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Surgery Alive

Single-port transperitoneal robotic-assisted laparoscopic radical prostatectomy (spRALP): Initial experience

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Abstract *Objective:* To assess the feasibility of single-port transperitoneal robotic-assisted laparoscopic radical prostatectomy (spRALP) and discuss its surgical technique.
Methods: A 60-year-old male was admitted with an elevated prostate-specific antigen (PSA) level of 13.89 ng/mL and confirmed with prostate cancer on biopsy showing three of 22 positive cores with a Gleason score of $3 + 4 = 7$. Multiparametric magnetic resonance (MR) and bone scintigraphy showed organ-confined disease. spRALP was performed using da Vinci Si HD surgical system, with access of a quadri-channel laparoscopic port placed supraumbilically. Two drainage tubes were placed before wound closure. The surgical procedure was largely in consistence with a conventional robotic-assisted laparoscopic radical prostatectomy.
Results: The surgery was successfully carried out with a duration of 152 min and an estimated blood loss of 100 mL. The patient was discharged on postoperative Day 4 after removal of both pelvic drainage tubes. Foley catheter was removed on postoperative Day 14. No major complications were encountered. Postoperative pathology showed a Gleason score of $3 + 4 = 7$ with no extraprostatic extension and negative surgical margins.
Conclusion: Single-port robotic prostatectomy is feasible using the currently available robotic instruments in most Chinese robotic urological centers. Meticulous preoperative planning and careful patient selection are mandatory. Further studies concerning perioperative complications and pentafecta outcome compared with the conventional multi-port robotic prostatectomy is required.

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1. Introduction

Laparoendoscopic single-site surgery (LESS) and natural orifice transluminal endoscopic surgery (NOTES) are recognized as the next leap of minimally invasive surgery, with the aim of minimizing postoperative pain and incision-related complications for better recovery and cosmesis [1]. LESS and robotic-assisted LESS were first explored in nephrectomy and pyeloplasty in urological procedures [2,3], showing feasible technical solution and comparable oncological and functional results as in conventional robotic surgeries [4]. Pure laparoscopic LESS prostatectomy was first attempted by Kaouk et al. [5] in 2008, but experienced extensively long surgical time, significant challenge with instrument clashing, limited operative space, and difficulty in dissection and ligation. Single-port robotic-assisted radical laparoscopic prostatectomy (spRALP) was only able to overcome the aforementioned drawbacks to a limited extent, and limited surgical space, frequent clashing of surgical instruments both inside and outside the body, crisscrossing of surgical instruments are still the major issues affecting surgical maneuverability. Therefore, spRALP remains poorly addressed and underdeveloped to date. Only a few centers have successfully performed laparoendoscopic single-site surgery robotic-assisted radical laparoscopic prostatectomy (LESS-RALP) worldwide [6–10]. In light of these issues, we modified the current technique and successfully performed transperitoneal RALP with use of a single port and straight da Vinci Si HD robotic instruments as in a conventional RALP. The surgical techniques are addressed.

2. Patient and methods

2.1. Patient

An otherwise healthy 60-year-old male, 163 cm in height and 74 kg in weight, with an elevated prostate-specific antigen (PSA) for 4 months was admitted on May 21, 2018. Total PSA (tPSA) at diagnosis was 13.89 ng/mL and free PSA (fPSA) was 5.99 ng/mL. Digital rectal examination was negative. The prostate volume was 33.8 mL, sizing 4.5 cm × 3.7 cm × 3.9 cm on multiparametric magnetic resonance (MR), with an organ-confined lesion on the left transition zone. Transperineal systemic plus targeted biopsy (cognitive fusion) revealed three of 22 positive cores with an overall Gleason score of $3 + 4 = 7$. No susceptible metastases were discovered on bone scintigraphy. spRALP was performed on May 24, 2018, in Changhai Hospital, Shanghai, China with a caseload of over 2000 in urologic robotic surgery. The console surgeon has a previous caseload of over 400 in robotic surgery.

2.2. Surgical procedure

The patient was securely padded and tucked on the operation bed in a Trendelenburg position. An 18 Fr Foley catheter was inserted after draping. An upper-half semicircle with a diameter of 6 cm was made supraumbilically. A commercially available 8 cm quadri-channel laparoscopic port (Lagiport™, Lagis Inc, Taichung, Taiwan, China) was placed, as previously reported [11]. The 12 mm camera port was placed caudally while the two 10 mm robotic ports were placed laterally, leaving the 12 mm cephalad channel as assistant port (Fig. 1A). da Vinci Si HD robotic system (Intuitive Surgical, Sunnyvale, CA, USA) was used to perform the surgical procedure. A 30° camera was installed looking upward (Fig. 1B). Monopolar scissor and Maryland bipolar forceps were used for dissection and hemostasis with optional use of harmonic scalpel, and large needle drivers were used for ligation of deep dorsal venous complex and vesicourethral anastomosis. The surgical procedures were largely in consistence with a standard RALP (Fig. 1C). Bilateral neurovascular bundles were not preserved, nor was pelvic lymph node dissection performed. Two drainage tubes were placed before wound closure (Fig. 1D).

