

# Laparoscopy Combined with Transvaginal Approach for Repairing Genital Tract Penetrating Injury: A Case Report

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**Abstract:** Female external genital injuries mainly include sexual-related injuries and accidental injuries. Severe cases may experience rapid and massive bleeding, with possible foreign body retention in the body or concurrent injuries to adjacent organs such as the rectum and bladder. Most of these cases require surgical treatment, and the intraoperative situation is complex and changeable. We report a patient with a penetrating injury of the genital tract and foreign body retention in the body, who was successfully treated using the laparoscopic combined with transvaginal full-layer suture technique. Compared with the traditional transvaginal approach, this method can comprehensively explore the lacerations and surrounding organs of the cavity, and thoroughly clean up residual foreign bodies in the body. This paper explores the safety, feasibility, related surgical techniques, and perioperative precautions of this technique in the treatment of genital tract penetrating injuries.

**Keywords:** laparoscopy, laceration, surgical procedures, operative

## Introduction

Female genital tract injuries are one of the gynecological emergencies. Due to their anatomical characteristics, with the urethra and bladder adjacent in the front and the anus and rectum adjacent in the back, the tissue structure is complex and the blood supply is rich. Therefore, injuries often lead to profuse and rapid bleeding. Whether it is a sexual-related injury or an accidental injury, it is necessary to fully understand the medical history and assess whether there are concurrent fractures, penetrating injuries, and organ injuries. Our team successfully treated a patient with severe violent vaginal wall laceration and massive bleeding using the laparoscopic combined with transvaginal full-layer suture technique in December 2023 and summarized the treatment experience and surgical techniques.<sup>1</sup> We believe that it is feasible and safe to use this technique for repairing severe violent vaginal wall lacerations. In April 2024, our center successfully treated another patient with traumatic genital tract injury - penetrating injury using this technique. Penetrating injuries of the female external genitalia are often accompanied by the retention of the injuring object in the body, and there is a high possibility of injuring adjacent organs such as the anus, rectum, and bladder. Currently, there are only a few reports on the successful laparoscopic repair of anorectal penetrating injuries internationally.<sup>2</sup> Therefore, this article reviews this case, summarizes the treatment decisions, surgical key points, and perioperative management of patients with genital tract penetrating injuries, and suggests that this approach can be considered as the primary treatment method for such patients. The study was approved by the Ethics Committee of Chongqing General Hospital of Chongqing University (KYS-2023-017-01), including the permission of publication of case details.

## General Information

Written informed consent for publication has been obtained from the patient. The patient was a 43-year-old female who was admitted to the hospital in April 2024 due to “foreign body stabbing the vagina with pain and vaginal bleeding for

over 2 hours". Over 2 hours before admission, while hiking in the mountains, she accidentally slipped down a steep slope and was stabbed about 10 cm deep into the vagina by the sharp end of a broken bamboo stick planted in the soil. After getting up, the bamboo stick was spontaneously pulled out of the body, resulting in severe pain and vaginal bleeding, which completely soaked a sanitary pad. When asking about the medical history without family members present, the patient denied a history of sexual violence. She had a history of laparoscopic myomectomy in 2020 and denied any history of allergies or blood transfusions. On admission, her blood pressure was 125/80 mmHg (1 mmHg = 0.133 kPa), and her heart rate was 66 beats/min. She had a pained expression. Abdominal examination showed a passive position, soft abdomen, mild tenderness in the lower abdomen, no rebound tenderness, and no tenderness in the pubic symphysis. Gynecological examination revealed an irregular laceration at the perineum, approximately 3×2 cm in size, with active bleeding. There was blood in the vagina, and an irregular laceration about 2×2 cm in size was seen on the right side of the posterior fornix. Bimanual and rectal examination detected a hard, strip-shaped foreign body between the rectum and the posterior vaginal wall, about 4 cm long and 1 cm wide, with obvious tenderness. Emergency pelvic CT scan (Figure 1) showed pelvic blood and fluid accumulation, slightly blurred fat spaces in the left lower abdomen and pelvis. There was a little free gas in the pelvis, the pre-rectal space, and the perineum. The perineal soft tissues were significantly swollen. The rectal and bladder walls were continuous, and no definite signs of trauma were observed. Clinical diagnosis: Penetrating injury of the genital tract, foreign body retention, possible organ injury? Pelvic hematoma.

