Overview of Diagnosis and Management of Placenta Accreta Spectrum

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Abstract

Background: Placenta accreta spectrum rates are rising. Placenta accreta prevalence was reported in observational surveys from the 1970s and 1980s to range between 1 in 2,510 and 1 in 4,017, compared with a rate of 1 in 533 from 1982 to 2002.The increasing incidence of placenta accrete is likely multi factorial, but partly due to factors such as the increasing number of cesarean deliveries, particularly since the areas of abnormal placental invasion are almost always in the area of the previous hysterotomy.Accurate antenatal diagnosis of PAS has been demonstrated to improve maternal outcomes, allowing appropriate risk assessment and planned delivery in a tertiary referral center with an experienced multidisciplinary team.Several population studies revealed that PAS was undiagnosed in half of the cases in the general population, even though antenatal diagnostic accuracy in a series from experienced centers approaches 95%

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Introduction:

Placenta accreta spectrum (PAS) rates are rising. Placenta accreta prevalence was reported in observational surveys from the 1970s and 1980s to range between 1 in 2,510 and 1 in 4,017, compared with a rate of 1 in 533 from 1982 to 2002 [1]. A similar Irish retrospective study with 36 years of data reported a doubling of the incidence of placenta accreta in patients with previous cesarean section from 1.06 per 1000 deliveries before 2002 to 2.37 per 1000 deliveries from 2003 to 2010 [2]. A Canadian study also showed an incidence of 14.4 per 10,000 deliveries in 2009 to 2010 [3]. While a national case-control study in the UK suggested the incidence to be only 1.7 per 10,000 pregnancies overall at the end of 2012 [4].

In contrast to other published studies, a 2016 study using the National Inpatient Sample found that the overall incidence of placenta accreta in the United States was 1 in 272 for women who had a birth-related hospital discharge diagnosis [5]. A change in risk factors, most notably the rising prevalence of cesarean deliveries, is likely to be the cause of the rising incidence of placenta accreta over the past four decades [5]. In Egypt, the incidence of PAS disorders was 9/1000 maternities (0.91%) [6].

The increasing incidence of placenta accreta is likely multifactorial, but partly due to factors such as the increasing number of cesarean deliveries, particularly since the areas of abnormal placental invasion are almost always in the area of the previous hysterotomy [7].

Risk Factors

Several risk factors have been associated with placenta accreta spectrum [4]:

Placenta Previa

Previous Cesarean Delivery

Uterine Surgery

Previous Uterine Curettage

Advanced Maternal Age

Multiparity

IVF Pregnancy

High Gravidity

Uterine Irradiation

Endometrial Ablation

Asherman Syndrome

Uterine Leiomyomata

Uterine Anomalies

Uterine Artery Embolization

Increased Female Births

Hypertensive disorders, smoking, and previous cesarean are risk factors for placenta accreta in Previa patients. In addition, an association was found between placenta accreta spectrum and

abnormally elevated second-trimester alpha fetal protein (AFP) and free β subunit of human chorionic gonadotrophin (β-hCG) levels in maternal serum [7].

Diagnosis of Placenta Accreta Spectrum (PAS)

Accurate antenatal diagnosis of PAS has been demonstrated to improve maternal outcomes, allowing appropriate risk assessment and planned delivery in a tertiary referral center with an experienced multidisciplinary team [8]. Several population studies revealed that PAS was undiagnosed in half of the cases in the general population, even though antenatal diagnostic accuracy in a series from experienced centers approaches 95% [9].

Therefore, women with relevant clinical risk factors for PAS (e.g., placenta previa and a cesarean scar) should have an ultrasound evaluation done in a facility that has experience with this condition. Several investigations have looked into the accuracy of various PAS ultrasound signs. However, there has been a lot of variation in how well these signs work [10].

