

Incomplete uterine rupture originating at the serosa: a proposed mechanism

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Case Report

Keywords: incomplete uterine rupture, uterine dehiscence, uterine serosa, myomectomy, cesarean section, adhesiolysis

Posted Date: October 4th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11211787/v1>

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Additional Declarations: The authors declare no competing interests.

Abstract

Uterine rupture is an obstetrical emergency, typically classified as either (1) complete when all layers of the uterine wall are separated, or (2) incomplete when the uterine muscle is separated but the visceral peritoneum is intact. This article reports an uncommon and previously undescribed aspect of uterine rupture, namely an incomplete rupture involving the uterine serosa as the initial site of disruption. This observation provides a new perspective on the potential mechanisms of uterine rupture and highlights that the uterine serosa is essential for uterine integrity, with true ruptures starting at the serosa. The proposed hypothesis has meaningful implications, emphasizing careful serosal preservation during surgery, such as adhesiolysis involving the uterine serosa, and restoring ideal serosa approximation with 2 to 3 layers of introflecting sutures during myomectomy. The incomplete uterine rupture described in previous literature is a relatively stable anatomical state that can be managed expectantly in asymptomatic preterm patients.

Introduction

Uterine rupture is an obstetrical emergency that can be catastrophic for both the fetus and the mother. Although spontaneous uterine rupture has been reported¹, a scarred uterus is the primary risk factor for uterine rupture in subsequent pregnancies. The reported uterine rupture rates in patients with prior low transverse cesarean incision, classical high vertical incision, and myomectomy are 0.7%, 1%-12%, and 0.5%-2%, respectively²⁻⁵.

Currently, research on uterine rupture is primarily retrospective cohort studies focused on identifying risk factors for uterine rupture, quantifying the exact magnitude of associated risks, and evaluating outcomes associated with various management strategies. No research has attempted to elucidate the mechanisms of uterine rupture and the possibility of intervening into mechanisms. Possible reasons for this include the relatively low incidence of uterine rupture and the rapid progression of the process. In most cases, separation of all layers of the uterine wall is discovered during an exploratory laparotomy, leaving the surgeon no clue as to how the process starts or progresses. This article reports an uncommon and previously undescribed aspect of uterine rupture, namely an incomplete rupture involving the uterine serosa as the initial site of disruption. This observation provides a new perspective on the potential mechanisms of uterine rupture and highlights the clinical importance of serosal integrity in uterine surgery. The study was approved by the Ethics Committee of Peking Union Medical College Hospital (I-23PJ595) on April 11, 2023. The patient has provided written informed consent for submission for publication.

Case Presentation

A 41-year-old primigravid woman presented to our hospital with fluid leakage and irregular contractions at 40 + 3 weeks of gestation. Her past medical history was significant for one laparoscopic myomectomy 23 months earlier, during which an 8 cm anterior intramural fibroid consisting of three

myomatous nodules (Fig. 1) was removed. The uterine defect was repaired with running baseball stitches (myometrium/serosa–myometrium/serosa direction) in one-layer with 1 – 0 absorbable suture. Ultrasonography upon admission showed a hypoechoic myoma measuring 5.7×4.5 cm at the fundus of the uterus; the placenta was located on the anterior wall, with its lower margin distant from the internal cervical os; the thickness of the uterine wall at the site of the fibroid resection scar was not mentioned; there was no free fluid in the pelvic cavity.

Eleven hours after admission, the patient complained of acute onset of severe upper abdominal pain. Her vital signs were stable. In the abdominal exam, she had an exquisite point tenderness at her myomectomy scar in the anterior wall of the uterus, with no rebound tenderness. Her cervix was four centimeters dilated. The fetal heart rate pattern was alarming with variable decelerations and severe fetal bradycardia of 60 bpm (Fig. 2). Uterine rupture was suspected, and an emergency cesarean section was performed within 33 minutes of diagnosis, delivering a viable male fetus with an Apgar score of 10 at 1 min and 5 min. The placenta attached to the fundus and anterior wall of the uterus. An incomplete uterine rupture with oozing bleeding was observed in the anterior uterine wall (the previous myomectomy scar). The tear area of the serosa and a small number of muscle fibers was 4×5 cm² (Fig. 3). Hemostasis was achieved with figure-of-eight sutures, and the total blood loss was estimated to be 300 ml. The patient and the infant were discharged in good condition on the third postoperative day.

