Original Article

Single Docking Robotic Surgery for Rectal Cancer

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Key Words
Single docking;
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Purpose. Robotic surgery with advantages potentially overcoming the limitations of laparoscopic surgery in pelvis was reported in many studies, but it is difficult to approach a wide range of operative field in rectal surgery including colon mobilization and pelvic dissection in once setting. The objective of this study is to evaluate the safety and feasibility of the single docking robotic surgery with arm flipping method for rectal cancer.
Materials and Methods. This is a retrospective review of the prospectively collected data of all patients who underwent single docking robotic rectal surgery at single-institution between January 2013 and October 2016. Baseline, perioperative and postoperative data were obtained for analysis.
Result. A total of 37 patients with a mean age of 61.79 years and a body mass index of 24.58 kg/m^2 who underwent robotic rectal surgery between January 2013 and October 2016 were collected. The most common operation was total mesorectal excision (62.16%) followed by low anterior resection (29.73%), abdominoperineal resection (8.11%). The mean operative and docking time was 211.07 (range 150-500) minutes and 22.44 (range 6-80) minutes, respectively. The median number of lymph nodes harvested was 18 (range 4-25). The median length of hospital stay was 6 (range 3-26) days. Anastomotic leakage occurred in two patients and surgical site infection in one patient. We had no conversion in these robotic operations.
Conclusions. Single docking robotic surgery with arm flipping method offers an adequate operative field, and it is safe and technically feasible for rectal cancer.
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Because of advantages of robotic surgery are the usage of multiarticulated instruments with superior dexterity and 3-dimensional visualization, it is thought to help overcoming the limitations of laparoscopic surgery in narrowing pelvis.[1] Robotic surgery has obtained an increasing amount of attention in the colorectal field after its successful implementation in urology and gynecology operation.[1-4] However, in robotic rectal surgery, due to the limited range of motion of the robotic arms and camera, it's difficult to approach different quadrant of abdomen for colon mobilization and pelvic dissection. Hybrid technique with laparoscopic assistant, arm flipping method, or double-docking method was applied to overcome these

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problems in rectal surgery.[5] Each of these approaches has its own advantages and deficits. The objective of this study is to evaluate the feasibility and safety of the single docking robotic surgery for rectal cancer.

Materials and Methods

Data collection

This is a retrospective review of the prospectively collected data of all patients who underwent single docking robotic rectal surgery using the da Vinci® Si-HD surgical system (Intuitive Surgical Inc., Sunnyvale, CA, USA) at single-institution between January 2013 and October 2016.

All patients undergoing single docking total robotic surgery for rectal cancer with arm flipping methods were enrolled in this study. Splenic flexure mobilization under robotic surgery was routinely performed in the cases receiving procedure of low anterior resection and total mesorectal excision. Diverting loop ileostomy was done in all cases of total mesorectal excision. Baseline, perioperative and postoperative data were obtained for analysis.

Operation procedure

In preparation, the patient is put in a lithotomy and Trendelenburg position with the patient's left side up. The patient's knees and body are in same level to avoid impact with the robotic arms. Both arms of the patient are tucked.

The ports and arms setting were described as the Fig. 1 for splenic flexure mobilization. The patient cart was docked on the left hip forming a 45 angle with the patient. Operative arms were placed one by one, in the following order: camera, Arm-1, Arm-2, and Arm-3. We perform splenic flexure mobilization along the embryologic plane with medial-to-lateral approach from the root of inferior mesenteric vein to the splenocolic ligament. Then we transect the gastrocolic ligament to divide the distal transverse colon from the greater omentum and the stomach. Afterwards, we deal the inferior mesenteric artery with high ligation and mobilize the left side colon with complete mesocolon.

Next, the Arm-3 is flipped to the left-upper port and the Arm-2 is flipped to the left-low port as Fig. 2 for pelvic dissection. Pelvic dissection is commenced posteriorly, and then continued bilaterally and anteriorly in a stepwise manner to the pelvic floor. The distal margin is transected by an Endo-GIA-45 mm/green (Ethicon Endo-Surgery, Inc, Cncinnati, Ohio, USA) through the port of the Arm-1 and total mesorectal excision is accomplished.

Anastomosis is performed using Circular Stapler, CDH-33 mm (Ethicon Endo-Surgery, Inc, Cncinnati, Ohio, USA). Routine intraoperative colonoscope is then performed to check for anastomotic leakage or bleeding.