Ultrasonography

Ultrasonography remains a noninvasive, widely available, and cost-effective modality for first-line diagnosis of placenta accreta spectrum in clinical practice. Limitations to trans-abdominal ultrasound include the effect of maternal body habitus as well as its suboptimal visualization of the lower uterine segment or area of placental invasion. The safety of trans-vaginal ultrasound in placenta previa has been accepted. It allows a closer view and more accurate examination of the lower uterine segment, leading to improved diagnostic accuracy [11].

Prenatal diagnosis of PAS disorders was performed using recently proposed standardized descriptors of ultrasound markers for PAS disorders, based on the following ultrasound signs [12]:

(1) Loss of the clear zone, defined as loss or irregularity of the hypoechoic plane in the myometrium underneath the placental bed.

(2) Placental lacunae, defined as the presence of numerous lacunae, often containing turbulent flow visible on grayscale or color Doppler ultrasound.

(3) Bladder wall interruption, defined as loss or interruption of the bright bladder wall (hyperechoic band or line between the uterine serosa and bladder lumen).

(4) Uterovescical hypervascularity, defined as a striking amount of color Doppler signal seen between the myometrium and the posterior wall of the bladder, including vessels appearing to extend from the placenta, across the myometrium and beyond the serosa, into the bladder or other organs, often running perpendicular to the myometrium.

(5) Increased vascularity in the parametrial region, defined as the presence of hypervascularity extending beyond the lateral uterine walls and involving the region of the parametria.

Color Doppler Ultrasonography

The use of color Doppler can improve the accuracy of diagnosis of placenta accreta spectrum by providing a more detailed assessment of the depth of trophoblastic invasion into the myometrium or serosa, especially in an anterior placenta [13]. The sensitivity and specificity of color Doppler in diagnosing placenta previa accreta range between 82.4 and 100% and 92 and 96.8%, respectively [13]. A finding of color Doppler flow within lacunae further increases diagnostic sensitivity to 100%, with an associated 83% positive predictive value for morbid placental adherence [13].

Characteristic findings on color Doppler ultrasound include:

(1) A diffuse lacunar flow pattern with high-velocity pulsatile venous-type flow (peak systolic velocity more than 15 cm/s) spread throughout the placenta, myometrium, and cervix;

(2) A central lacunar flow pattern with turbulent flow distributed regionally or focally in the parenchyma;

(3) Bladder–uterine serosal interphase hypervascularity;

(4) Markedly dilated vessels over the peripheral subplacentalzone;

(5) An absence of subplacental vascular signals in the areas lacking the peripheral subplacental hypoechoic zone;

(6) Abnormal vascular channels linking the placenta to the bladder [14].

Three-Dimensional Doppler

It is unclear whether three-dimensional ultrasonography adds any benefit to diagnostic accuracy for placenta accreta spectrum. However, viewing planes can be more easily manipulated to enhance views of the vascular framework of the placenta and adjacent tissues, thus improving detection of bladder and parametrial extension [15]. Four-dimensional ultrasound, on the other hand, permits instantaneous multiplanar reconstructions in real-time. This gives an added ability to display and rotate reconstructed images from any desired angle, and from any of the three planes: sagittal, coronal, or axial [15].

Three-Dimensional Color Power Doppler Ultrasound

The role of three-dimensional color power Doppler is better established. Color power Doppler ultrasound is reportedly the most sensitive and specific single criterion (sensitivity 97% and specificity 92%), with the highest positive predictive value currently reported for diagnosis. This is the single most reliable diagnostic modality, and it increases diagnostic confidence in determining the exact site, depth, and extent of invasion [16].

Characteristic findings on three-dimensional color power Doppler ultrasound include:

(1) Numerous dilated and coherent vessels involving the serosa–bladder interface on a basal view;

(2) Increased intraplacentalhypervascularity;

(3) Inseparable cotyledonal and intervillous circulations;

(4) Tortuous vascularity with chaotic branching;

(5) Detour vessels on the lateral view (Figure 5). [16]

Magnetic Resonance Imaging (MRI)

The primary diagnostic method for detecting and diagnosing PAS is ultrasound. However, it is now well-established that magnetic resonance imaging (MRI), with high sensitivity and specificity, plays a role in the diagnosis of PAS [17].

