

Available online at www.sciencerepository.org

Science Repository



Review Article

Current Status of Single Port Laparoscopic/Robotic Surgeries for Urogenital Cancers

Donghua Xie^{1#}, Yanda Lu^{2#}, Ming Lei¹, Di Gu¹, Cong Cai¹, Wen Zhong¹, Defeng Qi¹, Wenqi Wu¹, Yongda Liu¹ and Guohua Zeng^{1*}

¹Department of Urology, Minimally Invasive Surgery Center, The First Affiliated Hospital of Guangzhou Medical University, Guangzhou Institute of Urology, Guangdong Key Laboratory of Urology, Guangzhou, China

²Department of Oncology, the First Affiliated Hospital of Hainan Medical University, Haikou, China

#Contributed equally

ARTICLE INFO

Article history:

Received: 16 January, 2021

Accepted: 28 January, 2021

Published: 10 March, 2021

Keywords:

Single port access

laparoscopic

robotic

urogenital cancer

ABSTRACT

Single port laparoscopic or robotic surgery is emerging and progressing but is still very challenging for many surgeons due to less degree of motion and limited space leading to instrument crash. With the aid of new technology and instrumentation, limitations are constantly broken in robot-assisted laparoscopic surgery. A lot of initiations have been done over the past a few years. A wide range of single port laparoscopic or robot-assisted laparoscopic pelvic and retroperitoneal urological procedures can be done with different approaches for treating urogenital cancers. Randomized trials with larger sample size and longer postoperative follow up are suggested for further evaluation of the outcomes and added value.

© 2021 Guohua Zeng. Hosting by Science Repository.

Introduction

Laparoscopic or robot-assisted laparoscopic single-port surgery is to reduce the morbidity from placement of multiple trocars. Limitations include less degree of motion and limited space leading to instrument crash [1]. Due to the above-mentioned limitation, it is considered that laparoscopic single-site surgery should be performed by specially trained surgeons [2]. With newer technology and instrumentation, limitations are constantly broken in robot-assisted laparoscopic surgery. Robotic laparoendoscopic single-site technique (R-LESS) is therefore emerging and progressing. R-LESS is still very challenging for many surgeons due to inadequate triangulation, robotic arm clashing, access limitations for the bedside assistant, lack of wrist articulation, frequent need for an axillary/accessory port, lack of robust retraction, and ergonomic discomfort [3]. Cadaver studies had been carried out for single-site retroperitoneal renal surgery including radical and partial nephrectomies, radical cystoprostatectomy and bilateral pelvic lymph node dissection, and intracorporeal ileal conduit urinary diversion, and retzius-sparing radical prostatectomy [4-6]. Non-robotic

laparoendoscopic single-site surgery was found to be technically feasible and safe for various urologic diseases in a Japanese study with 469 cases [7]. We sought to do a systemic review on the progress of single port surgeries in managing urogenital cancers.

Nephrectomy

Laparoscopic partial nephrectomy is a standard surgery for localized renal tumors. A single-site laparoscopic approach would be even more preferable given its minimal invasiveness. While the pure laparoscopic approach offers rigid curved tools, robotic single-site systems provide manipulators with higher degrees of freedom. However, limitations still exist including straight deployment port only, lack of instrument integration, or inability to be reconfigured. The current major shortcomings of single-site surgery include limited tool dexterity and visualization, and surgeons' intuitive use. For partial nephrectomy in particular, the tumor accessibility in certain locations remains limited and requires invasive kidney mobilization. The surgery could be much prolonged [8].

*Correspondence to: Guohua Zeng, M.D., Ph.D., Department of Urology, Minimally Invasive Surgery Center, The First Affiliated Hospital of Guangzhou Medical University, Guangzhou Institute of Urology, Guangdong Key Laboratory of Urology, Guangzhou, Guangdong 510230, China; E-mail: gzyzgh@vip.tom.com

I Radical Nephrectomy

Single port robotic radical nephrectomy together with cholecystectomy was reported for an 1.3cm nodule in the upper pole of the right kidney and symptomatic gallbladder stones. Patient was placed in modified flank position. Multichannel single port device was placed using Hassan's technique through a 3cm supra-umbilical incision. An 8.5mm camera, two 5mm robotic arms and an assistant 5mm access were used. Surgery time and estimated blood loss were 208 minutes and 100mL, respectively [1]. In a retrospective study, 52 consecutive patients underwent single-port radical nephrectomy in the transperitoneal approach. For their patients undergoing right nephrectomy, a 2-mm liver retraction port was added. The pneumoperitoneum time (PT) was used as an index of surgical difficulty. They found that the PT was significantly shorter for right nephrectomy than left nephrectomy (94 vs. 123 min).

