

Case Report

Laparoscopic Management of Hemoperitoneum Due to a Cornual Pregnancy After an Ipsilateral Tubal Pregnancy: A Case Report

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Abstract

Background: Cornual pregnancy (CP) is a rare but life-threatening form of ectopic pregnancy. Severe complications include uterine rupture and massive hemorrhage, often requiring complex surgical management despite prompt intervention. We report a case of a ruptured left CP at 12 weeks, occurring three months after ipsilateral salpingectomy for a tubal pregnancy. **Case Presentation:** A 27-year-old woman, gravida 2, with a history of left salpingectomy, presented at 12 weeks of amenorrhea with severe pelvic pain and irregular uterine bleeding. Clinical examination, serum β -hCG testing, and transvaginal ultrasound confirmed hemoperitoneum due to rupture of a cornual pregnancy. Emergency laparoscopy was performed, with drainage of massive hemoperitoneum, excision of the ectopic gestation, and uterine wall repair. Uterine integrity was preserved, and the patient was discharged without complications. **Discussion:** Cornual ectopic pregnancy remains diagnostically and surgically challenging, with high risk of catastrophic hemorrhage. Transvaginal ultrasonography, supported by 3D ultrasound or MRI in equivocal cases, facilitates early diagnosis. Laparoscopy is increasingly recognized as the gold standard, offering reduced morbidity, faster recovery, and preservation of fertility compared with laparotomy, though it requires advanced surgical expertise. Long-term follow-up is essential due to the risk of uterine rupture in subsequent pregnancies, and elective cesarean delivery is often advised. **Conclusion:** This case demonstrates that minimally invasive laparoscopic management of ruptured CP with massive hemoperitoneum is feasible and safe when performed by experienced surgeons, but further studies are needed to optimize standardized protocols and assess reproductive outcomes.



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1. Introduction

Cornual pregnancy (CP), also known as interstitial pregnancy, is a rare and potentially life-threatening form of ectopic pregnancy in which the embryo implants within the intramural portion of the fallopian tube at the uterine cornua. Although CP accounts for only 2–4% of all ectopic pregnancies [1], it carries a disproportionately high risk of maternal morbidity and mortality, with reported mortality rates up to 2.5%, approximately seven times higher than for other ectopic sites. This increased risk is due to the myometrial implantation site, the delayed clinical presentation, and the rich dual blood supply from both uterine and ovarian arteries, which can result in catastrophic hemorrhage upon rupture.

Several factors [1–5] predispose individuals to CP, including:

- Previous ectopic pregnancies
- Tubal surgeries, such as salpingectomy or tubal ligation
- Assisted reproductive technologies (ARTs)
- Uterine anomalies, such as septate or bicornuate uterus
- Pelvic inflammatory disease
- Use of intrauterine devices (IUDs)

The underlying pathophysiological mechanisms and contributing risk factors are systematically outlined and synthesized in Table 1.

Table 1. Risk factors for cornual pregnancy.

Risk Factor	Mechanism/Explanation
Previous ectopic pregnancy	History of tubal pathology or damage increases likelihood of abnormal implantation
Tubal surgeries (salpingectomy, ligation)	Altered tubal anatomy or scarring may predispose to interstitial implantation
Assisted reproductive technologies (ARTs)	Embryo transfer may increase risk of implantation in cornual region
Uterine anomalies (septate, bicornuate)	Abnormal uterine shape can divert implantation toward cornua
Pelvic inflammatory disease (PID)	Tubal scarring and adhesions may impede normal transport of embryo
Intrauterine device (IUD) use	Prevents intrauterine implantation, occasionally leading to ectopic implantation elsewhere

The pathophysiology involves implantation in the intramural segment of the tube, where the gestational sac can expand for longer periods before causing symptoms due to the surrounding myometrium's distensibility.

In fact, CP often presents with nonspecific symptoms, including abdominal or pelvic pain, vaginal bleeding and signs of hemodynamic instability in cases of rupture [6]. Due to the intramyometrial location, CP may not be detected until later in gestation, often between 7 and 12 weeks [7]

Historically, CP was treated primarily by laparotomy, often requiring hysterectomy or cornual resection, due to the risk of uncontrolled bleeding [8,9]. Advances in transvaginal ultrasonography, β -hCG monitoring, and minimally invasive surgical techniques have transformed management. While systemic or local methotrexate therapy can be considered in selected, hemodynamically stable patients with early diagnosis [10], most CP cases are unsuitable for medical management due to advanced gestational age, high β -hCG levels, or symptomatic presentation. Laparoscopic resection with uterine preservation is now the preferred treatment in specialized centers, allowing safe removal of the ectopic gestation with meticulous repair of the uterine wall [11].

