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Bilateral Umbilical Artery Avulsion During Robot-Assisted Pelvic Lymphadenectomy for Endometrial Cancer: A Case Report Emphasizing Safe Hemostatic Management

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Abstract

Robot-assisted surgery has been rapidly adopted worldwide because of its advantages, including reduced blood loss, enhanced dexterity, and lower perioperative morbidity. However, the lack of haptic feedback remains an inherent limitation of robotic systems and may contribute to unintended vascular injury. When unexpected bleeding occurs, achieving hemostasis while avoiding secondary injury to adjacent organs and vessels becomes a critical challenge. A 54-year-old woman with a body mass index of 35 kg/m^2 underwent robot-assisted total hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymphadenectomy for clinical stage IA endometrial cancer. During development of the right paravesical space, traction applied by the robotic arm caused avulsion of the right umbilical artery at its origin, resulting in arterial bleeding from the right internal iliac artery. Temporary hemostasis was achieved with bipolar coagulation. After completion of the right pelvic lymphadenectomy, two large vascular clips were applied to reinforce hemostasis. Subsequently, removal of the traction suture used to elevate the bilateral umbilical arteries toward the abdominal wall for exposure of the bilateral paravesical spaces caused a similar avulsion of the left umbilical artery at its origin after completion of the left pelvic lymphadenectomy. Hemostasis was achieved with bipolar coagulation followed by the application of two large clips. The postoperative course was uneventful. Because our institutional surgical protocol involves developing the pararectal spaces before the paravesical spaces, the ureters had already been identified before the vascular injury occurred. This facilitated safe hemostatic management while minimizing the risk of ureteral injury. Although vascular clips provided effective hemostasis, their application through the assistant port was technically challenging because of the limited insertion angle in the deep pelvis. This case highlights the importance of appropriate surgical sequencing and preparedness for vascular emergencies while suggesting that articulating robotic clip appliers may facilitate safer and more efficient hemostasis.

Categories: Obstetrics/Gynecology
Keywords: endometrial cancer (ec), hemostatic management, intraoperative bleeding, pelvic lymphadenectomy, robot-assisted surgery, secondary injury, surgical strategy, umbilical artery, vascular injury

Introduction

Robot-assisted surgery has been widely adopted for the treatment of gynecologic malignancies because of its advantages, including reduced intraoperative blood loss, improved visualization, enhanced instrument dexterity, and lower perioperative morbidity [1,2]. In patients with early-stage endometrial cancer, robot-assisted hysterectomy with pelvic lymphadenectomy is commonly performed as a minimally invasive surgical approach.

Despite these advantages, the absence of haptic feedback remains an inherent limitation of current robotic systems. Without tactile sensation, surgeons must rely primarily on visual cues to assess tissue resistance and the degree of traction applied to vascular structures, which may increase the risk of unintended tissue or vascular injury [3,4]. When vascular injury occurs, the hemostatic procedure itself may place adjacent organs and vascular branches at risk of secondary injury, particularly within the confined space of the deep pelvis. Therefore, safe hemostatic management requires not only prompt control of bleeding but also careful preservation of surrounding anatomical structures.

The umbilical artery serves as an important anatomical landmark during development of the paravesical space and pelvic lymphadenectomy [5,6]. Although injury to this vessel is uncommon, avulsion at its origin from the internal iliac artery can result in substantial arterial bleeding. To our knowledge, reports of umbilical artery avulsion during robot-assisted gynecologic surgery are extremely rare, and practical strategies for its safe management have not been well described.

We report a rare case of bilateral umbilical artery avulsion during robot-assisted pelvic lymphadenectomy for endometrial cancer. The bilateral occurrence suggests that similar traction angles and instrument

positioning on both pelvic sidewalls may reproduce mechanical shear stress at the origins of the umbilical arteries, leading to avulsion injuries. This case highlights the importance of careful traction management, appropriate surgical sequencing, early identification of the ureters, and preparedness with suitable hemostatic instruments to achieve safe vascular control while minimizing secondary injury to adjacent structures.

Case Presentation

A 54-year-old woman (gravida 2, para 2) with a body mass index of 35 kg/m² and no significant medical history presented to a local hospital with abnormal uterine bleeding. Endometrial biopsy revealed grade 2 endometrioid adenocarcinoma. Pelvic magnetic resonance imaging and contrast-enhanced computed tomography suggested clinical stage IA disease without evidence of lymph node or distant metastasis (Figure *1*). She was referred to our institution for definitive surgical management.