For left nephrectomy, additional time was needed to dissect spleno-renal ligament to mobilize the spleen medially. Also, securing the adrenal, gonadal and lumbar veins is commonly needed before dividing the left renal vein. In patients whose renal artery was located cranial to the renal vein, PT tended to be longer than in the other patients (131 vs. 108 min) without statistical significance. In their study, they also found that in patients with a superior renal artery the inferior renal vein invariably covered the artery, making it difficult to ligate the renal artery through the umbilical approach. Their findings suggest that patients undergoing right nephrectomy in whom the renal artery is not located cranial to the renal vein are suitable for single-port laparoscopic radical nephrectomy [2]. In the study from Japan, single-port radical nephrectomy (40/469) was one of the most commonly performed surgeries in their institution [6, 7].

II Partial Nephrectomy

Standard management of the small renal mass is partial nephrectomy. Robotic single port partial nephrectomy had been carried out using Xi single-site platform (XiSSP), and newest model of SP surgical system (Intuitive Surgical, Sunnyvale, CA, USA) [9-11]. In a Korean study, retrospective chart review of patients underwent robot LESS by a single surgeon using the XiSSP from November 2016 and May 2019 was performed. Multichannel port and "Lap Single Vision" port access platform were placed through a single periumbilical incision. Five patients underwent single-site surgery with partial nephrectomy. Among surgeries for the partial nephrectomy patients, one case was converted to multi-port robotic surgery due to difficulty of tumor resection; all other four cases were successful completed [9]. In their other retrospective study, the feasibility of partial nephrectomy using the novel SP surgical system with comparison to XiSSP was investigated. For the SP system. A GelPOINT® access platform (Applied Medical, Rancho Santa Margarita, CA, USA) was placed through a single periumbilical incision. A 25-mm multichannel robotic port and assistant's ports were placed in the GelSeal cap. No additional incisions were required for the assistant or liver traction. Fourteen patients underwent single-site partial nephrectomy with the SP surgical system (n = 9) or XiSSP (n = 5). They experienced no limitations in accessing tumors in the upper aspect of the kidney using the SP system. One case of tumor fracture occurred with the SP system while one case of conversion to multiport robotic surgery

occurred with the XiSSP. The postoperative course was uneventful in all patients with only Clavien-Dindo 1 complications occurred. They found that the SP system resolved many limitations associated with LESS and the XiSSP, and true single-site partial nephrectomy could be performed safely with the SP surgical system [10]. In a US study with 100 patients who underwent single-port robotic urological surgeries using purpose-built single-port robotic platform, a wide range of pelvic and retroperitoneal urological procedures were able to be completed successfully with different approaches, including transperitoneal (n = 37), extraperitoneal (n = 53) and transvesical (n = 10) approaches. Among them, 6 patients underwent partial nephrectomy and all the surgeries were successful done [11].

Radical Cystectomy

In a study with 4 consecutive patients diagnosed with urothelial carcinoma of the bladder, all patient underwent robot-assisted radical cystectomy (RARC) with pelvic lymph node dissection (PLND) and ileal conduit urinary diversion using the da Vinci SP surgical system. A 3-cm midline incision was made 5-cm above the umbilicus. Insertion of the GelPOINT® advanced access platform with the SP Cannula was performed through the incision made after necessary dissection to access the abdominal cavity. A 12-mm AirSeal® (SurgiQuest Inc., Milford, CT, USA) port for the assistant was placed on the pre-marked stoma site. The surgeries were successfully completed and all were found to have negative surgical margins. The mean operative time was 454 min while the average blood loss was 312 mL. They were able to discharge all the patients on postoperative day 5. From their preliminary experience, RARC with PLND and ileal conduit urinary diversion was found to be feasible and safe using the da Vinci SP surgical system [12].

In a study from China, 38 LESS RCs with cutaneous ureterostomy (CU) and eight LESS RCs with orthotopic ileal neobladder (OIN) were performed. Access was achieved via a single-port, with four channels placed through a transumbilical incision. After the apex of prostate was separated from the urethra, a self-developed port ('Zhu's port') was inserted through the urethra to facilitate resection of prostate and urethrovesical anastomosis. For LESS RC with CU and LESS RC with OIN, the mean operating time was 215, and 328 min, mean estimated blood loss was 175 and 252 mL, and mean hospital stay was 9.4 and 18.2 days, respectively. Only six patients required blood transfusion (5.26%). Intra-operative complications occurred in two patients (1.75%), and postoperative complications occurred in nine (7.89%) [13]. In another study, transperineal approach for intracorporeal ileal conduit urinary diversion using a purpose-built single-port robotic system was reported. The benefits of the trans-perineal approach might include the avoided need of Trendelenburg position, with undoubted advantages for the patient and the anesthesiologist in terms of respiratory mechanics and hemodynamics [4].

