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Early Endometrial Cancer. Case-control study to evaluate the efficacy and safety of the new Robotic Single-site System

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Impossible is not a fact.
It is an opinion.

Muhammad Ali

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ABSTRACT

Objective: To compare surgical and cosmetic outcomes of robotic single-site (RSS) versus robotic multiport (RMP) approaches in early stage endometrial cancer.

Methods: This is a perspective case-control study, comparing peri-operative and early post-operative outcomes in RSS (cases) and RMP (controls) patients with early stage endometrial cancer. Clinical data including patient's demographics and peri-operative measures were recorded. Complications, hospital stay and post-operative pain were also considered. Cosmetic result was evaluated with Patient and Observer Scar Assessment Scale (POSAS).

Results: A total of 15 women who underwent RSS were matched with 13 controls treated by RMP. No significant differences were found in terms of age, histologic type, stage, and grading.
The mean operative time was similar (p=0.431) and also blood loss (p=0.611). No intra-operative complications occurred in both groups. The POSAS scores confirmed excellent cosmetic outcome of the RSS approach.

Conclusion: Our study suggests the safety and feasibility of RSS for staging early endometrial cancer without major differences from the RMP in terms of surgical outcomes. The POSAS revealed a significant higher evaluated cosmetic outcome in RSS patients.

CHAPTER 1

1. Background, rationale and objectives

Endometrial cancer (EC) is the most common gynecologic malignancy with over 40,000 cases diagnosed and >8000 women die from the disease each year in the United States[1]. Advanced disease (*International Federation of Gynecology and Obstetrics - FIGO* stage III/IV) has high probability of recur (until 50%) and 5-year survival is estimated around 50%. On the other hand, patients with early-stage disease (FIGO stage I, limited to the uterus) have an excellent prognosis, with 5-year survival of >90%[2].
Surgery is the mainstay for staging and optimizing treatment for women with EC, including a hysterectomy, bilateral salpingo-oophorectomy, and pelvic and para-aortic lymph node dissection, traditionally performed using a laparotomic midline incision.

In recent years, the surgical approach for the treatment of gynecologic cancers has considerably evolved, mainly thanks to the continuous technical and technological advances. Many procedures previously carried out through large incisions, deemed necessary to provide an adeguate access for abdominal and pelvic exploration, for complete staging and resection of the tumor, have been replaced by minimally invasive surgery.
Over the past 10 years, many studies have demonstrated that laparoscopy for the treatment of EC reduce blood loss, hospital stay, incidence and severity of surgical complications, is associated to better cosmesis compared with laparotomy, becoming effectively the standard surgical approach [3,4].

In 2005, the U.S. Food and Drug Administration (FDA) approved the da Vinci robotic computer based platform (*Intuitive Surgical Inc., Sunnyvale, CA, USA)* for gynecology (**Figure 1**), and in 2006, *Sert and Abeler* performed the first robotic-assisted radical hysterectomy with lymphadenectomy, having optimal clinical results [9].
Robotic surgery therefore appears as a revolutionary tool for the management of gynecological cancer, enabling surgeons to overcome many technical challenges typical of conventional laparoscopy by offering an ergonomic instrumentation, the three-dimensional imaging and an enhanced surgical precision [5,6]. Moreover, robotic surgery appears to offer an advantage in the management of very obese women with EC, with a lower conversion rate compared to standard laparoscopy [7,8].

Despite the role of laparoscopic surgery in the management of gynecological cancers and its potential for excellent outcomes are well-established, multiport laparoscopy is not without risks. Most gynecological procedures require 3-5 trocars placement, including muscle-splitting incisions, and recent reports highlight a greater risk of morbidity associated with multiple incisions (pain, infection, hernia) [10,11]. In order to reduce the number of accesses and the potential morbidity associated, as well as improve patient satisfaction, laparo-endoscopic single-site surgery (LESS) was developed [12,13].

The LESS approach is based on a unique umbilical incision to perform abdominal-pelvic surgery, keeping the possibility to make the same procedural steps carried out with multiport laparoscopy [14,15].
Although LESS has been shown to have peri-operative outcomes comparable with those of conventional laparoscopy, many technical and ergonomic limitations are highlighted and the uptake of LESS is still low among gynecologic oncologists [16-19].

Therefore, robotic single-site (RSS) surgery was proposed as alternative to LESS, developing in 2010 the *Da Vinci Single-Site©*

Surgical Platform, a set of single-site instruments and accessories by Intuitive Surgical Inc. that is specifically dedicated to RSS surgery.
The basic idea was to combine the surgeon dexterity and ergonomics obtained with the help of robotic technology with the full potential of the single access approach [20], giving the possibility to overcome some of the technical limitations of LESS [10].
Escobar et al. first reported on the feasibility of gynecologic applications with a newly designed robotic single-port in a cadaver series [21]. The presence of single-site port requires only one entry point (situated at the umbilical region) and it represents an attempt to achieve further reduction in port-associated complications and improvement of the cosmetic results.

