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Hand-assisted Robotic Approach for Ovarian Cancer Management

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Abstract

Robotic assisted staging surgery has been increasingly employed for a variety of gynecological malignancies such as ovarian, endometrial, and cervical cancers. Here we demonstrate a hand-assisted robotic approach for managing ovarian cancer with large tumor mass and predominantly solid components, where mini-laparotomy is performed followed by robotic surgical staging procedures. In this retrospective descriptive analysis of 29 ovarian cancer patients, admitted from December 2011 to May 2014, who had a large tumor mass (≥ 7 cm) and received laparoscopic surgical staging, traditional robotic surgical staging or hand-assisted robotic procedures, we reviewed for patient demographics, surgical procedures, and perioperative parameters. The results were comparable and we conclude the hand-assisted robotic approach offers a safe and feasible way to perform ovarian cancer surgical staging for patients with large tumor masses.

Keywords: Robotic surgery; Hand-assisted surgery; Ovarian cancer; Staging surgery; Laparoscopic surgery; Mini-laparotomy

Introduction

Since its introduction in 2005, robotic assisted surgical procedures have been widely adopted by gynecologists to perform surgical procedures such as cystectomies, sacral colpopexies, myomectomies, radical hysterectomies and cancer staging surgeries [1-6]. Recent studies show that, as compared to a conventional laparoscopic procedure or laparotomy, robotic surgery is associated with decreased blood loss; lower conversion rate; less intraoperative complications and shorter hospital stay [4,7-10]. Robotic assisted staging surgery has also been increasingly employed for a variety of gynecological malignancies such as ovarian, endometrial, and cervical cancers.

Ovarian cancer is a peritoneal disease, with a higher risk of peritoneal spread, compared to other gynecological cancers. Ovarian cancer is one of the ten leading cancer types and accounts for 3% of all new cancer cases among women in the United States in 2013 [11]. The overall 5-year survival rate of ovarian cancer is 43% [11], and when the disease is diagnosed in the early stages, the survival rate can be as high as 94% [12]. However, only 15% of women are diagnosed during the early stages, at which robotic surgery is considered an effective treatment [13]. For management at advanced stages, exploratory or extensive dissection of lesion sites in the abdomen and pelvis is required. With such cases, comprehensive surgical staging using robotic or laparoscopic procedures are thought to be difficult [13]. Robotic assisted surgery for these advanced cases faces obstacles such as difficulty removing large tumor masses without rupture into the peritoneal cavity and limited access to upper abdominal quadrants when disease is diffuse.

Here, we introduce a hand-assisted robotic cancer staging surgery technique, where a small midline laparotomy incision is first made caudal to the umbilicus. Large tumor masses may be aspirated and removed within an endo-bag under direct vision and upper abdominal procedures are done with more convenient access. Palpation of abdominal surfaces can also be done. The incision is then closed and the remaining robotic-assisted surgical staging procedures are performed as usual, with better field of vision. This technique for the management of large ovarian tumor masses and upper abdominal disease may save time and be an option where robotic staging surgery for ovarian cancer cases is considered.

Materials and Methods

From December 2011 to May 2014, a total of 32 ovarian cancer patients were treated by laparoscopy, traditional robotic-assisted surgery or hand-assisted robotic surgery for surgical staging procedures at our hospital. Among them, 29 patients had a large tumor mass, measuring greater than 7 cm, and these 29 patients were retrospectively analyzed for review of patient demographics, surgical procedures and peri-operative parameters.

Before surgery, all cases were evaluated by an expert meeting consisting of gynecologists, pathologists, radiologists, oncologists and robotic surgical team members. Among the enrolled cases, 12 patients received laparoscopic surgical staging, 6 patients received traditional robotic-assisted surgical staging, and 11 underwent hand-assisted robotic surgical staging. Robotic-assisted surgery was done sing a da Vinci Surgical Si System by a single surgeon. All cases reviewed were considered to have received optimal de-bulking and surgical staging. Intraoperative and postoperative parameters that were reviewed included operation time, blood loss, post-operative pain scores, and the time for hospital stay.

Technique: All patients underwent general anesthesia and were set in lithotomy position. Each patient was then draped in a sterile manner and a uterine manipulator was placed. All surgeries were performed by a single surgeon.

