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Placenta Accreta Spectrum: Diagnostic Standards, Guideline Concordance and Contemporary Management

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ABSTRACT

Background. Placenta accreta spectrum (PAS) encompasses abnormal placental implantation with pathological trophoblastic invasion of the myometrium and, in severe cases, adjacent organs. Rising cesarean delivery rates have increased PAS incidence, making it a major cause of severe obstetric hemorrhage and peripartum hysterectomy. Optimal outcomes depend on accurate prenatal diagnosis and coordinated multidisciplinary management.

Aim. To synthesize contemporary evidence and guideline recommendations on PAS diagnosis, classification, and management, focusing on imaging standards, operative strategies, and models of care.

Material and Methods. A narrative review was based on a targeted search of PubMed/MEDLINE and professional society resources conducted between January 2018 and November 2025. Priority was given to 8 major guideline documents and 5 systematic reviews/meta-analyses; additional observational studies were included for clinical and organizational context.

Results. Guideline documents consistently recommend ultrasound as the first-line test for PAS, with MRI reserved for selected cases requiring additional anatomical detail. Planned cesarean hysterectomy without attempted placental removal remains the standard approach for most invasive PAS. Evidence for conservative management and interventional radiology (IR) adjuncts is inconclusive, and recommendations vary. Centralized care and multidisciplinary team management are repeatedly associated with improved maternal outcomes.

Conclusions. PAS requires standardized diagnostic pathways and coordinated MDT care in specialized centers. Core recommendations align on early prenatal diagnosis (ultrasound with selective MRI) and planned cesarean hysterectomy for most invasive disease. Uncertainty persists for conservative strategies and IR adjuncts; ongoing prospective studies may inform future guideline updates and refine operative pathways, improving maternal safety and outcomes.

Keywords: placenta accreta spectrum, abnormally invasive placenta, placenta increta, placenta percreta, prenatal diagnosis, ultrasound, cesarean hysterectomy, obstetric hemorrhage

1. Introduction

Placenta accreta spectrum (PAS) refers to a group of obstetric disorders characterized by abnormal adherence or invasion of placental tissue into the myometrium, including placenta accreta, increta, and percreta. The pathogenesis is strongly associated with defective decidualization, aberrant trophoblastic invasion, and uterine scarring - most commonly following prior cesarean delivery.[1–3] The rising global rate of cesarean sections has contributed to a marked increase in PAS prevalence, now recognized as a major contributor to severe maternal morbidity, massive obstetric hemorrhage, and peripartum hysterectomy.[1,3–6] Early and accurate prenatal diagnosis is critical for optimal outcomes. Ultrasound is internationally recognized as the primary diagnostic tool, with several

characteristic imaging markers described in consensus guidelines and validated in systematic reviews.[7–9] Magnetic resonance imaging (MRI) is used selectively to assess posterior placentae or evaluate potential invasion beyond the uterus, though its role varies across clinical settings.[8,10] Despite significant advances, diagnostic performance remains highly operator-dependent and relies on standardized techniques and appropriate referral pathways.[2,7,8,11–13]

To address inconsistencies in clinical practice, multiple professional societies - including *International Federation of Gynaecology and Obstetrics (*FIGO), **American College of Obstetricians and Gynecologists** (ACOG), **Royal College of Obstetricians and Gynaecologists** (RCOG), **The Society of Obstetricians and Gynaecologists of Canada** (SOGC), Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), and national health authorities - have developed guidelines outlining screening, diagnostic standards, and recommended management strategies.[2,3,5,11–14] These guidelines collectively emphasize multidisciplinary team (MDT) care, planned delivery at tertiary centers with surgical expertise, and preparedness for massive transfusion and urologic or vascular complications. Cesarean hysterectomy without attempting placental removal remains the recommended approach for most patients with invasive disease.[2,11–13] Nevertheless, evolving evidence has renewed interest in conservative management, including leaving the placenta in situ or performing localized resection, with recent meta-analyses suggesting potential reductions in surgical morbidity in carefully selected cases.[15,16] Meanwhile, interventional radiology (IR) techniques - particularly prophylactic balloon occlusion of internal iliac or aortic vessels - remain debated due to inconsistent efficacy and variable integration into international guidelines.[2,4,11–13,15,16] Given the complexity and clinical significance of PAS, a comprehensive synthesis of up-to-date evidence is essential. This review integrates findings from high-quality systematic reviews, meta-analyses, and major international guidelines to summarize contemporary standards in diagnosis and management. By highlighting areas of consensus and ongoing controversy, it aims to support clinicians in evidence-based decision-making and to identify priorities for future research.[2–4,11–14,17]