Diagnosis remains challenging because CP may mimic angular or intrauterine pregnancies. Sonographic signs that improve detection include an empty uterine cavity, a gestational sac located more than 1 cm from the lateral endometrial edge, a myometrial mantle <5 mm, and the “interstitial line sign”—an echogenic line connecting the gestational sac to the endometrial cavity [12–14]. Sensitivity and specificity of these sonographic markers range from 80–100% and 80–98%, respectively, although these signs may be overlooked in emergency settings [15,16].

Recent advances have improved both diagnosis and intraoperative hemostasis in cornual pregnancy (CP) [5]. Three-dimensional transvaginal ultrasound (3D-TVUS) and power Doppler enhance visualization of the interstitial line sign and the thin myometrial mantle, increasing diagnostic confidence in differentiating CP from angular pregnancy [5,8,14]. When ultrasound is equivocal, pelvic MRI—especially T2-weighted sequences—helps delineate myometrial thickness and the relationship of the sac to the endometrial cavity [5,8,14]. On the therapeutic side, minimally invasive surgery remains standard in specialized centers, with adjuncts such as local vasopressin and meticulous multilayer suturing to reduce blood loss [5,8,14]. In selected high-risk scenarios, interventional radiology (e.g., uterine artery embolization or temporary arterial balloon occlusion) can be considered as an adjunct to stabilize hemorrhage or facilitate conservative management, though data on fertility outcomes remain limited [5,14].

We present a rare case of a 12-week singleton left CP rupture with massive hemoperitoneum occurring three months after ipsilateral salpingectomy. This case illustrates the ongoing diagnostic and therapeutic challenges of CP, highlights the potential for recurrence after salpingectomy, and emphasizes the need for high clinical suspicion in patients with atypical abdominal pain, even when prior ectopic pregnancy is thought to have been resolved.

2. Case Presentation

A 27-year-old nulliparous woman at twelve weeks of amenorrhea presented to the emergency department with acute-onset severe pelvic pain and irregular vaginal bleeding. She had a history of left salpingectomy for a prior tubal ectopic pregnancy three months earlier and no known vascular malformations, uterine anomalies, or chronic illnesses. The current pregnancy was conceived spontaneously.

She had no prior history of assisted reproductive treatments, pelvic inflammatory disease, or intrauterine device use. Her gynecologic and obstetric history was otherwise unremarkable, with no prior spontaneous abortions, infertility treatments, or chronic pelvic pain. There was no family history of congenital uterine anomalies or thromboembolic disease.

The previous salpingectomy had been performed 14 weeks before the current admission. The last menstrual period (LMP) was recorded 12 weeks before presentation, confirming that conception occurred shortly after the prior surgery and not before. Early first-trimester ultrasound at 7 weeks had demonstrated a viable intrauterine-like gestational sac, which was later clarified as an interstitial implantation. This chronology excludes the possibility that the current pregnancy was already present at the time of the salpingectomy.

Upon arrival, the patient appeared pale, tachycardic (124 bpm), and hypotensive (BP 88/60 mmHg). Abdominal examination revealed marked lower abdominal tenderness with guarding, especially in the left pelvic region. Pelvic examination demonstrated cervical motion tenderness and moderate vaginal bleeding. Laboratory tests revealed hemoglobin of 8.1 g/dL, hematocrit of 24%, and serum β -hCG approximately 90,000 mIU/mL, consistent with 12-week gestation.

Transvaginal ultrasonography using a Voluson E10 (GE Healthcare, 500 West Monroe Street, Chicago, Illinois, 60661) showed a normally sized anteverted uterus with an 8 mm

endometrial thickness, a highly vascularized gestational sac in the left cornual region, and a large hemoperitoneum in the pouch of Douglas.

Diagnostic paracentesis confirmed the presence of non-clotting blood. Differential diagnosis included angular pregnancy, ruptured CP, and other causes of hemoperitoneum; clinical and imaging findings favored ruptured CP.