Discussion

Uterine rupture is typically classified as either (1) complete when all layers of the uterine wall are separated, or (2) incomplete when the uterine muscle is separated but the visceral peritoneum is intact⁶. The latter is usually an occult finding in asymptomatic patients encountered on routine obstetric ultrasound or during planned cesarean section, where highly stretched serosa with or without an extremely thin myometrial layer beneath it is seen at the previous cesarean scar^{7–10}. Although some authors prefer to refer to this condition as "uterine dehiscence", it is still classified as incomplete uterine rupture.

To our knowledge, this is the first described case of uterine rupture involving only the serosa and a thin subserosal myometrial layer, which cannot be assigned to any of the above categories. Hence, we proposed the hypothesis that a "true" uterine rupture may originate from the serosal layer, and the uterine serosa is essential for maintaining the integrity of the uterus. A true uterine rupture is a highly unstable dynamic process that can pose a threat to the lives of both the mother and the fetus within a short period of time; on the other hand, the incomplete uterine rupture described in previous literature is a relatively stable anatomical state that can be managed expectantly in asymptomatic preterm patients and should be defined only as uterine dehiscence and not classified as uterine rupture.

The difference in nomenclature and classification is important as it indicates different prognoses and clinical management. For asymptomatic preterm uterine dehiscence patients, expectant management with the option of performing cesarean section before the onset of labor is appropriate^{11,12}. In contrast,

for patients suspected of a true uterine rupture, emergency cesarean section should be performed without delay. Confusion in nomenclature may contribute to inappropriate clinical management of the patients.

The role of uterine serosa in maintaining the integrity of the uterus

A detailed review of the literature on gravid uterus with cesarean scars would help support this hypothesis. Literature review indicates that the uterine rupture rate in patients undergoing a trial of labor after cesarean birth with a prior high vertical hysterotomy is higher than in those with a prior low vertical or transverse hysterotomy^{2,13,14}. However, there are no reports in English literature regarding the mechanism behind this phenomenon. The lower segment of the gravid uterus is formed by the gradual stretching of the isthmus, from approximately 4.5mm in the non-pregnant state to 100 mm at term pregnancy, especially after the onset of labor¹⁵, which is much greater than the stretching of the uterine body. It seems difficult to explain how the lower uterine segment incision reduces the incidence of uterine rupture if only the degree of stretching is considered. Therefore, we attempt to explain this difference based on the anatomical characteristics of each layer of tissue at the incision site.

The lower uterine segment incision is located below the loose peritoneum of the bladder fold, while the incision in the uterine body has the uterine serosa tightly adhered to the underlying muscular layer. In late pregnancy and after the onset of labor, the stretching tension of the serosal layer at the lower uterine segment incision will be much lower than that of the uterine body incision. A low vertical or transverse hysterotomy placed underneath the loose vesicouterine peritoneal reflection prevents overstretching and disruption of the serosa covering the uterine incision, thereby reducing the occurrence of uterine rupture (beginning from the serosa) (Fig. 4). Therefore, we draw the inference that the uterine serosa is essential for maintaining the integrity of the uterus.

Application of the inference in myomectomy

As the uterine serosa is essential for maintaining the integrity of the uterus, electrical energy, especially coagulation, should be used with great caution to diminish thermal damage to the serosa. When restoring the integrity of the uterine serosa, to achieve an ideal serosa approximation, the uterine defect should be closed with multi-layer (2 to 3 layers) introflexing sutures to decrease the surface tension of the incision¹⁶. Baseball suture (myometrium/serosa-myometrium/serosa direction) as employed in our case is not a preferable choice as it is very challenging technically to achieve perfect serosa approximation, especially in laparoscopic surgery (Video). It should be reserved for patients without fertility desire or in situations where there is excessive incision tension after the removal of adenomyosis lesions, or where severe bleeding occurs and hemostasis is an urgent priority.

Application of the inference in adhesiolysis involving the uterine serosa

Theoretically, adhesiolysis should be performed at the interface between the two adherent organs. However, in clinical practice, surgeons tend to choose the separation interface based on the importance

of the two adherent organs or the severity of the consequences in case of organ injury. Specifically, in the case of adhesions between the uterus and the intestines, separation is often performed closer to the uterus, sacrificing the uterine serosa and even part of the myometrium; uterine bleeding is then coagulated, further aggravating uterine damage. Hopefully, the proposed hypothesis will change the approach to the management of adhesions involving the uterus, especially for patients with fertility desires. The focus will no longer be on the integrity of the intestine alone, but on finding the correct interface between the uterus and the intestines. Suture is the preferred choice over extensive coagulation for hemostasis and restoration of the integrity of the uterine serosa after adhesiolysis.