2. Methods

This narrative review was based on a targeted search of PubMed/MEDLINE and professional society resources conducted between January 2018 and November 2025. Priority was given to 8 international and national guideline documents (FIGO, ACOG / Society for Maternal - Fetal Medicine (SMFM), RCOG, SOGC, RANZCOG, International Society for Abnormally Invasive Placenta (IS-AIP), The Irish Health Service Executive (HSE), and The Polish Society of Gynecologists and Obstetricians (PSGO)), as well as 5 recent systematic reviews and meta-analyses evaluating diagnostic standards, management strategies, and guideline concordance in PAS.

Additional observational studies were included when they provided relevant clinical or organizational context, particularly regarding models of care and outcomes across resource settings. In total, 30 sources were selected for detailed synthesis, including peer-reviewed journal articles, guideline documents, and trial registry records. Because this is a narrative rather than a systematic review, no PRISMA flow diagram or formal risk-of-bias assessment was performed. To complement the literature synthesis, ClinicalTrials.gov was searched for ongoing prospective studies, and 3 active clinical trials relevant to PAS prognosis and management were incorporated into the Future Directions section.

3. Epidemiology and Risk Factors

The incidence of PAS has increased substantially over the past two decades, paralleling rising global cesarean delivery rates. PAS is now recognized as one of the leading causes of severe maternal morbidity and peripartum hysterectomy worldwide.[1,6,11] Estimates of prevalence vary by population, referral patterns, and diagnostic criteria, but contemporary data consistently demonstrate a strong proportional relationship between PAS incidence and the number of prior cesarean deliveries.[1,3,6] The risk escalates dramatically when placenta previa overlies a uterine scar, making this combination the single strongest clinical predictor of PAS.[1,2,11,13] Beyond cesarean delivery, several additional maternal and iatrogenic risk factors have been identified. Prior uterine surgery, including myomectomy, operative hysteroscopy, curettage, endometrial ablation, and previous cesarean scar defects, has been associated with increased risk of abnormal placentation. A recent systematic review and meta-analysis confirmed that uterine procedures unrelated to cesarean birth also contribute significantly to the development of PAS in subsequent pregnancies.[18] Increasing maternal age, multiparity, assisted reproductive technologies, and placenta previa in the current pregnancy further compound risk, with many guidelines incorporating these variables into recommended screening pathways.[2,3,11–14] Epidemiologic patterns differ across health-care systems. In high-resource settings, the rising incidence is predominantly driven by increased cesarean rates, whereas in low- and middle-income countries (LMICs), delayed diagnosis, limited access to prenatal imaging, and constrained referral systems exacerbate the burden of severe PAS complications.[19,20] Reports from LMICs highlight substantially higher rates of massive hemorrhage, emergency hysterectomy, and maternal near-miss events, underscoring the importance of early identification and structured referral networks.[19,20] Together, these data indicate that PAS is a condition shaped by both biological and systems-level determinants. The strongest and most consistent risk factors - prior cesarean delivery, placenta previa, and uterine surgical history -form the basis of contemporary guidelines that emphasize targeted screening, early risk stratification, and referral to specialized centers for high-risk patients.[1–4,11–14] **As cesarean rates continue to rise**

globally, the epidemiologic trajectory of PAS is expected to follow, reinforcing the need for preventive obstetric strategies and standardized diagnostic pathways.[1–4,11,19,20]

