

CASE REPORT

Robotic-assisted laparoscopic hysterectomy and vasovagal reflex: A case report

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Abstract

No reports of vasovagal reflex activity during robotic-assisted laparoscopic hysterectomy (RALH) exist. We present a case of a woman who underwent a RALH for a uterine myoma with uterine adenomyosis. A lack of tactile feedback and a traction force sensor create unique risks of robot-assisted surgery. Anesthesiologists should be aware of these risks.

KEYWORDS

arrhythmia, bradycardia, hysterectomy, robot-assisted surgery, vasovagal reflex

1 | INTRODUCTION

A uterine leiomyoma is the most common benign pelvic tumor in women.¹ Although they are benign, they commonly cause severe symptoms, such as heavy, irregular, and prolonged menstrual bleeding and anemia.¹ A uterine leiomyoma develops in any part of the uterus due to the influence of local growth factors and sex hormones, such as estrogen and progesterone.¹ There are no definitive therapeutic agents for the treatment of uterine leiomyomas.¹ Gonadotropin-releasing hormone antagonists (GnRHa) are used to reduce leiomyoma-related blood loss and prevent iron deficiency anemia.¹ Myomectomy is still commonly performed, especially in women who desire to maintain their fertility; however, hysterectomy is the definitive surgical operation.¹

Robotic-assisted laparoscopic hysterectomy (RALH) has been well established in benign gynecology. In a previous study, RALH had a similar intraoperative complication rate to simple conventional laparoscopic surgery.² Arrhythmias have been reported to occur in 14%–27% of laparoscopic surgeries,³ and cardiac arrest has also been reported as a complication of total laparoscopic

hysterectomy.⁴ However, the activation of the vasovagal reflex during uterine traction in a RALH has not been reported. Furthermore, it has not been reported that the lack of tactile feedback and a traction force sensor in robot-assisted surgery could lead to unintentionally strong movements, a risk factor for vasovagal reflex activity. Herein, we report a case of vasovagal reflex activity that spontaneously disappeared with the release of uterine traction. The aims of this report are to describe the characteristics of a hysterectomy and ensure that anesthesiologists are aware of the differences between laparoscopic surgery and robot-assisted surgery. This manuscript adheres to the applicable CARE guidelines.

2 | CASE PRESENTATION

A 46-year-old woman (height: 162 cm, weight: 55 kg) received hormone therapy for heavy menstrual bleeding at her previous hospital for several years. She was referred to our hospital for further treatment of a uterine leiomyoma due to continuous heavy menstrual bleeding. The size of the leiomyoma in the uterine body was

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6.4 cm × 6.4 cm × 8.5 cm. The patient had no notable medical history other than a smoking habit.

She was diagnosed with a uterine leiomyoma with uterine adenomyosis and underwent a RALH and bilateral salpingo-oophorectomy under general anesthesia. As she had uterine adenomyosis, she requested a bilateral salpingo-oophorectomy for curative therapy of endometriosis. This case was the 16th case of RALH in our hospital.

Preoperative medications included a GnRHa and iron pills. Preoperative laboratory findings, including blood tests and a chest X-ray, were unremarkable. Preoperative electrocardiography revealed a sinus rhythm of 76 bpm with a normal QT interval (corrected QT interval, 397 ms), and no ischemic electrocardiogram changes.

Epidural anesthesia was performed before the induction of anesthesia in the lateral position. A catheter was placed to administer a thoracic (Th11–12) epidural. General anesthesia was induced with 100 mcg of fentanyl, 90 mg of propofol, and 40 mg of rocuronium to facilitate endotracheal intubation. An endotracheal tube with a 7.0-mm internal diameter was inserted without difficulty. For the initial epidural anesthesia, a 5-ml bolus of 0.2% ropivacaine was administered 10 min before making the skin incision. Anesthesia was maintained with 4.0 vol% desflurane, 100 mcg of intermittent fentanyl, and a continuous infusion of 7 mcg/kg/min rocuronium and 0.1 mcg/kg/min remifentanyl. The continuous epidural infusion of a 200-ml mixture of 0.2% ropivacaine (190 ml) and fentanyl (0.5 mg/10 ml) was maintained throughout the surgery at a rate of 6 ml/h.

