# Application of da Vinci® Robot in simple or radical hysterectomy: Tips and tricks

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## Abstract

The first robotic simple hysterectomy was performed more than 10 years ago. These days, robotic-assisted hysterectomy is accepted as an alternative surgical approach and is applied both in benign and malignant surgical entities. The two important points that should be taken into account to optimize postoperative outcomes in the early period of a surgeon's training are how to achieve optimal oncological and functional results. Overcoming any technical challenge, as with any innovative surgical method, leads to an improved surgical operation timewise as well as for patients' safety. The standardization of the technique and recognition of critical anatomical landmarks are essential for optimal oncological and clinical outcomes on both simple and radical robotic-assisted hysterectomy. Based on our experience, our intention is to present user-friendly tips and tricks to optimize the application of a da Vinci® robot in simple or radical hysterectomies.

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## Introduction

Robotic simple hysterectomy was first performed by Diaz-Arrastia et al. (1) in 2002, while robotic radical hysterectomy was first performed by Sert et al. (2) in 2006. These days, robotic-assisted hysterectomy is widely accepted as an alternative surgical approach and is applied in both benign and malignant gynecological surgical entities (3, 4). Post-operative outcomes can be optimized by taking into consideration the main aims of a disease-free outcome combined with functional preservation. Overcoming any technical challenge leads to an improved surgical operation including patients' safety, surgeons' fatigue, cost, and operative time. Based on our experience, our aim is to present user-friendly tips and tricks to optimize the application of a da Vinci® (Intuitive Surgical Inc.; CA, USA) robot in simple or radical hysterectomies.

### Preoperative management

The day prior to surgery, a clear liquid diet is offered, while mechanical bowel preparation is based on surgeons' preferences. Some surgeons offer their patients a bowel preparation such as magnesium citrate the afternoon before the procedure. Based on our experience, we believe that there is no need for any mechanical bowel preparation as this approach has been proved to be safe and effective to both robotic and laparoscopic procedures. All anti-inflammatory drugs and blood thinners, such as aspirin, clopidogrel, and warfarin, are withheld for at least 7 days before surgery, and patients with medical indications can instead have low molecular weight heparin. Preoperative assessment by an experienced anesthetist in robotic surgery is essential for challenging patients e.g., obese or elderly with comorbidities. General anesthesia is induced, and the patient is placed in the lithotomy position. We tend to position the patient prior to anesthesia induction to achieve the best possible uterine manipulation. Intraoperative antibiotics (e.g., co-amoxiclav or cephalosporin and metronidazole) are administered as a single dose based on the Centers for Disease Control and Prevention antibiotic guidelines.

### Set-up

A patient was positioned in the modified lithotomy position with her legs on Allen stirrups (5). A Foley urinary catheter was inserted, and we tended to use bilateral ureteric stents, in our radical hysterectomies in particular, that are immediately removed postoperatively. We applied methylene blue on hours 12, 3, 6, and 9 in the vaginal fornices. This can help to intraoperatively recognize the edge of the cervix to the vagina; sometimes, using this, we avoid the use of any uterine manipulators and complete the entire operation with a swab on a stick in the vagina. Otherwise, two Vicryl® (Ethicon Inc.; USA) sutures are applied on the cervix (hours 12 and 6) to make the traction of the uterus at the end of the operation through the vagina easier. Different types of uterine manipulators can be used such as ZUMI® (Cooper Surgicals; CT, USA), BARD® (BARD Inc.; Billerica, MA, USA), HUMI® (UNIMAR; Wilton, CT,

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USA), Clermont-Ferrand® (Karl Storz; Germany), HOHL® (Karl Storz; Germany), Endopath® (Ethicon Endo-Surgery Inc.; OH, USA), Hourcabie (by Jacques Alain Hourcabie) (5, 6). We prefer the use of either the Sparkman followed by a McCartney tube at the time of colpotomy or V-Care® (ConMed EndoSurgery; Utica, NY, USA) uterine manipulator with the use of an internally inflated balloon to preserve the pneumoperitoneum. As the Trendelenburg position is also intraoperatively fundamental, to have a clear view in the surgical field, we used a gel pad placed under the patient with the aim of preventing her from sliding in the Trendelenburg position. After trocar insertions, we checked the Trendelenburg position with an inclinometer, which can be found as a smartphone application to achieve an angle of 25–30°. However, enough Trendelenburg is achieved when the bowels can remain pushed cephalad of the promontory to have access to the field as well as to avoid bowel injury. However, this is sometimes difficult in obese patients with central adiposity or in patients with other comorbidities that do not allow a deep Trendelenburg position.