4. Pathophysiology

PAS results from defective decidualization over areas of uterine injury, most commonly a cesarean scar. In physiologic implantation, the decidua basalis limits trophoblastic penetration into the myometrium; when this layer is absent or attenuated, abnormal adherence (accreta), deep invasion (increta), or transmural infiltration (percreta) may occur.[1,2,12] Prior cesarean delivery is the most significant etiologic factor. Scar tissue is characterized by fibrosis, poor vascularity, and deficient decidua, creating a permissive environment for excessive trophoblastic ingrowth in subsequent pregnancies.[1–3] Other uterine procedures, such as myomectomy, hysteroscopy, curettage, and endometrial ablation, can similarly disrupt the myometrial–endometrial interface. A recent meta-analysis confirmed that non-cesarean uterine surgery also increases PAS risk by altering uterine architecture.[18] Radiologic–pathologic studies describe prominent neovascularization, thinning of the myometrium, and loss of the normal retroplacental clear zone, correlating with key ultrasound markers such as placental lacunae, subplacental hypervascularity, and bridging vessels.[7–9] **These imaging features directly reflect the underlying structural and vascular abnormalities at the implantation site.**[7–9] Although molecular mechanisms remain incompletely defined, PAS is understood as a disorder arising from the interplay of abnormal uterine healing, impaired decidual formation, and dysregulated trophoblastic invasion, influenced by systemic factors such as maternal age, multiparity, and assisted reproductive technologies .[11,13]

5. Terminology and Classification

PAS is a unified term describing a continuum of abnormal placental implantation disorders characterized by varying degrees of trophoblastic invasion into the uterine wall. The terminology has been standardized across major professional organizations, including FIGO, ACOG, RCOG, SOGC, and IS-AIP, to improve diagnostic consistency and facilitate interdisciplinary communication.[2,5,11–13] Within this spectrum, three categories are recognized based on depth of invasion: *accreta*, *increta*, and *percreta*, definitions that remain consistent across international guidelines and clinical literature.[1,2,12] The FIGO classification provides a structured staging system derived from intraoperative assessment, integrating the depth of myometrial involvement, extrauterine extension, and abnormal vascularity.[2,6] This framework has been widely adopted because higher FIGO grades correlate with increased operative complexity, greater hemorrhage risk, and a higher likelihood of requiring hysterectomy.[2,8,12,13] Prenatal imaging terminology, although not formally incorporated into FIGO staging, plays a complementary role in clinical practice. Ultrasound and MRI descriptors, such as placental lacunae, subplacental hypervascularity,

interruption of the myometrial interface, and bladder wall abnormalities, serve as reproducible markers aligned with underlying pathological changes and operative severity. These descriptors form a shared diagnostic lexicon that supports prenatal stratification and multidisciplinary planning.[7–9] Minor variation persists across guidelines, particularly regarding the use of topographic descriptors, including distinctions such as anterior versus posterior PAS or cesarean-scar implantation patterns. These additions appear in selected national or regional guidelines to aid surgical preparation but do not alter the core conceptual framework of PAS.[4] **Overall, international convergence toward unified terminology and FIGO-based classification has markedly improved comparability across studies and facilitated more coherent multidisciplinary management.**[2,4,11–13] Prenatal diagnosis is central to optimizing outcomes in PAS, as early identification allows for multidisciplinary planning, delivery in specialized centers, and reduction of maternal morbidity. International guidelines uniformly emphasize ultrasound as the primary diagnostic tool, with MRI reserved for selected cases requiring further anatomical delineation. Recent systematic reviews and guideline comparisons have clarified diagnostic performance, optimal timing, and referral thresholds for suspected PAS.[2,4,7–13]

6. Prenatal Diagnosis and Diagnostic Standards

6.1. Role of Ultrasound

Ultrasound is the cornerstone of PAS diagnosis and remains the first-line modality recommended across major guidelines, including those from ACOG, RCOG, FIGO, SOGC, and IS-AIP.[2,11–13,21] Its diagnostic accuracy is supported by systematic reviews demonstrating strong correlation between characteristic sonographic features and intraoperative findings.[7,9] Key markers include placental lacunae, loss or irregularity of the retroplacental clear zone, myometrial thinning, subplacental hypervascularity, and bridging vessels, all of which mirror underlying structural and vascular abnormalities at the implantation site.[7–9,22] Both transabdominal and transvaginal ultrasound contribute to optimal evaluation. Diagnostic performance increases with operator expertise and standardized reporting terminology, which has been widely implemented following international consensus efforts.[2,4,11–13,22] Although sensitivity and specificity vary among studies and settings, consensus documents consistently identify ultrasound as the most accessible and effective tool for routine screening and risk stratification in women at increased risk of PAS.[2,4,7,9,11–13,22]