For patients who received laparoscopic or traditional robotic surgical staging surgery, pneumoperitoneum was first obtained and trocar placement was done. Laparoscopic surgical staging was done

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with camera port set at the umbilicus and three trocars placed at the following sites: 8-10 cm caudal-lateral to the scope at the left side of the patient; 8-10 cm caudal to the scope on the midline; and assistant port at 8-10 cm caudal-lateral to the scope at the right side of the patient, as needed. Laparoscopic surgery was performed mainly using mono-polar curved scissors and bipolar forceps. Grasper and suction irrigation was used via the assistant port to assist the surgical procedures.

For traditional robotic surgical staging using the da Vinci Surgical Si System, three trocars were docked at the following sites: 6 cm along the midline above the umbilicus for the scope and 8 to 10 cm bilateral to the scope for the two side arms. In addition, one 10 mm trocar was placed 6 to 8 cm caudo-lateral to the left arm for the accessory port. The side cart was set between the patient's legs and the robotic arms were docked. The robotic surgery was performed with monopolar curved scissors and fenestrated bipolar forceps. Grasper and suction irrigation was used via the accessory port to assist the surgical procedures.

Surgical staging procedures included total hysterectomy, bilateral salpingo-oophrectomy, bilateral pelvic lymph node dissection (including obturator, internal iliac, external iliac and common iliac lymph nodes), para-aortic lymph node dissection, omentectomy and appendectomy. Large ovarian tumor masses were placed in an endo-bag and then aspirated to avoid peritoneal spillage. Suspected malignant masses were removed and subjected for frozen section analysis for confirmation before the remaining procedures were done. To minimize bleeding, uterine arteries were also cauterized before the hysterectomy procedure. After all procedures were completed, the trocars were removed and the intra-abdominal gas was released. The trocar sites were closed with sutures and the patient was subjected for further evaluation.

For the hand-assisted robotic surgical procedures, a 4 to 5 cm in length midline abdominal incision beginning at the umbilicus was first performed. Unilateral salpingo-oophorectomy was carried out for frozen section analysis, and ascites was collected for cytology analysis. For removal of the large tumor masses, suction was applied to drain the cyst fluid within an endo-bag to avoid spillage. After deflating the cyst, it was removed and subjected for frozen section analysis. The wound was then sutured closed, and, if malignancy was confirmed, docking of the da Vinci Surgical Si System followed. Then, the remaining surgical procedures, as described before, including contralateral salpingo-oophrectomy, omentectomy, peritoneal washings, and appendectomy were performed.

Patient demographics and operative parameters: The medical charts of the enrolled cases were reviewed for patient demographics, surgical approach and procedures, peri-operative parameters, pathological staging, and surgical-related complications. The reviewed baseline characteristics of the enrolled patients included age, body mass index (BMI), percentage of cases with positive lymph nodes, and pathological staging in accordance with the International Federation of Gynecology and Obstetrics. The assessed intraoperative parameters included operation time, estimated blood loss, and lymph node yield. The post-operative parameters included 24-hour pain scores, amount of time before the patient was able to resume a full diet after surgery, and the length of hospital stay.

The volume of blood loss was defined as the total volume of fluids collected by suction during surgery. The operation time was measured from the time of skin incision to skin closure. All patients received pain control with patient-controlled analgesia (PCA) and non-steroidal anti-inflammatory drugs (NSAIDs) during postoperative care. The 24-hour pain score was measured 24 hours after the operation. The pain scores were self-reported and routinely evaluated for each patient during postoperative care using an adult pain score numerical rating scale (NRS-11). For reference of the pain score, scoring 0 indicates no pain, and scoring 10 indicates the worst pain imaginable. The amount of time before full diet resumption was defined as the number of postoperative days until the patients could tolerate regular intake of solid food. The length of hospital stay was defined as the number of postoperative days until the patient was discharged.

Statistical Analysis

For statistical analysis, the mean, standard deviation (SD), median, and range of each parameter were reported. To examine the differences between the surgical groups, statistical analysis was performed with one-way ANOVA with Turkey HSD post-hoc analysis or Chi-Square analysis; a p-value of less than .05 was considered statistically significant between the groups. All data were analyzed using SPSS statistics (version 21.0, IBM). The research protocols were approved by the Taipei Medical University Joint Institutional Review Board (TMUJIRB-201301047).