Despite this, MRI has not yet proven to be more effective than ultrasound in the identification of PAS. When comparing the diagnostic efficacy of US and MRI for the diagnosis of PAS, it is important to keep in mind that MRI is not frequently used as a screening tool in women who have a higher chance of developing PAS. In fact, the ultrasound is responsible for the initial screening, and only women in whom a suspicion of PAS has been raised in the US are submitted to an MRI. This could result in an overestimation of the MRI's analytical capacity. In a recent study, MRI led to a change in diagnosis that, when altered, could change the clinical management of PAS in more than one-third of cases, but, when changed, the diagnosis was often incorrect [18].

Particularly with posterior placentation and in women with US suspicion of parametrial invasion, MRI has been suggested as a second-line imaging tool for the diagnosis of PAS to measure the depth of invasion and the lateral extension of myometrial invasion [19]. In fact, in certain circumstances, MRI can overcome the technical limitations related to the US diagnosis of PAS.

The MRI is unaffected by an adverse placental position or a high maternal body mass index. It is simple to study the complete pelvis, and it also enables offline reevaluation by various medical professionals. The opposite is also true: MRI costs more and is less accessible than US. Similar to the US, there is inconsistent terminology used for MRI in the research. The International Society for Placenta Accreta Spectrum has recently suggested a standardized definition of the MRI descriptors of PAS to facilitate international collaboration and comparison among studies [20].

The descriptors for magnetic resonance imaging (MRI) findings in abnormally invasive placenta involve heterogeneous placenta, placental bulge, dark intraplacental bands, placental ischemic infarction, loss of retroplacental dark zone, myometrial thinning, bladder wall interruption, focal exophytic mass, and abnormal vascularization of the placental bed [20].

Figure 5 (Please provide details about Figure 5 here, such as a description of what it depicts or a link to the image.)

Management of Placenta Accreta Spectrum

All treatments designed to prevent peripartum hysterectomy and its associated morbidity and consequences are referred to as "conservative management" of both abnormally adherent (placenta accreta) and invasive placenta (placenta increta and percreta). Four different primary methods of conservative management have been described in the international literature: (1) the extirpative technique (manual removal of the placenta); (2) leaving the placenta in situ or the expectant approach; (3) one-step conservative surgery (removal of the accreta area); and (4) the Triple-P procedure (suturing around the accreta area after resection).

These methods have been used alone or in combination and in many cases with additional procedures, such as those suggested by interventional radiology. In contrast to the extirpative technique, leaving the placenta in situ primarily aims to reduce the risks of severe maternal morbidity during cesarean delivery [21].

Conservative Management of Placenta Accreta Spectrum

A. The Extirpative Technique

This procedure consists of forcibly removing the placenta manually in an attempt to empty the uterus at delivery. This approach aims to avoid leaving retained placental tissues in the uterine cavity, and it is recommended by established worldwide guidelines as one of the first steps to manage postpartum hemorrhage [22, 23]. However, in cases of PAS disorders, this procedure often results in massive obstetric hemorrhage. Overall, most experts in the management of PAS disorders consider that attempts at manual removal of the placenta should be avoided in cases of planned cesarean hysterectomy [15].

B. “Leaving the Placenta in Situ” Approach

This approach consists of leaving the placenta in situ and waiting for its complete spontaneous resorption. It was initially called the “conservative treatment of placenta accreta” [24].

By leaving a placenta accreta in situ after the delivery of the fetus, one can expect a progressive decrease in blood circulation within the uterus, parametrium, and the placenta. This will result in secondary necrosis of the villous tissue, and theoretically, the placenta should progressively detach itself from the uterus and the percreta villi from the adjacent pelvic organs. In cases of invasive PAS disorders diagnosed prenatally, the exact position of the placenta should be determined by preoperative ultrasound, and the required surgical equipment for an emergent hysterectomy should be available in the operating theatre [25].

