

# National reference center for the diagnosis and management of placenta accreta spectrum (PAS). Five years of experience

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## Abstract

**Introduction:** Placenta accreta spectrum (PAS) is a serious obstetric complication where the placenta abnormally adheres to the uterus, posing risks of severe hemorrhage and maternal and neonatal mortality. Since 2018, has implemented multidisciplinary protocols to improve outcomes, promoting appropriate surgical management in a specialized center. **Objective:** To evaluate the effectiveness of the diagnostic and management algorithms for PAS implemented at the Hospital General de México Dr. Eduardo Liceaga over 5 years. **Material and methods:** This observational, cross-sectional, and descriptive study was conducted at the Hospital General de México Dr. Eduardo Liceaga and included 100 patients between. Various factors were evaluated, including age, parity, history of previous uterine surgeries, placenta previa, early ultrasonographic diagnosis, type of accreta, surgical management (cesarean, hysterectomy, and arterial embolization), maternal and neonatal complications, transfusions, and histopathological data. **Results:** In our studied population, with an average age of  $32.38 \pm 6.1$  years and an  $3 \pm 1.0$  pregnancies, a high association was found between placental accreta and factors such as previous cesareans (average 1.46), placenta previa (62%), and type of accreta (31% accreta, 33% increta, and 35% percreta). Total hysterectomy was the predominant treatment (89%) with few complications, highlighting vesical injuries in 10%. A low maternal mortality rate and a high preterm birth rate in neonates (average gestational age 35.3 weeks and average weight 2567.3 g) were reported. **Conclusions:** This study demonstrates that the implementation of a specialized diagnostic and multidisciplinary surgical management protocol at the Hospital General de México has significantly improved outcomes for patients with PAS. Early identification through ultrasonography and color Doppler, along with surgical techniques such as uterine artery embolization and the placement of double J catheters, contributed to low maternal mortality and effective management of complications.

**Keywords:** Placenta accreta spectrum. Embolization. Uterine arteries. Hysterectomy. Hemorrhage.

## Introduction

The placenta accreta spectrum (PAS) is defined as an abnormal adherence of the placenta to the uterine wall. It is traditionally classified as placenta accreta, increta, and percreta according to the depth of attachment of the placenta to the myometrium: superficial, deep, serous, and adjacent structures<sup>1</sup>. PAS occurs when there is damage at the boundary between the

endometrium and myometrium, allowing the placental trophoblast to grow into or through the uterine wall<sup>2</sup>.

It represents a devastating obstetric complication characterized by trans cesarean hemorrhage, in addition to disseminated intravascular coagulation (DIC), dysfunction, multiorgan failure, and death<sup>3</sup>. In Mexico, obstetric hemorrhage is the leading cause of maternal death; although studies have been conducted to predict

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Date of reception: 25-11-2024

Date of acceptance: 05-02-2025

DOI: 10.24875/HGMX.24000085

Available online: 20-05-2025

Rev Med Hosp Gen Mex. 2025;88(4):188-195

www.hospitalgeneral.mx

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the risk of obstetric hemorrhage through blood biometry or coagulogram analysis, this has not decreased its incidence<sup>4</sup>.

The worldwide incidence of placental accreta is three cases per 1,000 pregnancies. In our country, there are publications that report an estimated incidence of 0.6% and one case per 642 births<sup>5,6</sup>.

The most important risk factor for the development of PAS is the increased incidence of cesarean section, which may occur in association with other uterine surgeries such as myomectomy, curettage, endometrial ablation, or a history of Asherman's syndrome<sup>7</sup>. It is strongly associated with placenta previa, which affects approximately 0.5% of all full-term pregnancies. This figure rises to 5% or more depending on the number of cesarean sections previously performed. All patients with placenta previa should be evaluated for abnormal placentation<sup>8,9</sup>. The gold standard for the diagnosis of placenta accreta is a histopathologic examination of the uterus and placental attachment. The main diagnostic tool for early detection of PAS is high-definition ultrasonography plus color Doppler, in addition to three-dimensional reconstruction, performed by highly trained imaging physicians<sup>10-16</sup>. Ultrasonographic features suggestive of placenta accreta are: loss of echolucent area between placenta and uterus as well as between placenta and bladder wall, multiple placental lacunae, focal exophytic masses extending into the bladder. Color Doppler findings include vascular lakes with turbulent flow (< 15 cm/s.) hypervascularity of the serosa-bladder interface, abnormal vessels crossing the thickness of the placenta (bridging vessels), diffuse or focal lacunar flow, power Doppler, 3D with hypervascularity, abnormal vessels at the serosa-bladder interface, and abnormal cotyledonary and intervillous circulation with chaotic branching and aberrant vessels<sup>10-16</sup>. Ultrasonography performed as screening allows prenatal detection; however, up to 50% of cases remain undiagnosed, resulting in poor maternal prognosis.

