

Segmental Resection in Placenta Accreta Spectrum: Current Evidence and Evolving Role in Uterine Preservation

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Abstract

Background: Placenta accreta spectrum disorders are characterized by abnormal placental adherence and invasion into the myometrium and adjacent structures. Cesarean hysterectomy is effective in controlling hemorrhage but carries substantial morbidity and definitively terminates reproductive potential. Uterine-sparing approaches have therefore been developed for carefully selected patients.

Aim: To review uterine-sparing management of placenta accreta spectrum, with particular emphasis on antenatal diagnosis, patient selection, surgical principles, intraoperative considerations, and the effectiveness of segmental resection.

Conclusion: Segmental resection represents a uterine-sparing approach that directly addresses abnormal placentation through targeted excision and reconstruction. Appropriate patient selection, accurate preoperative mapping, multidisciplinary support, vascular control, and the capability to proceed immediately to hysterectomy when conservative management is unsuccessful are essential for safe application of this approach.

Keywords: placenta accreta spectrum; segmental resection; conservative management

Introduction

Ultrasound remains the primary and most widely used modality for the antenatal diagnosis of placenta accreta spectrum disorders, with the transabdominal and transvaginal approaches providing complementary information essential for clinical decision-making. The diagnostic performance of ultrasound in detecting PAS has improved substantially over the past two decades, driven by advances in imaging technology, increased awareness among sonographers and clinicians, and the development of standardized sonographic criteria ⁽¹⁾.

The rationale for conservative management of placenta accreta spectrum disorders is grounded in the recognition that cesarean hysterectomy, while effective in controlling hemorrhage, carries substantial morbidity and definitively terminates reproductive potential. The decision to pursue uterine-sparing management reflects a patient-centered approach that considers the woman's reproductive goals, the specific characteristics of the PAS disorder, and the available surgical expertise, with the aim of optimizing outcomes while respecting the patient's autonomy and preferences ⁽¹²⁾.

The anatomical rationale for conservative management is based on the observation that PAS is typically a focal condition rather than a diffuse process affecting the entire uterus. In the majority of cases, abnormal placental adherence is localized to the lower uterine segment, particularly in the region of a prior cesarean scar, with the remaining myometrium being relatively unaffected ⁽⁹⁾. This focal distribution creates the possibility of surgical management that removes only the affected portion of the uterus while preserving the remaining healthy tissue, thereby maintaining uterine integrity and future reproductive potential. The concept of segmental resection

exploits this focal nature of PAS, enabling targeted excision of the abnormal placental-myometrial unit with subsequent uterine reconstruction ⁽¹³⁾.

Antenatal Diagnosis and Preoperative Assessment

Ultrasound

Multiple sonographic markers have been identified as indicative of PAS, with varying degrees of diagnostic accuracy. The most widely recognized ultrasound features include loss of the normal hypoechoic retroplacental zone, also known as the “clear space,” which represents the decidua basalis in normal pregnancies and is absent or disrupted in PAS ⁽²⁾. Additional important markers include abnormal placental lacunae, which appear as irregular, anechoic spaces within the placental parenchyma and are present in the majority of PAS cases; bridging vessels or hypervascularity within the placental parenchyma; a thin or disrupted myometrial bladder interface; and placental protrusion beyond the uterine serosa in cases of percreta. The presence of multiple sonographic markers significantly increases the positive predictive value for PAS diagnosis ⁽³⁾.

Color Doppler and three-dimensional power Doppler ultrasound have enhanced the diagnostic capabilities for PAS by providing detailed assessment of placental vascularity and its relationship with surrounding structures ⁽⁴⁾. Doppler evaluation can identify hypervascular areas within the placenta, aberrant vessels crossing the placental-myometrial interface, and extension of placental vessels into adjacent organs, all of which are features of invasive placentation. The use of three-dimensional ultrasound reconstruction techniques allows for more precise anatomical mapping of the extent and depth of placental invasion, which is particularly valuable for surgical planning, including decisions regarding the feasibility of conservative management techniques such as segmental resection ⁽²⁾.

Despite the considerable advances in ultrasound-based PAS diagnosis, several limitations persist. The diagnostic accuracy of ultrasound is highly operator-dependent, with studies consistently demonstrating superior performance when examinations are conducted by sonographers and clinicians with specific expertise in PAS imaging ⁽¹⁾. Furthermore, the sensitivity of ultrasound is lower in the presence of certain confounding factors, including posterior placental location, maternal obesity, and oligohydramnios, all of which can impair visualization of the critical anatomical features required for PAS diagnosis ⁽⁸⁾.

