

Robot-Assisted Total Hysterectomy of Extremely Unusual Pelvic Anatomy: A Case Report and Literature Review

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ABSTRACT

We report a case of robot-assisted total hysterectomy in a patient with extremely rare pelvic anatomy. Robot-assisted total laparoscopic hysterectomy was performed for lobular endocervical glandular hyperplasia on the left side of the uterus. The sigmoid colon was present between the two uterine corpora of a uterine didelphys and was attached to the bladder via the mesentery and fat. During surgery, the surgeon left the console and confirmed the magnetic resonance images. The surgery was then completed safely after the surgeon understood the anatomy. The postoperative condition was good, and the patient was discharged on postoperative day 5. Robot-assisted surgery has various advantages, including a good field of view, accuracy of instrument movement, and ease of viewing information in the medical record by pausing the operation. Robot assisted surgery improves not only safety and operational precision but also intraoperative convenience. Further studies are needed regarding the specific anatomy seen in this case.

Key words anatomy; didelphic uterus; endocervical glandular hyperplasia; hysterectomy; robotic surgery

Robotic-assisted gynecological surgery was approved by the U.S. Food and Drug Administration in 2005 and is now widely used for hysterectomy, myomectomy, and surgery for malignancies. In Japan, the use of surgical robots for hysterectomy for benign tumors and endometrial cancer has been covered by insurance since 2018 and is now being used in various hospitals. Although robot-assisted surgery requires a longer surgical time than laparotomy or laparoscopy, it requires a shorter hospital stay and has lower blood loss, complication and blood transfusion rates, and rate of conversion to laparotomy than laparoscopy.¹ Robotic-assisted surgery benefits not only the patient but also the surgeon. In robot-assisted

surgery, three-dimensional, zoomed-in, and stabilized fields of view allow the surgeon to operate with a better field of view than that in conventional laparoscopic surgery. In particular, the three-dimensional field of view is effective for shortening the operation time and reducing complications, compared with that in conventional laparoscopic surgery.² The stabilizer and articulated instruments improve the accuracy of each operation, including suturing. Furthermore, the weight of the robot arm is not transmitted to the surgeon, making it easier to operate on obese patients.³ A surgeon can also use the TilePro function to display imaging information from ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) in their field of view, and they can operate from a surgeon's console, away from the surgical field where maximum barrier precautions are required, with less physical strain.

Herein, we report a case of robot-assisted total laparoscopic hysterectomy performed for lobular endocervical glandular hyperplasia (LEGH) on the left side of the uterus. Intraoperative pelvic findings showed an anatomy that had not been seen before. However, the surgeon was able to understand the anatomy by checking the MR images and three-dimensional field of view during the operation and was able to complete the operation safely.

PATIENT REPORT

A 55-year-old multiparous woman was diagnosed with multiple cervical cysts during cervical cancer screening. She had no history of abdominal surgery, perinatal complications, or familial history of congenital anomalies of the uterus. The cervical cytology was negative for intraepithelial lesion or malignancy. Pelvic MRI led to a suspicion of a didelphic uterus, uterine fibroid, and LEGH of the left cervix. The sigmoid colon appeared to run in an anterior-posterior direction, however there were no findings to suggest adhesions. No abnormalities such as bubbles were found in the bladder. Thus, she was referred to our department. Internal examination revealed a vaginal septum and watery discharge from a mildly enlarged left-sided cervix.

Transvaginal ultrasonography revealed a multifocal cystic lesion in the left cervical region. The colposcopy

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Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging

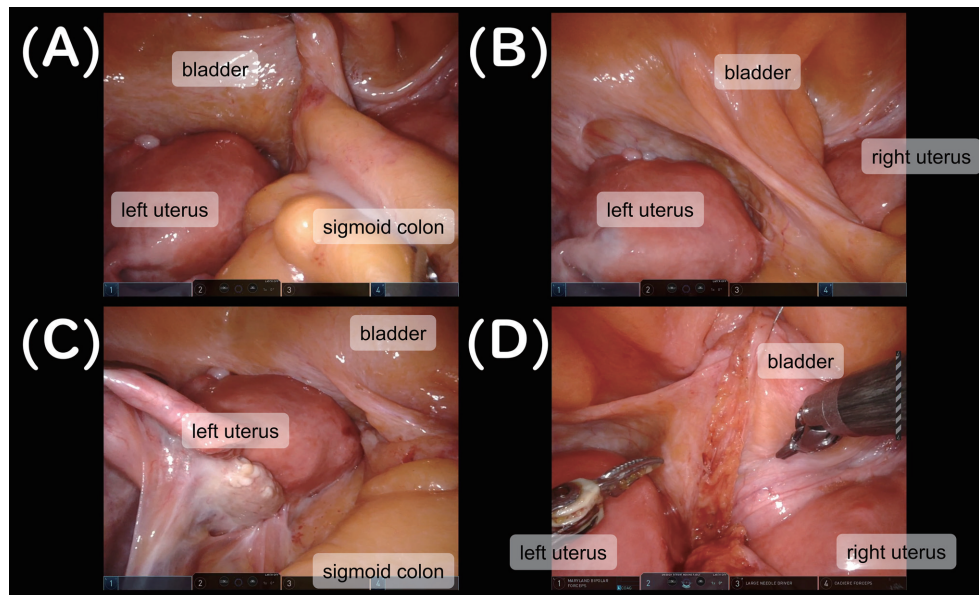


Fig. 1. Intraoperative findings: (A) The sigmoid colon ran between the bilateral uterine corpora and was attached to the bladder via the mesentery and fat. (B), (C) The sigmoid colon was attached to the bilateral uterine corpora. (D) After the incision of the border between the bladder and the sigmoid, we lifted the bladder to the abdominal wall by applying a suture to the peritoneum of the vesicouterine pouch.

findings were normal. Diagnostic cervical conization was performed; the histopathological diagnosis was LEGH. The margins were positive, and a robot-assisted total hysterectomy was performed. Drip infusion pyelography was performed to confirm the ureteral anatomy, but no urinary tract malformation or abnormal ureteral tract was found. Urinalysis showed no abnormality.

We used the da Vinci X Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA). First, we resected the vaginal septum transvaginally and then started the intraperitoneal operation, as shown in Fig. 1 and Supplementary Video 1. The uterine corpus was the size of a chicken egg and duplicated. The sigmoid colon ran between the bilateral uterine corpora and was attached to the bladder via the mesentery and fat (Fig. 2). Because we had never encountered this anatomy before, the surgeon left the console, confirmed the MR images (Fig. 3) and resumed the operation after having a better understanding of the anatomy. The sigmoid mesentery was fused with the bladder, and the uterine corpora were on both sides of the mesentery. We judged that the border between the sigmoid colon and the bladder was detachable and that the operator could separate the sigmoid colon from the uterus without bowel injury. After the incision of the border between the bladder and sigmoid, we lifted the bladder to the abdominal wall by applying a suture to the peritoneum of the vesicouterine

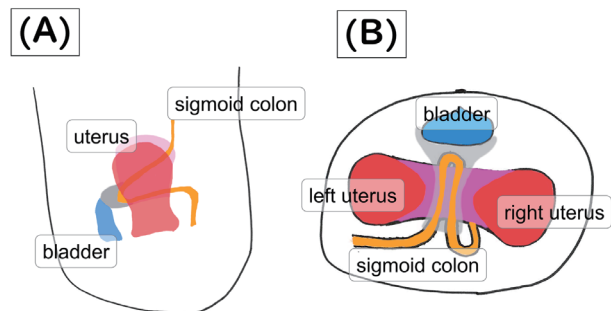


Fig. 2. Anatomy of the case (A) Sagittal section (B) axial section. Red and pink, uterus; blue, bladder; orange, sigmoid colon; gray, fat.

pouch. The surgeon completed the hysterectomy as usual, while detaching all adhesions between the bilateral uterine corpora, bladder, and sigmoid colon. No fistula was noted. The operation time, console time, and blood loss were 3 h 7 min, 2 h 33 min, and 10 mL, respectively. Mild pneumoderma was observed after surgery but it disappeared naturally. The patient's postoperative condition was good, and she was discharged on postoperative day 5. The patient's general condition after discharge was also good. Follow-up was completed at 2 months postoperatively.

