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Initial experience on extraperitoneal single-port robotic-assisted radical prostatectomy

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The surgical spectrum for radical prostatectomy (RP) has evolved from open surgery to novel minimally invasive approaches during the past few decades, with robotic-assisted radical prostatectomy (RARP) being collectively reckoned as an increasingly popular option for prostate cancer (PCa). A previous study has demonstrated the safety and effectiveness of radical-assisted Laparoscopic radical Prostatectomy (RALP).[1] While the transperitoneal route is the most popular surgical access option, alternative propositions include extraperitoneal, perineal, or transvesical access. Since the advent of the next-generation da Vinci Xi and single-port (SP) platforms, robotic laparoendoscopic single-site surgery (R-LESS) has emerged as an intriguing concept in various general or gynecological procedures and in partial nephrectomy. The first single-port robotic-assisted radical prostatectomy (spRARP) was reported in 2008,[2] but has not seen much improvement in surgical techniques and popularity thereafter, with less than 60 total cases reported globally.[3] A previous report[4] demonstrated that the adoption of transumbilical incision in spRARP surgery may cause reduced flexibility, limited working space, and frequent instrument clashing, potentially leading to longer surgeries and increased difficulty. Extraperitoneal RARP has been widely reported in the literature with similar trifecta outcomes and shows more rapid recovery and reduced peri-operative complication rates.[5] The current study aims to investigate the feasibility of extraperitoneal single-port RARP (espRARP) with the use of the da Vinci Si HD model.

We retrospectively analyzed 19 patients, aged 57 to 78 years with biopsy-confirmed PCa from November 15, 2018, to September 5, 2019, following institutional review board approval and informed consent signed by each individual. Multiparametric magnetic resonance imaging and bone scintigraphy were performed for all patients in the cohort, showing organ-confined disease. After informed consent, the patients had undergone espRARP. After evaluation with Briganti nomogram, all patients ruled out the necessity of performing pelvic lymph node dissection. Nerve-sparing procedures were performed for four preoperatively potent patients. The surgical operations were performed in a high-volume center by a console surgeon with a RARP caseload over 700. Surgical assistants and scrubbing nurses were a fixed team who have all passed the learning curve.

Under general anesthesia, the patient was placed in a 15° to 20° Trendelenburg position. A 5 cm transverse incision was made approximately 5 cm above the pubic symphysis. After incision of the anterior rectus fascia and separation of the rectus abdominis, extraperitoneal working space was created with an inflated surgical glove as a home-made dilator. Then, a commercially available 100-mm multichannel laparoscopic port (Senscure Biotech Co., Ltd., Ningbo, Zhejiang Province, China) was inserted beneath the rectus muscle [Figure 1A]. Da Vinci Si HD was used (Intuitive Surgical, Sunnyvale, CA, USA), with 8-mm monopolar scissors and Maryland bipolar forceps equipped to perform dissection procedures. As a modification to reduce clashing, a 12-mm 30° high-definition laparoscope was introduced and toggled 30° up throughout the operation [Figure 1B]. The anterior prostatic fat was removed and was followed by an incision of the lateral endopelvic fasciae. Dorsal venous complex was ligated using a 2-0 Monocryl suture. Then, the bladder neck was identified and transected, followed by ligation of the vasa deferentia and dissection of the seminal vesicles. The prostate was then suspended to develop the posterior plane of the prostate to expose posterior fascia. Next, the prostate

