

A New Silicon Sling Device for Traction During Robotic Gynecologic Surgery

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ABSTRACT

Background: One of the challenges of robotic gynecologic surgery is the appropriate traction of the organs and other structures surrounding the surgical field.

Methods: We developed a novel traction device, *VESOPASTA*, that can be used for organ traction during robotic gynecologic surgery. This study describes the utility and the safety of the use of *VESOPASTA* for ureteral traction during robotic-assisted laparoscopic radical hysterectomy in five cervical cancer patients.

Results: Ureteral suspension was successfully and safely performed using *VESOPASTA* during robotic-assisted laparoscopic radical hysterectomy in cervical cancer patients without causing any complications. The average time required for this procedure was less than 5 min.

Conclusions: We have developed a novel device, *VESOPASTA*, which can be used for organ traction during robotic surgery. This new device allows easy ureteral traction, facilitate the identification of ureter and prevent ureteral injuries during robotic-assisted laparoscopic radical hysterectomy.

Key Words: Tissue traction, Silicone sling, Robotic surgery, Radical hysterectomy, Cervical cancer

INTRODUCTION

Robotic gynecologic surgery has demonstrated advantages over open surgery in terms of fewer operative complications, reduced analgesia requirements, shorter hospital stay, and improved postoperative recovery.¹⁻³

One of the challenges of robotic gynecologic surgery is the appropriate traction of the organs and other structures surrounding the surgical field. Traditionally, intraoperative tissue traction relies mainly on either gravity (by patient positioning) or the use of several traction devices through additional assistant port.^{4,5} However, tissue traction relying on patient positioning is far from optimal. Moreover, use of several traction devices through additional assistant port is resource consuming and requires additional incision or assistant surgeon. In addition, a human assistant has an increased likelihood of fatigue and resulting decreased steadiness. Thus, the development of the new technology or instruments that allows appropriate and easy organ traction is eagerly needed.

We have just developed a new silicone sling, *VESOPASTA*, that has been developed for the traction of the organs during robotic surgery. In the current study, we introduce a safety and a utility of ureteral suspension using *VESOPASTA* during robotic-assisted radical hysterectomy in cervical cancer patients.

MATERIALS AND METHODS

Patients

The newly developed silicone sling, *VESOPASTA*, has been used in five cervical cancer patients who underwent robotic-assisted laparoscopic radical hysterectomy. Appropriate written informed consent for the use of *VESOPASTA* during surgery, publication of case report and accompanying images was obtained from all patients. Permission to proceed with the data acquisition and analysis was obtained from Nara Medical University Hospital's institutional review board.

Development of *VESOPASTA*

VESOPASTA, a novel traction device, has been jointly developed by Dr. Seiji Mabuchi and Akiyama Medical

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Informed consent: Dr. Mabuchi declares that written informed consent was obtained from the patient/s for publication of this study/report and any accompanying images.

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Manufacturing Co., Ltd (Tokyo, Japan) in 2019. As shown in **Figure 1**, *VESOPASTA* consisted of a 65-mm, straight, round-bodied needle with 2.5-mm silicone sling (length 45 cm). *VESOPASTA* has been developed for the organ traction during robotic surgery (trademark registration: 2019-097509).

Trocar placement for robot-assisted laparoscopic hysterectomy

Five ports were used, as shown in the **Figure 1B**. A primary puncture of an 8-mm port for the laparoscope was placed, which was placed 2–3 cm above the umbilicus. Two 8-mm robotic ports were placed horizontally at the right side, spaced 7 cm apart. An 8-mm robotic port and ancillary trocar (12 mm) were also placed horizontally on the left side, spaced 7 cm apart. An ancillary trocar is for the assistant surgeon who is in charge of suction, irrigation, exposing the field, introducing sutures, and removing specimens. Each port was docked onto the assigned robotic arms, except for an ancillary trocar.

Procedures of robot-assisted laparoscopic radical hysterectomy

All procedures were performed under general anesthesia, with patients placed in the Trendelenburg, lithotomy position. All patients underwent a bowel preparation and placement of intraoperative lower-extremity sequential compression devices for venous thrombosis prophylaxis. All surgical procedures were completed using the da Vinci Xi surgical system (Intuitive Surgical Inc., Sunnyvale, CA), consisting of three robotic instrument arms, a camera arm, and a remote control console with 3-dimensional visual capabilities. Intraabdominal pressure was kept under 12 mm Hg using a carbon dioxide gas. A zero-degree endoscope was used for the entire procedure. The whole procedure except for the vaginal closure was performed

using the robotic monopolar electro-surgical scissors placed through the right port, the fenestrated bipolar forceps, and grasping forceps placed through the left robotic ports. A uterine manipulator was not used.

