Case Report

Robotic-assisted Total Hysterectomy with Low Pneumoperitoneal Pressure (6 mmHg) and Use of Surgical Plume Evacuator System to Minimize Potential Airborne Particles According to the Joint Statement on Minimally Invasive Gynecologic Surgery during the COVID-19 Pandemic: A Case Report from Japan

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Abstract

We presented a case of uncontrolled genital bleeding caused by subserosal fibroid and treated by robotic-assisted hysterectomy during the coronavirus disease 2019 (COVID-19) pandemic. A 49-year-old woman had severe anemia with hypermenorrhea due to submucosal fibroid. Hysterectomy was deemed necessary to control genital bleeding. However, at that time, the number of confirmed COVID-19 cases has been increasing in Japan. Serious concerns have been raised about the risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) dissemination during minimally invasive surgery due to pneumoperitoneum-associated aerosolization of particles. We tried to prevent the spread of surgical plume by performing surgery under low pneumoperitoneal pressure at 6 mmHg and by using an evacuation/filtration system. As a result, we successfully performed robotic-assisted hysterectomy with minimized risk of spreading surgical plume-containing aerosol particles into the operating room. It is essential to follow the guidelines issued by the relevant societies and act accordingly to reduce the risk of SARS-CoV-2 infection in medical settings while performing surgery. We hope that our experience will help prevent secondary cases of future SARS-CoV-2 infections.

Keywords: Coronavirus disease 2019, evacuation/filtration system, robotic-assisted hysterectomy, surgical plume

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The COVID-19 pandemic poses many challenges for gynecologists working to optimize patient care. Serious concerns have been raised about the risk of SARS-CoV-2 dissemination during minimally invasive surgery due to pneumoperitoneum-associated particle aerosolization and the presence of the virus in the blood and stool.[1]

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Although elective surgeries may be limited during the COVID-19 pandemic, urgent and emergency surgeries for the treatment of malignancies, ruptured ectopic pregnancies, ovarian torsion, and other conditions requiring immediate care must be performed. In these situations, laparoscopic surgery may offer the best approach and patient outcomes. Its safety during the pandemic was recently noted by the American Association of Gynecologic Laparoscopists (AAGL) and the Royal College of Obstetricians and Gynaecologists/British Society for Gynaecological Endoscopy.[2]

Herein, we present a case of robotic-assisted laparoscopic hysterectomy for uncontrolled genital bleeding due to a subserosal fibroid. We describe our attempt to minimize the release of potential airborne virus particles into the operating room environment in accordance with the recent statements on minimally invasive gynecologic surgery during the COVID-19 pandemic.

Case Report

A 49-year-old woman (gravida 4, para 3) had severe anemia with uncontrolled genital bleeding due to a submucosal fibroid. Her height, weight, and body mass index were 154 cm, 49 kg, and 20.7 kg/m^2, respectively. Pelvic magnetic resonance imaging revealed a submucosal fibroid and an intramural fibroid, both 7 cm in diameter, in the posterior wall [Figure 1a and b]. Because the submucosal fibroid protruded from the uterine cavity into the cervical canal, hormonal control of genital bleeding was difficult, and hysterectomy was therefore deemed necessary.