A low transverse skin incision allowing access to the lower half of the uterus can be performed if the upper margin of the anterior aspect of the placenta does not rise into the upper segment of the uterus. If the placenta is anterior and extending toward the level of the umbilicus, a midline skin incision may be needed to allow for a high upper-segment transverse uterine incision above

the upper border of the placenta. The opening of the uterus should be by a transverse incision at a distance from the placental bed [25].

After delivery of the fetus, and only if there is no clinical evidence of percreta placentation (i.e., no placental tissue seen invading through the surface of the uterus), the surgeon may carefully attempt to remove the placenta by controlled cord traction and the use of uterotonics. Failure to do so suggests the diagnosis of a PAS disorder, and in these cases, the cord should be cut close to its placental insertion, and the uterine cavity should be closed. Postoperative antibiotic therapy is usually administered prophylactically to minimize the risk of infection. A literature review performed up to 2007, including 48 case reports describing the outcome of 60 women presenting with PAS disorders and managed by leaving the placenta in situ, found that of the 26 women managed without the use of additional therapies, 22 (85%) had a favorable outcome. Expectant management failed in 4 (15%) cases, and secondary hysterectomy had to be performed owing to massive obstetric hemorrhage or infection [26].

Additional procedures (i.e., embolization or vessel ligation, temporal internal iliac balloon occlusion, methotrexate, hysteroscopic resection of retained tissues) have been used in a conservative approach with the placenta left in situ to decrease morbidity or to accelerate placental resorption [27].

Methotrexate Adjuvant Treatment

Some authors have proposed the use of methotrexate to hasten placental resolution [28]. Only case reports and small case series with no control group have been reported [26]. A recent observational case series, including 24 women with PAS disorders left in situ after birth and treated with methotrexate, reported placental delivery in 33.3% of the cases (spontaneously in 55% and 45% using dilatation and curettage) [29].

In women with a placenta in situ who are successfully treated with methotrexate, β-hCG levels and Doppler vascular resistance indices of the uteroplacental arterial circulation decrease faster than in those with treatment failure [29]. Overall, the use of methotrexate is not recommended until further evidence is available on its efficacy and safety [25].

Preventive Surgical or Radiological Uterine Devascularization

There is also very limited data on the use of these adjuvant techniques [30]. Preventive devascularization can be achieved by surgical or interventional radiology procedures, also used in the management of severe postpartum hemorrhage, such as stepwise uterine surgical devascularization, bilateral uterine or hypogastric artery surgical ligation, iliac artery embolization, or balloon occlusion. Embolization before performing a hysterectomy may reduce the risk of intraoperative blood loss [31], and prophylactic devascularization may prevent the occurrence of secondary hemorrhage and could also accelerate placental resorption [32]. Overall, these uterine-sparing procedures seem to be less effective in cases of PAS disorders [33].

Systematic Hysteroscopic Resection of Retained Accreta Tissue

In a small series of 23 women with PAS disorders with the placenta left in situ, 12 hysteroscopies were performed under ultrasound guidance owing to pain and/or bleeding with retained tissues. The use of bipolar energy was limited to avoid any potential uterine perforation. The median size of the retained placenta was 54 mm (13–110 mm). Complete removal (11/12) was achieved after one, two, and three hysteroscopic procedures in 5 (41.7%), 2 (16.7%), and 4 (33.3%) cases, respectively. These results suggest that hysteroscopic resection could shorten the recovery time without major adverse effects [34].

Monitoring of the "Leaving the Placenta in Situ" Approach

The pattern of follow-up after leaving the placenta in situ in cases of PAS disorders is not supported by randomized controlled trials. The residual villous tissue in the uterine wall may require up to 6 months to be completely absorbed [32]. In rare cases, a coagulopathy or septicemia may develop, requiring an emergent secondary hysterectomy [35]. Measuring serum β-hCG every week to check if it falls continuously can reassure to some extent, but low levels do not guarantee complete placental resorption so this should be supplemented by expert ultrasound imaging. There is insufficient evidence to recommend the use of MRI [32].