The primary aim of this study was to compare the RSS system versus the robotic multiport (RMP) system in the treatment of early stage endometrial cancer in terms of surgical efficacy and safety. The secondary objective was to investigate and compare the cosmetic results of scarring in the study groups, based on subjective and objective evaluations.

CHAPTER 2

2. Materials and Methods

This is a prospective case–control study, comparing surgical outcomes of RSS and RMP systems in the in early stage endometrial cancer patients. The study was conduct with the collaboration of Gynecology and Obstetrics Unit of “Villa Sofia Cervello” Hospital, University of Palermo (Italy) and the the Gynecologic Oncologic Unit, National Cancer Institute “Regina Elena”, Rome (Italy), both referral centers for gynecological endoscopic surgery. The institutional review board and the local ethics committee approved the study.

2.1 Patients and data collection

Eligibility criteria include: histological diagnosis of early stage endometrial cancer (FIGO stage IA - IB) [22], endometrioid histotype at biopsy, no lymph nodes, adnexal and/or cervical involvement at computed tomography (TC) /magnetic resonance imaging (MRI), adequate vaginal access, uterine size over 12 weeks of pregnancy, age 18 years or older and absence of any cognitive impairment. Every endometrial biopsy was performed by office hysteroscopy.

Exclusion criteria were as follows: documented clinically important cardiopulmonary disease or conditions that contraindicate for minimally invasive approach (obese patients who could not sustain a steep Trendelenburg position) and patients with large uterine requiring morcellation, prior pelvic or abdominal radiotherapy, severe hip disease precluding the use of the dorso-lithotomy position. Considering the secondary outcome of the study (evaluation of

cosmetic results), previous abdominal surgery was considered an exclusion criteria, except previous Pfannestiel incision (for cesarian or benign pathology).

Women were informed on both the RSS and RMP techniques, and signed a written informed consent, presenting the risk of laparoscopic and/or laparotomic conversion for completion of the procedure. Pre-treatment clinical data included: demographic data, medical history collection, physical and vaginal-pelvic examination, chest X-ray, ultrasound scan, and abdominal-pelvic II level imaging (TC and/or MRI).

Intra-operative parameters including operative time (in minutes), blood loss (in milliliters), conversion rate and complications were recorded. Operating time was defined from the beginning of skin incision to completion of skin closure. The estimated blood loss was calculated by the difference in the total amounts of suctioned and irrigation fluids. Intra-operative complications were defined as any injury to the bowel, bladder, ureteres, nerves or blood vessels or an estimated blood loss exceeding 300 ml. Pelvic lymphadenectomy was performed based on pre-operative analysis of the uterus (i.e., myometrial invasion >50%, and grade 2-3). Post-operative parameters included complications, length of hospitalization (in days), pain at hospital discharge, definitive histology, cosmetic result of scarring. Post-operative complications were defined as any adverse event occurring within 30 days from surgery.

Post-operative pain at the time of discharge was evaluated using VAS scale (Visual Analogue Scale), which consists simply of a strip of 10 cm paper at the ends presenting two "end points" that are defined with "no pain" and "worst pain that I can imagine" [23]. Cosmetic outcome was evaluated at least 6 months after procedure, thought the *POSAS - Patient and Observer Scar Assessment Scale*, an international validated questionnaire based on the opinions of both the patient and the surgeon regarding the appearance of the

scar [24], Patients were allowed to go home when they were fully mobile, apyrexial, and passing urine satisfactorily.

2.2 Surgical technique

All patients have antibiotic prophylaxis and peri-operative low molecular weight enoxaparin. The vaginal cavity is cleansed with povidone iodine solution and bladder catheterization was performed by Foley. No uterus manipulator devices were used, but the cervix was closed with a traditional tenaculum or using a specific modified tenaculum [25] and a medical grade silicone balloon, named colpo-pneumo occluder (*Cooper Surgical, Trumbull, CT, USA*) was also emplaced in the vagina for preserving the adequate pneumoperitoneum during colpotomy.

All procedures were performed under general endotracheal anesthesia. A careful inspection of the entire abdomino-pelvic cavity was always performed with the endoscope in order to identify any suspicious peritoneal lesion that would exclude the patient from the study (need to modify the management to the pathology) and peritoneal washing was routinely carried out.
In all patients, the uterus, the adnexa and eventual lymph nodes were extracted throughout the vagina; the vaginal vault was closed using the vaginal way and each layer of the access port was sutured separately.