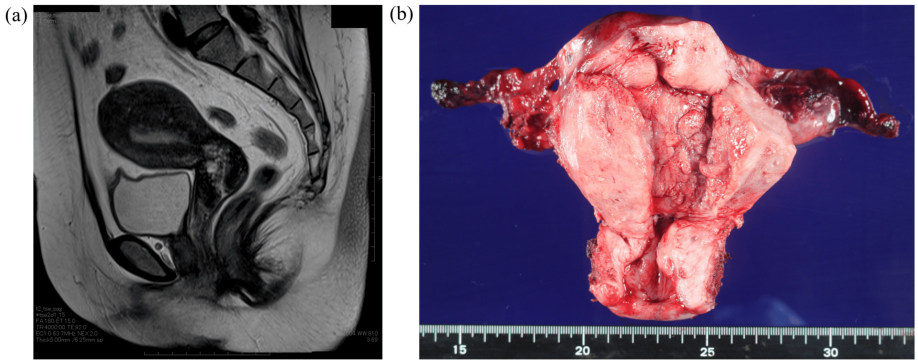
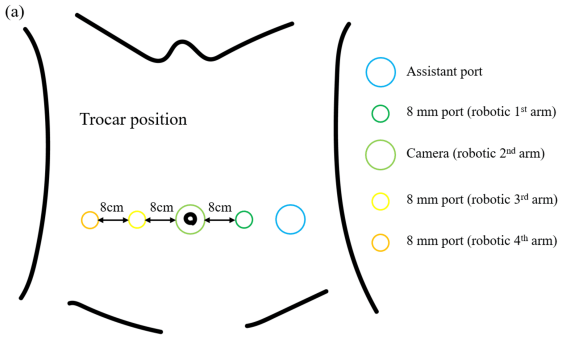


FIGURE 1: Preoperative imaging and surgical specimen.

(a) Sagittal T2-weighted magnetic resonance image showing the uterine tumor. (b) Macroscopic appearance of the surgical specimen after robot-assisted total hysterectomy and bilateral salpingo-oophorectomy.

The patient underwent robot-assisted total hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymphadenectomy using the da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, California, United States). The procedure was performed using a standard four-arm robotic technique with an assistant port in accordance with our institutional protocol (Figure *2*).



(b)

Used instruments

1st arm	Fenestrated bipolar forceps
3rd arm	Monopolar curved scissors Vessel sealer extend Mega needle driver
4th arm	Force bipolar

FIGURE 2: Port placement and instruments used for robot-assisted surgery.

(a) Schematic illustration of the port layout and robotic instruments used during robot-assisted total hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymphadenectomy. (b) Instruments used for robot-assisted surgery.

The image is original and was created by the authors using Microsoft Paint and Microsoft PowerPoint (Microsoft Corporation, Redmond, Washington, United States).

At our institution, the pararectal spaces are routinely developed before the paravesical spaces during pelvic lymphadenectomy. This approach allows early identification of the ureters and major pelvic vessels before further dissection of the pelvic sidewall [5]. To facilitate exposure of the paravesical spaces, the bilateral umbilical arteries were elevated toward the abdominal wall using a traction suture.

After completion of the hysterectomy, development of the right paravesical space was initiated. During traction with the robotic arm, the right umbilical artery was unexpectedly avulsed at its origin from the right internal iliac artery, resulting in pulsatile arterial bleeding (Figure 3).

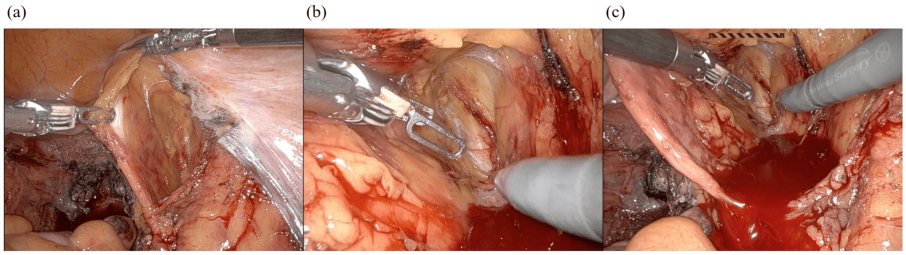


FIGURE 3: Avulsion of the right umbilical artery during development of the right paravesical space.

Intraoperative images obtained from the surgical video. (a) Development of the right paravesical space. (b) Further dissection of the right paravesical space until the levator ani muscle was exposed, revealing bleeding in the lower right portion of the surgical field. (c) A wider view obtained by withdrawing the camera, revealing pulsatile arterial bleeding from the origin of the right umbilical artery at the right internal iliac artery.