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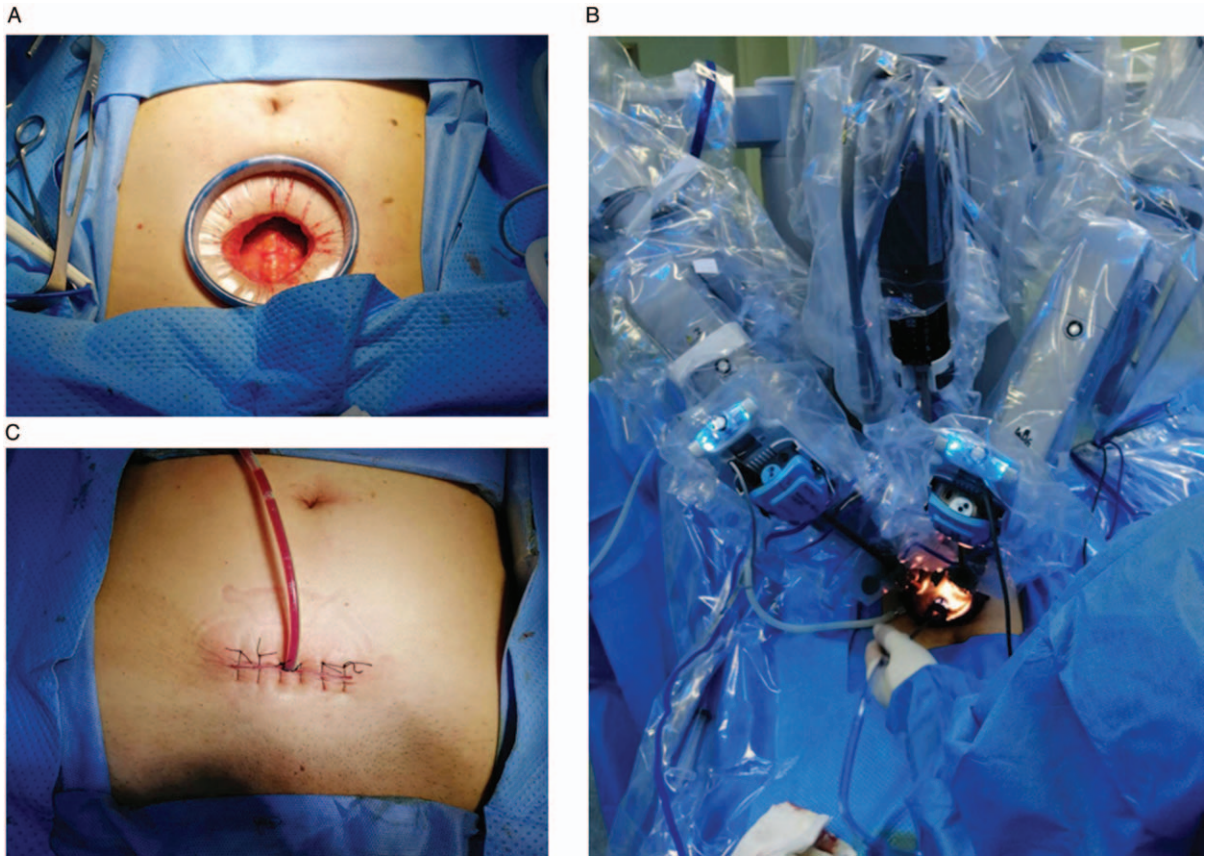

Figure 1: Illustration of Extraperitoneal single-port robotic-assisted radical prostatectomy. (A) Abdominal incision and port placement, showing a 5 cm transverse incision approximately 5 cm above the pubic symphysis, with a wound protector placed extraperitoneally. (B) Intra-operative installation, showing a quadrichannel port installed with two robotic arms, and a camera facing 30-degree up installed at the caudal side, with the cephalad port used as the assistant's port. (C) Wound closure with a Jackson-Pratt drainage placed in the same incision.

was dissected extra- or intra-fascially, depending on the patient's eligibility for nerve-sparing procedures. After mobilizing and transecting the distal urethra, the prostate was removed entirely and put in a sample bag, followed by urethrovesical anastomosis with the use of 3-0 two-way barbed suture. A Jackson-Pratt drainage was placed in the same incision before wound closure [Figure 1C].

Patients had monthly follow-ups at the clinic. Median follow-up was 7 (range, 3–13) months. (The median of the statistics is 7 months, but until the deadline, 4 of 19 patients did not reach the follow-up time of 6 months) prostate-specific antigen (PSA) was examined at 2-, 4-, and 6-week post-operatively, and monthly thereafter. Daily pad usage and pad weight gain were documented. Continence was defined as using no pads or one security pad per day with a pad weight gain of less than 50 g. Patients were instructed with pelvic muscle exercise after Foley catheter removal. The 5-item version of the International Index of Erectile Function (IIEF-5) score was examined for patients with nerve-sparing procedures, and phosphodiesterase inhibitors of type 5 (PDE-5) inhibitor were advised. All follow-up data were uploaded to PC-Follow version 5.0, the largest multicenter online PCa database in China.