2.2.1 RSS procedure

A 2 cm long incision (along the longitudinal axis of the body) over the lower rim of the umbilicus, under the level of the fascia was performed. Using an a-traumatic clamp, the Single-site® port *(Intuitive Surgical, Sunnyvale, CA)* was grasped just above the lower rim, after its lubrication in a sterile solution (saline or water). The leading edge of the folded port was inserted into the incision, while counter-traction was provided by retractors within the incision

(**Figure 2**). Then, CO2 insufflation of approximately 12 mmHg was started to obtain the opportune pneumoperitoneum: the proper positioning of the port was achieved when the top port flange lies flat against the abdominal wall and the port was not bulging or deformed. Then, the table was placed in the Trendelenburg position (30°).

Before docking, the Da Vinci Si robotic column was positioned between the patient's feet and the robotic arms were opened: the setup joints were extended in a straight line and the camera arm was fixed in the “sweet spot” of the blue stripe on the arm. A Da Vinci Si 8.5 mm 30° endoscope was inserted vertically. Then, a 5x250 mm curved cannula (Arm 2) was lubricated and inserted through the designated lumen while the external rim of the port was held by the assistant to avoid displacement. The cannula, constantly visualized, was guided near to the uterus and then held still to allow docking. This was done by holding the cannula still in one hand while the other hand brings and mounts the arm to the second 5x250 mm curved cannula (Arm 1). Finally, the instruments were introduced: a monopolar cautery on Arm 2 and a curved scissor on Arm 1 (**Figure 3**). The assistant's 5 mm accessory cannula, with which the assistant holds and moves either a suction/irrigator or another laparoscopic device (mono or multi-function).

Class A radical hysterectomy plus bilateral salphingo-oophorectomy, with or without pelvic lymphadenectomy, was performed according to Querleu and Morrow classification [26]. After the resection of the round ligament and an incision of the retroperitoneum over the course of the iliac external vessels, the retroperitoneal spaces (paravesical space, Lasko fossa, medial pararectal fossa, or Okabayashi pararectal space) were developed, from the right side to the left. The ureter was visualized, a window was opened between the ovarian pedicle above and the ureter below, and ovarian pedicles resection were performed. The uterus and the adnexa were extracted through the vagina and sent for frozen section analysis for all patients. Lymph

node dissection was judged unnecessary for low-risk early-stage endometrial cancer.

2.2.2 RMP procedure

Patients were placed in the lithotomy position with the arms tucked at each side. After the creation of a pneumoperitoneum to 12 mm Hg with a transumbilical Veress needle, a 12-mm trocar was placed at the umbilical level. Three 8-mm trocars, specific for the da Vinci robotic systems *(Intuitive Surgical)* were placed: one (Arm 1) on the right side of the abdominal wall, medial and cranial to the right anterior upper iliac spine, and two on the left side of the abdominal wall. The first (Arm 2) on the left lowest rib and the second (Arm 3) medial and cranial to the left anterior upper iliac spine on the same line of the right trocar, and fastened to the robotic arms. An assistant 10-mm trocar was placed on the right side of the abdominal wall, 7 to 10 cm laterally, from the supra-umbilical trocar (**Figure 4**).

After we obtained the Trendelenburg position (30°), the da Vinci robotic column was positioned near the operating table between the patient's feet and docked. The instruments were introduced: a bipolar grasper and a grasper on the left robotic trocars (Arms 2 and 3, respectively), and a monopolar scissor on the right robotic trocar (Arm 1). A 30° Surgical Intuitive endoscope was used during all operations. Class A radical hysterectomy plus bilateral salphingo-oophorectomy, with or without pelvic lymphadenectomy, was performed according to Querleu and Morrow classification [26], as specified above.

2.3 POSAS - Patient and Observer Scar Assessment Scale

The POSAS is a recent and validated scar assessment tool incorporating both observer and patient scar evaluations. It consists of 2 distinct scales: the OSAS and the PSAS [24].

The original version of the OSAS consisted of 5 variables: thickness, relief, pliability, vascularity, and pigmentation; then, a modified version was created because another item, that is the “surface area” evaluation, was added. It was based on the results of a linear regression analysis that showed that the opinion of the observer is most influenced by the dimension of the scar area [27].

The PSAS consists of 6 items evaluated by the patient: scar-related pain, itchiness, color, stiffness, thickness, and irregularity.

Each POSAS item has a 10-point scoring system, with 1 representing normal skin and 10 the worst imaginable scar or sensation; these items are then summed to obtain a total score ranging from 6 to 60 for each scale.

In addition to the POSAS score, both observer and patient gave their own overall opinion on the appearance of the scar using a 10-point scale. The scale was administered by the attending physician to the patients at the appointment scheduled at least 6 months after surgery.

2.4 Statistical analysis

Absolute and relative frequencies have been reported for qualitative variables, and medians (interquartile ranges) have been reported for quantitative, non-normally distributed variables. Normal distribution was verified by Shapiro-Wilk’s test for normality, and median data were compared using the Mann-Whitney test. Categorical variables were analyzed using chi^2 test (Mantel-Haenszel). For all analyses, a p-value of 0.05 was assumed to indicate significance. Age and all variables that were found to be associated with PSAS 60<11 in the bivariate analysis with a $p<0.2$ were included in a multivariable logistic regression model. Goodness of fit was calculated for each model, and the model with the lowest Akaike Information Criterion was considered to have the best fit. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated for the variables retained in the final model. All data were analyzed using STATA v14.2 statistical software.

