = < .05$). The rates of postoperative complication and readmission were similar between the two groups. A detailed breakdown of the postoperative complications and reasons for readmission were summarized in Supplementary Table 2. A greater portion of patients in the outpatient group did not require any analgesia (42.2% vs 8.9%, $P = < .05$) and opioids (63.2% vs 40%, $P = < .05$). On discharge, however, despite having a similar pain score ($P = .163$), opioid-free prescription was more common in the outpatient group (89.4% vs 74.8%, $P = < .05$).

DISCUSSION

Since its early introduction in 1996, different studies have been performed to assess the feasibility of applying the Enhanced Recovery After Surgery (ERAS) protocol to different urological procedures, including RP. The protocol relied on multidisciplinary collaborations and perioperative interventions to promote earlier discharge and reduce perioperative complications. Despite some demonstrable benefits in reducing postoperative pain and length of hospital stay, there remained a paucity of evidence on how changes in RP surgical practices can significantly influence these early postoperative outcomes.[12-14] To our knowledge, this retrospective review of 865 consecutive patients with localized prostate cancer managed with three contemporary RARP approaches represented the largest single-institution series, which provided insights into the effects of regionalizing RARP on perioperative and early postoperative outcomes.

With the increasing utility of the purpose-built SP robotic platform, our study identified that SP-EP and TV RARP allowed for enhanced recovery when compared to MP-TP, as indicated by the significant reduction in the LOS and with more of the procedures performed in the outpatient setting (Fig. 2). The benefits of shorter inpatient stays had been previously demonstrated, including an overall cost reduction, decreased risks of hospital-associated complications, as well as reducing hospital bed pressures.[15] On review of the literature, we have identified several studies that reported the feasibility of same-day discharges following RARP, as summarized in Table 2. Despite some heterogeneities, such as in terms of the intraoperative techniques and measured outcomes, we identified that our same-day discharge rate was on the higher end of the previously reported 16%-82% range, and with SP approaches performing better than the MP series.[14,16-23] More importantly, we also identified that earlier discharges did not correspond to increased rates of postoperative complication and readmission. Albeit not reaching statistical significance, the risks of major postoperative complications and readmissions of 1.1% and 3.7% following SP-TV RARP were lower compared to the 2.9% and 5.5% risks after MP-TP RARP.

Postoperative analgesia requirements were not routinely reported in previous studies.[14,16-23] We have observed in our series that there existed a trend toward significantly reduced analgesia and opioid requirements following the more recent techniques of SP-EP and SP-TV RARP (Fig. 2). Opioid-sparing approaches to postoperative analgesia have been demonstrated to reduce morbidity, especially those related to opioid adverse effects, such as sedation and postoperative nausea and vomiting.[24,25] The lower postoperative pain may be attributed to the single, lower incisions without the need for additional port, especially for the TV approach, as well as the localized surgical field inside the EP space or within the walls of the bladder, without the need for pneumoperitoneum (Fig. 1).

Another benefit of SP-TV RARP also included the shorter Foley catheter duration with a median of only 4 days, as compared to the standard of care of 7 days following MP-TP and SP-EP RARP. The shorter Foley catheter duration has become part of routine clinical practice in the TV cohort following the initial success in earlier catheter removal without significant clinical sequelae. Despite the shorter catheter duration, patients who underwent SP-TV RARP achieved a faster return of urinary continence with a median time to continence of 3.5 days and with a greater portion of patients being continent at 6 weeks and 6 months, especially when compared to MP-TP RARP (6 weeks, 66% vs 51%; 6 months, 93% vs 82%). This encouraging outcome can be credited to the better preservation of the supporting structures of the bladder, which promoted better continence, especially in SP-TV RARP.[2] The risks of urinary retention also remained similarly low between the three approaches, with them being 3.7%, 4.3%, and 1.2% following SP-TV, SP-EP, and MP-TP RARP, respectively.

Furthermore, despite the highlighted advantages of enhanced postoperative recovery, the intraoperative outcomes of the two SP procedures remained favorable. These included the TV cohort having the lowest intraoperative blood loss and with no cases necessitating any additional ports or surgical conversion. The risk of intraoperative complication of only 0.1% also remained very low for the SP cases. The longer operating time in SP-TV RARP, especially when compared with MP-TP RARP, may need to be considered in the setting of the continuing improvement in the learning curve of an experienced robotic surgeon. Of note, decreased operating time can be appreciated for the latest 50 consecutive cases of SP-TV RARP with a median operating