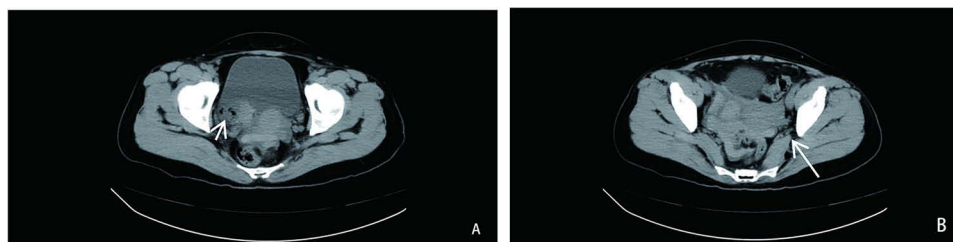
After obtaining informed consent, emergency laparoscopic exploration, adhesiolysis of the intestine, suture and hemostasis of the posterior vaginal fornix, removal of the foreign body in the rectovaginal space, and repair of the vaginal laceration were performed.

## Surgical Procedures

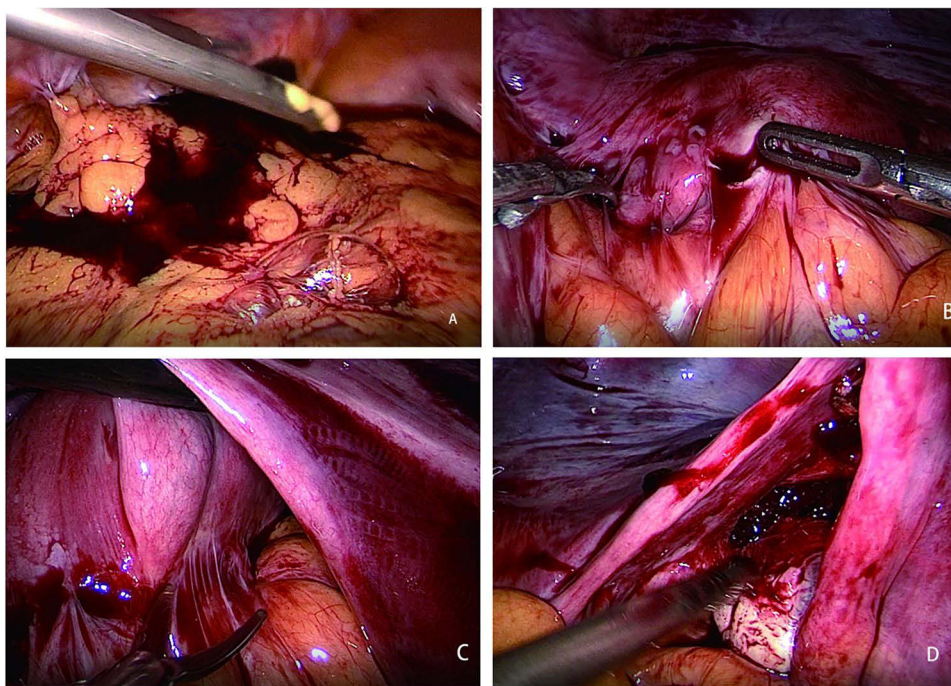
Under general anesthesia, the patient was placed in the lithotomy position. After routine disinfection and draping, laparoscopic exploration revealed approximately 500 mL of pelvic and abdominal blood (Figure 2A). The bladder serosa was intact. The sigmoid colon was densely adhered to the left pelvic wall and the posterior wall of the uterus (Figure 2B and C). The left fallopian tube was distorted and adhered to the left pelvic wall. Irregular ruptures with active bleeding were seen in the right vaginal fornix and the posterior lobe of the right broad ligament (Figure 2D). The peritoneum of the right pelvic wall was dark purple, and there was a retroperitoneal hematoma on the pelvic wall. The surgical procedures are shown in Figure 3 and Table 1.