CHAPTER 3

3. Results

A total of 28 women were enrolled between January 2015 and July 2017 and included in the study analysis. Fifteen patients who underwent RSS hysterectomy (*cases*) were matched with 13 *controls* treated by RMP hysterectomy.

3.1 Patient's characteristics

No significant differences between groups were observed (**Table 1**), except for the BMI (26.6 *vs* 35.1, *p 0.001*). No significant difference were found in comorbidity rate between the two groups. Previous abdominal surgery was performed in 32% of the patients (9/28). No patients were converted to laparotomy or laparoscopy.

3.2 Peri-operative parameters

All women underwent class A radical hysterectomy and bilateral salpingo-oophorectomy, with or without pelvic lymphadenectomy, based on frozen section analysis (**Table 2**).

Patients in the RSS and RMP group had a similar median operative time of the control group with 90 and 80 minutes, respectively. No statistically significant differences were recorded about estimated blood loss, complications and hospital stay (**Table 2**).

Neither in RSS than in RMP patients intra-operative complications were observed. No additional assistant port was added for traction or coagulation purposes. No conversion to laparotomy or laparoscopy was necessary.

Pathologic findings were similar between the two groups in terms of FIGO stage and grading. Surgical margins of dissected vagina were free of disease in all cases (**Table 2**).

The number of pelvic lymph nodes removed were similar in the two groups: 1 pelvic lymphadenectomy were performed in IB FIGO stage G2 endometrial cancer, six in IB FIGO G2 endometrial cancer, and 2 in 1B FIGO stage G3. Definitive histologic results confirmed the frozen section examination: all of the specimens were diagnosed as endometrioid adenocarcinoma FIGO stage IA (73% in RSS and 61% in RMP group respectively) and FIGO stage IB (27% in RSS and 39% in RMP, respectively). The total amount of lymph nodes retrieved were negative for metastasis.

3.3. Post-operative parameters

The incidence of post-operative complications among groups was not statistically significant. In the RSS group, one patient had post-operative fever that need two more days of hospital stay; in RMP group, one patient had persistent vomiting in 2nd and 3rd post-operative days.

Patients with high-risk disease (stage IB; G3) underwent further adjuvant radiotherapy. The VAS data were comparable in two study groups (**Table 2**). To date, all patients were free from recurrence (range of follow-up, 6-30 months).

3.3.1 POSAS evaluation

Data on cosmetic outcomes, based on POSAS analysis, revealed significative differences between two groups. In the RSS group, PSAS and OSAS evaluation were comparable (**Table 3**), resulting in in a great esthetic impact of surgery. On the contrary, data from RMP group, expressed a worse cosmetic result with a significant statistical difference (*p <0,001*) (**Figure 6 and 7**).

CHAPTER 4

4. Discussion

After the preliminary encouraging results of application of RSS system for gynecological procedure on porcine and cadaveric model [28], in 2011 the first case worldwide of RSS hysterectomy was performed [29]. Since then, different experiences on the topic were reported in the international literature, showing the feasibility and safety of this innovative approach and suggesting a number of advantages, also in obese patients [30-34].

Already the introduction of LESS was a very important evolution: the use of a single small skin incision instead of the multiple accesses of the conventional laparoscopy improved port-related complications, recovery time, pain and cosmesis, respecting standard oncologic principles [13-15,35,36]. However, the actual role of this approach in the field of minimally invasive gynecologic surgery still remains to be accepted. Certainly, there are significant challenges compared with standard laparoscopy, such as loss of port triangulation with instrument crowding, loss of depth perception, need to manipulate a flexible camera and surgical instruments in a coordinated fashion through a small umbilical incision [16,19].
Consequently, the endoscopic surgeon needs a long learning curve period to achieve the proficiency to perform the LESS surgery comparable to standard surgical technique.

On the contrary, robotic surgery has today a clear role in gynecologic oncology surgery, thanks to its speed learning curve, greater maneuverability, comfortable ergonomics for the surgeon and good

operative outcomes. However, it still shows some disadvantages, as the size and number of port sites and the high costs [37].

Based on these considerations, the idea of blend together the principles of robotic surgery with the single access technique was quite consequential, in order to maximizing the advantages reducing their limits. It provides three-dimensional images, the semirigid, curved instrumentation offers a stable and safe platform with lack of instrument collisions, a rotation of the camera and of the instruments of about 45° in both sides, facilitating the execution of the surgical procedure [30].