6.2. Role of MRI

MRI serves as an adjunctive modality when ultrasound findings are inconclusive or when additional anatomical detail is necessary for surgical planning. This is particularly relevant in cases involving a posterior placenta, suspected parametrial or bladder invasion, or complex pelvic anatomy.[8,10,21] MRI provides superior soft-tissue contrast and can delineate the depth and lateral extent of invasion,

thus refining preoperative assessment and guiding multidisciplinary strategy.[8,10,21] Despite these advantages, MRI is not recommended as a universal screening tool. Its incremental diagnostic value is limited when high-quality ultrasound is available, and its use is constrained by cost, availability, and the need for specialized interpretation.[2,8,10–13] Consequently, guidelines endorse a selective approach: MRI is reserved for specific high-risk scenarios where the extent of disease remains uncertain after expert sonographic assessment.[2,4,8,10–13,21]

6.3. Early Prediction and First-Trimester Assessment

Early identification of women at risk of PAS enhances the opportunity for appropriate counseling and referral. First-trimester assessment combines clinical risk factors - most notably prior cesarean delivery, placenta previa, and history of uterine surgery - with early imaging features. Recent studies suggest that implantation on or within a cesarean scar, markedly thinned myometrium at the scar site, and abnormal sac–myometrium interfaces in early pregnancy may be associated with subsequent development of PAS.[23] Several guidelines advocate targeted early screening for women with a history of cesarean delivery or other significant uterine surgery, especially when low-lying placenta or placenta previa is detected in the first or early second trimester.[2,4,11–13] Although predictive models remain under refinement and are not yet uniformly adopted, the integration of first-trimester ultrasound markers with established clinical risk factors offers a promising approach to improving risk stratification and ensuring timely referral to specialized centers.[2,4,11–13,23]

6.4. Diagnostic Pathways and Referral Criteria

International guidelines propose structured diagnostic pathways that link risk assessment, sequential imaging, and referral decisions in a coherent framework.[2–4,11–14,21] These pathways typically include systematic evaluation of placental location and myometrial interface at routine mid-trimester scans, targeted assessment in women with prior cesarean delivery or other uterine surgery, and escalation to advanced imaging in cases with suspicious findings. Central to these recommendations is the principle that any pregnancy with placenta previa overlying a uterine scar or clear sonographic markers of PAS should be managed as high risk and considered for referral to a tertiary or quaternary center.[2–4,11–14] Evidence from diverse health-care settings indicates that structured referral systems and concentration of care in specialized centers are associated with reduced emergency delivery, lower rates of uncontrolled hemorrhage, and improved maternal outcomes.[19,20] These data underpin guideline recommendations that women with suspected PAS be transferred, when feasible, to institutions with experienced, MDT access to IR, and comprehensive blood bank support.[2–4,11–14,19,20] Taken together, contemporary diagnostic standards promote a proactive, tiered strategy in which clinical risk assessment, high-quality ultrasound, selective MRI, and timely referral are integrated to optimize maternal safety.[2–4,7–14,19,20]

7. Clinical Practice Guidelines and Standards of Care

7.1. Overview of Key Guidelines

Major professional organizations, including ACOG, FIGO, RCOG, SOGC, RANZCOG, and IS-AIP, have produced comprehensive guidance addressing the diagnosis, classification, and management of PAS.[2,3,6,11–14,21,24,25] These guidelines consistently emphasize the central role of high-quality ultrasonography, early recognition of risk factors, delivery planning within specialized centers, and multidisciplinary care models.[2,11–13] FIGO and RCOG highlight the need for standardized terminology and endorse the FIGO intraoperative classification to ensure consistent staging of invasion depth and extrauterine extension.[2,6,12,21] ACOG and SOGC similarly stress structured clinical pathways, including the involvement of anesthesiology, urology, and transfusion services as integral components of care.[11,13] Regional guidelines, such as those from RANZCOG and HSE, reinforce the importance of early triage and referral within coordinated perinatal networks.[3,14]