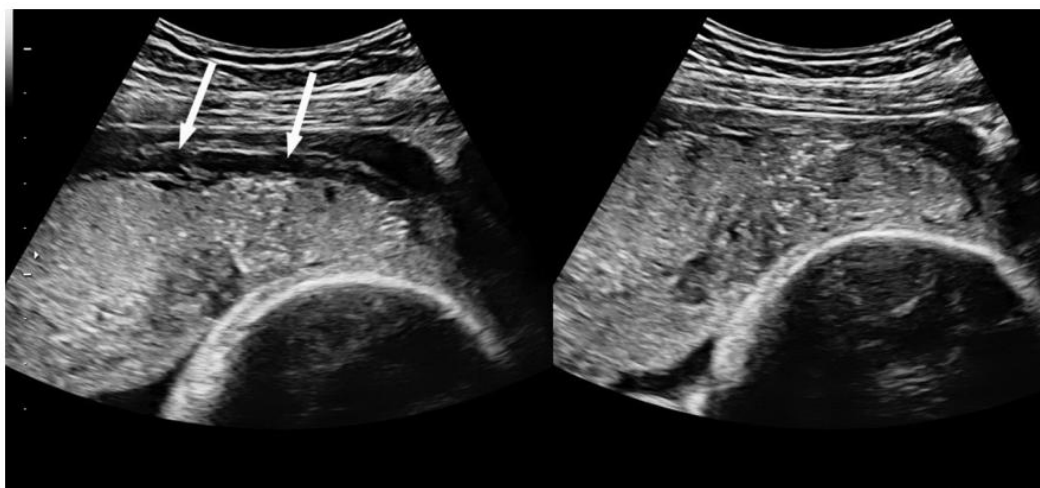


Figure 1. Transabdominal ultrasound longitudinal views of placental bed at 34 weeks in pregnancy after 3 prior cesarean deliveries showing changes on clear zone (arrows) with probe pressure (right). ⁽⁶⁾

Adjunctive Role of MRI

Magnetic resonance imaging (MRI) serves as a valuable adjunctive modality for the diagnosis and assessment of placenta accreta spectrum disorders, particularly in cases where ultrasound findings are equivocal

or when additional information regarding the extent of placental invasion is needed for surgical planning ⁽⁷⁾. The role of MRI in PAS evaluation has evolved significantly, with improved imaging protocols, higher field strength magnets, and the development of specific imaging sequences enhancing its diagnostic capabilities. While ultrasound remains the primary screening tool for PAS, MRI provides complementary information that can refine the diagnosis, assess the depth of myometrial invasion, and identify extension into adjacent pelvic structures ⁽²⁾.

Several MRI features have been identified as indicative of PAS, including uterine bulging, which refers to focal outward contour abnormality of the uterine wall at the site of placental implantation; heterogeneous placental signal intensity on T2-weighted sequences, reflecting the presence of abnormal intraplacental vasculature; disruption of the myometrial wall, particularly the hypointense junctional zone; and direct visualization of placental tissue extending beyond the uterine serosa into adjacent organs ⁽⁷⁾. The identification of dark intraplacental bands on T2-weighted imaging, which correspond to fibrotic areas and abnormal vascular channels, has been reported as a particularly specific finding for PAS ⁽⁸⁾.

The specific clinical utility of MRI in the context of uterine-sparing surgical techniques deserves particular emphasis. For procedures such as segmental resection, accurate preoperative mapping of the extent and boundaries of placental invasion is critical for determining the feasibility of conservative management and planning the surgical approach ⁽⁹⁾. MRI can provide detailed three-dimensional information about the relationship between the placenta and the uterine wall, the extent of surrounding myometrial involvement, and the proximity of the placental invasion to critical structures such as the uterine vessels and the bladder. This information is invaluable for surgical planning, as it helps determine the margins of resection and anticipate potential intraoperative challenges ⁽²⁾.

These considerations support the current consensus that MRI should be used selectively as an adjunct to ultrasound rather than as a routine screening tool, with referral for MRI recommended in cases of equivocal ultrasound findings, posterior placenta, suspected deep myometrial invasion, or when surgical planning requires detailed anatomical mapping ⁽¹⁰⁾.