Because the right ureter had already been identified during the preceding development of the pararectal space, the bleeding site could be exposed while minimizing the risk of ureteral injury. The bleeding point at the origin of the right umbilical artery was identified, and temporary hemostasis was achieved using bipolar coagulation. As bleeding was controlled, the right pelvic lymphadenectomy was completed before additional hemostatic reinforcement. Subsequently, to ensure secure hemostasis and reduce the risk of recurrent bleeding, the bedside assistant applied two large Weck™ Hem-o-lok™ polymer ligating clips (Teleflex Inc., Wayne, Pennsylvania, United States) to the injured vessel through the assistant port using an endoscopic clip applier, thereby achieving definitive hemostasis.

Subsequently, after completion of the left pelvic lymphadenectomy, removal of the traction suture used to elevate the bilateral umbilical arteries resulted in a similar avulsion of the left umbilical artery at its origin from the left internal iliac artery, causing pulsatile arterial bleeding (Figure 4). We speculate that traction-related mechanical stress concentrated at the origin of the umbilical artery during manipulation of the suture, leading to avulsion at this anatomically vulnerable site. After initial control with bipolar coagulation, the bedside assistant applied two large Weck™ Hem-o-lok™ clips through the assistant port using an endoscopic clip applier, resulting in secure hemostasis (Figure 5).

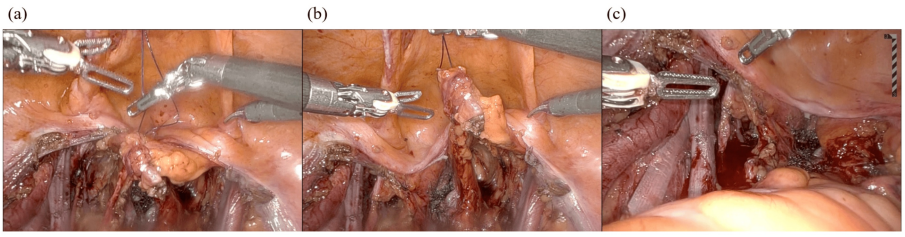


FIGURE 4: Avulsion of the left umbilical artery after removal of the traction suture.

Intraoperative images obtained from the surgical video. (a) The traction suture used to elevate the umbilical arteries before removal. (b) The traction suture becoming caught on the left umbilical artery during attempted removal. (c) Pulsatile arterial bleeding from the origin of the left umbilical artery at the left internal iliac artery following removal of the traction suture.

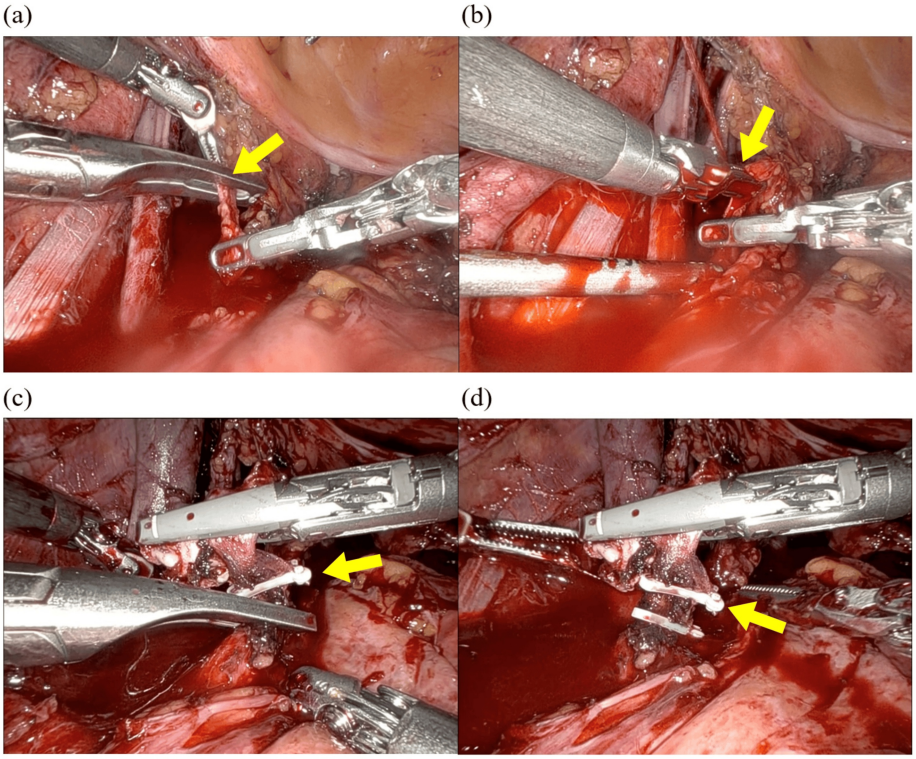


FIGURE 5: Hemostatic management of bleeding from the left internal iliac artery.