Once the diagnosis of PAS is established, it is necessary to implement an organized and interdisciplinary medical-surgical management plan. The key points to be included are: the type of accretism, placental location, timing of delivery, surgical approach chosen (hysterectomy or conservative treatment), and the use of adjunctive treatment and techniques. An intervention plan is also recommended in case the patient requires an earlier delivery due to unexpected or persistent hemorrhage<sup>15-17</sup>. PAS is responsible for 38% of cesarean hysterectomies and is associated with significant Maternal and Neonatal Morbidity and Mortality<sup>15</sup>. The recommended options in the literature for the management of

PAS are cesarean hysterectomy with placenta in utero, expectant management with intentional placental retention, and conservative management with uterine preservation surgery<sup>18-24</sup>.

Both the American College of Obstetricians and Gynecologists and the Royal College of Obstetricians and Gynecologists recommend management by a multidisciplinary team with expertise in the diagnosis of abnormal placentation and the management of complex pelvic surgeries, preferably in a specialized SBP center with access to blood products, adult and neonatal intensive care units, and interventional radiology to assist with hemorrhage control during surgery<sup>18-24</sup>.

As of August 18, 2018, the Hospital General de México Dr. Eduardo Liceaga, is recognized by the National Center for Equity and Gender and Reproductive Health, as the "National Center for the Diagnosis and Care of PAS." Since then, several diagnostic and medical-surgical management algorithms have been implemented in the gynecology and obstetrics service (Figs. 1 and 2), with the aim of reducing the incidence of morbidity and mortality at the maternal-fetal level.

## Objective

To evaluate the effectiveness of the diagnostic and medical-surgical management algorithms implemented at the Hospital General de México Dr. Eduardo Liceaga, during a 5-year period for the management of PAS, analyzing their impact on the reduction of maternal and neonatal morbidity and mortality, through the evaluation of demographic characteristics, high definition ultrasound diagnosis, types of surgical treatment, complementary procedures, blood transfusions, and maternal and neonatal outcomes, and comparing these results with the current literature on the condition.


## Material and methods

The observational, cross-sectional, descriptive study was conducted at the Hospital General de México Dr. Eduardo Liceaga.

This study included 100 patients in a period from January 2019 to April 2024 to our diagnostic and treatment algorithm.

We present our format for calculating the PAS scale as shown in Fig. 1. In addition, the following flowcharts of the diagnostic and therapeutic protocol were performed in our reference center (Fig. 2).

The incidence of the condition in the patients was reported in relation to: age, parity, hospital or site of



## VALORACIÓN ECOGRÁFICA DEL ESPECTRO DE PLACENTA ACRETA

**FECHA REALIZACIÓN:** \_\_\_\_\_ **FUM (CORREGIDA):** \_\_\_\_\_  
**PACIENTE:** \_\_\_\_\_ **EDAD:** \_\_\_\_\_ **ECU:** \_\_\_\_\_  
**IDX:** \_\_\_\_\_

**ANTECEDENTES**

**GESTAS:** 0  **PARTOS:** 0  **REV. INSTRUM:** 0  **CESAREAS:** 0  **ABORTOS:** 0  **LEGRADOS:** 0

**CIRUGIA UTERINA PREVIA:** N  **FECHA ÚLTIMA QX UTERINA (CESAREA, LEGRADO, REV. INSTRUM.,TC):** \_\_\_\_\_

**MIOMAS UTERINOS:**  **NUMERO:** 0  **LOCALIZACION:** \_\_\_\_\_ **TAMAÑO:** \_\_\_\_\_

**TABAQUISMO (PASIVO):** N  **TIEMPO:** \_\_\_\_\_

**LOCALIZACION ACTUAL DE LA PLACENTA (PREDOMINIO):** \_\_\_\_\_

**BORDE PLACENTARIO CUBRE OCI:** S  **DISTANCIA (mm):** \_\_\_\_\_

**PRIMER TRIMESTRE**

Saco gestacional ubicado en la parte más inferior del segmento inferior.  
 Múltiples espacios vasculares irregulares observados dentro del lecho placentario.  
 Implantación del saco gestacional en el sitio de cicatriz previa (Ectópico en cicatriz de cesárea).