7.2. Systematic Reviews of Guidelines

Systematic comparisons of global PAS guidelines have revealed substantial concordance across major recommendations. Bonanni et al. (2025) demonstrated widespread agreement regarding the primacy of ultrasonography, optimal timing of delivery, and the necessity of management in tertiary centers.[17] Similarly, Giouleka et al. (2024) found that guidelines from North America, Europe, and Australasia share consistent recommendations for diagnostic criteria, referral thresholds, and operative planning.[4] These reviews also identify differences in recommendations surrounding conservative therapy and IR, reflecting variation in regional practice patterns and available evidence.[4,17]

7.3. Areas of Consensus

Across international guidance, several areas of consensus are clear. Ultrasound is uniformly recognized as the primary diagnostic tool for PAS, with MRI considered a supplementary modality reserved for cases requiring additional anatomical detail.[2,7–13] There is universal agreement that patients with suspected or confirmed PAS should receive care and deliver in high-acuity centers with access to experienced MDT, blood products, and specialized surgical support.[2,3,11–14] Another consistent recommendation is that planned cesarean hysterectomy-without attempting placental removal- is the standard of care for most cases of increta and percreta due to the high risk of catastrophic hemorrhage.[2,11–13] Guidelines also concur on the importance of early risk identification, systematic imaging protocols, and coordinated perioperative planning to reduce morbidity and improve outcomes.[2–4,11–14]

7.4. Areas of Divergence and Controversy

Despite broad alignment, notable differences exist among guidelines. The most prominent relate to IR techniques, such as prophylactic balloon occlusion of the internal iliac or aortic arteries. While some European and specialized centers consider these techniques in selected high-risk cases, ACOG and others emphasize insufficient evidence to support routine use.[2,4,11–13] Discrepancy is also evident in recommendations concerning conservative management, such as leaving the placenta in situ or performing localized resection. Systematic reviews show that some guidelines cautiously endorse these approaches for select patients under expert care, whereas others consider them investigational or advise their use only in specialized centers with extensive experience.[4,15–17] Additional variation appears in guideline terminology (e.g., topographic descriptors such as anterior vs. posterior PAS) and approaches to post-treatment surveillance in conservatively managed patients.[4]

8. Management Strategies

Management of PAS centers on coordinated multidisciplinary care, risk-stratified delivery planning, and surgical strategies tailored to the severity of invasion. International guidelines consistently emphasize that outcomes improve when diagnosis is established prenatally, delivery occurs in specialized centers, and standardized perioperative pathways are implemented.[2–4,11–14]

8.1. General Principles

Across all major guidelines, two principles underpin PAS management: advance planning and multidisciplinary care. Patients with suspected PAS should be managed in high-acuity centers with obstetric surgeons experienced in complex pelvic dissections, anesthesiology teams adept in massive transfusion management, and access to urology, IR, and critical care services.[2,3,11–14] Perioperative preparation includes readiness for major hemorrhage, availability of blood products, activation of massive transfusion protocols, and coordination of surgical subspecialties, which together reduce morbidity and emergency hysterectomy. Structured care models have demonstrated improved outcomes in both high-resource and lower-resource environments, underscoring their central role in PAS management.[19,20]

8.2. Timing of Delivery

International guidelines recommend planned preterm delivery between 34+0 and 36+6 weeks, balancing the risk of spontaneous labor or bleeding against neonatal prematurity.[2,11–13,24] Delivery should be scheduled before the onset of labor, before membrane rupture, and ideally during daytime hours when full MDT are available. Corticosteroid administration is advised when delivery is anticipated before 37 weeks. Earlier delivery may be warranted in cases of recurrent bleeding, preterm labor, or maternal instability.[2,4,11–13]