Adhesions were lysed first to restore normal anatomy. To prevent the tumor spillage, bilateral fallopian tubes were ligated with surgical clips. After round ligaments were cut, the anterior and posterior leaves of the broad ligament was opened. The bladder flap was developed, and the bladder was gradually dissected away from the cervix and vagina. After development of paravesical and pararectal spaces using gentle blunt dissection, the bilateral uterine arteries were identified and cut at its origin. After the uterine vessels were placed on medial tension, the ureters were unroofed from the retroperitoneum. Ureters are retracted using *VESOPASTA* and gently dissociated from the surrounding connective tissue. After ureters were separated from the uterine artery and the parametrium-paracolpium, cardinal ligaments and vesicouterine ligaments were transected. In cases requiring bilateral salpingo-oophorectomy, the infundibulopelvic ligaments were isolated, coagulated, and transected. After the peritoneum between the uterosacral ligaments is incised, the uterosacral ligaments were transected, and the rectum is brought down gently away from the vagina. The vaginal wall was incised at 2 cm distal from the uterine cervix. After removal of the specimen from the vagina, and vaginal closure was carried out using 0-Vicryl sutures on CT-1 needles with a continuous running nonlocking technique using a needle driver. Standard antibiotic prophylaxis and routine postoperative care were prescribed.

Ureteral suspension using conventional silicone slings during laparoscopic radical hysterectomy

As shown in **Figure 2**, using atraumatic forceps, the silicone sling is introduced into the pelvis via the ipsilateral trocar (i). The sling is applied around the ureter. The two

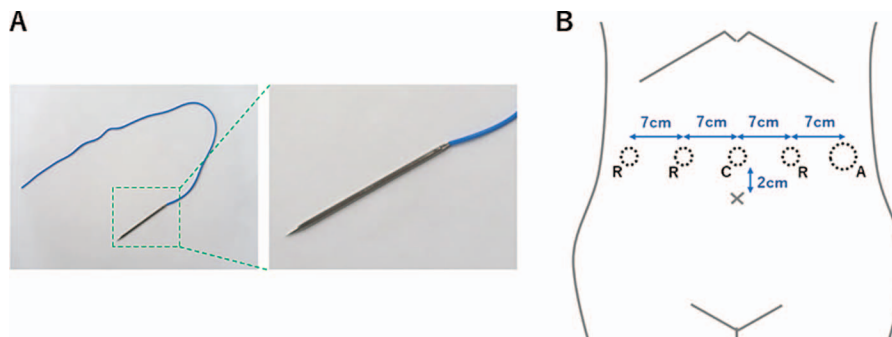


Figure 1. A. Pictures showing *VESOPASTA*. B. Trocar placement for robot-assisted laparoscopic hysterectomy. C, camera; R, robotic; A, assistant.

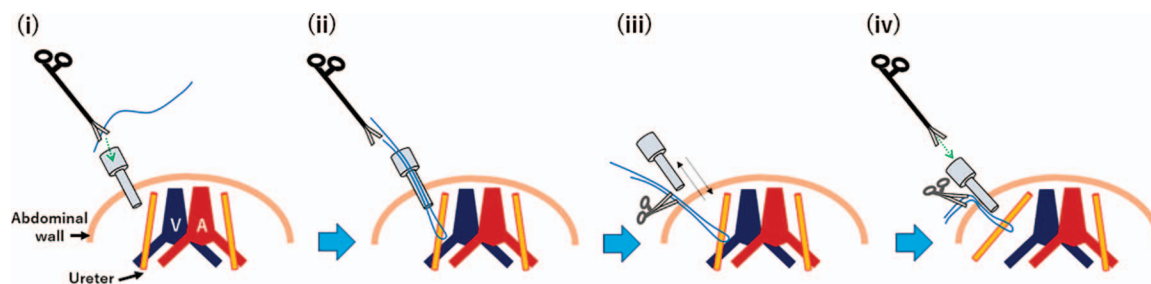


Figure 2. Surgical steps in ureteral suspension during laparoscopic radical hysterectomy. V, inferior vena cava. A, aorta.

ends of the slings are pulled up and brought out of the pelvis via the ipsilateral trocar (ii). The ipsilateral trocar is removed, and the sling is pulled until adequate traction on the ureter is obtained. Then the sling is secured with haemostatic forceps outside the abdomen (iii). The trocar is reinserted along the sling, and the surgery is restarted. The sling is removed at the end of the surgery (iv).

Ureteral suspension using *VESOPASTA*

In the setting of laparoscopic surgery, as illustrated in **Figure 2**, ureteral suspension can be achieved using silicone sling. However, it requires removal and insertion of the trocar through the port incision. In contrast, in the setting of robotic surgery, trocars are docked on the robotic instrument arm (**Figure 3A**). Thus, performing the same procedure described in **Figure 2** during robotic surgery is not realistic. Thus, we decided to develop a novel silicone sling, *VESOPASTA*, for the traction of the organs surrounding the surgical field during robotic surgery.