## Postoperative Conditions

The operation lasted for 180 minutes. The total intraoperative blood loss was 650 mL, including 500 mL of pelvic blood. Intraoperative fluid infusion was 2700 mL, and intraoperative urine output was 650 mL. No blood transfusion was required. Tetanus immunoglobulin was intramuscularly injected within 24 hours after the operation. The urinary catheter was removed 2 days after the operation, and the patient urinated normally on her own. The patient passed gas 2 days after the operation and had a bowel movement 3 days after the operation. Three days after the operation, the patient experienced chest tightness, dizziness, and dyspnea, with a blood oxygen saturation of 80–90%. Pulmonary CTA showed pneumonia and pleural effusion. Albumin supplementation and anti-infection treatment were given. The patient was



**Figure 1** (A) Pelvic effusion; (B) Blurred fat space (The area pointed by the arrow).



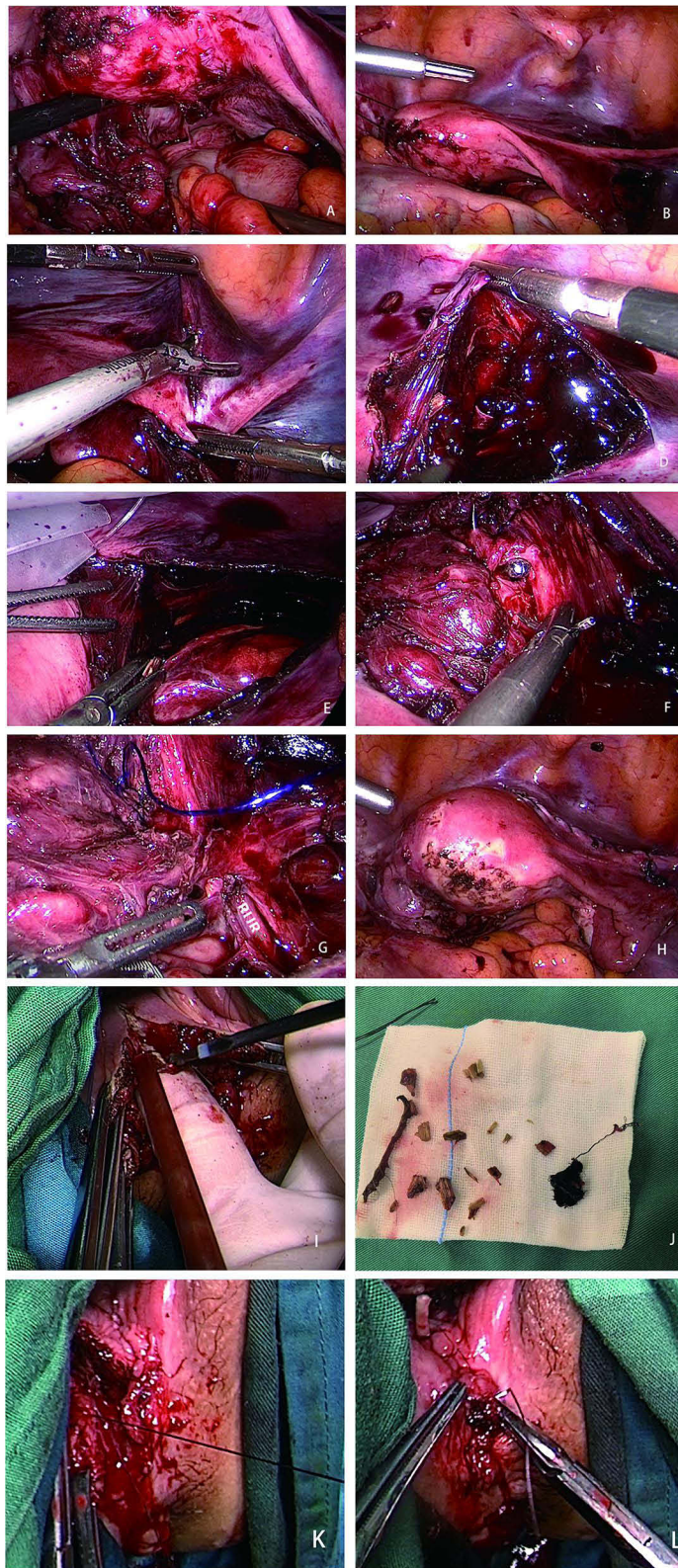
**Figure 2** (A) Pelvic and abdominal blood accumulation; (B). Adhesion between the sigmoid colon and the left pelvic wall; (C) Adhesion between the sigmoid colon and the posterior wall of the uterus; (D) Irregular rupture of the right broad ligament.

discharged 11 days after the operation, and the vaginal incision healed well. The patient resumed sexual life 2 months after the operation. Follow-up until July 2024 showed no abnormalities.