**Pneumoperitoneum and trocar placement**

Pneumoperitoneum (up to 15–20 mmHg) is achieved either with a Veress needle in the middle of the umbilicus through Palmer's point or with the open Hasson technique. All ports were placed under direct vision. We placed the 12-mm primary trocar for the camera using Visiport™ (Covidien; USA) in the umbilicus or above it in a way that the distance of the uterine fundus from the umbilical port would be at least 10 cm. The correct placement of ports is crucial for avoiding robotic arm collision. Surgeons should avoid tunneling in the abdominal fat during trocar insertion. The operative trocars should be bilaterally positioned in an "M" or arch shape. More specifically, the robotic arms on the right were placed at least 8–10 cm apart, with the lower port slightly above the anterior superior iliac spine and the upper port triangulated between the umbilical port and lower port. The left-sided port was then placed parallel to the lower right-sided port. A 12-mm assistant port was then placed on the cephalad and to the left of the umbilical trocar. We prefer side docking, and we used bipolar diathermy at 40 in the left main port, scissors in the right main port with monopolar diathermy at 40 cut and coagulation, and ProGrasp™ (Intuitive Surgical Inc; CA, USA), Cadiere™ (Intuitive Surgical Inc; CA, USA) or Maryland™ (Intuitive Surgical Inc; CA, USA) forceps at the third arm. Additionally, 12 mmHg intra-abdominal pressure was intraoperatively used because of the deep Trendelenburg position, which could be decreased down to 8 mmHg if requested by the anesthetist for the patient's safety.

**Technique of simple hysterectomy**

Round ligaments are coagulated with bipolar diathermy and incised with monopolar scissors, and broad ligaments are opened. When we planned to perform pelvic lymph node dissection, we laterally incised the round ligaments. Ureters were bilaterally identified, and infundibulopelvic (IP) pedicles were taken with bipolar and monopolar. Laparoscopic clips could be used for extra hemostasis. We prefer to use hemalocks on IP pedicles. The bladder peritoneum was reflected. Uterine vessels were skeletonized and were then taken with bipolar and monopolar. Methylene blue spots were identified on hours 12, 3, 6, and 9. At the moment we used a Sparkman manipulator for uterine manipulation, we changed it to a McCartney tube™ (LiNA Medical ApS; United Kingdom). The vagina was entered either anteriorly or posteriorly between uterosacral ligaments but was always on top of the manipulator's (V-Care®) cervical cap or on top of the McCartney tube, and the dissection was circumferentially continued using monopolar scissors and bipolar diathermy. A uterine specimen was extracted through the vagina by pulling cervical sutures. A glove with a 9×9-cm swab was inserted in the vagina to maintain the pneumoperitoneum to minimize the cost in V-Care manipulator use; otherwise, the McCartney tube can be used for the same reason, but the cost would be higher. The vaginal vault was closed with a continuous v-loc barbed suture from the right to the left (7). No knot was necessary at the end, and it should be mentioned that it locked after the second stich. V-loc® (Covidien, USA) suture facilitates the easy suturing of the vault.

**Technique of radical hysterectomy**

The uterus is preferred to be instrumented with the V-Care® manipulator or a swab on a stick to avoid tumor contamination. Two Vicryl® sutures were used on the cervix (hours 12 and 6) to retract the specimen at the end of the operation. Round ligaments were coagulated with bipolar diathermy and incised with monopolar scissors, and broad ligaments opened. Paravesical and pararectal spaces were developed to identify cardinals, parametrial web, and lateral parametrium. The ureters were bilaterally identified and followed to the crossing with the uterine arteries. Bilateral ureteric stenting can optimize this step. We started with pelvic lymph node dissection bilaterally (the technique is going to be described in the following paragraph). Pelvic lymph nodes are sent for frozen section, and if proven positive, then para-aortic lymph node dissection is suggested higher to the level of the inferior mesenteric artery or up to renal vessels to clarify the extent of radiation field. The completion of radical hysterectomy is following if the lymph nodes are negative. More specifically, parametrial division was performed at the origin of the uterine vessels from the internal iliac artery and vein. The rectovaginal space was caudally developed caudally to the upper vaginal third; the ureters were separated from the peritoneum, and uterosacral ligaments were dissected depending on the type of radical hysterectomy. Bladder reflection followed to the upper vaginal third, and the ureters were followed to the entrance in the parametrial tunnel. A space was created above the ureter with monopolar, and the ventral part of the vesicouterine ligament was transected, and the ureter was unroofed. We tend to keep infundibulopelvic ligaments until the completion of radical hysterectomy to achieve better traction. At the end of the operation, they are taken with bipolar and monopolar, and hemalocks were used. If the adnexae were preserved, tubo-ovarian pedicles were divided along the lateral wall of the uterus, including the broad ligament. The vagina was entered anteriorly or posteriorly between the uterosacral ligaments on top of the manipulator, and dissection was circumferentially continued with monopolar and bipolar. The next steps are similar to simple hysterectomy.