**SEGUNDO TRIMESTRE**

Lagunas vasculares irregulares, múltiples en la placenta, con predominio en la región basal


Modificado del original: Li Liu, Qidai Sun, Danni Yang, et al. Scoring system for the prediction of the severity of placenta accrete spectrum in women with placenta previa a prospective observational study. Archives of Gynecology and Obstetrics, Springer-Verlag GmbH Germany, 2019.


**TERCER TRIMESTRE**

Variable	Puntuación			
	0	1	2	3
Lagos placentarios	No se observan	Entre 1 a 3 regulares (<3cm)	Entre 4 a 6 irregulares (2-6cm)	Irregulares > 6cm
Pared Uterina (Invasión placentaria)	Posterior o Anterior Alta	Lateral Baja	Anterior Baja	
Vascularización en interfase vesíco-uterina	Flujo mínimo a moderado	Incremento del flujo	Interfase infiltrada por vasos	
Pared vesical	Clara y completa	Irregular	Perdida	
Longitud cervical	>4cm	1-4cm	<3cm	
Grosor del miometrio y zona zona placentaria anexica	Miometrio >2mm con zona regular	Miometrio >2mm con zona irregular	Miometrio <2mm con zona perdida	
Cesáreas previas	0	1	2	>4
<b>Puntuación Total</b>				

Bajo Riesgo <1    Placenta Acreta 2 a 6    Placenta increta 6 a 9    Placenta percreta > 9

**Diagnóstico:** \_\_\_\_\_





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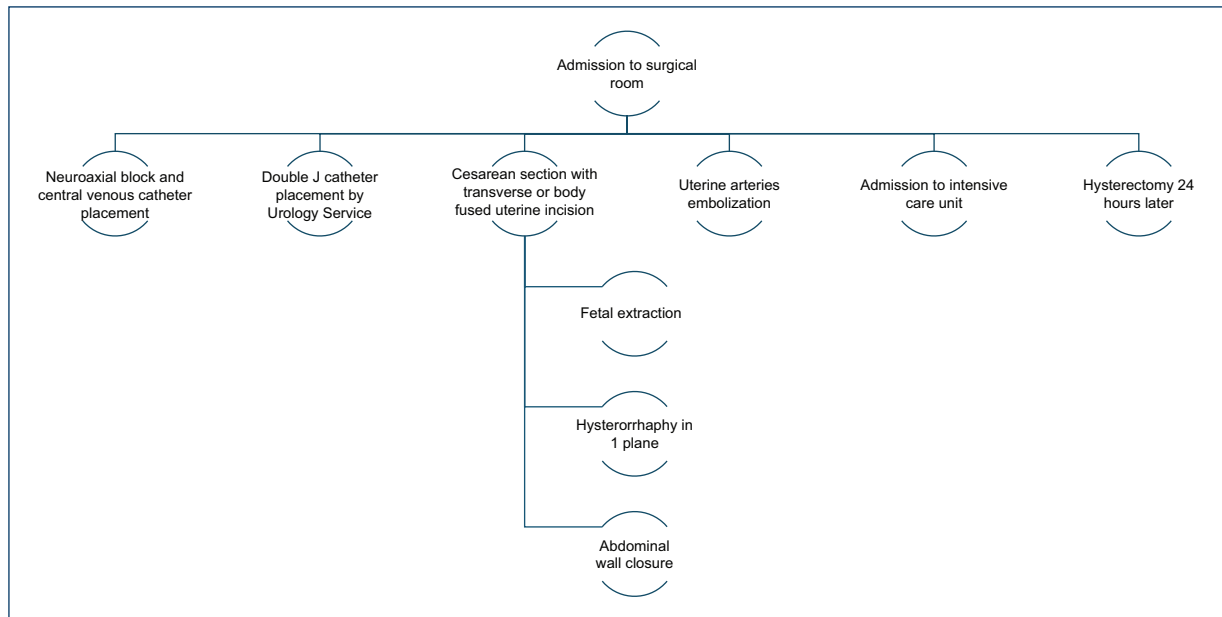
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Figure 1: Placental accreta scale format.

delivery, previous uterine surgeries, placenta previa and/or low insertion, ultrasonographic detection by early screening, gestational age, PAS scale, type of accreta (accreta, increta, and percreta), performance of

cystoscopies, ureteral catheter placement, fetal pulmonary maturity scheme used, type of cesarean section and hysterorrhaphy, trans cesarean hemorrhage, newborn data (gender, average weight, APGAR, CAPURRO,