Intraoperative images obtained from the surgical video. The pararectal space had been developed before the vascular injury, allowing medial displacement and identification of the ureter. Before hemostatic procedures were performed, the ureter was confirmed to be sufficiently distant from the bleeding site. (a) Placement of a vascular clip caudal to the injured site (arrow). (b) Identification of the cranial bleeding point at the injured site (arrow). (c) Application of the first Weck™ Hem-o-lok™ polymer ligating clip to the cranial aspect of the injured site (arrow). (d) Application of the second clip to the cranial aspect of the injured site to achieve definitive hemostasis (arrow).

Although definitive hemostasis was successfully achieved on both sides, clip application through the assistant port was technically challenging because of the limited angle of approach within the deep pelvis. On both occasions, the injured vessel had to be gently elevated with a robotic instrument to facilitate clip placement by the bedside assistant. Particular care was taken during these maneuvers to avoid iatrogenic injury to adjacent branches of the internal iliac artery. Conversion to laparotomy was considered as a potential option for managing the vascular injuries. However, because bleeding was adequately controlled and the operative field remained clearly visualized, hemostasis could be safely completed robotically without conversion.

The total operative time was nine hours and 57 minutes, and the estimated blood loss was 645 mL. No blood transfusion was required. Given the prolonged operative duration, conversion to laparotomy was considered in view of the potential risks associated with extended anesthesia. However, the patient's hemodynamic and respiratory conditions remained stable throughout the procedure, and adequate surgical visualization was maintained, allowing safe completion of the surgery without conversion. The patient was successfully extubated in the operating room without difficulty. Postoperative venous thromboembolism prophylaxis included intermittent pneumatic compression and early mobilization. Mild anemia was noted on postoperative day 1 and was managed with oral iron supplementation. The postoperative recovery was otherwise uneventful, and the patient was discharged on postoperative day 5 according to the standard postoperative schedule. At the first outpatient follow-up within one month after discharge, no clinically significant abnormalities were observed. The patient remains under regular postoperative follow-up.

Histopathological examination confirmed grade 2 endometrioid carcinoma, FIGO 2008 stage IA (pT1aN0), without lymphovascular space invasion. Surgical margins and peritoneal cytology were negative. Because the patient was classified as being at low risk of recurrence, no adjuvant therapy was administered. She remains under routine follow-up without evidence of disease recurrence.

Discussion

Robot-assisted surgery has become an established approach for the treatment of endometrial cancer because

it offers improved visualization, articulated instrumentation, and reduced surgical morbidity compared with open surgery. Nevertheless, the absence of haptic feedback remains an inherent limitation of current robotic systems [3,4]. Surgeons must rely primarily on visual cues to assess tissue resistance and traction force, which may increase the risk of unintended tissue or vascular injury, particularly during dissection around major pelvic vessels [7].

Although minimally invasive surgery is generally considered safe for surgical staging of endometrial cancer, perioperative complications remain clinically relevant. In a large series of robotic staging procedures for endometrial cancer, major postoperative complications occurred in 7.6% of patients, blood transfusion was required in 3%, venous thromboembolism occurred in 1.7%, and postoperative lymphedema was reported in 13.4% [2,8]. In the Gynecologic Oncology Group LAP2 trial, laparoscopic staging for uterine cancer was associated with fewer postoperative complications and shorter hospitalization than laparotomy, supporting the safety of minimally invasive surgery [1]. However, pelvic lymphadenectomy is performed in close proximity to major pelvic vessels, and vascular injury remains an important intraoperative complication [7,9].

Pelvic lymphadenectomy requires dissection around the external and internal iliac vessels, the interiliac region, and the obturator nerve. Potential sources of bleeding include the external and internal iliac vessels, obturator vessels, and pubic vessels, including the corona mortis [5]. Vascular injury has been reported in approximately 1% of patients undergoing laparoscopic pelvic and para-aortic lymphadenectomy in a large series [10,11]. In addition, a review of major vascular injuries during gynecologic cancer surgery identified lymph node dissection as the most common operative step associated with vascular injury [7].

The umbilical artery is an important anatomical landmark during development of the paravesical space and pelvic lymphadenectomy and may also be used as a traction point [5]. Although injury to this vessel is uncommon, avulsion at its origin from the internal iliac artery can result in substantial arterial bleeding. To our knowledge, bilateral umbilical artery avulsion during robot-assisted gynecologic surgery has rarely been reported.