Patient demographic data are listed in Supplementary Table 1, http://links.lww.com/CM9/A350. The patients were aged 66.1 ± 5.2 years, with a mean body mass index of 23.4 ± 2.7 kg/m^2. One patient was stratified as low-risk and the other 18 patients were intermediate risk, according to D'Amico criteria. Median PSA was 7.96 ng/mL (interquartile range [IQR], 6.044–12.193 ng/mL). Patients were graded as cT1c-2bN0M0 with no signs of regional lymph node invasion or distal metastasis. Five, 13, and 1 patients had a biopsy Gleason Score of 3 + 3, 3 + 4, and 4 + 3, respectively. The median duration of surgery was 95.0 min (IQR, 67.50–110.00 min), with a console time of 68.5 min (IQR, 50.75–82.25 min). The estimated blood loss was 50 mL (IQR, 50.0–100.0 mL). Surgical procedures were successfully implemented with no conversion to open surgery or additional ports being placed. Bilateral intra-fascial nerve-sparing was conducted in four cases. The median post-operative stay was 3 days (range, 1–4 days). The Foley catheter was removed 14 days post-operatively. No patient required narcotics after surgery. No intra- or post-operative complications of Clavien grade III or above were recorded. All but one patient had drainage removed before discharge, in which case he carried the drainage catheter home for one additional week. One patient had a wound dehiscence 10 days after discharge and was treated at the clinic, with no signs of wound infection. Post-operative pathology showed ten patients (52.6%) with the locally-advanced disease; eight patients had extracapsular invasion and two had seminal vesicle invasion. The overall positive margin rate was 15.8% (3/19). Four patients had adjuvant

external beam radiation therapy (EBRT) after recovery of continence, two of whom had concomitant androgen deprivation therapy, and the other two had simple EBRT. Continence recovery rate immediately after Foley catheter removal was 26.3% (5/19). Post-operative continence recovery rate on the first, third, and sixth months were 36.8% (7/19), 73.7% (14/19), and 100.0% (15/15), respectively. For the four patients who underwent nerve-sparing procedures, two had spontaneous morning erections within 1 month post-operatively, without the use of phosphodiesterase-5 (PDE5) inhibitors, nor had they attempted any sexual activities during follow-up.

The study indicated that adopting an extraperitoneal route with single-port access in RARP is a safe and feasible procedure. Since the first report of R-LESS RARP in 2008 by Kaouk *et al*,[2] this surgical option has not been used often, probably due to technical hurdles such as inadequate instrument triangulation, robotic arm collision, surgical difficulties for operators, and limitation of working space. As reported, transperitoneal single-site RARP with a single incision closely above the umbilicus has been successfully performed.[4] The procedure was conducted successfully but had room for improvement. By moving the incision to a position lower than approximately 5 cm above the pubic symphysis, the common position for transvesical RARP, instrument clashing, specifically inside the surgical field or of the external robotic arms, can be significantly reduced without the necessity of software compensation for instrument crossing. The trocar placed caudally was used as a camera port with a 30-degree up camera for the entire procedure, which also contributed to better triangulation and reduced instrument clashing. After the initial experiences, espRARP can be routinely performed with da Vinci Si models. Following enhanced recovery after surgery protocols, eligible patients can be sent home the day after surgery.

SPL can decrease intra-abdominal adhesions.[2] In our opinion, because both SPL and espRARP are single port, the espRARP approach seemed highly recommended for patients with prior abdominal surgeries and intra-abdominal adhesions. The adoption of an extraperitoneal route does not require an extreme Trendelenburg position, which may also contribute to faster full recovery by alleviating facial edema and airway swelling. However, caution when interpreting these results before validation by high-level evidence is advisable.

This analysis has several limitations. The conclusions are drawn from its retrospective nature and low-volume sample size require further validation with controlled and perspective studies, comparing this technique with conventional multi-port transperitoneal RARP. One major limitation of espRARP is a technical difficulty in lymph node dissection, which has also been reported in both extraperitoneal RARP and single-port transperitoneal RARP.[6] Limited PLND is feasible but not validated in the setting of espRARP.

In summary, extraperitoneal single-port robotic-assisted radical prostatectomy with da Vinci Si models is feasible in clinically localized PCa in terms of perioperative safety profile and functional outcomes. Longer follow-up and prospective controlled studies must be performed in the future to investigate any potential perioperative benefits over conventional multi-port transperitoneal RARPs.

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Conflicts of interest

None.

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