**Figure 2:** Surgical algorithm.

and early neonatal complications), type of uterine and collateral artery embolization, material used, average procedure time and complications, type of hysterectomy, trans-hysterectomy hemorrhage, neighboring organ injury, number of cases referred to Intensive Medical Care, need for blood transfusion and hemo-components, rate of puerperal infections, recommended antibiotic regimen, days of stay until discharge, maternal deaths and ultrasonographic correlation with the histopathological analysis of the surgical specimen.

## Results

According to our study population, our patient profile has a mean age of 32.38 years (standard deviation [SD] 6.15) with a range of 20-45 years, which shows a population of active reproductive age. Regarding parity, we found an average of three pregnancies (SD 1.04), suggesting a higher exposure to risk factors such as uterine scars (Table 1).

Regarding obstetric history, we found an average of 1.46 (SD 0.91) in previous cesarean sections, which reinforces its association with placental accretism. Abortions and ectopic pregnancies have a low incidence in our population (0.44% and 0.03%, respectively).

Regarding placental characteristics, placenta previa, and low insertion placenta represent the majority of cases (62 and 34%), confirming their strong link with the disorder (Table 2). The cases are distributed among the types of accreta as follows: accreta (31%), increta (33%), and percreta (35%).

In consideration of surgical procedures and complications, total hysterectomy is the predominant management (89%). The lesions associated with the procedure are unusual, but bladder lesions stand out at 10%. Maternal mortality is low, with only one case reported.

Regarding maternal and neonatal outcomes, we found that the average bleeding increased according to the severity of the accreta: 800 cc in placenta accreta, 1,200 cc in increta, and 1,400 cc in percreta. Blood product transfusions were necessary in 56% of the cases with an average of 3.5 units of erythrocyte concentrates. The newborns had a mean gestational age of 35.3 weeks (SD 4.58) and a mean weight of 2567.3 g (SD 659.6), indicating a high rate of prematurity.

Regarding protocols and management, uterine embolization was used in 100% of the cases as part of the management protocol designed by our institution. In 67% of the cases double J catheter placement was performed as suggested in our therapeutic algorithm. The average length of stay after hysterectomy was 4.78 days (SD 10.9), whereas the total length of stay from diagnosis to discharge was 10.24 days (SD 4.8).

## Discussion

In our country, obstetric hemorrhage is the first cause of maternal death. Therefore, measures should be taken regarding timely diagnosis and treatment. Early detection by means of high-definition ultrasonography with Doppler allows planning adequate management strategies.

**Table 1.** Clinical parameters of the population studied

Parameter	Media (range)	SD
Age (years)	32.38 (20-45)	6.15
Parity	3 (1-5)	1.04
Delivery	0.32 (0-2)	0.74
Caesarean section	1.46 (0-4)	0.91
Abortions	0.44 (0-2)	0.65
Ectopics	0.03 (0-1)	0.17
Average embolization time	2.5 hours	
Placental accretism	800 mL	
Placental Incretism	1200 mL	
Placental percretism	1400 mL	
Days of stay Post-hysterectomy	4.78 (2-29)	10.9
Days of stay diagnosis-management	10.24 days (4-57)	4.8
Newborn data		
Gestational age (weeks)	35.3 (14-40)	4.58
Weight (gr)	2567.3 (1090-3350)	659.6
CAPURRO	33.5 weeks	
APGAR	7/8	

The diagnosis of PAS by ultrasonography remains a mainstay in the early identification of this high-risk obstetric condition. In our population, we found that placenta previa and low insertion were the most frequent sonographic findings, accounting for 62 and 34% of cases, respectively, reflecting a strong association with PAS. The high frequency of placenta previa in our population underscores the importance of carefully monitoring patients with an obstetric history that includes cesarean section, as this condition is associated with a significant increase in trophoblastic invasion.

In relation to ultrasound findings, it is important to note that although ultrasound is highly effective in identifying abnormal placental features such as placenta previa or low insertion, accurate identification of the type of PAS (accreta, increta, or percreta) through ultrasound alone may be limited. As noted by Lizárraga-Verdugo *et al.* (2024), ultrasound is a key initial tool, but in cases of deep myometrial invasion, magnetic resonance imaging (MRI) has been shown to be an essential adjunct to confirm the extent of placental invasion. In our series, the distribution of PAS types (31% accreta, 33% increta, and 35% percreta) is consistent with the literature, which describes variability in the severity of the disorder. However, isolated ultrasound evaluation may not be sufficient to distinguish between

these types of PAS definitively, especially in cases of percreta, which present deeper invasion.