## Discussion

### Current Treatment Status of Genital Tract Injuries

Acute genital injuries for non-obstetric causes mainly include two categories: one is sexually related injuries such as dyspareunia, sexual assault, sexual abuse, sexual violence, rape, etc.; the other is injuries caused by accidental trauma, including blunt injuries (straddle injury, kicking injury, bruise, etc.), sharp instrument injury, pelvic fracture, high-altitude fall and other injuries. The perforation of the vagina is generally on the right side, and this is due to the natural rotation of the uterus and for the presence of the rectum on the left side.<sup>3</sup> Patients typically present with massive vaginal bleeding as the main clinical manifestation. Common treatment options are as follows: 1) Transvaginal suture repair of lacerations: This traditional surgical method features minimal trauma and rapid postoperative recovery. It conforms to anatomical structures and allows prompt exploration of vaginal wounds, thus gaining wide recognition and adoption by physicians. However, the narrow operative space in the vagina affects surgical field exposure. When the vaginal laceration is deep or the wound bleeds profusely, insufficient exposure may lead to suture failure. 2) Transvaginal suture combined with double-lumen balloon catheter-assisted hemostasis: To reduce operation time and wound edema exacerbated by surgical manipulation, only obvious vaginal bleeding points and hematomas are sutured, followed by compression with a double-lumen balloon catheter and gauze. This is suitable for cases with genital inflammation or fragile vaginal tissues prone to tearing. Reports suggest this method can significantly reduce postoperative vaginal bleeding, infection, and induration rates in patients with severe vaginal lacerations, effectively promoting first-class wound healing.<sup>4</sup> It is not indicated for patients with rapid bleeding or unknown vaginal wall laceration status. 3) Pelvic artery embolization: The vaginal artery is supplied by the internal iliac artery. Internal iliac artery embolization has been reported to successfully treat severe reproductive tract laceration bleeding caused by pregnancy and childbirth.<sup>5</sup> However, its use in young fertile patients is controversial: some scholars believe internal iliac artery embolization may affect ovarian function.<sup>6</sup> Numerous studies have confirmed<sup>7-9</sup> that internal iliac or uterine artery embolization can cause intrauterine adhesions, leading to infertility or adverse pregnancy outcomes. 4) Transabdominal/laparoscopic



**Figure 3** (A) Separate the intestine from the surrounding adhesions to expose the Douglas pouch; (B) Suture the fundus of the uterus and pull the suture to suspend; (C) Open the right lateral peritoneum and the anterior lobe of the broad ligament; (D) Use a suction device to clean the blood in the broad ligament; (E) Put the thin bamboo stick retained in the body into a specimen bag and remove it; (F) Use a curved clamp to explore and guide from the rupture of the vaginal fornix; (G) Free the ureter and suture the vaginal rupture; (H) Close the peritoneum; (I) Incise the vaginal wall tissue in front of the tunnel; (J) The foreign body removed from the body through the vagina; (K) Suture the anterior rectal fascia tissue; (L) Reinforce the suture of the vagina.