The main educational value of this case lies not in the vascular injury itself, but in the strategy used to achieve hemostasis while minimizing secondary injury to adjacent structures. Intraoperative bleeding may occur despite careful surgical technique, and safe management requires not only rapid control of hemorrhage but also preservation of surrounding organs and vascular anatomy.

At our institution, the pararectal spaces are routinely developed before the paravesical spaces during pelvic lymphadenectomy. As a result, the ureters and major pelvic vessels had already been identified before the vascular injuries occurred. This surgical sequence facilitated clear identification of the bleeding sites and reduced the risk of ureteral injury during hemostatic management. Although the optimal sequence of retroperitoneal dissection may vary among surgeons and institutions, our experience suggests that early identification of critical anatomical structures can enhance the safety of hemostatic procedures when unexpected vascular injury occurs. To minimize the risk of umbilical artery avulsion, alternative traction techniques, such as applying traction to the more fibrous portion of the umbilical ligament or creating a peritoneal fold for traction, may help reduce excessive mechanical stress at the origin of the umbilical artery. Careful consideration of traction direction and force is also important to prevent similar vascular injuries.

Another important lesson from this case is the need for appropriate preparation of hemostatic instruments. Bipolar coagulation provided initial control of bleeding; however, because the injuries involved the origins of the umbilical arteries adjacent to the internal iliac arteries, vascular clips were additionally applied to achieve secure hemostasis. Clip application through the assistant port was technically challenging because of the restricted angle of approach within the deep pelvis. Placement of the clips required gentle elevation of the injured vessel with a robotic instrument while the bedside assistant manipulated the clip applier. Although these maneuvers were completed safely, excessive manipulation of the injured vessel could potentially result in iatrogenic injury to adjacent branches of the internal iliac artery [12]. Importantly, clipping the umbilical artery at its origin may compromise blood flow to its branches, particularly the superior vesical arteries, potentially affecting bladder perfusion. Although collateral circulation within the pelvis may mitigate this risk, careful attention to the clipping site and preservation of adjacent vascular branches is essential to minimize ischemic complications [13].

In this context, the availability of an articulating robotic clip applier may be advantageous. Such an instrument could improve maneuverability within the deep pelvis, allow the console surgeon to apply clips directly, and potentially facilitate safer and more efficient vascular control while reducing the need for additional manipulation of the injured vessel. However, because an articulating robotic clip applier was not used in the present case, these potential benefits remain theoretical and require further evaluation.

Taken together, this case suggests that safe management of unexpected vascular injury during robot-assisted pelvic surgery depends largely on preparation before bleeding occurs. Appropriate surgical sequencing, early identification of critical anatomical structures, and readiness with suitable hemostatic

instruments may reduce the risk of secondary injury to adjacent organs and vessels during emergency hemostatic management. To prevent umbilical artery avulsion, excessive traction should be avoided, particularly near the arterial origin. Applying traction to the more fibrous portion of the umbilical ligament or using a dissected peritoneal fold for retraction may help minimize mechanical stress on the vessel. The prolonged operative time of nine hours and 57 minutes and estimated blood loss of 645 mL highlight the substantial procedural burden associated with managing unexpected vascular injuries. Although the patient's hemodynamic and respiratory conditions remained stable and no blood transfusion or conversion to laparotomy was required, these findings underscore the importance of continuous assessment of patient safety, including consideration of conversion when necessary.

Conclusions

Unexpected vascular injury remains an inherent risk of robot-assisted pelvic surgery, particularly because the absence of haptic feedback may make it difficult to accurately judge the amount of traction applied to vascular structures. However, the clinical challenge extends beyond achieving hemostasis alone. Preventing additional injury to adjacent organs and vascular structures during hemostatic management is equally important.

This case demonstrates that safe hemostatic management begins before bleeding occurs. Appropriate surgical sequencing with early identification of the ureter and adequate preparation of hemostatic instruments enabled prompt vascular control while minimizing the risk of additional injury. Furthermore, robotic articulating clip appliers may facilitate safer vascular control in the deep pelvis by improving maneuverability during emergency hemostatic procedures. Our experience suggests that establishing a predefined strategy for unexpected vascular injury should be considered an essential component of robot-assisted pelvic surgery. Such preparation may not prevent every vascular injury, but it can substantially improve the safety of hemostatic management and reduce the likelihood of iatrogenic injury.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Review Board of Nagoya University Hospital issued approval 2018-0400. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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