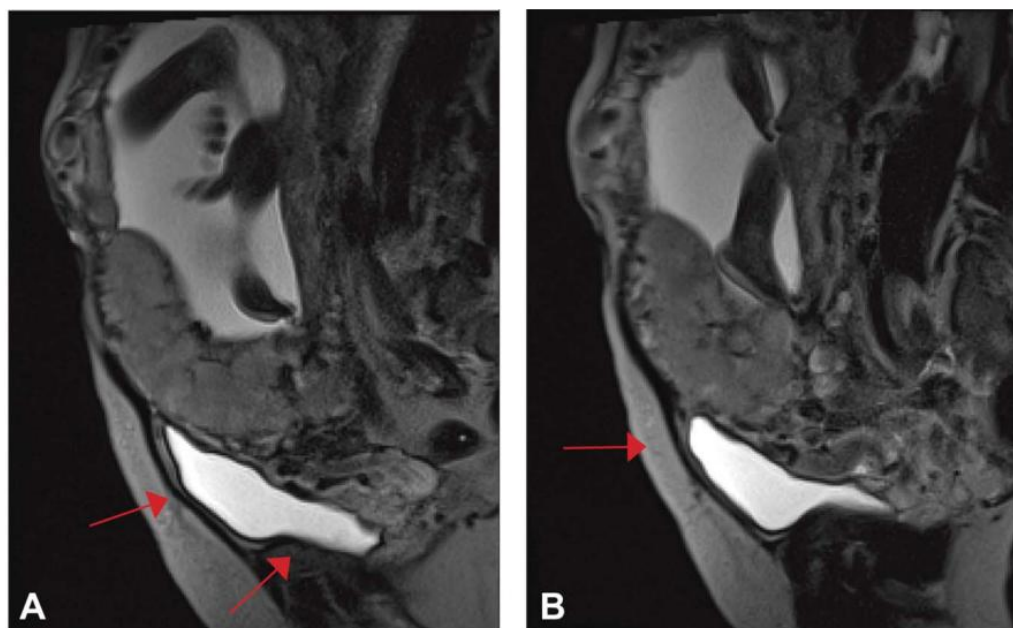


Figure 2. Magnetic resonance image demonstrating placenta percreta. A. Vessels in bladder wall (arrows). B. Percreta at bladder dome (arrow). Source: ⁽¹¹⁾

Uterine-Sparing Surgical Techniques in PAS

The FIGO consensus guidelines on PAS disorders explicitly acknowledge the role of conservative management as a legitimate option for carefully selected patients, provided that appropriate surgical expertise and support services are available ⁽¹⁰⁾.

The accumulating evidence supporting the safety and feasibility of conservative management has strengthened the rationale for uterine-sparing approaches. A systematic review and meta-analysis comparing conservative management with cesarean hysterectomy for PAS found that conservative surgical approaches were associated with significantly reduced estimated blood loss, lower transfusion rates, and shorter operative times compared to hysterectomy, without significant differences in maternal mortality or severe morbidity rates ⁽¹⁴⁾. These findings suggest that conservative management, when performed by experienced surgeons can offer comparable or superior maternal safety outcomes while preserving fertility ⁽¹⁵⁾.

The segmental resection technique, which is the primary focus of this review, represents a fundamentally different approach to uterine-sparing PAS management. Rather than attempting to remove the placenta from the uterine wall, segmental resection involves excision of the entire area of abnormal placentation, including the placenta and the underlying myometrium, as a single surgical unit ⁽¹³⁾. The uterine defect is then reconstructed using standard surgical techniques, restoring uterine integrity and preserving the potential for future fertility. This approach is conceptually analogous to oncological surgical principles, where the goal is to achieve complete excision of the pathological tissue with clear margins, and it offers the advantage of addressing the underlying pathology directly rather than attempting to separate adherent tissues ⁽⁹⁾.

The one-step conservative surgery represents another systematic approach to uterine-sparing PAS management. This technique involves a standardized surgical algorithm that begins with a fundal or suprafundal uterine incision to deliver the fetus without disturbing the placenta, followed by bilateral internal iliac artery ligation for hemostasis, and then careful assessment of the placental-myometrial interface to determine the appropriate conservative technique. If the area of abnormal placentation is localized and amenable to resection, a segmental myometrial excision is performed with subsequent uterine reconstruction ⁽¹⁷⁾.

The approach of leaving the placenta entirely in situ, sometimes referred to as “expectant management” or “conservative management,” represents the most conservative end of the uterine-sparing spectrum. In this approach, the placenta is deliberately left undisturbed within the uterus after delivery of the infant, with the expectation that it will undergo spontaneous resorption over a period of weeks to months ⁽¹⁰⁾. While this approach has been successful in many reported cases, it is associated with a substantial risk of delayed complications, including delayed hemorrhage, infection, and the need for secondary surgical intervention ⁽¹⁵⁾.