The use of MRI has been suggested in studies such as those by Markfeld-Erol *et al.* (2024) and Tadayon *et al.* (2022) as an effective means to more accurately determine the extent of myometrial invasion, especially when ultrasound does not provide a clear assessment. Although MRI was not routinely used in our study, we recognize that its implementation could have complemented the diagnosis in more complex cases, providing crucial details for planning surgical management.

In addition, the studies reviewed (Lizárraga-Verdugo *et al.*, 2024; Markfeld-Erol *et al.*, 2024) highlight that, although ultrasonography can identify suspicious placental characteristics, the definitive diagnosis of SBP is sometimes only confirmed by post-operative procedures, such as histopathology. This aspect highlights the importance of maintaining a high clinical suspicion in women with risk factors and relevant obstetric history, and of not relying exclusively on ultrasound to determine the severity of the condition.

In the population included in our study, the findings are consistent with global trends reported in the literature on the PAS, particularly in terms of risk factors, placental characteristics, associated complications, and

**Table 2.** Characteristics of the population studied

Parameter	Percentage
Previous uterine surgeries	16
Placental insertion site	
Placenta Prior	62
Low Insertion	34
Placenta loud	4
PAS Scale Result	
Accreta	31
Incretism	33
Percretism	35
Correlation of SBP scale and histopathological result	
Accreta	31
Incretism	29
Percretism	40
Type of caesarean section (fundic)	
Transverse	25
Vertical	75
Type of hysterectomy	
Total	89
Subtotal	11
Injuries associated with surgical procedure	
Bladder injury	10
Ureteral injury	1
Uterine artery injury	1
Embolization-associated injuries	
Perforation of the right uterine artery	1
Postpartum infections	1
Maternal deaths	1
Newborn data	
Application of lung maturity scheme	
Betametasona 70%	72
Dexametasona 30%	
Sending Hospital	
Hospital General de México	52
Hospital de la Mujer	20
ISSEMYM	10
Instituto Nacional de Perinatología	4
Others	14

maternal and neonatal outcomes. The mean age of 32.38 years in our sample is within the range described in several studies, such as that of Tadayon *et al.* (2022), which reports that women with PAS are usually in their reproductive age range, with an increased prevalence in women older than 30 years. This could reflect increased exposure to risk factors, such as previous cesarean sections and other uterine procedures<sup>25</sup>.

Regarding parity, our population with an average of three gestations is in line with the findings of previous studies, where it has been identified that PAS is more

frequent in women with a higher number of gestations, which increases the probability of uterine scarring and, therefore, placental alterations. In fact, as highlighted by Markfeld-Erol *et al.* (2024), the presence of previous cesarean sections and parity are key risk factors for the development of PAS, which explains the high prevalence of cesarean sections in our population (1.46 previous cesarean sections on average)<sup>26</sup>.

A relevant finding is the strong association between PAS and placenta previa, which accounts for 62% of cases in our population. This data reinforces what was

reported by Lizárraga-Verdugo *et al.* (2024) and Markfeld-Erol *et al.* (2024), who emphasize that placenta previa, especially in women with previous cesarean sections, significantly increases the risk of developing PAS. Furthermore, the distribution of the types of accreta in our population (31% accreta, 33% increta, and 35% percreta) reflects the variability in the severity of the disorder, a finding that is consistent with studies suggesting that the severity of SBP correlates with the type of placental insertion and myometrial invasion<sup>26,27</sup>.

Regarding surgical management, the fact that total hysterectomy is the predominant treatment in our series (89%) is consistent with the recommendations of several studies, such as those of Markfeld-Erol *et al.* (2024), which emphasize the need for radical surgical procedures in severe cases to prevent complications such as massive hemorrhage and preserve maternal life. The low maternal mortality observed in our series, with only one case, reflects the efficacy of well-established surgical protocols, such as uterine embolization and the use of double J catheters to minimize renal complications, as suggested by Arakaza *et al.* (2023)<sup>28</sup>.