Given her hemodynamic instability and acute anemia, medical management was contraindicated. After informed consent, the patient underwent emergency laparoscopy, as shown in Video S1. Pneumoperitoneum was established using a Veress needle at the umbilicus, followed by insertion of a 10 mm supraumbilical trocar. Three additional suprapubic trocars were placed: one 5 mm midline and two lateral (5 mm left, 10 mm right).

Laparoscopic inspection revealed massive hemoperitoneum secondary to rupture of a left cornual pregnancy. Approximately 1800–2000 mL of blood was evacuated. Given the large intra-abdominal volume, free fluid was actually visualized in the anterior cul-de-sac and confirmed intraoperatively to extend to the upper abdomen, including the hepatorenal (Morison's) space, consistent with the 1800–2000 mL hemoperitoneum evacuated.

Vasopressin was injected locally to reduce bleeding. The ectopic gestation was excised via enucleation, and the uterine defect was repaired with three interrupted 0 Vicryl sutures, avoiding electrosurgery near the cornua to prevent thermal injury.

Hemostasis was primarily achieved with local vasopressin injection, which markedly reduced intraoperative bleeding. After enucleation of the ectopic tissue, careful multilayer interrupted suturing of the myometrium provided definitive hemostasis and preserved uterine integrity. Electrosurgery was deliberately avoided to minimize the risk of thermal damage to the cornual region and maintain myometrial strength.

No surgical drain was deemed necessary because meticulous hemostasis was achieved intraoperatively with vasopressin injection and layered suturing. The peritoneal cavity was thoroughly irrigated and aspirated, leaving no residual clots or active bleeding sites. Given the patient's stable postoperative course and the minimally invasive approach, we considered a drain unnecessary.

The procedure lasted 68 min. The patient received two units of cross-matched blood intraoperatively and recovered uneventfully, being discharged on postoperative day three. Histology confirmed cornual pregnancy.

3. Discussion

3.1. Epidemiology and Clinical Significance

Cornual pregnancy is considered an uncommon variant of ectopic gestation, yet it carries a disproportionate burden of maternal morbidity and mortality compared with other ectopic sites. Its rarity is reflected in reported incidence rates ranging from approximately 1 in 2500 to 1 in 5000 pregnancies, representing only 2–4% of all ectopic gestations [9,17]. Despite this relatively low frequency, the clinical significance of cornual pregnancy lies in its often delayed diagnosis and the unique anatomical and vascular characteristics of the implantation site. Because the interstitial portion of the fallopian tube is surrounded by thick myometrial tissue and benefits from a dual blood supply from both uterine and ovarian arteries, pregnancies implanted in this location may progress asymptotically for longer than tubal ectopics before rupture occurs. However, once rupture ensues, the consequences are typically catastrophic, with massive intraperitoneal hemorrhage leading to hypovolemic shock, significant transfusion requirements, and, in some cases, maternal death. Indeed, maternal mortality associated with cornual pregnancy has been reported to be up to seven times higher than for ectopic pregnancies overall [7]. These risks underscore the importance of heightened clinical vigilance, especially in women with predisposing risk factors such as prior salpingectomy, assisted reproductive techniques, or uterine anomalies.

From a public health perspective, while the absolute number of cases remains low, the disproportionate risk of life-threatening hemorrhage positions cornual pregnancy as a clinically significant entity that demands timely recognition and intervention.

3.2. Anatomical and Embryological Considerations

The anatomical and embryological context of cornual (or interstitial) pregnancy is central to understanding its unique clinical behavior and associated risks. The interstitial portion of the fallopian tube is embedded within the myometrium of the uterine wall, traversing the muscular layer for approximately 1–2 cm before opening into the endometrial cavity. This segment is narrower and less distensible than the ampullary or isthmic regions of the tube, but because it is surrounded by thick myometrium, an implanted gestational sac can expand further than in most other ectopic sites before rupture occurs. This delayed rupture, often around the end of the first trimester or early in the second trimester, creates a deceptive window during which the pregnancy may mimic a normal intrauterine implantation, thereby complicating diagnosis. Vascular supply further compounds the risk: the cornual region receives dual blood flow from both the uterine artery and the ovarian artery, creating an extensive anastomotic network. As a result, rupture is frequently catastrophic, with torrential hemorrhage that is difficult to control surgically and that accounts for the disproportionately high maternal morbidity and mortality of cornual pregnancy compared with other ectopic localizations. From an embryological standpoint, the cornual region represents the junction of the Müllerian ducts, and incomplete or abnormal fusion during development may predispose to uterine anomalies such as a bicornuate or septate uterus. These anomalies, along with intratubal adhesions or distortions resulting from prior infections, surgery, or salpingectomy, can alter the tubal-uterine anatomy in a way that favors aberrant implantation in the cornual segment. Clinically, distinguishing cornual pregnancy from angular pregnancy, in which the embryo implants medial to the uterotubal junction within the endometrial cavity, is critical, as the latter can in some cases progress to viability. The key anatomical differences—including the position relative to the round ligament and the thickness of surrounding myometrium—carry profound implications for prognosis and management. Understanding these anatomical and embryological nuances not only aids in accurate diagnosis but also guides the choice of surgical approach, the assessment of future reproductive risks, and the counseling of affected patients [7].