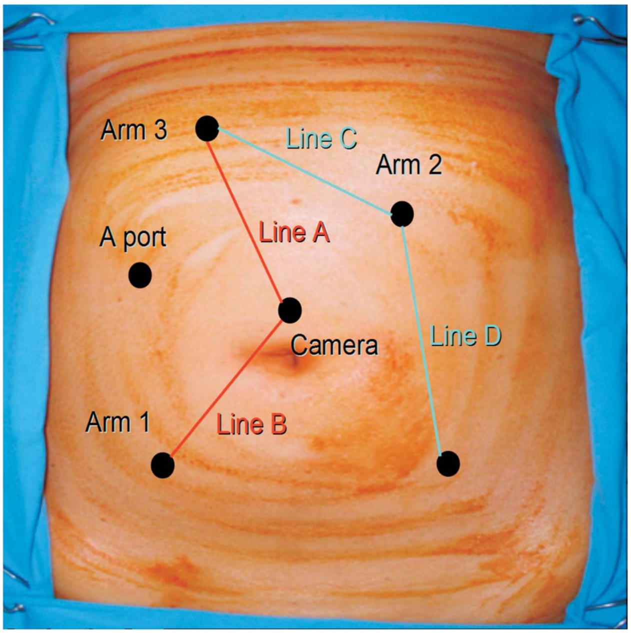

Fig. 1. For splenic flexure mobilization. The camera port as 12 mm trocar is set over supraumbilical area. The right-low port for Arm-1 is set over McBurney point and the left-low port is set over counter Mcburney point. The ports for Arm-3 and Arm-2 are set over right-upper quadrant and left-upper quadrant respectively. Length of the Line-A is equal to the Line-B and length of the Line-C is equal to the Line-D. Greater angles between Line-A to Line-B and Line-C to Line-D offer better operative space for robotic arms. The A-port is set over right abdomen for assistant.

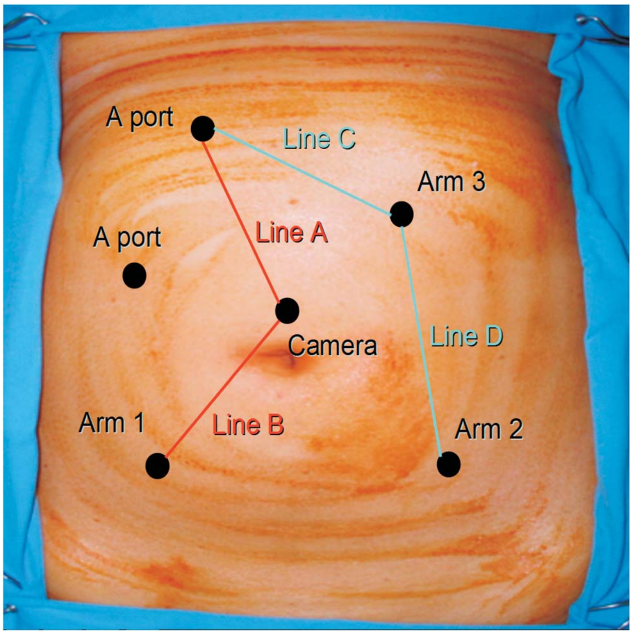

Fig. 2. For pelvic dissection. The Arm-3 is flipped to the left-upper port and the Arm-2 is flipped to the left-low port for pelvic dissection.

Results

The general and clinical characteristics data regarding the patients with rectal cancer are summarized in Table 1. A total of 37 patients were collected with a mean age of 61.28 and a body mass index of 24.54.

The operative procedure types for the 37 patients are presented in Table 2. The most common operation was total mesorectal excision (62.16%) followed by low anterior resection (29.73%), abdominoperineal resection (8.11%).

The peri-operative outcomes of robotic rectal surgery for the 37 patients are summarized in Table 3. The mean operative and docking time was 284.07 (range 150-500) minutes and 21.44 (range 6-80) minutes, respectively. The median number of lymph nodes harvested was 18 (range 12-37). The median length of hospital stay was 6.69 (range 3-26) days.

The short-term outcomes are summarized in Table 4. In all cases, anastomotic leak occurred in two patients who underwent robotic TME. Anastomotic leak rate of single docking total robotic rectal surgery was 5.4%. Surgical site infection was noted in one patient. There was mortality in a patient with an underlying disease as atrial fibrillation, and ischemic small bowel disease occurred at the fifth postoperative day. We had no conversation in these robotics operations to either laparoscopic surgery or open surgery.