8.3. Cesarean Hysterectomy

Cesarean hysterectomy without attempting placental removal remains the standard of care for most cases of increta and percreta, supported consistently across ACOG, FIGO, RCOG, and SOGC guidelines.[2,11–13,24] Attempted manual removal of the placenta is strongly discouraged due to the high risk of massive hemorrhage. After fetal delivery, the umbilical cord is typically ligated close to the placenta, and hysterectomy proceeds by a team experienced in PAS surgery.[1,2,8,12] Studies show that outcomes improve when surgeons anticipate distorted anatomy, prepare for ureteric displacement, and collaborate with urology when bladder invasion is suspected. The use of vertical or classical uterine incisions to avoid transecting the placenta is standard practice, guided by intraoperative assessment and preoperative imaging.[2,7–13]

8.4. Conservative Management

Conservative approaches aim to preserve the uterus and include leaving the placenta in situ and localized resection with uterine reconstruction. Evidence from systematic reviews indicates that in selected cases, conservative management may reduce surgical morbidity, transfusion requirements, and urologic injury.[15,16,25] However, conservative strategies carry risks, including delayed hemorrhage, infection, need for secondary hysterectomy, and prolonged follow-up, and are therefore not uniformly recommended across guidelines. Some national and international guidelines endorse conservative management only in carefully selected patients and within experienced multidisciplinary centers, whereas others regard it as investigational.[2,4,11–13,15–17,25] Close monitoring with serial imaging and clinical surveillance is essential when conservative management is chosen. The potential contribution of IR as an adjunct to both surgical and conservative strategies is addressed in detail in Section 10.[2,4,11–13,15,16]

9. Role of IR

IR has emerged as a potential adjunct in the management of PAS, although its role remains controversial. IR techniques may serve prophylactic or therapeutic purposes, yet evidence supporting their routine use is inconsistent, and major guidelines diverge in their recommendations.[2,4,11–13,15,16]

9.1. Types of IR Procedures in PAS

Several IR procedures have been utilized in the management of PAS. The most commonly described technique is prophylactic balloon occlusion of the internal iliac arteries or, less frequently, the aorta, placed preoperatively to reduce pelvic blood flow during cesarean delivery.[2,4,11–13,15,16] Some centers also use intraoperative or postoperative uterine or pelvic arterial embolization, typically as a therapeutic intervention for hemorrhage rather than as a purely prophylactic measure.[15,16] IR techniques aim to reduce intraoperative blood loss and facilitate surgical dissection; however, their

use varies widely between institutions, largely because of differences in local expertise, availability of IR services, and interpretation of the heterogeneous evidence base.[2,4,11–13,15,16]

9.2. Evidence on Prophylactic Balloon Occlusion

Evidence regarding the effectiveness of prophylactic balloon occlusion remains heterogeneous. A systematic review of conservative management strategies reported inconsistent outcomes, with some studies suggesting modest reductions in intraoperative blood loss, whereas others demonstrated no significant benefit.[15,16] Additional reports have highlighted potential complications, including vascular injury, thrombosis, limb ischemia, and radiation exposure to the fetus, which further complicate risk–benefit considerations.[15,16] Given the variability of results, the current literature does not support routine use of prophylactic balloon catheters in all patients with PAS. Most studies underline the importance of careful patient selection and emphasize that any potential benefit is likely restricted to highly specific scenarios within expert centers.[2,4,11–13,15,16] Major guidelines differ substantially in their recommendations regarding IR. ACOG and SOGC explicitly advise against routine prophylactic balloon occlusion, citing insufficient evidence of benefit and the potential for complications.[11,13] FIGO also takes a cautious stance, emphasizing that IR should not replace standard surgical management and should be used only in select cases where local expertise exists.[2,24] In contrast, some European and IS-AIP-aligned institutions allow for individualized use of IR techniques, particularly in cases of suspected bladder involvement or planned conservative management, provided procedures are performed in high-volume centers with experienced teams.[4,12] Guidelines consistently note that embolization may have a role as a therapeutic tool for postpartum or delayed hemorrhage, particularly after conservative treatment, rather than as a prophylactic intervention.[15,16]