3.3. Diagnostic Approaches

Accurately distinguishing between cornual and angular pregnancies is critically important due to their vastly different clinical implications. Angular pregnancies, in many cases, can progress safely to term, whereas cornual pregnancies carry a significantly elevated risk of uterine rupture, which can result in life-threatening hemorrhage [17]. One of the primary tools for differentiation is ultrasonographic assessment of the myometrial mantle surrounding the gestational sac. In angular pregnancies, the myometrial mantle typically measures greater than 5 mm, reflecting implantation within the endometrial cavity adjacent to the uterine cornu. In contrast, cornual pregnancies demonstrate a thinner myometrial mantle, generally less than 5 mm, indicating implantation within the interstitial portion of the fallopian tube embedded in the myometrium. Additionally, the presence of the “interstitial line sign”—a hyperechoic line extending from the endometrial cavity to the gestational sac—is considered pathognomonic for cornual pregnancies and is absent in angular pregnancies, thereby serving as a valuable diagnostic indicator [18].

Transvaginal ultrasonography remains the first-line imaging modality due to its accessibility and resolution; however, its sensitivity can be limited in very early gestational stages. Three-dimensional ultrasound offers enhanced spatial resolution and can signifi-

cantly improve visualization of subtle features, including the interstitial line sign, thereby increasing diagnostic confidence [18]. In cases where the diagnosis remains uncertain or when evaluating the integrity of the myometrium for planning conservative management, magnetic resonance imaging (MRI) can provide complementary, high-resolution detail without radiation exposure [19]. Doppler ultrasonography may also be employed to assess vascular patterns surrounding the gestational sac, which can offer additional clues suggestive of a cornual pregnancy.

In our reported case, the combination of advanced gestational age and massive hemoperitoneum facilitated a prompt and accurate diagnosis using standard ultrasonography alone, underscoring the importance of correlating clinical presentation with imaging findings to guide timely intervention and optimize patient outcomes.

Beyond conventional TVUS criteria (empty cavity, myometrial mantle < 5 mm, and the interstitial line sign), 3D-TVUS and 3D power Doppler can better map the sac's eccentric location and its vascular bed, improving discrimination between interstitial and angular implantations [5,18–20]. Reported performance of these sonographic markers is high but operator-dependent; when doubt persists, MRI provides complementary, radiation-free assessment of the myometrial junctional zone and the precise trajectory from the endometrial cavity to the gestational sac [5,17–19]. Incorporating these modalities into a stepwise algorithm can reduce delayed or missed diagnoses in emergency settings [5,18–20].

3.4. Management Strategies

Management of ectopic pregnancies depends on several factors, including hemodynamic stability, gestational age, sac size, fetal cardiac activity, and serum hCG levels. Treatment can be categorized into three main approaches: expectant, medical, or surgical management, as summarized in Tables 2 and 3.

Table 2. NICE Guidelines for management of ectopic pregnancy.