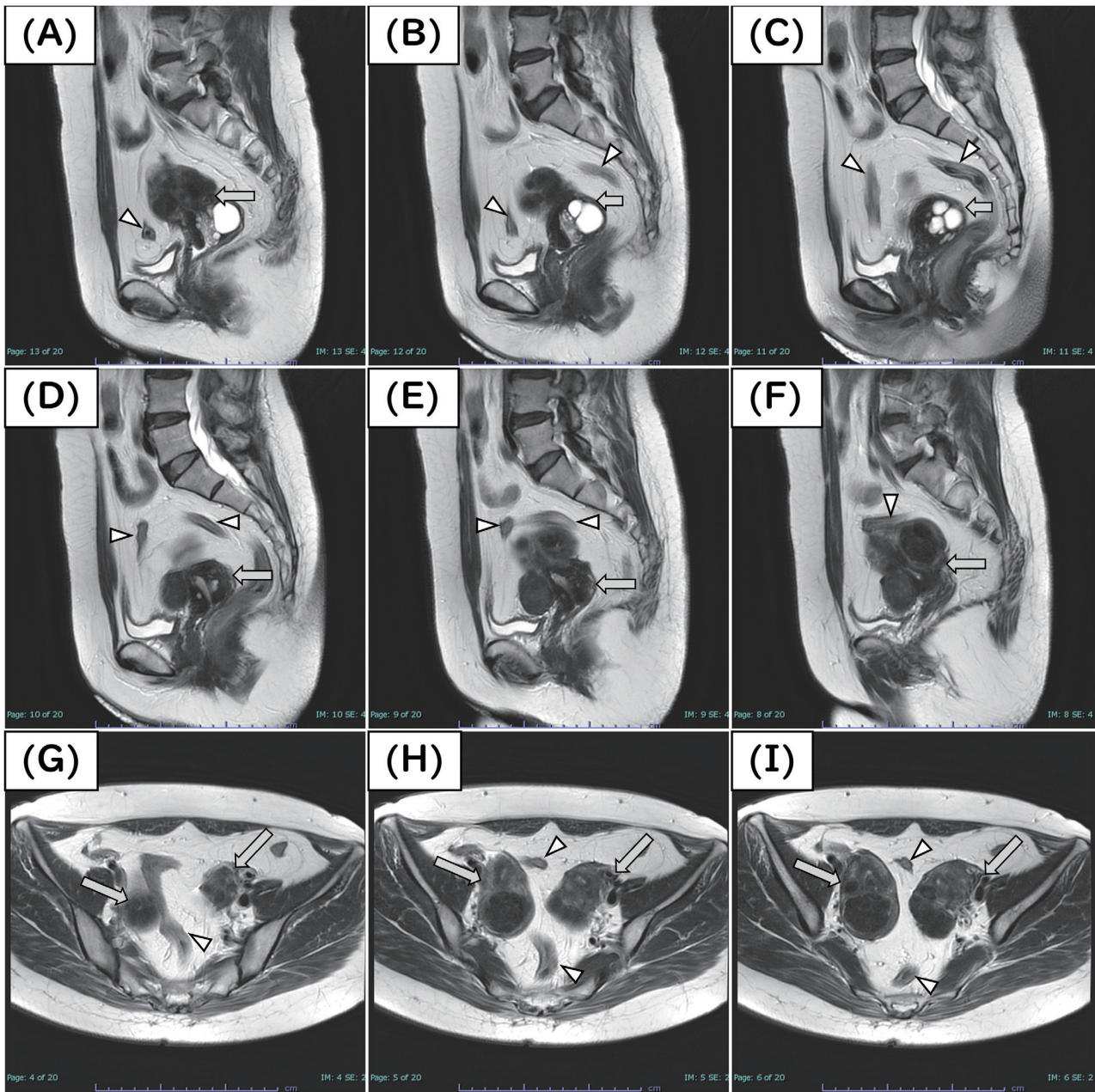


Fig. 3. MR images (A)–(F): Sagittal section (left to right), (G)–(I): axial section (cranial to caudal). Arrow, uterus; arrow head, sigmoid colon.

DISCUSSION

We encountered an unusually placed sigmoid colon during a robot-assisted laparoscopic total hysterectomy for a didelphic uterus. The prevalence of uterine malformations is approximately 4.3% in the general population and fertile women, but the incidence of a didelphic uterus with vaginal septum is 1/3000.⁴ A case of LEGH in combination with this uterine malformation is very rare and has not yet been reported. In this case, the sigmoid colon ran in an anterior-posterior direction

between the bilateral uterine corpora. Although 43% of uterine malformations are associated with unilateral renal aplasia, no congenital anomalies in the renal or urological system were observed in this case.⁵ Uterine malformations are associated with a high incidence of spontaneous abortion, preterm labor, and low pregnancy rates, but only a slight increase in preterm birth rates has been reported for duplicated uteruses.⁶ In this case, uterine malformation was not noted despite two vaginal deliveries. This may be because the didelphic uterus has

little effect on pregnancy and childbirth.