Overall, IR occupies a limited but potentially useful role in PAS management, primarily in specialist settings and for therapeutic rather than routine prophylactic purposes.[2,4,11–13,15,16]

10. Models of Care and MDTs

10.1. Centralization of Care and Referral Systems

Centralization of PAS care is a universally recommended strategy across guidelines. Patients with suspected or confirmed PAS should be referred to tertiary or quaternary centers with experience in complex pelvic surgery, comprehensive blood bank resources, and access to IR, urology, and critical care services.[2,3,11–14] Health systems that have implemented regionalized referral models demonstrate significantly improved outcomes, including lower rates of emergent delivery, reduced intraoperative hemorrhage, and fewer unplanned hysterectomies.[19,20,26] Centralization also facilitates standardized imaging protocols, coordinated prenatal planning, and the availability of specialized surgical teams during planned delivery.[2,3,11–14]

10.2. Composition and Roles of the MDT

A well-coordinated MDT is essential for optimal management of PAS. Core team members typically include maternal–fetal medicine specialists, experienced obstetric surgeons, anesthesiologists skilled in massive transfusion protocols, urologists, IR, neonatologists, transfusion medicine specialists, and perioperative nursing teams.[2,11–13,24,26] Anesthesiology plays a critical role in hemodynamic monitoring and fluid resuscitation, especially given the risk of rapid-onset hemorrhage. Urology is often required when bladder invasion is suspected, as preoperative stent placement and intraoperative consultation can reduce genitourinary complications.[1,2,12] IR contributes selectively, particularly in the context of therapeutic embolization when hemorrhage persists after delivery or during conservative management.[15,16]

10.3. Preoperative Planning and Simulation

Preoperative planning meetings, ideally conducted weeks before scheduled delivery, allow MDT members to coordinate roles, review imaging, anticipate surgical challenges, and plan for resource allocation. Such planning is repeatedly emphasized in ACOG, FIGO, and RCOG guidance as a critical component of risk reduction.[2,11–13] High-volume centers increasingly employ multidisciplinary simulation drills, which improve communication, clarify team roles, and enhance the efficiency of intraoperative decision-making during high-blood-loss scenarios. Evidence from clinical practice reports demonstrates reduced delays, improved hemorrhage control, and overall smoother workflow when simulation-based preparation is undertaken.[19]

10.4. Intraoperative Communication and Logistics

Intraoperative management benefits from predefined communication protocols. Clear leadership, typically by the maternal–fetal medicine specialist or lead obstetric surgeon, ensures coordinated surgical steps, timely involvement of subspecialists, and structured responses to hemorrhage. Access to intraoperative blood salvage, rapid blood product availability, and real-time laboratory monitoring are integral components of intraoperative logistics recommended across multiple guidelines.[2,3,11–14] Team communication is further strengthened by the use of operative checklists specific to PAS, which improve adherence to protocolized management and minimize delays in activating massive transfusion pathways.[3,12–14]

10.5. Postoperative Monitoring and Critical Care

Postoperative management typically requires high-dependency or intensive care monitoring due to the risk of delayed hemorrhage, coagulopathy, infection, and organ injury. Guidelines recommend proactive surveillance in the immediate 24–48 hours following surgery, with readiness to escalate care as needed.[2,3,11–13] Centers with dedicated maternal critical care teams report improved recovery trajectories and earlier detection of complications. Such systems also facilitate postpartum

counseling and long-term follow-up, particularly for patients undergoing conservative management who require ongoing imaging surveillance.[15,16]

11. Future Directions and Research Priorities

Key research priorities in PAS focus on improving diagnostic accuracy, refining management strategies, and strengthening models of care. International guidelines highlight the need for standardized diagnostic terminology and imaging criteria, as variability in the interpretation of ultrasound and MRI findings continues to affect reproducibility across centers.[2–4,11–14] Advancements in quantitative imaging, predictive modeling, and early first-trimester assessment, particularly regarding cesarean-scar implantation, require validation in larger, prospective studies to support integration into clinical pathways.[7–9,18,19,23] Further evidence is also needed to clarify the comparative effectiveness of management strategies. Conservative approaches and variations in surgical technique remain insufficiently studied, and long-term maternal and reproductive outcomes are poorly defined. Prospective registries and multicenter trials would help determine which patients benefit from conservative management and how perioperative pathways influence outcomes.[1,2,12,15,16,27]