Indications and Patient Selection

Appropriate patient selection is paramount for the success of uterine-sparing surgical techniques in the management of placenta accreta spectrum disorders. The decision to pursue conservative rather than radical management must be individualized based on a comprehensive assessment of clinical, anatomical, and patient-specific factors ⁽¹⁰⁾. International guidelines emphasize that conservative PAS management should be restricted to centers with appropriate surgical expertise, multidisciplinary team support, and the capability to proceed immediately to hysterectomy if conservative management is unsuccessful ^(18,19).

The extent of placental involvement, as assessed by preoperative imaging, is a critical factor in patient selection for segmental resection. Ideally, the area of abnormal placentation should be limited to a segment of the uterus that can be excised without compromising the structural and functional integrity of the remaining organ ⁽¹³⁾. The upper uterine segment and fundus should be preserved, as these regions are essential for future fertility and normal uterine function. Cases in which the placenta involves the uterine fundus or extends circumferentially around the internal os are generally not suitable for segmental resection, as excision of the affected area would result in an inadequate residual uterine cavity ⁽¹⁶⁾.

Patient-specific factors also influence the selection of conservative versus radical PAS management. Hemodynamic stability, preoperative hemoglobin levels, and the absence of significant coagulopathy are prerequisites for conservative surgery, as these approaches require a degree of operative complexity and duration that may be poorly tolerated by hemodynamically compromised patients ⁽²⁰⁾. The patient's desire for future fertility must be clearly established and documented, as the primary indication for conservative management is the preservation of reproductive potential ⁽²¹⁾.

The availability of institutional resources and surgical expertise is perhaps the most critical determinant of whether conservative PAS management can be safely offered. Successful implementation of uterine-sparing techniques requires a multidisciplinary team with specific expertise in PAS management, including experienced surgeons, anesthesiologists, interventional radiologists, and blood bank support ⁽⁵⁾.

Segmental Resection Technique and Its Effectiveness

The segmental resection technique for placenta accreta spectrum disorders represents a conceptually elegant approach to uterine-sparing surgery that directly addresses the pathological anatomy of abnormal placentation through targeted excision and reconstruction. The technique involves the surgical removal of the entire area of abnormal placentation, including the placenta and the underlying affected myometrium, as a single en bloc specimen, followed by reconstruction of the uterine wall to restore anatomical and functional integrity ⁽¹³⁾. This approach is grounded in the fundamental surgical principle that complete excision of pathological tissue with adequate margins provides the best opportunity for successful treatment while minimizing the risk of recurrence and complications ⁽⁹⁾.

The surgical procedure begins with a carefully planned laparotomy, typically through a midline vertical incision to maximize exposure. Following delivery of the infant through a fundal or suprafundal uterine incision that avoids the placental mass, the surgical team assesses the area of abnormal placentation and plans the resection margins ⁽¹³⁾. The key technical principle is to identify the boundaries between the normally adherent and abnormally adherent placental regions, which can usually be discerned by visual inspection and palpation of the uterine surface. The area of placental adherence is typically evident as a region where the placenta appears to be firmly attached to the uterine wall without a visible decidual plane, and where the uterine serosa overlying the placenta may appear bulging, hypervascular, or disrupted ⁽¹⁷⁾.

The resection itself involves making an incision through the myometrium at a safe distance from the visible margins of the abnormal placentation, typically 1 to 2 centimeters from the apparent boundary of placental adherence. The incision is carried through the full thickness of the myometrium, encompassing the adherent placental tissue, until a plane of normal myometrium is identified beyond the area of abnormal adherence ⁽¹³⁾. The use of temporary vascular occlusion techniques, including bilateral internal iliac artery clamping or balloon catheter occlusion, may be employed to reduce blood loss during the resection. The excised specimen, which includes the adherent placenta and the surrounding rim of myometrium, is sent for histopathological examination to confirm the diagnosis and assess the resection margins ⁽⁹⁾.

Following resection, the uterine defect is reconstructed in layers using standard surgical techniques. The myometrial layers are approximated using absorbable sutures, with careful attention to hemostasis and the restoration of normal uterine wall thickness and integrity ⁽¹³⁾. The serosal surface is then closed to minimize the risk of postoperative adhesion formation and to restore the normal anatomical contour of the uterus. The principle of tension-free closure is important to ensure optimal healing and to minimize the risk of uterine dehiscence or rupture in subsequent pregnancies ⁽¹⁶⁾.