The results of this study suggests the safety and feasibility of RSS in staging of early endometrial cancer without significant differences from the RMP in terms of surgical outcomes, post-operative pain, complications and conversions rates. These findings are similar to those obtained in other series reported in the literature [33].

In 2013, Vizza et al. reported the first study aimed at evaluating the feasibility and early post-operative outcomes of RSS in a consecutive series of 17 low-risk early endometrial cancer patients [30]. These data were a preliminary confirmation of the feasibility and safety of the RSS approach. Successively, Fagotti et al. reported the first retrospective case-control study comparing peri-operative outcomes of early-stage endometrial cancer patients who underwent RSS hysterectomy with the outcomes of a group of patients who underwent LESS hysterectomies [37]. The main conclusion obtained from this study was that the two procedures were similar in terms of operative time, blood loss and conversion/complication rates [37]; however, the robotic surgeon was also an expert in LESS and probably this aspect did not allow to adequately highlight the real advantages of RSS, first of all the annulment of the conflict between the instruments and the three-dimensional view.

In our experience, the absence of difference in the peri- and post-operative outcomes between the patients of two study groups is probably related to the high skill of the involved endoscopic surgeons. It is not a secondary aspect in the surgery field and in particular in robotic approach. However, literature data evidenced that the RSS technique can be learned by skillful surgeons in few number of cases: after a learning curve phase of about 10 cases, the surgeon may achieve a high level of competence [29].

One relevant limitation of the single-site platform is the semi-flexibility of the robotic instruments, which results in fewer degrees of freedom than multiport robotic surgery [30]. To overcome this limit, a project of *endowrist* instruments for the single-site device was created and it will be available soon. This innovation will be a jump forward in robotic filed, with significant reduction of operative time and costs.

Our study had the “cosmetic outcome” as accessory objective, considering that for female patients undergoing gynecologic surgery choosing a minimally invasive approach, the scar result is an important consideration, mainly in young patients. It's known that the problem of scarring can be wider, with relevant associated symptoms (pain, tenderness, and itching), distress, loss of self-esteem and a potential negative impact on overall quality of life [38].
The scar appearance is dependent from many factors (incision, type of suture, technique of skin apposition), some of which “surgeon-independent”. Certainly, the RMP system has a significant limit from this point of view and the possibility of use a RSS system should represent the way to overcome it, keeping the advantages of robotics.

For many years, the Vancouver Scar Scale [39], studied for the evaluation of burn scars, was the most frequently used scar assessment scale in clinical studies [40]. Nevertheless, over the years this scale showed some relevant limitations; in particular it it was inadequate when applied to other types of scarring and lacked in

evaluation of symptoms in terms of subjective opinion, that is important for an overall impression of the outcome.

To meet these needs, the POSAS was proposed as an important tool for the evaluation of all scar types and for achieve a global (subjective and objective) opinion of the scar. In this study, for the first time, we compared the cosmetic outcome in patients undergone to RSS and RMP surgery for early endometrial cancer. As expected, POSAS results in RSS group were significantly better than RMP group (p <0.001), confirming the excellent cosmetic outcome of RSS using a validated model of evaluation. Fewer incisions would also be expected to lead to fewer incisional complications including trocar insertion injuries to vascular or enteric structures, hernias, and nerve entrapment. It is important to note that the POSAS results of RMP group were anyway low values (PSAS 60/OSAS 60: 18; PSAS/OSAS: 5) and it could be explain considering that also multi-port technique remains a mini-invasive surgical approach, especially in comparison with laparotomic cases.

However, some limitations can be identified in this study, first of all the small size of the study population and short follow-up evaluation. Larger randomized studies and long-term follow-up data are needed to confirm these preliminary results.

In conclusion, our experience showed that, in experienced hands, RSS approach seems to be safe and feasible in endometrial cancer staging, with operative results comparable with traditional RMP surgery and with favorable short-term outcomes. Moreover, it is evident that the very satisfying cosmetic data on the singular umbilical scar is an important added value of the procedure.

TABLES AND FIGURES

Table 1. Demographic data of study population.

	RSS, n=15	RMP, n=13	*p*
Age, mean (DS)	59 (11)	60 (9)	0,712
BMI, mean (DS)	26,6 (6,0)	35,1 (5,2)	0,001
Parity, median (IQR)	2 (1-3)	1 (0-2)	0,750
Hypercholesterolemia, n (%)	8 (53)	7 (54)	0,978
Diabetes, n (%)	3 (20)	5 (38)	0,281
Cardiopathy, n (%)	1 (6)	0 (0)	0,343
Multiple sclerosis, n (%)	0 (0)	1 (8)	0,274
Inguinal hernia, n (%)	0 (0)	1 (8)	0,274

Table 2. Clinical data and surgical outcomes.