Approach	Indications (Eligibility)	Advantages	Limitations/Risks
Expectant	Asymptomatic Clinically stable Ectopic mass < 35 mm No visible fetal heartbeat Serum β -hCG < 1000 IU/L and declining Reliable follow-up possible	Avoids intervention Preserves fertility No surgical or drug-related complications	Requires close monitoring Risk of rupture if condition changes Not suitable if follow-up unreliable
Medical (Methotrexate)	Hemodynamically stable Ectopic mass < 35 mm No visible fetal heartbeat Serum β -hCG < 1500 IU/L (single-dose protocol) Patient compliant with follow-up	Minimally invasive Avoids surgery Fertility preservation	Side effects of methotrexate (e.g., stomatitis, abdominal pain, liver toxicity) Risk of treatment failure and rupture Requires serial β -hCG monitoring
Surgical	Hemodynamically unstable Severe pain or hemoperitoneum Ectopic mass \geq 35 mm Visible fetal cardiac activity Serum β -hCG \geq 5000 IU/L Contraindication to methotrexate Patient preference	Definitive treatment Immediate resolution Appropriate in emergencies	Risks of anesthesia and surgery Possible loss of tube/uterine integrity Adhesion formation Impact on future fertility depending on procedure

Table 3. Surgical approaches to cornual pregnancy.

Surgical Approach	Indications	Advantages	Limitations/Risks	Fertility Outcomes
Cornuostomy (incision + evacuation, uterine preservation)	Hemodynamically stable patients, small unruptured CP, fertility desired	Minimally invasive, preserves uterine architecture, shorter recovery, lower blood loss compared to wedge resection, fertility preservation.	Risk of persistent trophoblastic tissue requiring follow-up, possible uterine rupture in future pregnancies if myometrial repair inadequate.	Generally favorable, but increased monitoring required
Cornual Resection (wedge resection of cornual segment)	Larger CP, ruptured CP with significant myometrial involvement	More radical excision, lowers risk of persistent trophoblastic tissue, reduces recurrence.	Higher intraoperative blood loss, larger myometrial defect, increased adhesion formation, greater risk of uterine rupture in subsequent pregnancies.	High rates of preserved fertility if myometrium is adequately repaired
Laparoscopy (preferred minimally invasive route)	Hemodynamically stable patients, availability of expertise and equipment	Minimally invasive, reduced morbidity, faster recovery, lower adhesion risk, fertility preservation, suitability for enucleation or wedge resection.	Requires advanced surgical expertise, limited availability in unstable patients with massive hemorrhage.	High rates of preserved fertility if myometrium is adequately repaired
Laparotomy	Hemodynamically unstable patients, massive hemoperitoneum, limited resources	Faster access in unstable patients, more direct control of hemorrhage, feasible in resource-limited settings.	Higher morbidity, more postoperative pain, prolonged recovery, adhesion risk.	Fertility often preserved but depends on extent of uterine damage
Hysterectomy	Life-threatening hemorrhage, uncontrolled bleeding, completed family or no desire for fertility	Definitive treatment, eliminates recurrence risk, lifesaving in uncontrolled bleeding.	Complete loss of fertility, significant morbidity.	Not applicable
Robotic-assisted surgery (in select centers)	Complex CP cases, availability of robotic platform	Enhanced dexterity, precision suturing, excellent visualization, fertility preservation comparable to laparoscopy.	High cost, limited availability, requires dedicated training.	Fertility preservation comparable to laparoscopy, but limited data
Interventional radiology (uterine artery embolization / temporary arterial balloon occlusion)	Anticipated high bleeding risk; desire for uterine preservation; adjunct to conservative surgery or when immediate surgical hemostasis is challenging	Hemorrhage control; may reduce transfusions; can facilitate minimally invasive, uterus-sparing repair	Limited evidence base; requires IR expertise and coordination; potential impact on future fertility unclear	Insufficient high-quality data; cautious counseling advised

According to NICE guidelines [10], expectant management may be offered to women who are clinically stable and pain-free, have a tubal ectopic pregnancy smaller than 35 mm

with no visible heartbeat on transvaginal ultrasound, have serum hCG levels of 1000 IU/L or less, and are able to return reliably for follow-up.

Medical management typically involves systemic administration of methotrexate (MTX), a chemotherapeutic agent that inhibits DNA synthesis, thereby targeting rapidly proliferating trophoblastic cells [20]. The standard regimen is a single dose of 50 mg/m², with careful consideration of maternal comorbidities due to potential side effects ranging from mild gastrointestinal symptoms and transient elevation of liver enzymes to severe complications such as gastric perforation, pulmonary fibrosis, pneumonitis, kidney failure, cirrhosis, and bone marrow suppression.