Robot-assisted surgery was performed using a da Vinci Xi system (Intuitive Surgical Inc.). Before commencing robotic surgery, the patient was placed in a steep Trendelenburg lithotomy position (18-degree head-down tilt), and a pneumoperitoneum was created with carbon dioxide insufflation at an intra-abdominal pressure of approximately 10 mmHg.

Sudden bradycardia occurred when the uterine body was pulled upward. The anterior and lateral walls of the vagina were resected (Figure 1), and the posterior wall of the vagina was resected by pulling the uterus upward. This event occurred 1–2 min prior to the removal of the uterus from the vagina. At this time, the patient's heart rate dropped from 60 to 30 bpm. The electrocardiogram waveform was composed of a prolonged PP interval and the transient absence of sinus P waves, with a maximum sinus pause of 2.1 s (Figure 2). The posterior wall of the vagina was excised, the uterus was disconnected from the vagina, and the uterine traction was released. The bradycardia improved spontaneously after the uterine traction was released, without any administrations of atropine.

At that time, the blood pressure was 110/70 mmHg, which remained unchanged from the value noted a few

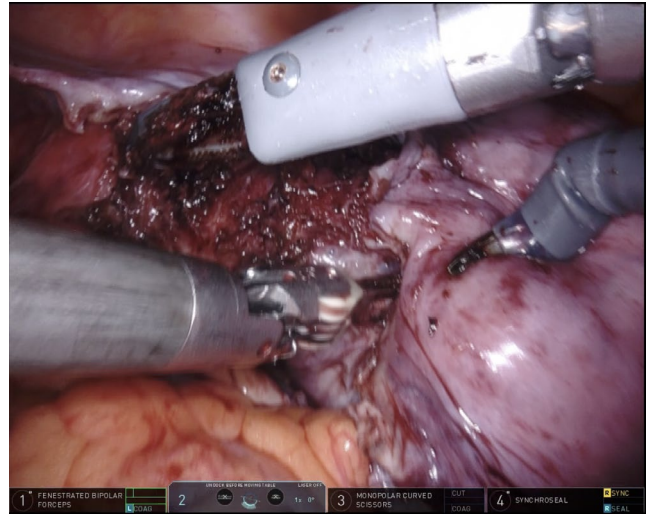


FIGURE 1 Intraoperative view. The lateral wall of the vagina was resected while the uterus was compressed to the right using a da Vinci Xi system (Intuitive Surgical Inc.)

minutes before. The intestine had not been manipulated at that time. The carbon dioxide insufflation pressure was constant at 10 mmHg, and no rapid carbon dioxide insufflation was observed. The monitored values, including end-tidal carbon dioxide levels, were stable throughout the surgery. The patient was extubated in the operating room and was neurologically intact. She had no wound pain and no weakness or numbness of the lower limbs. No pinprick or cold tests were performed, so the specific areas within the range of epidural anesthesia were not detailed. There were no abnormal vital signs to note at the time of discharge.

The patient was transferred to the ward after the surgery. Blood samples taken postoperatively showed no electrolyte abnormalities. Furthermore, no abnormal findings were observed via chest X-ray. The patient also displayed clear consciousness with no other notable symptoms. The postoperative course was smooth, and the patient was discharged 4 days post-surgery.

3 | DISCUSSION

Here, we describe an experience of severe bradycardia due to uterine traction during RALH. The bradycardia was thought to be due to the induction of the vasovagal reflex by uterine manipulation because the heart rate improved after the uterine traction was released. To date, we found no prior report of vasovagal reflexes during RALH. Furthermore, the vasovagal reflex may have been caused by strong surgical manipulation.