This is the first case report of a sigmoid colon fused to the bladder and uterus strongly via the mesentery and fat without any history of abdominal surgery, pelvic infections, or endometriosis. Normally, the sigmoid colon is a mobile organ.

The endoderm and visceral mesoderm of the yolk sac partially become the primitive gut, which is divided into the foregut, midgut, and hindgut at 4 weeks of gestation. The transverse colon and below arise from the hindgut, and the last part opens into a common excretory cavity with the urogenital membrane. Until 8 weeks of gestation, the urorectal septum from the mesoderm enters between the urogenital membrane and hindgut, dividing the excretory cavity into the urogenital sinus and anorectal tract. Subsequently, the vesicoureteral area of the urogenital sinus dilates into the bladder. In contrast, the paramesonephric ducts derived from mesoderm make contact at the caudal side and fuse toward the cephalic side to form the uterovaginal canal at 8–9 weeks of gestation. The uterovaginal canal leads to the formation of the upper vagina, uterus, and fallopian tubes.⁷

The fusion of the bilateral Müllerian ducts may have involved the nearby hindgut and ureter. Another possibility is that an anomaly occurred on the cephalic side during division by the urorectal septum, leaving the bowel and bladder fused. Similar cases should be considered in the future.

Robot-assisted surgery allows high-resolution, three-dimensional, and zoomed-in views to be controlled and fixed by the surgeon. The scaling function and anti-shake and articulated instruments, aiding suturing and dissection, improve the accuracy of each operation. With these advantages, robot-assisted surgery reduces hospital stay, incidence of complications, blood loss, and blood transfusion rates compared with those seen in open surgery and conventional laparoscopic surgery. The surgeon's console is ergonomically designed, and the armrest, foot switch, etc., can be customized for each surgeon. The console is located away from the sterile field, allowing the surgeon to perform the surgery without maximal barrier precautions. Image data such as CT and MRI can also be displayed in the field of view.

Robot-assisted surgery allows the surgeon to pause the operation and easily view the information in the medical record because the surgeon is in a non-sterile field. In this case, the surgeon left the console and referred the electronic medical record to reconfirm the anatomy, including the course of the colon, during the operation. Because he was not required to be sterile for the surgery, he could quickly return to the operation and

safely perform the surgery after confirming the images.

In addition to robot-assisted surgery, other ways are available to reconfirm the anatomy during surgery. In recent years, mixed reality technology using head-mounted displays and other devices has been used to confirm detailed anatomy, including that of the blood vessels during surgery. Mixed reality technology is considered useful not only for improving surgery but also for medical and patient education.⁸

However, to use mixed reality data, CT data must be processed and images must be created in advance. The weight of the head-mounted display itself can be an obstacle if it is used regularly during surgery. In robotic surgery performed at a surgeon's console, the surgeon can easily access patient information by standing up from the console and opening the medical records in the operating room. The TilePro function allows access to image information even within the surgeon's console, although prior equipment configuration is required. Although Augmented Reality and mixed reality technologies have their advantages, we believe that robotic surgery, which does not require any special advance preparation, has advantages in dealing with unpredictable situations, such as in this case.

Robot-assisted surgery has a lower complication rate than open or laparoscopic surgery. However, it is important to be aware of the complications associated with robot-assisted surgery, such as a lack of tactile sensation. There are reports of worsening and comparable oncological outcomes when minimally invasive surgery is performed for cervical cancer.⁹ However, in robot-assisted radical hysterectomy for cervical cancer, the recurrence rate has been reported to increase when the surgeon's proficiency is low. According to a previous study, thirteen cases are needed to flatten the learning curve for robot-assisted laparoscopic total hysterectomy.¹⁰

This was an operation for a benign uterine disease, and there were no intraoperative or postoperative complications. When robot-assisted surgery is performed for various diseases, we need to be very careful and skillful, without relying too much on the performance of the robot.

We encountered a case with extremely rare pelvic anatomy in which a robot-assisted total hysterectomy was safely performed. Although we identified pelvic anatomy that was not known preoperatively, we safely completed the surgery by reviewing the images intraoperatively. Robot-assisted surgery improves safety, operational precision, and intraoperative convenience. Various technologies are expected to emerge in the future to improve surgery.

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The authors declare no conflict of interest.

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