	RSS, n=15	RMP, n=13	*p*
Operative time (min), median (IQR)	90 (80-92)	80 (70-100)	0,431
Blood loss (mL), median (IQR)	50 (20-75)	50 (30-80)	0,611
Intra-op complications, n (%)	0 (0)	0 (0)	-
Conversion LPS/LPT, n (%)	0 (0)	0 (0)	-
Hospital stay, median (IQR)	4 (3-5)	4 (3-5)	0,750
Histology, n (%)			
-G1	6 (41)	8 (61)	0,476
-G2	8 (53)	4 (31)	
-G3	1 (6)	1 (8)	
FIGO stage, n (%)			
-1A	11 (73)	8 (61)	0,505
-1B	4 (27)	5 (39)	
Pelvic lymph nodes, n (%)	4 (27)	5 (39)	0,505
Post-op complications, n (%)	1 (6)	1 (8)	0,916
VAS, median (IQR)	1 (0-2)	1 (0-3)	0,055

Table 3. *POSAS* evaluation results.

	RSS, n=15	RMP, n=13	*p*
PSAS 60	8 (7-11)	18 (15-20)	<0,001
PSAS	1 (1-2)	5 (4-6)	<0,001
OSAS 60	8 (7-10)	18 (14-20)	<0,001
OSAS	2 (1-3)	5 (4-6)	<0,001

Figure 1. Components of the *da Vinci* Surgical System (A. Patient-side cart; B. Surgeon console), associated to a *Vision system*.

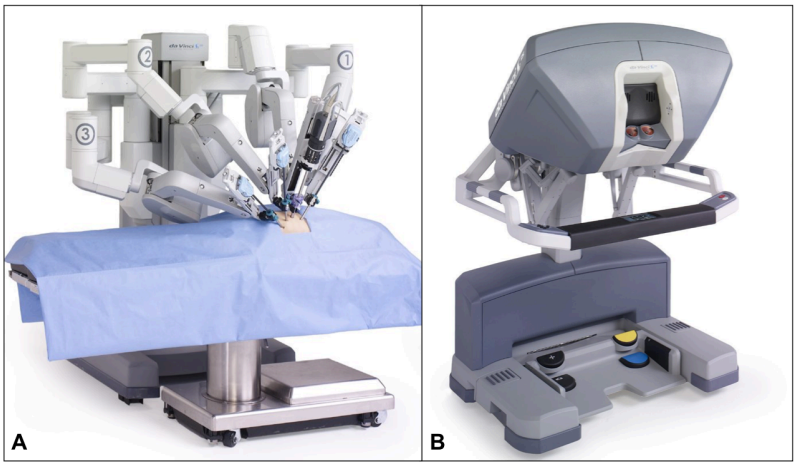


Figure 2. *da Vinci* Single-site port (*Intuitive Surgical Inc.*). In B the use of a-traumatic clamp to positioning the port, that than was placed in umbilical incision (C) [30].

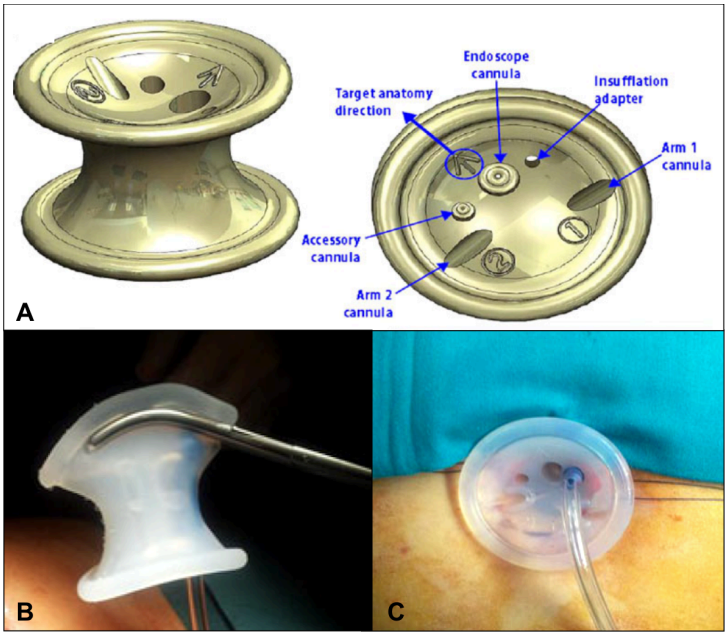


Figure 3. Single-site cluster (A) and robotic port dock (B) [29].