Ureteral suspension was performed using *VESOPASTA* during robot-assisted laparoscopic radical hysterectomy in five cervical cancer patients. As shown (**Figure 3, B–D**), using atraumatic forceps, the silicone sling is introduced into the pelvis via the assistant trocar. After the sling is applied around the ureter using robotic fenestrated bipolar forceps and grasping forceps, a surgical clip is applied on the slings. The needle is held with a robotic needle holder and is passed through the lower abdominal wall posterior-anteriorly, brought out of the abdomen. The sling is pulled up until adequate traction on the ureter is obtained. The slings were secured with hemostatic forceps outside the abdomen. Then the robot-assisted laparoscopic radical hysterectomy is continued.

RESULTS

Table 1 lists demographic information for each case. Robotic-assisted laparoscopic radical hysterectomy was

safely performed in all cases, and no patients experienced intraoperative or postoperative complications. No cases required conversion to an open surgery.

Ureteral suspension could be safely performed using *VESOPASTA* in all cases without causing any surgical complications. The time required for this procedure (suspension of a ureter) was less than 5 min in all cases. No cases required an additional assistant port during this procedure. No tissue tearing or other damage was noted after removal of the *VESOPASTA*.

DISCUSSION

To safely perform robotic surgery, tissue traction is very important and essential, especially when working in the narrow surgical spaces (e.g., small pelvis). In gynecologic surgery, the traction of ureter or external iliac vessels are required during radical hysterectomy or pelvic lymphadenectomy, respectively. However, in the setting of robotic surgery, few instruments to facilitate traction of the organs and increase the surgical field are available. Thus, the development of novel instruments is eagerly desired.

In the setting of laparotomy or laparoscopic surgery, the utility of silicone sling for the ureteral suspension has been reported.⁶ As illustrated in **Figure 2**, ureteral suspension using silicone sling during laparoscopic surgery requires removal and insertion of the trocar through the port incision. However, in the setting of robotic surgery, trocars are docked on the robotic instrument arm. To perform the same procedure described in **Figure 2**, multiple time-consuming steps are additionally required in a robotic surgery. Because such complicated procedures are not realistic, the fourth robotic arm or the assistant surgeon has usually been used for the traction of the ureter during robot-assisted laparoscopic radical hysterectomy.⁴

To break this situation, recently we have developed a novel traction device, *ENDOPASTA*, for the traction of the