In this case, the bradycardia was thought to be due to induction of the vasovagal reflex by uterine



FIGURE 2 Electrocardiogram waveform revealed a prolonged PP interval (indicated with solid arrows) and the transient absence of sinus P waves. A small premature P' wave (indicated with a dashed arrow) was found in the areas where sinus P waves were absent. The maximum sinus pause was 2.1 s

manipulation. Although intraoperative vasovagal reflex activity can be caused by other factors, such as traction of other abdominal organs, celiac plexus reflex, elevated intra-abdominal pressure, epidural anesthesia, nondepolarizing muscle relaxation administration, and opioid administration,^{5–7} none of these factors were likely to be the primary cause of bradyarrhythmia in this case. We did not change the patient's position, pneumatic pressure, or infusion rate of any drugs, including epidural anesthesia, muscle relaxants, and opioids, for 90 minutes before this vagal reflex activity. Additionally, surgical manipulation was localized to the uterus. A prior case of cardiac arrest during the resection of the anterior wall of the vagina has been reported, suggesting the possibility of vagal distribution.⁴ However, the precise cause of cardiac arrest was not definite. In this case, the anterior wall of the vagina had already been resected. During laparoscopic surgery, peritoneal stretching, attributable to the pneumoperitoneum and intraoperative manipulations involving organs within the abdominal cavity, have been reported as triggers of the vasovagal reflex.^{6,7} In this case, the pneumatic pressure remained constant. Therefore, the vasovagal reflex activity was thought to have been triggered by peritoneal stimulation due to uterine traction during epidural anesthesia and remifentanyl administration.^{5,8}

The vasovagal reflex may have been triggered by strong surgical manipulation.⁸ This surgery was performed by a surgical team that was not familiar with RALH. The learning curve for robot-assisted surgery in gynecology has been addressed in several studies.^{2,9,10} Competency is gained upon the completion of approximately 20–28 procedures.² Therefore, the manipulation by an untrained surgeon may have led to unintentional strong surgical manipulation. The use of the da Vinci Xi system is accompanied by an excessive traction risk compared to laparoscopic surgery because the surgeon does not receive tactile feedback.¹¹ Although it was visually obvious that the uterus was being pulled, it was impossible to measure how strong the traction was, since the da Vinci Xi system is not equipped with a traction force sensor. Although the risks of vasovagal reflex due to the use of opioids and epidural anesthesia were the same as in laparoscopic surgery,

epidural anesthesia was administered continuously in small doses for more than 90 min, and remifentanyl, which has a short context-sensitive half-time, was administered at a constant rate. Furthermore, these administrations were not changed before and after the vasovagal reflex occurred, and there was no recurrence of a vasovagal reflex afterward. Therefore, we believe that the conditions unique to robot-assisted surgery triggered the vasovagal reflex in this case.

The visceral peritoneum (VP) was pulled together while providing traction on the uterus. The upper part of the uterus is covered by the VP, and the VP is distributed by the uterovaginal plexus, which is a branch of the pelvic plexus. In rat models, sensory nerves derived from the vagal nerve are not distributed in the parietal peritoneum. However, afferent fibers distributed in the VP and mesentery are part of the vagal and spinal nerves.¹² Furthermore, the VP responds primarily to traction and pressure and not to cutting, burning, or electrostimulation.¹³ Therefore, excessive traction and pressure of the uterus is potential cause of the reflex.

The electrocardiogram (Figure 2) showed PP prolongation followed by a small P wave, and then QRS dropout, which suggested nonconducted premature atrial contractions. The maximum sinus pause was 2.1 s. The constant PQ interval, the changed waveform of the P wave, and the prolongation of the PP were different from the characteristics of atrioventricular block.

As a limitation of this case report, we could not consider the effect of uterine traction alone because we used epidural anesthesia and opioids, which have a risk of vasovagal reflex. Nonetheless, it is uncommon to avoid the use of both in this surgery in Japan, so it is difficult to determine the true effects of the traction.

In this case, the vasovagal reflex occurred during uterine traction in RALH. Strong surgical manipulation may have triggered the vasovagal reflex. Bradycardia in laparoscopic surgery can also lead to cardiac arrest. Although vasovagal reflex activity is not a frequently encountered complication, anesthesiologists should be aware of and be prepared for the possibility of vasovagal reflex activity due to unexpected manipulation when performing robot-assisted surgery.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests associated with this manuscript.

AUTHOR CONTRIBUTIONS

EI helped search the literature and write the case report. SK helped obtain the figure and draft the manuscript. MN helped search the literature and critically revise the manuscript. MY helped draft and critically revise the manuscript.

CONSENT

Written informed consent was obtained from the patient for the publication of this case report and the accompanying images.

DATA AVAILABILITY STATEMENT

Data sharing not applicable – no new data generated.

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