Conclusion

This article reports an uncommon and previously undescribed aspect of uterine rupture, namely an incomplete rupture involving the uterine serosa as the initial site of disruption. This observation provides a new perspective on the potential mechanisms of uterine rupture and highlights that the uterine serosa is essential for uterine integrity, with true ruptures starting at the serosa. The proposed hypothesis has meaningful implications, emphasizing careful serosal preservation during surgery, such as adhesiolysis involving the uterine serosa, and restoring ideal serosa approximation with 2 to 3 layers of introflecting sutures during myomectomy. The incomplete uterine rupture described in previous literature is a relatively stable anatomical state that can be managed expectantly in asymptomatic preterm patients.

Declarations

Conflicts of interest

The authors report no conflict of interest.

Role of funding source

This research did not receive any grant from funding agencies in the public, commercial or not-for-profit sectors.

Acknowledgement

We would like to thank Yiping Yu for the voiceover in the video.

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Figures

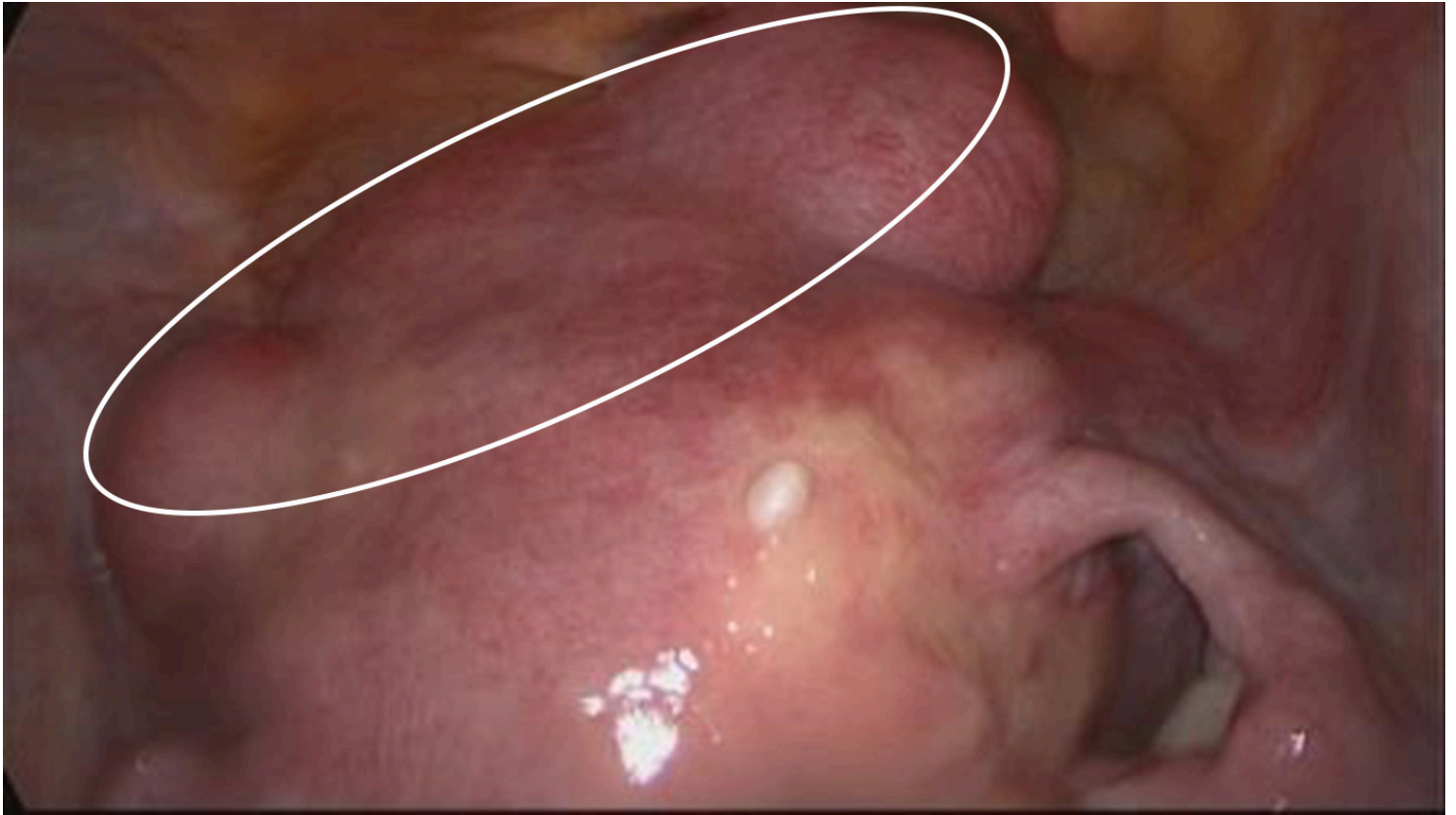


Figure 1

Figure 1. Laparoscopic view of the uterus before myomectomy. An 8 cm anterior intramural fibroid consisting of three myomatous nodules (*white circle*) was removed during laparoscopic myomectomy.

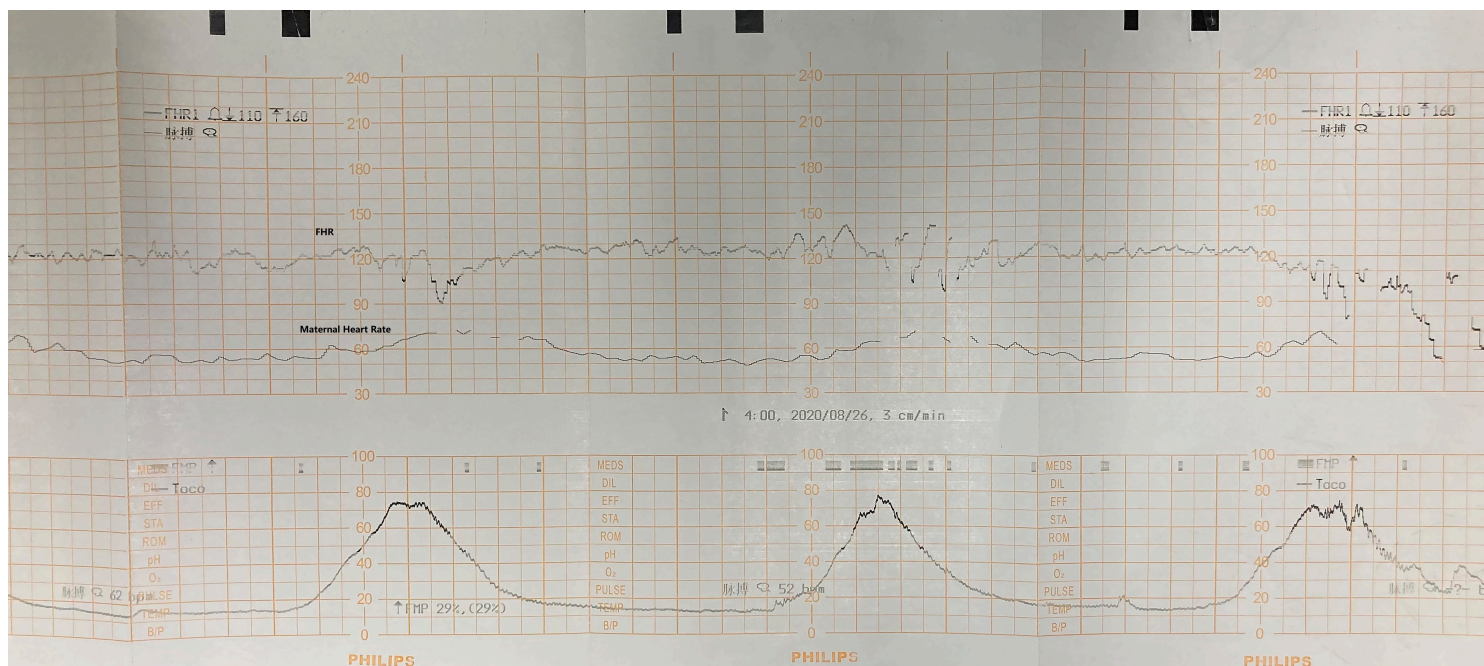


Figure 2

Figure 2. FHR pattern. FHR pattern showed the onset of variable decelerations and severe fetal bradycardia.