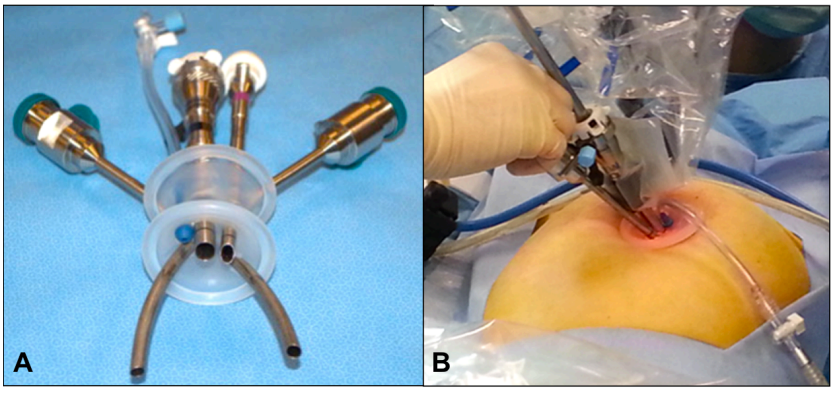


Figure 4. RSS system access (A) compared to RMP trocars (C), with respective graphic representation (B-D).

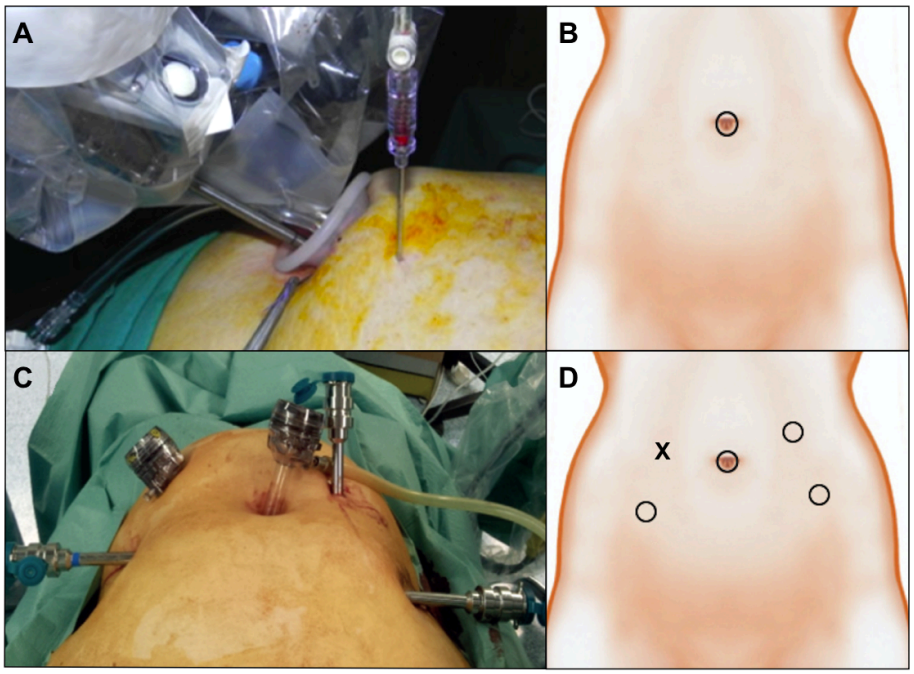


Figure 5. POSAS scheme [40].

		Observer Scar Assessment Scale (OSAS)										
	Normal skin	1	2	3	4	5	6	7	8	9	10	Worst scar imaginable
Vascularity		o	o	o	o	o	o	o	o	o	o	
Pale												
Pink												
Red												
Purple												
Mix												
Pigmentation		o	o	o	o	o	o	o	o	o	o	
Hypo												
Hyper												
Mix												
Thickness		o	o	o	o	o	o	o	o	o	o	
Thicker												
Thinner												
Relief		o	o	o	o	o	o	o	o	o	o	
More relief												
Less relief												
Mix												
Pliability		o	o	o	o	o	o	o	o	o	o	
Supple												
Stiff												
Mix												
Surface area		o	o	o	o	o	o	o	o	o	o	
Expansion												
Contraction												
Mix												
Overall opinion		o	o	o	o	o	o	o	o	o	o	
	Patient Scar Assessment Scale (PSAS)											
	No, not at all	1	2	3	4	5	6	7	8	9	10	Yes, very much
Has the scar been painful the past few weeks?		o	o	o	o	o	o	o	o	o	o	
Has the scar been itching the past few weeks?		o	o	o	o	o	o	o	o	o	o	
	No, as normal skin	1	2	3	4	5	6	7	8	9	10	Yes, very different
Is the scar colour different from the colour of your normal skin at present?		o	o	o	o	o	o	o	o	o	o	
Is the stiffness of the scar different from your normal skin at present?		o	o	o	o	o	o	o	o	o	o	
Is the thickness of the scar different from your normal skin at present?		o	o	o	o	o	o	o	o	o	o	
Is the scar more irregular than your normal skin at present?		o	o	o	o	o	o	o	o	o	o	
	As normal skin	1	2	3	4	5	6	7	8	9	10	Very different
What is your overall opinion of the scar compared to normal skin?		o	o	o	o	o	o	o	o	o	o	

Figure 6. Scar result after RSS surgery (A). In B, particular of umbilical area.