3. Results

Total time of surgery was 152 min, in which console time was 131 min and the time of anastomosis was 21 min. Estimated blood loss was 100 mL. The surgical procedure was successfully carried out with no conversion to open surgery or additional ports being placed. Left and right drainage tubes were removed on postoperative Day 2 and 3, respectively. The patient had clear liquid diet on postoperative Day 1, resumed normal diet and was off-bed on the next day, and was discharged on postoperative Day 4. Foley catheter was removed on postoperative Day 14. No major perioperative complication was recorded. Postoperative pathology showed that the prostate sized 4.0 cm × 3.0 cm × 2.8 cm with a left lobe lesion of $<5\%$ of total prostate volume, and a Gleason score of $3 + 4 = 7$. No extraprostatic extension was observed, and upper and lower surgical margins were negative. PSA was 0.02 ng/mL 1 month postoperatively, with a daily pad usage of 1–2.

4. Discussion

LESS, also described in literature as single-port, single-puncture, or single-incision laparoscopic surgery (SILS), is loosely defined as minimally invasive laparoscopic surgery having only one skin incision, without a strict and objective standard available [1]. Earlier reports applied a single incision with multiple independent fascial punctures, as

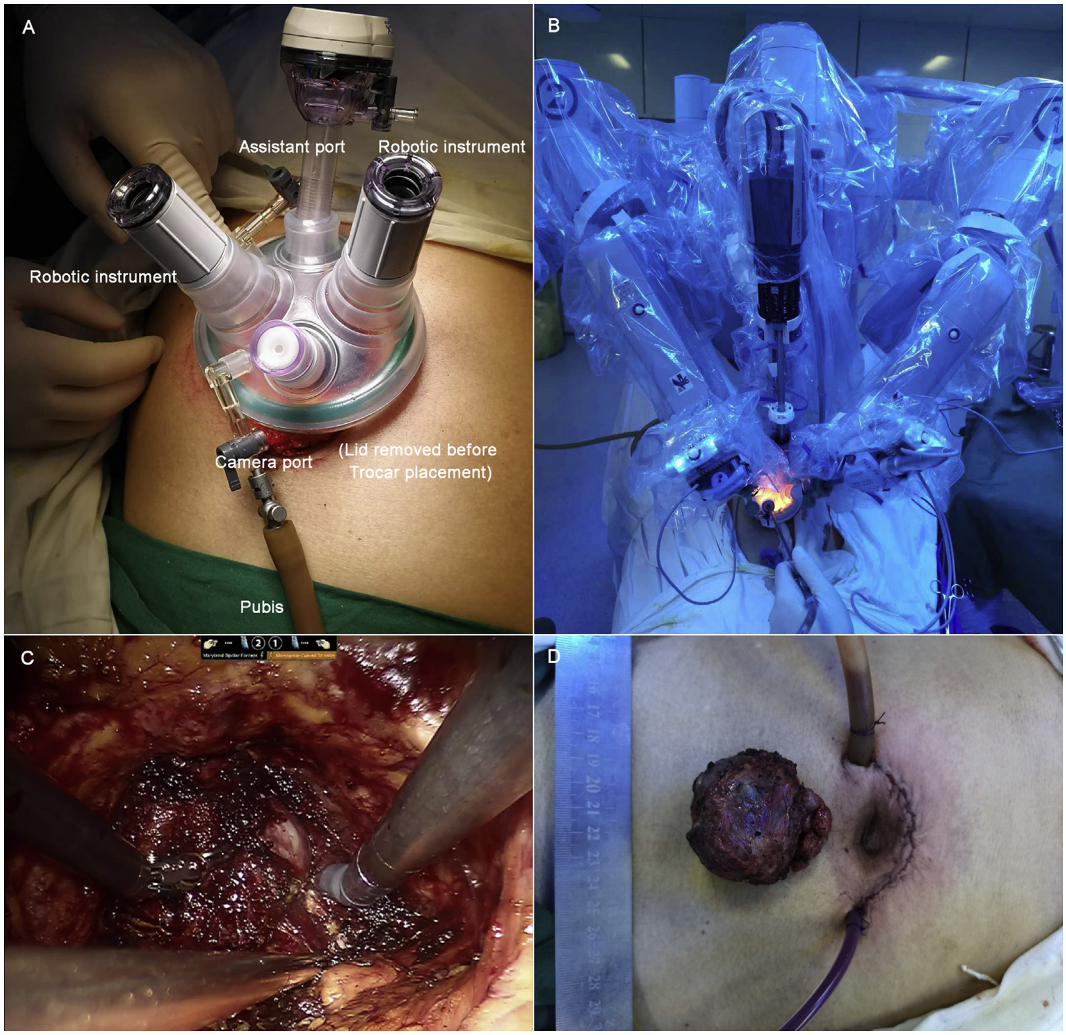

Figure 1 Intraoperative port placement and design. (A) Transumbilical port placement; (B) Robotic arm installation; (C) Intraoperative surgical field; (D) Postoperative overview after wound closure.

described by Leewansangtong et al. [7] from Thailand in 2009. However, this method is considered to be related to increased risk of skin maceration, fascial tear, delayed wound healing and so forth [12]. Before the advent of commercially available surgical access ports, home-made ports were designed, usually achieved with a wound retractor and a surgical glove [3,12]. To the best of our knowledge, the current study is the first single-port robotic prostatectomy successfully performed in Asia using a da Vinci Si HD model.

Modifications regarding robotic single-port prostatectomy requires either curved cannula with articulated robotic instruments [13], or with use of a new single-port platform [9]. Surgical operations with pre-curved cannulae on the VesPa platform was crisscrossed for the entire procedure, and required software-compensated control rearrangements. The single-port platform shows promising potential for surgical breakthrough and remains in preclinical phases. Curved cannulae and 5 mm articulated robotic instruments are still not readily available in China, where the S and Si models remain the most popular in most centers. In order to achieve a true single-port access in a setting of straight robotic arms, clashing both internally and externally, limited surgical space and loss of freedom are the biggest challenges. Both White et al. [8] and Kaouk et al. [6] made concession by placing one or both robotic trocars closely outside the transumbilical port, and articulated robotic instruments were