It is interesting to note that the average bleeding increases according to the severity of SBP (800 cc in placenta accreta, 1200 cc in increta, and 1400 cc in percreta), which is an expected finding and aligned with the literature, which documents that more severe cases (percreta) tend to have more significant bleeding (Tadayon *et al.*, 2022). Blood product transfusions, which were necessary in 56% of cases, also reflect the demands in terms of resources and intensive care to manage these complications. This is an aspect pointed out by Lizárraga-Verdugo *et al.* (2024), who discuss how the management of SBP requires a multidisciplinary approach to mitigate these risks.

The low birth weight and prematurity in the newborns (mean weight of 2567 g and gestational age of 35.3 weeks) are also consistent with previous studies, such as that of Markfeld-Erol *et al.* (2024), which report a high rate of preterm delivery and low birth weight newborns in women with PAS. This high rate of prematurity is probably related to the obstetric interventions needed to manage complications, such as bleeding, which often require induction of preterm labor.

Finally, the multidisciplinary approach and the implementation of standardized protocols, such as uterine embolization and the use of double J catheters, are crucial to managing PAS cases safely, as noted in the literature (Markfeld *et al.*, 2024; Arakaza *et al.*, 2023). These protocols allow safer and more effective management, reducing mortality and associated complications

and favoring a faster recovery for patients, as reflected by the average hospital stay of 10.24 days in our series.

## Conclusion

PAS is a high-risk obstetric disorder with significant implications for maternal and neonatal health. Early identification and appropriate management are crucial to reduce the morbidity and mortality associated with this condition. In this study, we demonstrate that the implementation of a multidisciplinary diagnostic and surgical management protocol in our national referral center has substantially improved clinical outcomes for both mother and neonate.

Early diagnosis through high-definition ultrasonography and color Doppler, as was performed in our population, is essential for the detection of abnormal placental features, such as placenta previa and low insertion, which are key risk factors for the development of PAS. These initial ultrasound findings allow early identification of the disorder and facilitate surgical planning, minimizing the risks associated with massive hemorrhage and other complications.

Surgical management in our series, which consisted mostly of total hysterectomies (89%), is consistent with current guidelines that recommend radical treatment in severe cases to prevent complications, such as massive hemorrhage. The use of complementary techniques, such as uterine artery embolization and double J catheter placement, also played a crucial role in reducing complications and improving maternal outcomes, as indicated by previous studies. These interventions were essential for the control of intraoperative hemorrhage, as well as for the prevention of renal injuries, which, although rare, were detected in 10% of the cases.

The low maternal mortality observed in our study (with only one case reported) highlights the effectiveness of well-established surgical protocols and specialized care at referral centers. This result is especially noteworthy given that PAS is known for its high rate of serious complications, such as hemorrhagic shock, DIC, and multi-organ failure. Effective management of these cases is essential to save lives and reduce long-term sequelae.

On the other hand, findings related to neonatal health show that PAS has a significant impact on perinatal outcomes. The high rate of prematurity (with an average gestational age of 35.3 weeks) and low birth weight (average 2567 g) are consistent with what is reported in other studies, which associate the need for obstetric interventions such as early cesarean section and trans cesarean hemorrhage with an increase in

preterm deliveries. These factors reflect the need for intensive neonatal care and close follow-up of the newborns, highlighting the importance of preparedness for associated neonatal complications.

While ultrasound is the key initial tool for the diagnosis of PAS, our experience reinforces what other studies have reported: definitive confirmation of the diagnosis and classification of the severity of the disorder may require the combination of several diagnostic methods. MRI, although not routinely used in our study, has been shown to be a useful adjunct, especially in the more complex cases where placental invasion is deep and difficult to evaluate with ultrasound alone.

An important aspect that is also reflected in our results is the need for a multidisciplinary approach to the management of PAS. Specialized teams, including obstetrician-gynecologists, surgeons, radiologists, anesthesiologists, and neonatologists, are essential to ensure comprehensive care and minimize risks during pregnancy, delivery, and postpartum. The use of advanced surgical techniques, together with access to adult and neonatal intensive care units, is crucial for the management of complications that may arise during treatment.

## Funding

The authors declare that they have not received funding.

## Conflicts of interest

The authors declare no conflicts of interest.

## Ethical considerations

**Protection of humans and animals.** The authors declare that no experiments involving humans or animals were conducted for this research.

**Confidentiality, informed consent, and ethical approval.** The authors have obtained approval from the Ethics Committee for the analysis of routinely obtained and anonymized clinical data, so informed consent was not necessary. Relevant guidelines were followed.

**Declaration on the use of artificial intelligence.** The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

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