Results

Twenty-nine cases were evaluated in this study. All patients were reviewed for patient demographics, surgical procedures, and peri-operative parameters (Table 1). The mean ages were 42.2 ± 11.0 (traditional robotic surgical staging), 39.6 ± 12.3 (hand-assisted robotic surgical staging), and 45.5 ± 8.5 (laparoscopic surgical staging) for each surgical group. The mean BMIs were 22.8 ± 3.3 (traditional robotic surgical staging), 20.9 ± 3.1 (hand-assisted robotic surgical staging), and 22.9 ± 4.7 (laparoscopic surgical staging) kg/m2. The percentages of cases with positive lymph node findings from each group were 33.3% (traditional robotic surgical staging), 27.3% (hand-assisted robotic surgical staging), and 16.7% (laparoscopic surgical staging). The percentage and case number of each disease stage and histological type were also reported in the Table 1. The differences in age, BMI, disease

	Robotic surgical staging (n=6)	Hand-assisted robotic surgical staging (n=11)	Laparoscopic Surgical staging (n=12)	p-value
Age (years)	42.2 (11.0)	39.6 (12.3)	45.5 (8.5)	0.899
BMI (kg/m^2)	22.8 (3.3)	20.9 (3.1)	22.9 (4.7)	0.824
Tumor size (cm)	9.2 (2.5)	12.8 (4.7)	10.8 (3.4)	0.167
History of prior pelvic surgeries, % (n)	33.3% (2/6)	36.4% (4/11)	30.8 (4/13)	0.959
Cases with positive lymph nodes, % (n)	33.3% (2/6)	27.3% (3/11)	16.7% (2/12)	0.744
Pathological Stage				
Stage I	66.6% (4/6)	54.5% (6/11)	75.0% (9/12)	0.698
Stage II	0% (0/6)	9.1% (1/11)	8.3% (1/12)	0.754
Stage III	33.3% (2/6)	36.4% (4/11)	16.7% (2/12)	0.562

Table 1: Baseline characteristics of the enrolled patients.

stage, cases with positive lymph nodes, and pathological staging were found to be insignificant between the groups, indicating that the study population of each group was comparable.

The intra-operative and post-operative parameters for all patients are shown in Table 2. The operation time was significantly reduced in the traditional robotic and hand-assisted robotic surgical staging group (mean 151.8 ± 28.8 min and 185.8 ± 45.3 min, respectively) compared with the laparoscopic surgical staging group (266.7 ± 96.9 min). The volume of blood loss during the operation was also significantly decreased in the traditional robotic and hand-assisted robotic surgical staging group (mean 66.7 ± 40.8 mL and 145.5 ± 119.3 mL, respectively) compared with the laparoscopic surgical staging group (412.5 ± 371.2 mL). The average number of dissected lymph nodes appeared comparable as seen in Table 2. Intra-operative complications were not observed in any cases. No patient in the traditional robotic surgical staging or laparoscopic surgical staging group underwent conversion to laparotomy during the operation.

Post-operative outcomes including pain scores, amount of time before resumption of full diet and days of hospital stay for all surgical groups were evaluated as well (Table 2). The average 24-hour postoperative pain score and amount of time before resumption of full diet for the three groups showed no significant difference. Furthermore, compared with the laparoscopic surgical staging group (6.3 ± 2.7 days), the traditional robotic surgical staging group (3.03 ± 0.6 days) and hand-assisted robotic surgical staging group (3.4 ± 1.5 days) showed significantly decreased duration of hospital stay. Postoperative complications were not observed in any of the cases.

Discussion

The hand assisted robotic approach offers a safe and feasible way to perform ovarian cancer staging surgery for patients with large tumor masses and solid components. Our results show that many peri-operative parameters of the hand-assisted robotic staging surgery group are comparable to the traditional robotic-assisted staging surgery group. Considering the hand-assisted robotic approach includes a laparotomy wound, it was expected that operation time, pain scores or length of hospital stay would differ from the traditional robotic approach, but our data showed that both groups had similar results in these categories. This may be due to small case number, surgeon experience or use of patient controlled analgesia postoperatively. Operation time may also have been comparable due to direct and clear view and access after docking provided by removal of the tumor mass first, so other surgical procedures could be done smoothly. Without a tumor mass hindering the surgical field, an experienced surgeon could easily and swiftly perform the necessary procedures. In the end, the hand-assisted robotic approach still showed to have improved results compared to the laparoscopic approach, such as decreased operative time and blood loss. Therefore, the hand-assisted robotic surgical staging is an option when deciding a surgical approach for large ovarian tumor masses with predominantly solid components.