Radical Prostatectomy

In the study by Jihad Kaouk *et al.* using a purpose-built single-port robotic platform, single port radical prostatectomy was the most commonly performed surgery (60/100) with good outcomes [11]. In his other study, 10 cases of extraperitoneal robot-assisted radical prostatectomy (RARP) were performed using the da Vinci SP® Surgical

System [14]. The extraperitoneal SP-RARP was performed step-by-step as follows. Firstly, a 3-cm incision approximately 2 cm below the umbilicus was made. Dissection of the extraperitoneal space was achieved using a kidney shaped Spacemaker™ balloon (Covidien, Dublin, Ireland), placed through the infra-umbilical incision caudally reaching the retroperitoneal space. The balloon was subsequently deployed; the space was created and verified under direct vision with a laparoscopic endoscope. A GelPOINT® mini advanced access platform was then inserted, and a dedicated 25-mm multichannel port was placed with a 12-mm accessory laparoscopic port through the gel-seal cap into the same incision. The da Vinci SP surgical platform robot was then docked with the patient in a supine position. RARP was then performed. No drain and no additional assistant ports were utilized. The median operative time was 197.5 (185.5-229.7) min. They found possible advantages including a small single incision, no additional ports, no Trendelenburg positioning, minimal postoperative pain and use of opioids, and same day discharge [14].

Chang *et al.* reported a single port radical prostatectomy (spRALP) performed with a Si-Robotic system, with a quadri-channel laparoscopic port placed supraumbilically [15]. The surgery was successfully carried out with a duration of 152 min and an estimated blood loss of 100 mL. In the study by Kim *et al.*, initial single-surgeon experience with SP-RARP using the da Vinci SP surgical system was reported [16]. SP-RARP was performed using the conventional approach through an umbilical port with a GelPOINT access system and an additional assist port. During surgery, the camera was placed in the 6- or 12-o'clock position, and a traction arm was placed in the counterpart position for upward or downward traction. In 11 patients that underwent lymph node dissection, the median number of lymph nodes removed was 19. Median operative time was 245 minutes, and median console time was 190 minutes. Median blood loss was 200 mL, and there were no intraoperative complications or open conversion. In Su *et al.* study, 68 LESS RPs were performed with the help of the Zhu's transurethral port [13]. The average operating time was 152 min. Estimated blood loss was 117 mL. Fourteen out of 68 (20.6%) patients who underwent LESS RP had positive surgical margins. In the prostate cancer cases, good urinary control was observed in 35.3%, 97.1% and 100% of patients at 1, 6 and 12 months after the operation, respectively, while biochemical recurrence was observed in 11.8% patients.

Other Urogenital Cancer Surgeries

Single port adrenalectomy, nephroureterectomy, retroperitoneal lymph node dissection (RPLND), and extirpative pediatric urological cases were reported with successful outcomes [8, 10, 17]. In the study from Japan, both single port adrenalectomy (177/469) and nephroureterectomy (40/469) were commonly performed in their institution [8].

Summary

A wide range of single port laparoscopic or robot-assisted laparoscopic pelvic and retroperitoneal urological procedures can be done with different approaches. Randomized trials with larger sample size and longer postoperative follow up period are suggested for further evaluation of the outcomes and added value.

Acknowledgement

None.

Conflicts of Interest

None.

Abbreviations

R-LESS: Robotic Laparoendoscopic Single-Site Technique
PT: Pneumoperitoneum Time
XiSSP: Xi Single-Site Platform
RARC: Robot-Assisted Radical Cystectomy
PLND: Pelvic Lymph Node Dissection
LESS: Laparoendoscopic Single-Site Technique
RC: Radical Cystectomy
CU: Cutaneous Ureterostomy
OIN: Orthotopic Ileal Neobladder
RARP: Robot-Assisted Radical Prostatectomy
spRALP: Single Port Radical Prostatectomy
SP-RARP: Single-Port Robot-Assisted Radical Prostatectomy
RP: Radical Prostatectomy
RPLND: Retroperitoneal Lymph Node Dissection