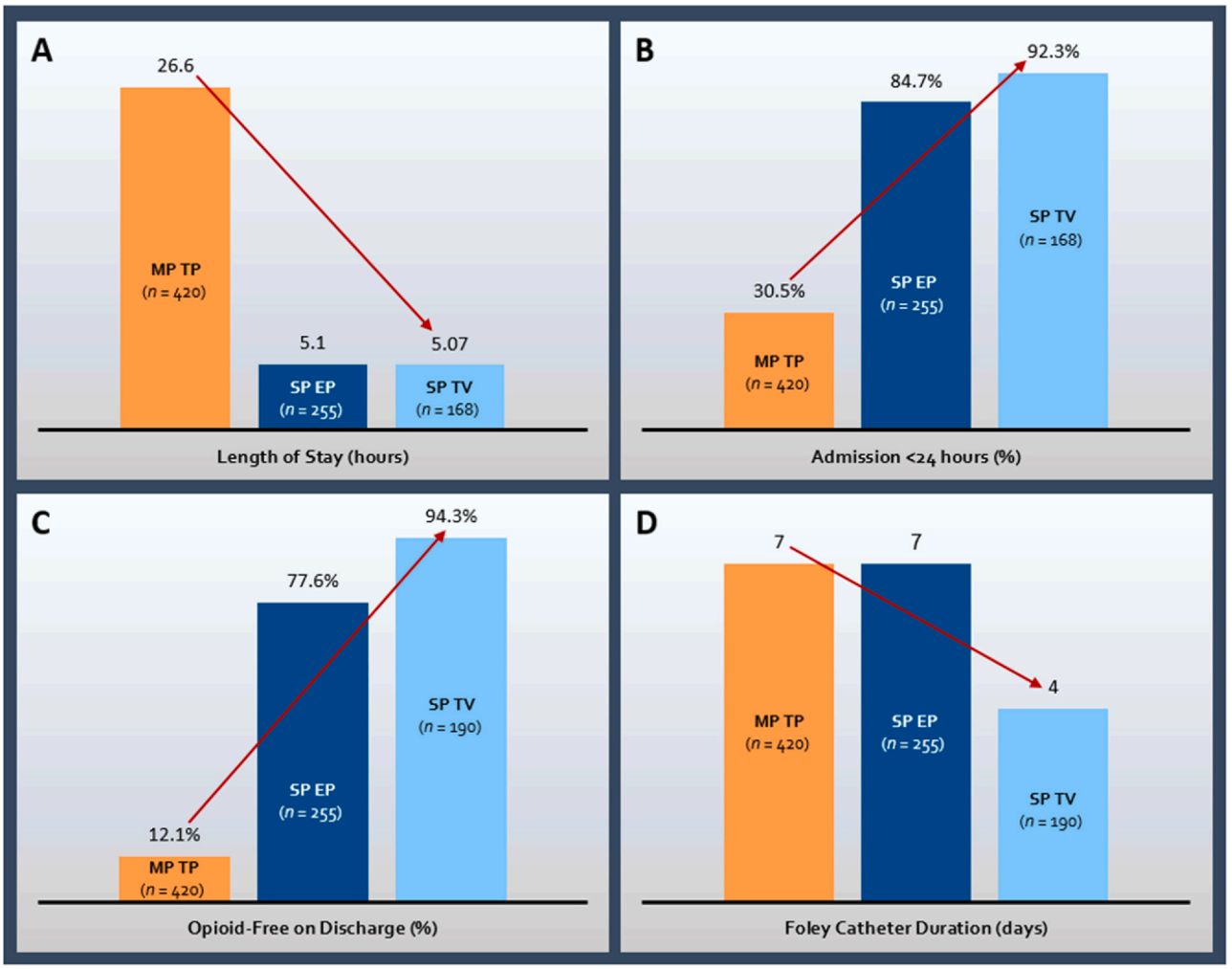

Figure 2. **(A)** The median length of stay (in hours) following completion of Multi-Port Transperitoneal (MP-TP), Single-Port (SP) Extraperitoneal (EP), and SP Transvesical (SP-TV) robot-assisted radical prostatectomy (RARP); **(B)** Proportion of patients with duration of inpatient stay less than 24 hours following completion of MP-TP, SP-EP, and SP-TV RARP; **(C)** The proportion of patients without any opioids prescribed on discharge following MP-TP, SP-EP, and SP-TV RARP; **(D)** The median Foley catheter duration (in days) following MP-TP, SP-EP, and SP-TV RARP. (Color version available online.)

time of 183.5 minutes (IQR 166-200 minutes), as opposed to the group median of 197 minutes (IQR 174.3-225 minutes).

With regards to oncological outcomes, positive surgical margin (PSM) rates were similar between the three RARP approaches ($P = .315$), with most being limited margin involvement with a linear length of less than 3 mm (Table 1). In patients with available follow-up data, 12-month biochemical recurrence was identified in 2.8%, 3.9%, and 3.3% of SP-TV, SP-EP, and MP-TP RARP, respectively ($P = .847$). It is important to appreciate that of all patients with PSM in the aforementioned groups, only 4.5%, 4.2%, and 1.7% developed biochemical recurrence. Given the primary focus of this study was to evaluate the perioperative and early postoperative outcomes, detailed analyses of oncological and functional outcomes were not performed.