**Table 1** Surgical Procedure

Surgical Steps	Advantages	Risks	Contraindications
1. Pack the vagina with gauze.	Compression hemostasis	If there is a foreign body in the body, pay attention to avoiding secondary injury caused by gauze packing.	Avoid repeated packing or removal of gauze
2. Exploration of the pelvic and abdominal cavity	To understand whether there is adhesion in the pelvic and abdominal cavity blood, accumulation, and whether there is combined organ injury	If adhesions exist, adhesiolysis is required to restore normal anatomy, so as to identify organ injuries hidden by adhesions	If intestinal adhesions exist, it is necessary to make full use of the functions of various instruments, combine blunt and sharp dissection to find gaps, and use cold knife instruments for separation.
3. Use the suspension method to retract the uterus for surgical field exposure	Reduce auxiliary incisions and dependence on assistants	Suture the fundus of the uterus or peritoneum to avoid vascular injury	It is not recommended for use in cases of severe inflammation or tissue prone to avulsion
4. Carefully explore penetrating injuries and bleeding sites	Can identify the specific site of organ injury, remove residual foreign bodies in the body, and locate damaged blood vessels for precise hemostasis	To avoid new injuries to adjacent blood vessels and organs, it is necessary to open the vesicoperitoneal reflection, push the bladder downward to locate the ureter.	It is forbidden to perform blind electrocoagulation for hemostasis without understanding the anatomy, and to directly remove foreign bodies.
5. Laparoscopic suture of vaginal laceration	Can precisely suture the laceration and achieve hemostasis	Pay attention to avoiding the ureter and paravaginal blood vessels	Prohibited to suture blindly without clear anatomy
6. Clean up the hematoma, repeatedly irrigate the pelvic and abdominal cavity with normal saline, and close the peritoneum.	Can prevent postoperative infection.	A drain can be placed to avoid postoperative pelvic hematocele	Avoid leaving dead space and foreign bodies to prevent postoperative infection
7. Incise the vaginal wall tissue in front of the tunnel and remove the foreign body from the tunnel transvaginally	Can thoroughly inspect and clean foreign bodies in the tunnel	Explore the anatomy of the rectum and vagina clearly to avoid rectal injury	Completely close the tunnel and avoid leaving dead space. Place a drain strip when necessary
8. Reinforce the suture of the vagina.	Can restore normal anatomy and avoid vaginal relaxation	Avoid excessive tightness in vaginal suturing to prevent difficulty during sexual intercourse	Prohibit suturing the vagina and perineal body. The vaginal width should be at least two transverse fingers after suturing

combined with transvaginal suture hemostasis: Cheng et al<sup>10</sup> reported a case of a 16-year-old girl who underwent laparotomy for vaginal wall laceration, intestinal perforation, acute peritonitis, and pelvic abscess due to coitus. Our team recently reported a case of successfully treating a patient with violent severe vaginal wall laceration and massive hemorrhage using laparoscopic combined with transvaginal full-thickness suture technology.<sup>1</sup> The first three treatment methods have limitations in disease assessment and are unsuitable for penetrating injuries or cases with combined organ damage. Open abdominal surgery may increase patient trauma, conflicting with the concept of minimally invasive surgery. In recent years, the incidence of non-obstetric genital injuries has been on the rise. Therefore, how to safely, effectively, and minimally invasively assess the condition comprehensively and treat genital injury patients is a topic worthy of urgent discussion and need.

## Advantages of the Laparoscopic Combined with Transvaginal Full - Layer Suture Technique for Repairing Genital Tract Injuries

There are a few case reports internationally on the treatment of genital tract injuries using the laparoscopic combined with transvaginal approach. Laparoscopic surgery provides an optimized surgical field of view, allowing for a comprehensive assessment of bleeding, organ injuries, and the presence of foreign body retention in the body. Cohen et al<sup>11</sup> believe that laparoscopy can not only display the entire vaginal wall defect but also help surgeons examine adjacent organs to ensure the timely detection and repair of visceral injuries and is more conducive to cleaning peritoneal bleeding. Austin et al<sup>12</sup> also believe that when it is difficult to obtain a sufficient surgical field of view and operating space through transvaginal surgery alone, laparoscopic surgery can more thoroughly evaluate the bleeding site and the injury of other organs. At the same time, compared with laparotomy, it can significantly reduce the recovery time, blood loss, and pain. Our center believes that for patients with limited vaginal operating space, massive bleeding,<sup>1</sup> and vaginal penetrating injuries, choosing the laparoscopic combined with transvaginal approach to repair genital tract injuries is safer, more effective, has a higher hemostasis success rate, allows for a more comprehensive assessment of the condition,

and can completely remove retained substances in the body that may not be detected otherwise. It can be considered as the preferred surgical method.