Systemic MTX may be offered to women who have minimal pain, an unruptured tubal ectopic pregnancy with an adnexal mass smaller than 35 mm and no visible fetal heartbeat, a serum hCG level below 1500 IU/L, no evidence of intrauterine pregnancy on ultrasound, and the ability to comply with follow-up. Serum hCG levels are monitored on days 4 and 7 to ensure a decrease of at least 15%. If successful, weekly monitoring continues until levels fall below 15 IU/L. If the decrease is insufficient, repeat transvaginal ultrasound is warranted to rule out persistent ectopic activity or hemoperitoneum [21,22].

Surgical intervention is indicated as the first-line treatment for women who cannot return for follow-up or who present with any of the following: significant pain, an ectopic pregnancy with an adnexal mass, ≥ 35 mm, a visible fetal heartbeat on ultrasound, or a serum hCG level of 5000 IU/L or higher.

In select cases, when serum hCG levels are between 1500 and 5000 IU/L, women are pain-free, have an unruptured ectopic pregnancy with an adnexal mass < 35 mm, no visible heartbeat, no intrauterine pregnancy, and can adhere to follow-up, both medical and surgical options may be considered.

In cornual pregnancies, MTX is frequently ineffective due to late presentation and high hCG levels, making surgical management the primary option for symptomatic or unstable patients [23]. Surgical techniques include:

- Cornuostomy: Incision and evacuation while preserving the uterus.
- Cornual resection: Removal of the affected segment, often necessary in advanced gestation or rupture.
- Hysterectomy: Reserved for uncontrolled hemorrhage or completed parity.
- Robotic-assisted laparoscopy: Offers precision, though its use is limited by cost and availability.

In cases of rupture with massive hemoperitoneum, laparoscopic enucleation with secure suturing can preserve uterine integrity when performed by experienced surgeons [24]. The use of local vasopressin and careful avoidance of electrosurgery near the cornua help minimize intraoperative blood loss [25,26].

Interventional radiology as an adjunct: in carefully selected cases—particularly where bleeding risk is substantial or uterine preservation is paramount—adjunctive interventional radiology can be considered [25,26]. Options include (i) uterine artery embolization (pre-, intra-, or post-operative) to control or prevent hemorrhage, and (ii) prophylactic temporary balloon occlusion of the uterine or internal iliac arteries to facilitate a bloodless field during conservative surgery [23–26]. These techniques may decrease transfusion needs and enable uterine-sparing approaches; however, evidence is limited to small series and case reports, and the impact on subsequent fertility requires further study. Multidisciplinary availability and institutional expertise should guide their use [23–26].

Comparison of surgical techniques: our case was managed with laparoscopic enucleation and layered suturing, which allowed excision of the gestational sac while preserving maximal myometrial tissue. Compared with cornual wedge resection, enucleation is less invasive, results in smaller myometrial defects, and may preserve uterine strength, thereby

potentially lowering the risk of rupture in subsequent pregnancies. However, enucleation carries the risk of incomplete removal of trophoblastic tissue, necessitating careful follow-up with histology and serial β -hCG. Conversely, cornual wedge resection provides more radical excision and may reduce recurrence risk, but it is associated with increased intraoperative blood loss, a greater likelihood of postoperative uterine wall weakening, and higher rates of adhesion formation. Hysterectomy, while definitive, sacrifices fertility and is reserved for uncontrolled hemorrhage or women without reproductive desire. Thus, surgical decision-making should balance hemodynamic stability, the extent of uterine involvement, reproductive wishes, and surgical expertise. In our patient, enucleation was selected as the most fertility-preserving approach while ensuring adequate hemostasis through vasopressin use and multilayer suturing.

3.5. Minimally Invasive Surgery

Laparoscopy is widely regarded as the gold standard for surgical management of ectopic pregnancies and related gynecologic procedures, largely due to its multiple clinical advantages over traditional open surgery. Compared with laparotomy, laparoscopic approaches are associated with shorter operative times, reduced intraoperative blood loss, lower postoperative morbidity, quicker recovery, and shorter hospital stays, all of which contribute to improved overall patient outcomes. Additionally, laparoscopy offers superior preservation of fertility, an essential consideration for women of reproductive age [27,28].

Recent advances in laparoscopic technology, including three-dimensional (3D) laparoscopy, have further expanded the feasibility of performing complex procedures, allowing enhanced depth perception, precise tissue dissection, and more delicate suturing, even in anatomically challenging or high-risk cases. Beyond technological improvements, structured simulation-based training programs and tele-mentoring initiatives are increasingly being used to train surgeons and disseminate advanced laparoscopic skills, particularly in resource-limited settings where access to high-volume surgical centers or expert mentorship may be restricted. These educational strategies not only improve surgical competency and confidence but also enhance patient safety and expand the availability of minimally invasive approaches worldwide.