The role of IR remains one of the most significant uncertainties in PAS care. Current evidence on prophylactic balloon occlusion is inconsistent, and guidelines diverge in their recommendations. Future research should focus on identifying patient subgroups that may benefit from IR and on defining its role in therapeutic management of postpartum hemorrhage, particularly after conservative treatment.[15,16]

Finally, MDT models and regionalized care systems, while broadly endorsed, require stronger empirical evaluation. Studies comparing outcomes across different MDT structures, resource settings, and referral pathways are essential for optimizing global PAS care, especially in low- and middle-income regions where morbidity remains disproportionately high.[19,20]

Emerging prospective studies are expected to address several of the most critical gaps in PAS care. A large multicenter study evaluating the topographic classification of PAS aims to determine whether detailed anatomic phenotyping can improve prenatal risk stratification and guide operative planning in a reproducible manner.[28] A randomized feasibility trial comparing one-step conservative surgery with hysterectomy directly examines the balance between uterine preservation and surgical morbidity, and may provide the first comparative data to support or refine conservative strategies in carefully selected patients.[29] In parallel, an ongoing randomized trial comparing planned delivery at 37 versus 36 weeks in pregnancies with placenta previa and PAS is designed to clarify the optimal timing of elective cesarean delivery, seeking to balance the risks of antepartum hemorrhage and emergency delivery against neonatal morbidity.[30] These data may inform future updates; current

guidance continues to favor earlier planned delivery in confirmed invasive PAS.[2,11–13,24] Together, these studies are likely to inform future guideline recommendations on classification, surgical decision-making, and gestational age at planned delivery in PAS.[28–30]

12. Limitations

This review has several limitations. First, it is a narrative rather than a systematic review, and no formal risk-of-bias assessment or PRISMA-based reporting framework was applied. The selection of studies may therefore be subject to selection bias, despite prioritizing high-quality guidelines, systematic reviews, and meta-analyses. Second, only English-language, peer-reviewed publications were included, which may have excluded relevant evidence from non-English or gray literature sources. Finally, the rapidly evolving nature of PAS research means that some very recent data, particularly from ongoing registries and multicenter collaborations, may not yet be fully captured. Nonetheless, the focus on major international guidelines and contemporary comprehensive reviews provides a robust synthesis of current standards in PAS diagnosis and management.

13. Conclusions

PAS remains one of the most complex and high-risk conditions in modern obstetrics, with rising incidence driven largely by increasing cesarean delivery rates. Early and accurate prenatal diagnosis, anchored in high-quality ultrasound and supported selectively by MRI, forms the foundation of effective management. International guidelines consistently emphasize the importance of delivering care within specialized centers, where MDT can coordinate surgical planning, anesthetic management, transfusion support, and postoperative critical care. While cesarean hysterectomy remains the standard approach for most cases of invasive disease, ongoing research continues to refine the role of conservative strategies and IR in selected patients. Despite advances in imaging, surgical techniques, and organizational models of care, significant knowledge gaps persist, particularly regarding early prediction, optimal operative pathways, and long-term maternal outcomes. Future progress will depend on harmonized diagnostic criteria, multicenter research collaboration, and strengthened health-system capacity across diverse resource settings. By integrating evolving evidence with structured models of care, clinicians can continue to improve maternal safety and enhance the quality of management for patients affected by PAS.

Disclosures

Author's contribution:

Conceptualization: BP, NMK, WP; Methodology: BP, JAW, MMT, LO; Software: AP, JP, WP; Check: AG, AK; Formal analysis: BP, NMK, AP; Investigation: AG, LO, AK; Resources: JAW, MMT; Data curation: BP, JP, WP; Writing-rough preparation: MMT; Writing -review and editing:

NMK, BP, JAW, AG; Visualization: JP, AP, LO; Supervision: AK, WP, MMT; Project administration: NMK, BP, JAW

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