REFERENCES

- Francisco Hidelbrando Alves Mota Filho, Luis Felipe Sávio, Rafael Eiji Sakata, Renato Fidelis Ivanovic, Marco Antonio Nunes da Silva et al. (2018) Robot-assisted Single Port Radical Nephrectomy and Cholecystectomy: Description and Technical Aspects. *Int Braz J Urol* 44: 202-203. [[Crossref](#)]
- Kazuhiro Matsumoto, Akira Miyajima, Keishiro Fukumoto, Akari Komatsuda, Naoya Niwa et al. (2017) Factors Influencing the Operating Time for Single-Port Laparoscopic Radical Nephrectomy: Focus on the Anatomy and Distribution of the Renal Artery and Vein. *Jpn J Clin Oncol* 47: 976-980. [[Crossref](#)]
- Ryan J Nelson, Jaya Sai S Chavali, Nitin Yerram, Paurush Babbar and Jihad H Kaouk (2017) Current Status of Robotic Single-Port Surgery. *Urol Ann* 9: 217-222. [[Crossref](#)]
- Juan Garisto, Riccardo Bertolo and Jihad Kaouk (2018) Transperineal Approach for Intracorporeal Ileal Conduit Urinary Diversion Using a Purpose-built Single-port Robotic System: Step-by-step. *Urology* 122: 179-184. [[Crossref](#)]
- Matthew J Maurice, Daniel Ramirez and Jihad H Kaouk (2017) Robotic Laparoendoscopic Single-site Retroperitoneal Renal Surgery: Initial Investigation of a Purpose-built Single-port Surgical System. *Eur Urol* 71: 643-647. [[Crossref](#)]
- Chi-Fai Ng, Eddie S Y Chan and Jeremy Y C Teoh (2019) The Use of the Da Vinci SP System for Retzius-sparing Radical Prostatectomy in Cadaveric Model. *Urology* 125: 260. [[Crossref](#)]
- Fuminori Sato, Ken Nakagawa, Akihiro Kawauchi, Akio Matsubara, Takatsugu Okegawa et al. (2017) Laparoendoscopic Single-Site Surgeries: A Multicenter Experience of 469 Cases in Japan. *Int J Urol* 24: 69-74. [[Crossref](#)]

8. E Amanov, T-D Nguyen, S Markmann, F Imkamp and J Burgner-Kahrs (2018) Toward a Flexible Variable Stiffness Endoport for Single-Site Partial Nephrectomy. *Ann Biomed Eng* 46: 1498-1510. [[Crossref](#)]
9. Hyung Ho Lee, Joon Chae Na, Young Eun Yoon, Koon Ho Rha and Woong Kyu Han (2020) Robot-assisted Laparoendoscopic Single-Site Upper Urinary Tract Surgery With Da Vinci Xi Surgical System: Initial Experience. *Investig Clin Urol* 61: 323-329. [[Crossref](#)]
10. Joon Chae Na, Hyung Ho Lee, Young Eun Yoon, Won Sik Jang, Young Deuk Choi et al. (2020) True Single-Site Partial Nephrectomy Using the SP Surgical System: Feasibility, Comparison With the Xi Single-Site Platform, and Step-By-Step Procedure Guide. *J Endourol* 34: 169-174. [[Crossref](#)]
11. Jihad Kaouk, Alireza Aminsharifi, Guilherme Sawczyn, Soodong Kim, Clark A Wilson et al. (2020) Single-Port Robotic Urological Surgery Using Purpose-Built Single-Port Surgical System: Single-Institutional Experience With the First 100 Cases. *Urology* 140: 77-84. [[Crossref](#)]
12. Jihad Kaouk, Juan Garisto, Mohamed Eltemamy and Riccardo Bertolo (2019) Step-by-step Technique for Single-Port Robot-Assisted Radical Cystectomy and Pelvic Lymph Nodes Dissection Using the Da Vinci® SP™ Surgical System. *BJU Int.* [[Crossref](#)]
13. Jian Su, Qingyi Zhu, Lin Yuan, Yang Zhang, Qingling Zhang et al. (2018) Transumbilical Laparoendoscopic Single-Site Radical Prostatectomy and Cystectomy With the Aid of a Transurethral Port: A Feasibility Study. *BJU Int.* 121: 111-118. [[Crossref](#)]
14. Jihad Kaouk, Rair Valero, Guilherme Sawczyn and Juan Garisto (2020) Extraperitoneal Single-Port Robot-Assisted Radical Prostatectomy: Initial Experience and Description of Technique. *BJU Int.* 125: 182-189. [[Crossref](#)]
15. Yifan Chang, Xiaojun Lu, Qingliang Zhu, Chuanliang Xu, Yinghao Sun et al. (2019) Single-port Transperitoneal Robotic-Assisted Laparoscopic Radical Prostatectomy (spRALP): Initial Experience. *Asian J Urol* 6: 294-297. [[Crossref](#)]
16. Kwang Hyun Kim, Wan Song, Hana Yoon and Dong Hyeon Lee (2020) Single-port Robot-Assisted Radical Prostatectomy With the Da Vinci SP System: A Single Surgeon's Experience. *Investig Clin Urol* 61: 173-179. [[Crossref](#)]
17. Ronak A Gor, Christopher J Long, Aseem R Shukla, Andrew J Kirsch, Marcos Perez-Brayfield et al. (2016) Multi-institutional Experience in Laparoendoscopic Single-site Surgery (LESS): For Major Extirpative and Reconstructive Procedures in Pediatric Urology. *Urology* 88: 173-178. [[Crossref](#)]