3.6. Reproductive Outcomes and Follow-Up

Postoperative fertility represents a critical consideration following surgical management of cornual or ectopic pregnancies. Adequate healing of the myometrium is essential, as incomplete or impaired myometrial repair can significantly increase the risk of uterine rupture in future pregnancies, posing serious maternal and fetal hazards. To evaluate the integrity and thickness of the uterine wall after surgery, follow-up imaging—such as hysterosonography or magnetic resonance imaging (MRI)—is generally recommended within 3 to 6 months postoperatively. These assessments allow clinicians to identify any areas of thinning, scarring, or dehiscence that could compromise uterine strength during subsequent gestations.

In addition to imaging, preconception counseling is strongly advised, enabling patients to understand potential risks, optimal timing for conception, and appropriate monitoring strategies. Once pregnant, early and close surveillance of the gestation is recommended, including first-trimester ultrasonography to confirm intrauterine implantation and regular follow-up to monitor myometrial integrity. In certain cases, elective cesarean delivery may be suggested to reduce the risk of rupture during labor. Encouragingly, reproductive outcomes following successful repair are generally favorable, with approximately 60–70% of patients achieving subsequent intrauterine pregnancies. This highlights that, with careful

surgical technique, appropriate postoperative monitoring, and individualized counseling, fertility preservation is often attainable.

3.7. Significance of This Case

This case underscores the potential for CP recurrence even after ipsilateral salpingectomy, highlighting the importance of maintaining high clinical suspicion in women with atypical pelvic pain. Advanced laparoscopic skills enabled safe management of massive hemoperitoneum, preserving fertility and minimizing morbidity [28].

3.8. Future Directions

Further research is needed to standardize laparoscopic techniques in the management of cornual and other complex ectopic pregnancies. Key areas for investigation include the identification of optimal suture methods, standardized hemostasis protocols, and structured postoperative follow-up strategies to ensure uterine integrity and preserve fertility. Establishing multicenter registries could provide a valuable repository of clinical data, enabling analysis of surgical outcomes, complication rates, and long-term reproductive success. Such collaborative efforts would help refine evidence-based guidelines and inform best practices. Additionally, comparative studies evaluating conventional laparoscopy versus robotic-assisted approaches could elucidate the relative advantages of each modality, particularly in technically challenging cases, potentially improving surgical precision, reducing operative complications, and optimizing patient outcomes in complex ectopic pregnancy management.

Another promising area is the integration of artificial intelligence (AI) into diagnostic and management pathways for cornual pregnancy. AI-enhanced algorithms applied to ultrasonographic and MRI images could improve early and accurate differentiation between interstitial, angular, and intrauterine pregnancies, thereby reducing diagnostic delay and misclassification. Machine learning models might also support individualized risk stratification and prediction of intraoperative bleeding, assisting clinicians in tailoring surgical versus interventional approaches. Although still in exploratory stages, incorporation of AI into imaging and decision-support systems holds the potential to refine diagnostic accuracy, optimize treatment planning, and ultimately improve reproductive outcomes.

4. Conclusions

In conclusion, laparoscopic management of cornual pregnancies (CPs) is widely recognized as a safe, effective, and fertility-preserving approach, even in challenging scenarios such as rupture accompanied by massive hemoperitoneum. The success of this approach depends heavily on early and accurate diagnosis, a high index of clinical suspicion, and the availability of experienced surgeons proficient in advanced minimally invasive techniques. Meticulous surgical execution is essential to control hemorrhage, preserve myometrial integrity, and minimize complications.

Equally important is structured postoperative care, which includes imaging to assess uterine healing, preconception counseling, and individualized pregnancy planning. Such measures help reduce the risk of recurrence, ensure early detection of potential complications in future gestations, and optimize reproductive outcomes. By integrating early recognition, surgical expertise, and comprehensive follow-up, laparoscopic management of CP provides a balance between maternal safety and fertility preservation, making it the preferred approach in both elective and emergent settings.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/reprodmed6040027/s1>, Video S1: surgical management of cornual pregnancy.

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