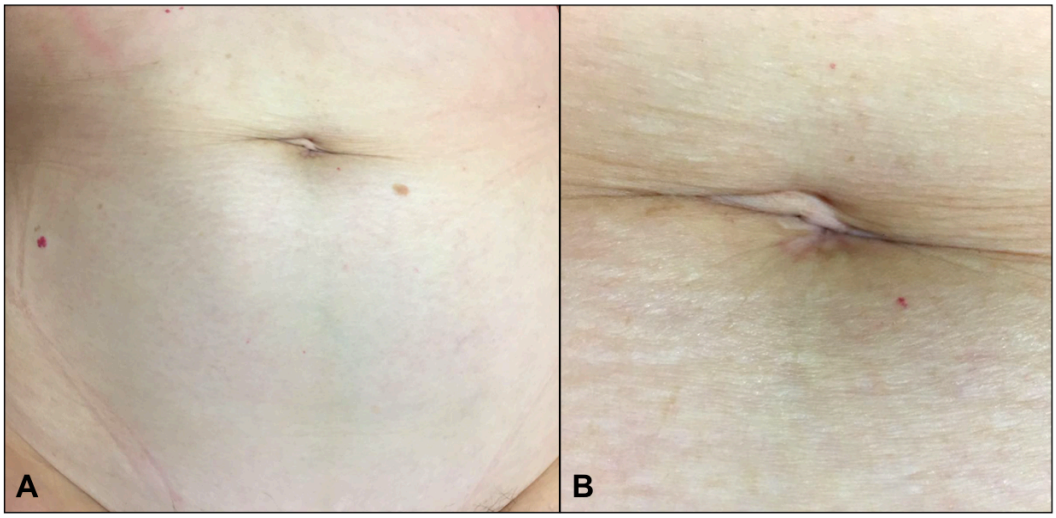
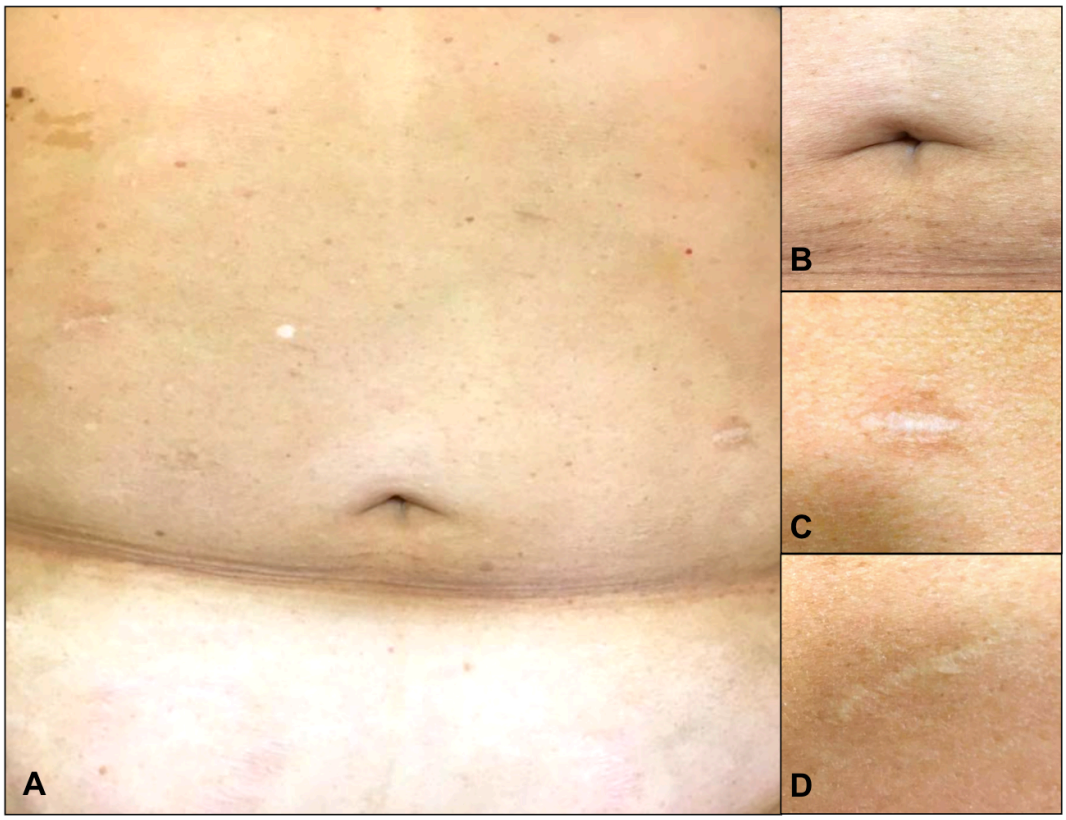


Figure 7. Scar result after RMP surgery (A), with specific magnifications (B-D).



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