used. Even so, a "chopsticks" phenomenon has been frequently addressed [14], for the seemingly inevitable crossing of instruments. However, for us Chinese people, if you are crossing your chopsticks, you are using them in the wrong way. In our opinion, like chopsticks, laparoscopic instruments are never meant to be used in a crossing fashion throughout the procedure. Our technique showcases a genuine "chopstick" maneuver with straight robotic instruments compatible with the most popular S or Si model, in which triangulation is maintained without crossing the instruments. In order to reduce clashing, a 30° camera looking upward should be adopted throughout the procedure, which was also recommended by White et al. [8]. Also, keeping the camera afar from the surgical field and further abducting the proximal robotic arms is crucial to reduce external collision and provides extra space for robotic arm movement. Manual adjustment for digital zooming at the surgeon's console by 2× or 4× can compensate for the loss of visual acuity.

Theoretically, placing the port at a certain level below the umbilicus beyond the "crossing point" may improve maneuverability and reachability, similar to the transvesical approach reported by Desai et al. [15] on cadaver models, but its perioperative complication profile remains unknown. A suprapubic extraperitoneal approach may be feasible and requires further validation.

Like any other surgical innovations, patient selection is pivotal at the beginning of the surgical learning curve. Patients that are younger at age, with ≤175 cm in height, body mass index (BMI) ≤25 kg/m^2, a prostate volume ≤50 mL, without necessity for pelvic lymph node dissection or nerve-sparing procedures, and with no history of abdominal surgery, are considered more suitable candidates for the operation. Meticulous planning should be made preoperatively, with regard of digital rectal examination, evaluation of prostatic imaging, and design of the incisions and port placement and so forth. The console surgeon and assistants should also be highly experienced with a relatively large caseload of RALP in high-volume centers. Learning curve analysis and pentafecta outcome comparison with the traditional multi-port RALP should be conducted in future studies.

5. Conclusion

Robotic prostatectomy with a single-port access and rigid robotic instruments on a da Vinci S or Si model is feasible in selected patients. Further cases should be discussed to improve the surgical technique and to standardize and streamline the procedure. Future analysis on surgical learning curve, perioperative complications, and prospective studies comparing its benefit with conventional RALP is required.

Author contributions

Study concept and design: Shancheng Ren, Yinghao Sun, Yifan Chang.
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Drafting of manuscript: Yifan Chang.
Critical revision of the manuscript: Shancheng Ren, Chuanliang Xu, Yinghao Sun.

Conflicts of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ajur.2018.08.002.

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