**Technique of nerve-sparing radical hysterectomy**

Nerve-sparing radical hysterectomy can improve the quality of life by reducing urinary, rectal, and sexual dysfunction. The retroperitoneal space was opened to identify the ureter. The ureter was laterally removed, and the hypogastric nerve was identified posteriorly and medially to the ureter. Keeping the ureter and hypogastric nerve always under vision, the peritoneum was cut toward the pouch of Douglas. The rectum was dissected from the posterior part of the vaginal wall till the elevator muscle of the anus was reached. More specifically, the pararectal space was opened up to the level of the uterine veins with a Prograsp™ or Maryland™ forceps, preserving the branches of the pelvic splachnic nerves. The cardinal and the uterosacral ligaments were identified and dissected posteriorly to the paravesical area, and the hypogastric nerves that lie laterally to the uterosacral ligaments were spared. The branches of pelvic splachnic nerves can be found below the dissected uterine veins, which direct in the direction of the inferior hypogastric plexus. It is important to preserve the intact bladder branch of the inferior hypogastric plexus. With a Maryland™ forceps, the ureteric tunnel was dissected. The ureteric tunnel was unroofed, and the veins were identified, ligated and cut, while the ureter was laterally pushed. With this surgical step, the ureteric and bladder branches of the inferior hypogastric plexus were laterally moved. The bladder branch passing under the inferior vesical vein can be visible and preserved. The remaining operation is continued as described above.

**Technique of pelvic lymph node dissection**

The pelvic side wall was entered overlying the external iliac vessels. We suggest good traction of the round ligament remnant using the third arm. A thorough dissection of lymph nodes from the common iliac vessels down to the external iliac vessels follows. The dissection is suggested to start from the external iliac artery down to the deep iliac circumflex vein and to return toward the internal iliac artery with a U turn. The dissection was performed after recognizing the genitofemoral nerve laterally, the ureter medially, the deep iliac circumflex vein inferiorly, and the inferior mesenteric artery superiorly. The dissection was completed after the identification of the obturator nerve. Following the U-turn technique, all pelvic lymph nodes could be dissected as a single specimen. We tend to extract the pelvic lymph nodes through the vagina in laparoscopic bags. However, the assistant port can be used for the same reason.

**Postoperative care**

Our patients followed enhanced recovery protocol and are allowed free fluids the day of the operation and have breakfast the next morning (8). Early mobilization is encouraged based on our enhanced recovery protocols. For simple hysterectomies, we took the catheter out on the first postoperative day, usually at 6 am, and a scan was performed to check the bladder residual. Majority of our patients went home in the first 24 h postoperatively. In cases of radical hysterectomy, patients went home with a bladder catheter, which remains for 5–7 days and is then removed in an outpatient clinic.

**Comment**

The main advantages of the robotic approach are the wrist-like motion of the robotic arms, allowing difficult movements deep in the pelvis, a three-dimensional view, lower blood loss (even <50 mL), fewer wound complications, fewer urinary tract injuries, minimal rates of conversion to open, a reduced length of hospital stay (approximately 24 h), and a faster return to normal activities (5, 9). Surgeons' fatigue is minimized as he/she operates in the sitting position. The da Vinci® robot also decreases the learning curve for intracorporeal suturing. The main disadvantages include the high cost and the necessary learning curve, although the operative time continues to decrease with increasing experience (5, 10, 11). The overall costs of robotics are higher than those of the other approaches, depending on the instrumentation required. However, the standardization of the technique and an experienced team (including surgeon, assistant, and scrub nurse) can minimize the operative time and cost, while the increased efficiency provided by robotics to less-experienced surgeons would also overcome the increased equipment costs (11). When a comparison is performed with single-port laparoscopic hysterectomy and standard laparoscopic hysterectomy, we can see that the robotic-assisted technique, apart from offering obvious advantage to surgeons, such as comfort, can also sustain the abdominal wall, reducing the need of the pneumoperitoneum, in obese patients in particular. A decreased pneumoperitoneum is correlated with a decreased risk for venous gas embolism, decreased venous return to the heart, and cardiovascular collapse. Nevertheless, robotic and laparoscopic hysterectomy seems to present similar intraoperative and short-term postoperative outcomes (12). Moreover, the robotic single-port hysterectomy could also be a feasible and safe procedure, and ergonomic limitations are gradually corrected by the development of new instruments (13). However, more studies are necessary to assess the possible benefits of such an approach, such as better cosmetic results and use in obese patients or in patients with large uteri (14, 15). A recent SGO survey showed that there is a significant increase in the overall use and indications for robotic surgery (16). By suggesting our tips and tricks to literature, we aim to minimize the cost to achieve the effective utilization of instruments and operative time and to achieve a quicker learning curve.

## Conclusion

Robotic-assisted hysterectomy is an equally effective alternative to the standard open or laparoscopic approach. The standardization of the technique and recognition of critical anatomical landmarks are essential for optimal oncological and clinical outcomes in both simple and radical robotic-assisted hysterectomy. Furthermore, the standardization of the technique using tips and tricks can, without doubt, shorten the learning curve of the operation in such a way that the surgeon can achieve cost-effective use of the equipment.

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