## Surgical Techniques and Management Experience of Laparoscopic Combined with Transvaginal Full - Layer Suture for Genital Tract Penetrating Injuries

1) Adequate Exposure: To complete the ligation and suture hemostasis of the vaginal side wall and blood vessels under laparoscopy, it is necessary to fully expose the vaginal lateral space up to the pelvic diaphragm. Since the use of a uterine manipulator is not suitable for most vaginal injuries, to reduce the difficulty of separating the parauterine and paravaginal spaces during the operation, the suspension method<sup>13</sup> can be used. Suture and suspend the fundus of the uterus, and pull the uterus towards the patient's head or laterally as required during the operation to expose the surgical field. To meet the surgical needs, suturing and suspending the bladder peritoneal reflection, bilateral adnexa, etc., are helpful for fully exposing the surgical field.

2) Bleeding Assessment: During the operation, it is necessary to quickly judge the bleeding site and bleeding rate as much as possible. When the anatomical structure is not clear, a gauze can be temporarily used to compress the wound surface for hemostasis, or the vagina can be packed with gauze for hemostasis. In this case, after compressing the wound surface with a laparoscopic gauze, the bleeding slowed down, providing sufficient time to release adhesions and separate the spaces.

3) Assessment of Pelvic Organ Injuries: When a sharp instrument penetrates the urogenital diaphragm from the vagina into the pelvic cavity, it is easy to injure adjacent organs such as the bladder and intestines. It is necessary to comprehensively examine whether the serosa and muscle layers of each organ are intact. Therefore, for patients with pelvic adhesions or intestinal adhesions, it is necessary to restore the normal anatomical structure before fully examining.

4) Space Separation: The key to this operation lies in separating the vesicovaginal space, vaginal lateral space, and vesical lateral space. In this case, the intestine was densely adhered to the surrounding tissues. To avoid new vascular injuries and accessory organ injuries during the operation, the space dissection method<sup>14</sup> should be used. Skillfully use the ultrasonic scalpel in combination with "cold instruments" for separation. When separating intestinal adhesions, adhere to the principle of "from simple to difficult". According to the intestinal tract's shape, find the loose space and gradually advance. When freeing the ureter and separating blood vessels, find the natural spaces around them. Blunt - ended instruments can be used to gradually separate within the spaces. Avoid violent pulling. For small blood vessels, bipolar electrocoagulation can be used for hemostasis, but avoid thermal injury to the ureter.

5) Expose the anatomical structures: To avoid new injuries to adjacent blood vessels and organs, the anatomical structures around the genital tract wound should be fully exposed under laparoscopy. It is necessary to open the vesicoperitoneal reflection, push the bladder downward, locate the ureters, and open the ureteral tunnels if necessary. Additionally, the paravaginal space may need to be opened to identify bleeding vessels for electrocoagulation and suture hemostasis of the wound. The surgery is preferably performed by a surgeon experienced in radical hysterectomy for cervical cancer.

6) Keep the Surgical Field Clean: Continuous bleeding from the wound may affect the surgical field. The assistant can use a suction device to continuously apply a small negative pressure to the bleeding point or use a laparoscopic gauze to compress the wound surface and then suction the blood to keep the surgical field clean, which is conducive to finding the bleeding blood vessels and hemostasis.

7) Removal of Retained Substances in the Body: It is necessary to clearly determine whether there is a possibility of the injuring object remaining in the body before the operation. If the injuring object that caused the penetrating injury is still retained in the body, it should not be removed before the operation. Before the operation, it is necessary to understand the circumstances of the injury, the detailed process, and the surrounding environment of the injury site in detail, and combine imaging for evaluation. For small, non - metallic foreign bodies, imaging examinations may not be able to accurately assess, such as in this case. Comprehensive exploration is required during the operation. For large retained substances that may penetrate large blood vessels or important organs, multidisciplinary cooperation is required for the operation after preoperative assessment.

8) Protect Pelvic Autonomic Nerves: The hypogastric nerve and sacral nerve converge into the pelvic plexus below the deep uterine vein and then branch to innervate organs such as the vagina, cervix, uterus, bladder, and rectum.<sup>15</sup> Injury to the main trunk or branches of this nerve plexus can cause symptoms such as difficulty in urination and defecation and urinary retention. During the operation, it is necessary to fully protect these nerves. Avoid excessive electrocoagulation for hemostasis, and suture if necessary. If the blood vessels are freed properly, vascular clips can be used for hemostasis.