This study was not without its limitations. The first pertained to the retrospective nature of this study, which was based on a single surgeon experience in a single institution. In addition, it remains important to consider that the findings of this study included cases completed early in the learning curve of the new SP platform and the novel TV approach. Hence, the findings presented in this study may not accurately reflect the clinical experiences of other surgeons in other institutions. Secondly, different selection criteria were employed for the different approaches, particularly for SP-TV RARP. Despite their benefits in patients with a hostile abdomen, patients with prostate volume greater than 100 mL and those with a high risk of lymph node involvement that may require extensive nodal dissection were not initially included. As such, despite the significantly lower prostate volumes in the TV cohort, we have identified a greater

Table 2. Previously published series assessing the feasibility of same-day discharge for robot-assisted radical prostatectomy (RARP).

Authors (Year)	Country	Study Type	*n*	Approach	Same-day Discharge (SDD); Length of Stay (LOS, in h), Median (IQR)	Pain Score Median (IQR)	Readmission, *n* (%)	Postoperative Complication *n* (%)
Reddy et al. (2022)[16]	United States	Prospective	101	MP TP	SDD = 73 (72.3%); LOS = 12 (11-13)	2 (1 - 4)	4 (5.4%)	4 (5.4%)
					Non-SDD = 28 (27.7%); LOS = 29 (27-30)	3 (1 - 4)	1 (3.5%)	2 (7%)
Mulholland et al. (2022)[17]	Australia	Prospective	28	MP TP	SDD = 11 (39.3%); Mean LOS = 426 ± 105 min	–	1 (9.1%)	Minor only = 2 (18.2%)
					Non-SDD = 17 (60.7%); Mean LOS = 1536 ± 797 min	–	1 (5.9%)	Minor only = 3 (21.4%)
Balasubramanian et al. (2022)[18]	United States	Prospective	51	SP TP SP RS	SDD = 15 (29.4%)	No opioid = 13.3%	3 (20%)	3 (20%)
					Non-SDD = 36 (70.6%)	No opioid = 36%	2 (5.6%)	3 (8.3%)
Ploussard et al. (2020)[14]	France	Prospective	52	RARPNOS	SDD = 27 (51.9%)	0/10 pain in 87.5%	3.7%	11.1%
					Non-SDD = 25 (48.1%); Mean LOS = 1.6 d	–	4%	16%
Khalil et al. (2020)[19]	United States	Retrospective	1548	RARPNOS	SDD = 258	–	2.6%	3.1%
					Non-SDD = 1290; Mean LOS = 2.7 ± 2.3 d	–	3.9%	4.7%
Wilson et al. (2020)[20]	United States	Retrospective	60	SP EP	SDD = 45 (75%); LOS = 3.9	Mean = 2	4 (7%)	11 (18.3%)
Aminsharifi et al. (2020)[21]	United States	Retrospective	120	SP EP	SDD = 98 (81.7%); LOS = 4.1 (3.2-6.9)	2 (0 - 3)	–	13 (13.3%)
					Non-SDD = 22 (18.3%); LOS = 25.4 (24.1-29.5)	2 (0.3 - 3.5)	–	3 (13.6%)
Banapour et al. (2018)[22]	United States	Retrospective	51	RARPNOS	SDD = 25 (49%)	–	–	1 (4%)
					Non-SDD = 26 (51%)	–	–	2 (8%)
Berger et al. (2016)[23]	United States	Retrospective	56	RARPNOS	SDD = 30; Mean LOS = 14 ± 1.2	–	–	1 (3.9%)
					Non-SDD = 26; Mean LOS = 44 ± 17.9	–	–	0 (0%)

IQR, interquartile range; MP TP, Multi-Port Transperitoneal; NOS, not otherwise specified; SP EP, Single Port Extraperitoneal; SP RS, Single Port Retzius-Sparing; SP TP, Single Port Transperitoneal.

portion of patients with higher ASA scores and with a previous history of abdominal surgery. Nevertheless, the introduction of newer techniques with the purpose-built SP robotic platform should not replace but rather enrich the repertoire of currently available surgical management options for localized prostate cancer that can be better tailored for each individual patient.

CONCLUSION

The SP robotic platform has allowed for the localization of RARP, with demonstrable benefits in promoting enhanced postoperative recovery. This was evident by the shorter LOS, decreased analgesia and opioid requirements, as well as shorter Foley catheter duration in patients who underwent SP-TV RARP.

Declaration of Competing Interest

Jihad H. Kaouk is a speaker for Intuitive Surgical, Inc and is a consultant for EndoQuest Robotics, Method AI, and VTI. All the other authors have no conflict of interest to declare.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.urology.2023.07.001.

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