The segmental resection technique specifically emphasizes several technical refinements that contribute to its effectiveness. These include the use of preoperative imaging, including both ultrasound and MRI, to precisely map the extent of placental invasion and identify the optimal resection margins; tourniquet occlusion of the uterine vessels at the level of the isthmus to provide proximal vascular control during the resection; and a standardized approach to uterine reconstruction that ensures adequate wall thickness at the resection site ⁽¹³⁾.

A novel surgical technique, known as the CMNT-PAS technique, has been proposed as an evolution of the segmental resection approach. It combines principles of segmental resection with additional vascular control and uterine reconstruction modifications. In a pilot study of 35 patients, the CMNT-PAS technique was associated with a uterine preservation rate of 94.3% and a mean estimated blood loss of 1,850 mL, with no maternal mortalities reported ⁽²²⁾.

Intraoperative Considerations

Comprehensive preoperative planning, including detailed imaging review, multidisciplinary team briefing, and contingency planning for potential complications, is essential for optimizing outcomes ⁽⁵⁾. The surgical team should have a clearly defined plan that includes the approach to uterine incision, the method of vascular control, the technique of resection and reconstruction, and the specific criteria that would trigger conversion to hysterectomy if conservative management is unsuccessful ⁽¹⁸⁾.

The blood bank should be notified preoperatively, and appropriate blood products should be cross-matched and immediately available. A cell salvage device should be set up and available for use, as it can significantly reduce the need for allogeneic blood transfusion ⁽²³⁾.

Vascular control represents one of the most important intraoperative considerations in segmental resection for PAS. Internal iliac artery ligation or temporary occlusion using vascular clamps or balloon catheters is the most commonly employed approach, as it reduces arterial inflow to the uterus and significantly decreases intraoperative blood loss ⁽⁹⁾. The uterine tourniquet technique, in which a Penrose drain or similar device is tightened around the lower uterine segment to occlude the uterine vessels, is a simpler alternative that can be effective for cases with anterior lower segment involvement ⁽¹³⁾.

The presence of extensive placental involvement beyond the originally anticipated area, unexpected deep invasion into the parametrium or adjacent organs, uncontrolled hemorrhage, or hemodynamic instability should prompt consideration of conversion to hysterectomy ⁽¹⁸⁾. Importantly, conversion to hysterectomy during a planned conservative procedure should not be considered a failure of management but rather an appropriate and sometimes life-saving adaptation to unexpected intraoperative findings ⁽¹⁵⁾.

Outcomes and Long-Term Considerations

A multicenter cohort study reported a successful uterine preservation rate of 78% with conservative management. Women managed conservatively had significantly lower estimated blood loss and lower rates of blood transfusion compared to historical controls managed with cesarean hysterectomy ⁽¹⁵⁾.

A systematic review and meta-analysis found that conservative surgical approaches were associated with a significantly reduced risk of massive hemorrhage, lower transfusion requirements, and shorter operative times compared to cesarean hysterectomy. The analysis did not find significant differences in maternal mortality or composite severe morbidity between the two approaches ⁽¹⁴⁾.

The long-term outcomes following conservative PAS management are an area of active investigation, with particular attention to uterine integrity, menstrual function, and subsequent fertility. Available data suggest that the majority of women who undergo successful conservative PAS management resume normal menstrual function, with reported rates of spontaneous return of menstruation exceeding 90% within six months of delivery ⁽²¹⁾. Uterine synechiae and Asherman syndrome have been reported as potential long-term complications, particularly following conservative management techniques involving manual placental removal or curettage, although the risk appears to be lower with segmental resection approaches that avoid intrauterine instrumentation ⁽¹⁵⁾.

Conclusion

The FIGO guidelines recommend that the management of PAS should be individualized based on the severity of invasion, the clinical circumstances, available resources, and the patient's wishes, and they recognize

conservative management as a legitimate option for carefully selected cases ⁽¹⁰⁾. The guidelines emphasize that conservative management should only be offered in centers with appropriate surgical expertise, multidisciplinary support, and blood bank services, and that patients should be fully informed of the potential benefits, risks, and uncertainties of conservative approaches. Segmental resection involves excision of the entire area of abnormal placentation, including the placenta and the underlying myometrium, as a single surgical unit, followed by uterine reconstruction ⁽¹³⁾. Accurate preoperative mapping, appropriate patient selection, vascular control, meticulous reconstruction, and the capability to proceed immediately to hysterectomy if conservative management is unsuccessful remain essential components of uterine-sparing PAS management.

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