9) During the operation, remove all hematomas, and repeatedly rinse the wound surface with normal saline or dilute povidone-iodine to reduce the possibility of contamination. After the operation, close the peritoneum to avoid adhesions. If there is a retroperitoneal hematoma, it is not necessary to close all peritoneal surfaces. Leave some gaps for drainage. Drains can be placed in the pelvic and vaginal cavities.

10) Suture and Reinforce the Vaginal Wall Laceration through the Transvaginal Approach: After completing the laparoscopic suture hemostasis, it is necessary to re-examine through the transvaginal approach to assess whether there are vaginal space tunnels, foreign body retention, etc., and reinforce the suture to achieve thorough hemostasis.

## Surgical Indications, Contraindications, and Perioperative Management Experience of Laparoscopic Combined with Transvaginal Full-Thickness Suture for Genital Tract Injuries

The team rescued 2 cases of genital tract injuries in a short term, among which 1 case was related to sexual violence with rapid bleeding that could not be sutured hemostasis via vagina; this case was a penetrating injury caused by a sharp bamboo strip, with multiple bamboo fragments remaining in the body. Both cases were successfully treated by laparoscopy combined with a transvaginal layered suture technique. Through summarizing perioperative management, the main improvements in experience are as follows:

1) Surgical indications: Based on treatment experience, for penetrating injuries with foreign bodies in the vagina or cases with rapid vaginal bleeding where the wound surface cannot be well exposed transvaginally, laparoscopy combined with transvaginal approach can be directly selected for repair, as pure transvaginal exploration and suture have limitations.

2) Hemostasis strategies: For patients with rapid vaginal bleeding, massive gauze packing in the vagina can effectively compress for hemostasis; for pelvic wound bleeding, laparoscopic gauze compression can be used to gain time for comprehensive laparoscopic exploration and operation.

3) Nutritional support: Due to the severe impact of trauma, patients often have hypoalbuminemia and anemia, so postoperative nutritional support must be strengthened. Previous studies have shown that hypoalbuminemia (albumin <35 g/L) is an independent risk factor for complications after gynecological tumor surgery.<sup>16</sup> In this case, the patient had an albumin level of 25 g/L on the first postoperative day, presenting with pleural effusion, pneumonia, and dyspnea, possibly related to this. After intravenous infusion of 20 g albumin daily for 6 days, the albumin increased to 36 g/L, cough symptoms gradually relieved, pleural effusion completely resolved at the 10-day postoperative review, and no recurrence was found at the 2-month follow-up.

4) Anti-infection measures: Antibiotics were used prophylactically before and during surgery, and tetanus immunoglobulin was used postoperatively for prophylaxis. After surgery, the patient showed elevated blood counts combined with pneumonia, so antibiotics were upgraded. Seven-day anti-infection therapy normalized the blood counts, suggesting that intensive perioperative anti-infection can reduce perioperative complications.

5) Surgical contraindications: Same as emergency surgery contraindications, including severe cardiopulmonary insufficiency, severe coagulation disorders, uncontrolled severe infections, etc. Patients without vaginal penetrating injuries or with minimal vaginal bleeding who can be repaired transvaginally alone do not need combined laparoscopy. Meanwhile, this surgery is not suitable for primary surgeons without experience in laparoscopic radical hysterectomy.

## Conclusion

With the continuous improvement of laparoscopic equipment and its long-term application in benign and malignant surgical procedures in general surgery, the anatomical structure of the pelvic floor urogenital diaphragm and surgical techniques have

been recognized and mastered by most gynecological oncology surgeons. Theoretically, for patients with severe bleeding or those who require repair or even fistula formation due to concurrent organ injuries, the operation can be completed under laparoscopy. If necessary, assistance from relevant departments such as general surgery and urology can be sought. The combined transvaginal full - layer suture technique for repairing genital tract penetrating injuries can not only explore the pelvic and abdominal cavities but also better examine the vaginal structure, enabling a more reliable assessment and repair of injuries. The prognosis of patients treated by this surgical method is good, and there are no long - term complications. It can provide a reference for the surgical treatment of similar clinical cases.

## Ethical Statement

The study was approved by the Ethics Committee of Chongqing General Hospital of Chongqing University (KYS-2023-017-01).

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## Disclosure

The authors report no conflicts of interest in this work.

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