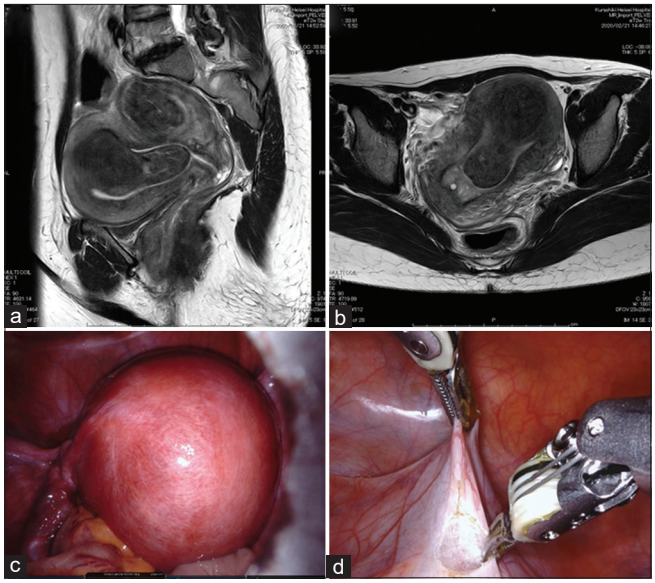

Figure 1: (a and b) T2-weighted sagittal (a) and transverse (b) magnetic resonance images. (c) Laparoscopy showing an enlarged uterus in the abdominal cavity. (d) Photograph showing the cutting of the vesicouterine peritoneum using the double bipolar method

The COVID-19 pandemic was declared on March 11, 2020, by the World Health Organization,[3] at which time the number of confirmed COVID-19 cases in Japan was increasing. At that time, our patient had no fever or respiratory infections and did not meet the criteria for COVID-19 testing as stipulated by Japanese government policy. The AAGL and other related societies issued a statement regarding minimally invasive gynecologic surgery on March 27, 2020. Thus, on April 1, 2020, we performed robotic-assisted hysterectomy for the patient without testing for COVID-19.

Robotic-assisted hysterectomy was performed using a 4-arm da Vinci Xi robot (da Vinci Surgical System; Intuitive Surgical Inc., Sunnyvale, CA, USA) under general anesthesia. Owing to the limited supply of N95 masks and the patient's low risk of COVID-19, the operator and the assistant wore standard surgical masks during surgery. The endoscope port was placed at the umbilicus. The lateral ports for the robotic instruments were mounted directly on the robotic arms and placed 7 cm to the right and 7 cm to the left of the umbilicus. The assist port was placed at a site 2–3 cm medial and superior to the anterior superior ileac spine. A pneumoperitoneum was produced using the AirSeal System (Conmed Corporation, Utica, NY, USA) without a dedicated trocar. The pneumoperitoneal pressure was maintained at 12–15 mmHg (standard pressure) to allow trocar insertion and at 6 mmHg (low pressure) for the remainder of the surgery to reduce intra-abdominal CO_2 pressure.

Before docking the robot, the patient was placed in a 25° Trendelenburg position. After the endoscope reached the abdominal cavity, the small intestine was evacuated to the upper abdomen to secure the operative field, and the operation was started with the patient in a 15° Trendelenburg position. Laparoscopy revealed that the uterus was about the size of a newborn's head and unattached to the pelvic cavity [Figure 1c]. Hysterectomy and bilateral salpingectomy were performed using a double bipolar method involving the simultaneous use of Maryland bipolar forceps (Intuitive Surgical, Inc.) with the right hand and fenestrated bipolar forceps (Intuitive Surgical, Inc.) with the left hand [Figure 1d].[4] We used the Maryland forceps as the cutting device with a Force Triad energy platform (Medtronic, Covidien, Minneapolis, MN, USA) of 70 W in the macro-mode and the fenestrated forceps for bipolar coagulation at 25–35 W. To minimize the spread of the surgical plume, an automated system capable of filtrating and evacuating the plume (IC Medical Crystal Vision 450D, AMCO, Tokyo, Japan) was used in conjunction with the energy device.

After colpotomy, we adjusted the intra-abdominal pneumoperitoneal pressure to 0 mmHg, and the smoke-containing CO_2 gas was actively desufflated through

the smoke filtration and evacuation system before removing the excised uterus from the vagina. Next, the extirpated uterus was successfully removed from the vagina without CO_2 outflow to the operating room. Vaginal cuff closure was performed using interrupted 0-vicryl sutures on CT-1 needles. Finally, the robotic-assisted device was undocked after pneumoperitoneal desufflation through the smoke filtration and evacuation system. No intraoperative complications occurred. The total operative time including the console time was 147 min, and the blood loss was 50 mL. The immediate postoperative recovery was uneventful, and the patient was discharged from the hospital within 84 h after surgery [Supplemental Video 1].