Table 1. Basic characteristics of patients (n = 37)

Parameter	
Gender (n)	
Men	19
Women	18
Age (mean/years)	61.28 (38-84)
BMI (mean/kg/m^2)	24.54 (17.31-34.66)
Previous abdominal surgery (n)	6
ASA physical status (n)	
ASA-I	0
ASA-II	30
ASA-III	7
Tumor location (n)	
Upper rectum	12
Middle rectum	16
Low rectum	9
Neoadjuvant chemoradiation (n)	12
Pathological stage (n)	
Stage I	9
Stage II	5
Stage III	19
Stage VI	2
Complete response (n)	2

Table 2. Types of operative procedure (n = 37)

Procedure	n
LAR	11 (29.73%)
TME	23 (62.16%)
APR	3 (8.11%)

Table 3. Perioperative outcome of robotic surgery (n = 37)

Parameter	
Docking time (mean/mins)	21.44 (6-80)
Console time (mean/mins)	124.40 (80-300)
Operative time (mean/mins)	221.07 (150-500)
Blood loss (mean/ml)	68.38 (30-500)
Distal margin (mean/cm)	2.98 (0.5-7)
Circumferential margin (mean/cm)	0.95 (0.1-3)
Harvested lymph node (median/n)	18 (12-37)

Table 4. Short-term outcome of robotic surgery (n = 37)

Parameter	
Complication (n)	8
Surgical site infection	1
Anastomosis leakage	2
Ileus	2
Urinary retention	1
Pneumonia	1
Small intestine ischemia	1
Postoperative hospital stay (median/days)	6 (3-26)
Remove F oley, post-op day (median/days)	2 (1-4)
Conversion (n)	0
Mortality (n)	1 (small bowel ischemia)

Discussion

Many studies have described the potentially significant benefits in robotic rectal surgery,[6] especially; its lower conversion rate and better surgical specimen quality compared to laparoscopic surgery may offer improving survival.[6-12]

Although there are advantages of robotic rectal surgery, one of major deficit of robotic operation is the limited range of motion of robotic arm and camera during multiquadrant surgeries such as rectal surgery. Nevertheless, it is especially important to perform splenic flexure mobilization to achieve an appropriate length to create a tension-free anastomosis and safe margin in rectal surgery.[13-15] Frequently, dual docking technique is the method of choice to overcome this problem, but this may prolong the time of operation. In this study, an arm flipping method was used; this setting allowed surgery to complete splenic mobilization and rectal dissection without re-docking robotic surgical cart. It could reduce extra cost as surgical time and also offered benefit of robotic surgery on both quadrants.

There was no conversion in these series, whether to open method or laparoscopic surgery. Previous study suggests that conversion to open surgery could have a negative impact on overall recurrence rate.[9,12] The low conversion rate of surgical intervention for rectal cancer suggests expected better postoperative courses and improved oncological outcomes.[16]

In addition, the perioperative results are comparable with previously published study and our early experience with dual docking robotic surgery in rectal cancer.[17,18] Short-term oncological outcome including distal resection margin, circumferential margin and harvested lymph node are comparable to other series. As far as complication is concerned, arm flipping method did not increase the rate of complication, postoperatively.

The main limitation of this study lies in its retrospective nature and its small numbers. The condition of autonomic nerve preservation, urinary retention, fecal incontinence, and long-term outcome was not recorded in our series.

Conclusions

Single docking robotic surgery arm flipping method offers an adequate operative field, and it is safe and technically feasible for rectal cancer. However, more evidence is needed regarding whether it is superior to convention laparoscopic colorectal surgery or other colorectal surgical method.

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Nil.

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原　著

單次設置之直腸癌機器人手臂手術

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目的　許多研究報導了機器人手臂手術有潛力克服腹腔鏡手術在骨盆中的局限性。但單次設置之機器人手臂手術較難以操作範圍較大的手術，如直腸癌手術中，包含腹腔中結腸的剝離及骨盆腔中直腸的剝離。本研究的目的是評估單次設置機器人手臂手術於直腸癌的安全性和可行性。

材料和方法　這是對 2013 年 1 月至 2016 年 10 月間接受直腸癌機器人手臂手術所有患者的回顧性研究。針對病患基本資料、手術相關資料和術後數據進行分析。

結果　收集了於 2013 年 1 月至 2016 年 10 月間接受直腸癌機器人手臂手術的病人共 37 例。平均年齡 61.79 歲，平均體重指數為 24.58 kg/m^2。其中最常見的手術是全直腸切除術 (62.16%)，其次為低前位切除術 (29.73%)，腹部會陰切除手術 (8.11%)。平均手術時間和機器人手臂設置時間分別為 211.07 (150-500) 分鐘和 22.44 (6-80) 分鐘。摘取淋巴結中位數為 18 (4-25) 顆。住院時間中位數為 6 (3~26) 天。吻合處滲漏 2 例，手術部位感染 1 例。我們在這些機器人手臂手術中沒有改變術式。

結論　利用手臂翻轉的方式使單次設置之機器人手臂手術提供了適當的手術視野及範圍，並且對於直腸癌手術是安全和技術上可行的。

關鍵詞　單次設置、機器人手臂手術、直腸癌機器人手臂手術、直腸癌。