Figure 3

Figure 3. Incomplete uterine rupture was found during cesarean section. A 4×5 cm² tear area of the serosa and a small number of myometrial fibers with oozing bleeding in the anterior uterine wall (the previous myomectomy scar).

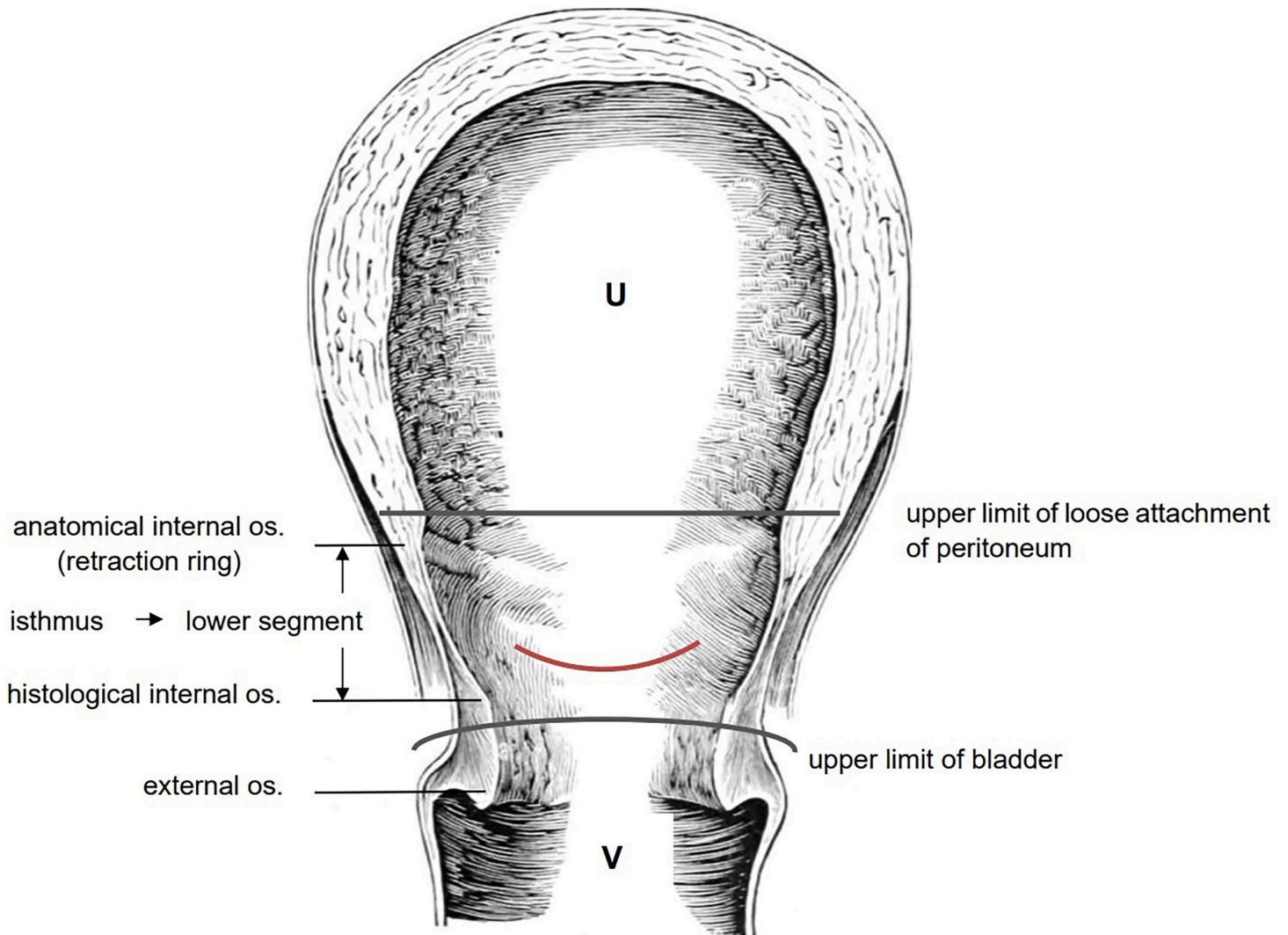


Figure 4

Figure 4. A low transverse hysterotomy (red line) placed underneath the loose vesicouterine peritoneal reflection prevents overstretching and disruption of the serosa covering the uterine incision, thereby reducing the occurrence of uterine rupture.

Supplementary Files

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