Discussion

We performed robotic-assisted hysterectomy with low pneumoperitoneal pressure (6 mmHg) for the treatment of uncontrolled genital bleeding caused by a submucosal fibroid. The hysterectomy took place in Japan during the COVID-19 pandemic.

COVID-19 emerged in December 2019 in Wuhan, China, and has unfortunately continued to spread worldwide.[5] To limit the exposure of frontline medical personnel to patients with COVID-19, hospitals have withheld nonurgent periodic surgeries. However, urgent and emergency surgeries should be performed regardless of the patients' infection status.

Short hospital stays may decrease the possibility of hospital-acquired COVID-19.[6] Hence, procedures that minimize hospital stays (e.g., robotic-assisted laparoscopic and other minimally invasive surgeries) may best safely achieve effective outcomes. However, at present, open surgery, instead of minimally invasive surgery, is universally employed because of concerns regarding surgical plume-containing aerosolized viral particles generated by cutting and coagulation. Whether pneumoperitoneal surgical plume-containing gas can transmit the virus to humans is currently unknown. However, owing to this possibility, reducing the spread of plume-containing gas is a key to safe performance of minimally invasive surgery during the COVID-19 pandemic.

We encountered a case that required surgery shortly after the release of a Joint Statement from the AAGL and other academic societies.[2] Although deferral of surgery was also taken into consideration, we decided to perform a robotic-assisted hysterectomy with reference to the released statement, which included several notes on how to do so.[2]

First, we successfully performed robotic-assisted hysterectomy under low pneumoperitoneal pressure (6 mmHg), which reduces the risk of the surgical plume escaping through the trocar port. Although robotic-assisted hysterectomy usually requires the use of 15 mmHg of pneumoperitoneal pressure, the statement recommended 10–12 mmHg. A previous study found no differences in operation times and complication rates for gynecologic surgeries performed using 7 versus 15 mmHg of pneumoperitoneal pressure and the AirSeal system.[7] Therefore, robotic-assisted hysterectomy at a low pneumoperitoneal pressure of 6 mmHg may be feasible and safe.

Second, we reduced the amount of surgical plume derived from tissue overcoagulation by using a double bipolar method.[4] Coagulation of thickly grasped tissues in the bipolar mode generates a surgical plume. Such thick tissues can be cut by a spark, which generates less surgical plume when double bipolar forceps with a thin bite is used.[4] As described in the AAGL Statement, tissue is grasped little by little in the double bipolar method, which helps prevent surgical plume formation.[2]

Third, we evacuated and filtered the surgical plume to prevent the spread of aerosols into the operating room.[2] We used the IC Medical Crystal Vision 450D system, which filters up to 0.10-μm particles via an ultralow particulate air filter. Because the SARS-CoV-2 is approximately 0.125 μm in size, this device minimizes (although does not completely abolish) surgical plume spread into the operating room.

Fourth, after uterus removal, intraperitoneal gas was desufflated using an evacuation and filtration system after forcibly eliminating the pneumoperitoneum.[2,8] Doing so further reduced the risk of surgical plume exposure in the operating room.

In summary, we successfully performed robotic-assisted hysterectomy in accordance with the recent statement on minimally invasive surgery during the COVID-19 pandemic. Our procedures minimized the spread of the surgical plume-containing aerosol particles into the operating room. We hope that our experience will help prevent secondary cases of future SARS-CoV-2 infections.

Ethical approval

This case report was approved by the institutional review board of Kawasaki Medical School (approval no. 3887).

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

Prof. Mitsuru Shiota, an editorial board member at *Gynecology and Minimally Invasive Therapy*, had no role in the peer review process of or decision to publish this article. The other authors declared no conflicts of interest in writing this paper.

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