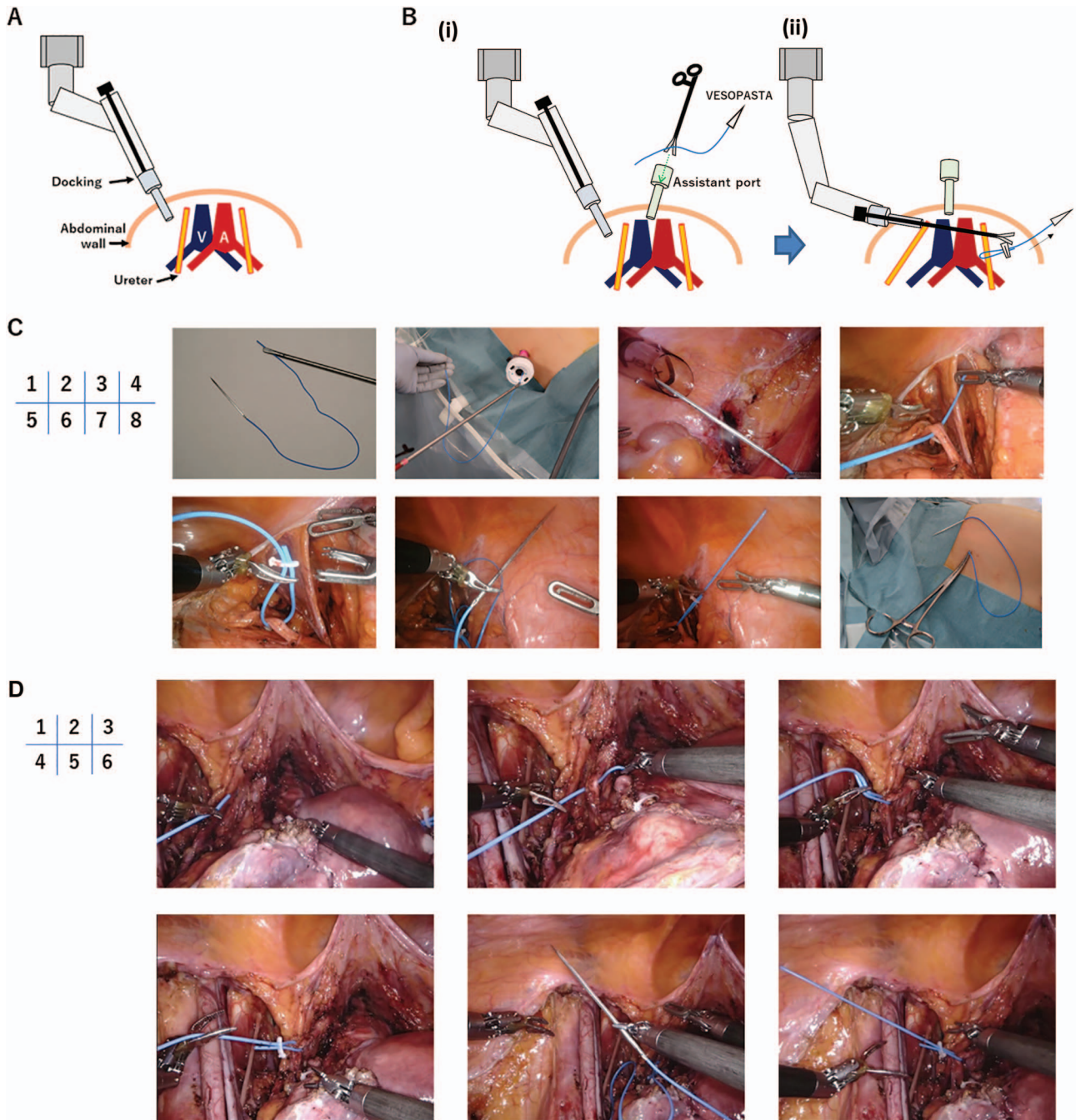


Figure 3. Ureteral suspension using *VESOPASTA* during robot-assisted laparoscopic hysterectomy. **A**, Schematic illustration of a robotic instrument arm and trocar. V, inferior vena cava. A, aorta. **B**, Ureteral suspension using *VESOPASTA*. **C** and **D**, Representative pictures of the surgical steps (**C**, Suspension of right ureter; **D**, Suspension of left ureter).

organs surrounding the surgical field during robotic surgery. In the current study, we have shown that ureteral traction can be safely and easily performed using *VESOPASTA*. It took less than 5 min for a traction of a

ureter by using *VESOPASTA*. Although no complications were observed in our cases, the potential risk for the use of *VESOPASTA* is the injury of the blood vessels located in the abdominal wall (e.g., epigastric artery and vein). How-

Table 1.
Patients Included In This Study

Variables	Case 1	Case 2	Case 3	Case 4	Case 5
Age (years)	49	39	43	64	55
BMI (kg/m ²)	18.1	20.9	22.4	24.9	27.3
FIGO stage	IB2	IB2	IB1	IB1	IB1
Histology	SCC	SCC	SCC	SCC	SCC
Surgery	RH+BSO+PLN	RH+PLN	RH+PLN	RH+BSO+PLN	RH+BSO+PLN
Surgical complications	No	No	No	No	No

FIGO, International Federation of Gynecology and Obstetrics; SCC, squamous cell carcinoma; BMI, body mass index; RH, radical hysterectomy; BSO, bilateral salpingo-oophorectomy; PLN, pelvic lymphadenectomy.

ever, we believe that it can be avoided by performing a transirumination test.

The limitations of the current study need to be addressed. First, the current study is a single-arm retrospective study including a small number of patients. To demonstrate the safety and the benefit of using *VESOPASTA* for ureteral suspension, a future prospective clinical trial, especially in a randomized setting, is required. Second is that we evaluated the utility of ureteral suspension using *VESOPASTA* in cervical cancer patients. However, given the results of a randomized clinical trial comparing minimally invasive versus abdominal radical hysterectomy in cervical cancer patients,⁷ a robotic approach should be carefully used after sufficient counseling for cervical cancer patients.

We believe that the use of *VESOPASTA* during robot-assisted laparoscopic radical hysterectomy has important clinical implications. First is the cost of this device; it costs roughly \$13. Second, this device eliminates the need for an assistant during ureteral traction. Third, by using this device, we can preserve the fourth robotic arm for other purposes. Moreover, by using this device, we may be able to minimize the number of robotic ports, leading to negating the risk of port site hernia or port site infection. Lastly, we think this device can be used for the traction of other lumen organs or major blood vessels such as external iliac arteries or veins. We do not recommend the routine use of *VESOPASTA*, but we believe that *VESOPASTA* makes a significant contribution during robotic surgery in selected cases in which tractions of ureter or other organs are necessary. We hope the utilities of this novel traction device be investigated further in the future study of robotic surgery.

CONCLUSION

We have developed a novel silicone sling, *VESOPASTA*, which can be used for organ traction during robotic surgery. This new instrument helps surgeons to obtain an optimal surgical field, which can be a great help for surgeons involved in robotic surgery.

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