Though a laparotomy incision may be contradictory to minimally invasive surgery, it allows the surgeon to overcome previous limitations seen with robotic assisted surgical staging surgery. Tumor rupture and spillage into the peritoneal cavity can be avoided and access to upper abdominal quadrants is achieved. In our experience, tumor masses 7 cm or larger are more difficult to manipulate and remove through the trocar wound within an endo-bag when the traditional robotic surgical staging method is employed. The hand-assisted method's small laparotomy wound would provide easy access and controlled removal of these tumor masses. All the while, the advantages of robotic surgery, including better visualization and more precise surgical manipulation, can be reserved for the deep retroperitoneal spaces of the pelvic cavity where it is most needed, such as for lymph node dissection.

Large tumor masses are difficult to remove without rupture while

	Robotic surgical staging (n=6)	Hand-assisted robotic surgical staging (n=11)	Laparoscopic surgical staging (n=12)	Post-hoc analysis	p-value
Operation time (min)					
Mean	151.8 (28.8)	185.8 (45.3)	266.7 (96.9)	R=H<L	0.013
Median	153	195	285		
Range	(116-185)	(95-240)	(100-390)		
Estimated blood loss (mL)					
Mean	66.7 (40.8)	145.5 (119.3)	412.5 (371.2)	R=H<L	0.015
Median	50	50	300		
Range	(50-150)	(50-450)	(50-1200)		
Lymph node yield a					
Mean	30.3 (27.6)	32.2 (10.4)	20.2 (8.2)	R=H=L	0.27
Median	19	27	18.5		
Range	(15-71)	(21-47)	(7-33)		
24-hour pain score					
Mean	1.7 (1.2)	1.7 (1.0)	4.3 (2.4)	R=H=L	0.053
Median	1	1	3		
Range	(1-3)	(1-3)	(1-8)		
Receiving full diet (days)					
Mean	1.8 (1.0)	1.7 (0.8)	1.9 (1.1)	R=H=L	0.968
Median	1.5	2	1		
Range	(1-3)	(1-3)	(1-3)		
Hospital stay (days)					
Mean	3.0 (0.6)	3.4 (1.5)	6.3 (2.7)	R=H<L	0.001
Median	3	3	6.5		
Range	(2-4)	(1-7)	(3-10)		

Table 2: Intra-operative and post-operative parameters of the enrolled patients.

performing robotic surgery. Use of laparoscopic bags is common but may still pose a risk if integrity of the bag is not maintained. Previous data show conflicting conclusions about the effect of intraoperative capsular rupture on the prognosis of ovarian cancer patients, but should still be avoided, as rupture or spillage will upstage the disease and may cause spread of tumor cells in the peritoneal cavity. Hand-assisted laparoscopic surgery for ovarian cancer patients was previously described by Krivak et al. where traditional laparoscopy was combined with placement of a hand intraperitoneally through a 6-7 cm midline vertical incision, providing the surgeon with tactile sensation during the procedure and ability to palpate peritoneal surfaces and retroperitoneal structures [14]. But here we have introduced a hand-assisted robotic staging surgery technique for ovarian cancer with a smaller vertical midline incision that can provide an opening to better wholly remove large ovarian tumor masses. In addition, upper abdominal procedures of staging surgery can be performed through this incision as well.

Robotic surgery was previously not suggested for patients with advanced ovarian cancer due to limited upper abdominal access with the standard trocar set-up for pelvic surgery. However, through the years, robotic surgery techniques have improved and new methods have been developed. In 2013, Nehzat et al. described a hybrid technique of combined conventional and robotic-assisted laparoscopy for staging and debulking of ovarian cancer, allowing better access to all four abdominal quadrants [15]. Here, we offer another option to resolve limited upper abdominal access through a midline incision, which most surgeons are familiar with and may decrease operating time. Through this incision, the surgeon is also able to palpate the abdominal cavity walls for peritoneal seeding and other tumor masses [16].

In our study, we have retrospectively reviewed ovarian cancer cases that have undergone hand-assisted robotic staging surgery. The hand-assisted robotic approach offers a safe and feasible way to perform ovarian cancer surgical staging for patients with large tumor mass and predominantly solid components. Though an additional midline incision seems contradictory to the principles of minimally invasive surgery, this technique provides a method to possibly decrease operating time and overcome current limitations of robotic surgery. The limitations of our study include small case number, the retrospective nature, and only short-term follow-up done. Further studies to compare outcomes, both short term and long term, between this technique and traditional robotic assisted staging surgery should be done to fully understand the benefits and disadvantages.

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