Subsequent management usually requires weekly follow-up visits during the first 2 months and then in the absence of complications, monthly visits until complete resorption of the placenta. The follow-up consultation should include a clinical examination (bleeding, temperature, pelvic pain), pelvic ultrasound (size of retained tissue), and laboratory tests for infection (hemoglobin and leukocytes count, vaginal sample for bacteriological analysis) [36].

Long-term Obstetric and Fertility Outcomes

Successful conservative treatment for PAS disorders does not appear to compromise subsequent fertility or obstetric outcomes, but data are limited. Pregnancies following prior PAS disorders are at increased risk for adverse maternal outcomes, including recurrent PAS disorders, uterine rupture, postpartum hemorrhage, and peripartum hysterectomy [36]. Overall, the risk of recurrence of PAS disorders ranges between 22% and 29% whereas the risk of early postpartum hemorrhage ranges between 8.6% and 19%. Long-term complications also include intrauterine adhesions and secondary amenorrhea, which both have a direct effect on fertility [36].

C. Alternative Conservative Surgical Procedures

One-Step Conservative Surgery

This surgical procedure has been described primarily by one author [37, 38]. It consists of resecting the invasive accreta area (partial myometrial resection) followed by immediate uterine reconstruction and bladder reinforcement [38]. This strategy aims to combine the advantages of both the "leaving in situ approach" of preserving the uterus and cesarean hysterectomy with

minimal risk of secondary bleeding or infection. The main steps in this uterine-sparing technique can be performed via a modified Pfannenstiel or midline incision [37]. It is advantageous for low- and middle-income countries where expensive additional treatments such as interventional radiology may not be available.

One-step conservative surgery approach for placenta accreta spectrum (PAS) disorders includes the following:

Vascular disconnection of newly-formed (feeder) vessels and the separation of invaded uterine tissues from invaded vesical tissues.

Upper-segmental hysterotomy and delivery of the fetus.

Resection of all invaded myometrial tissue and the entire placenta in one piece with previous local vascular control.

Surgical procedures for hemostasis.

Myometrial reconstruction in two planes.

Bladder repair if necessary [37].

Stepwise Surgical Approach for Placenta Accreta Spectrum (PAS) Disorders

Combined early intravenous uterotonics just before delivery of the fetus.

Transverse “high” uterine incision at the upper border of the placenta without cutting through the placenta.

Fetal delivery.

The uterus is exteriorized and compressed against the symphysis pubis by an assistant (transient bilateral kink of uterine arteries).

Bilateral anterior division of internal iliac artery ligations.

Placental extraction (delayed after pelvic devascularization).

Proper identification of the lower uterine segment by index and ring fingers after identification of the internal cervical os by the middle finger of the left hand.

Repair of uterine incision [39].

The Triple-P Procedure

A novel uterine-sparing procedure for PAS disorders called the “Triple-P procedure” was recently proposed [21]. The aim of this procedure is to avoid incising through the vascular placental

venous sinuses, to excise the myometrium with PAS disorder tissue, and to reconstitute the uterine defect.

The main steps of this procedure include:

Perioperative placental ultrasound localization of the superior edge of the placenta.

Pelvic devascularization involving preoperative placement of intra-arterial balloon catheters (anterior division of the internal iliac arteries).

No attempt to remove the entire placenta with large myometrial excision and uterine repair. If the posterior wall of the bladder is involved, the placental tissue invading the bladder is left in situ to avoid cystotomy.

Tamponade Technique

Small case series have also reported the successful use of compression sutures [40], using the cervix as a natural tamponade by inverting it into the uterine cavity and suturing the anterior and/or the posterior cervical lips into the anterior and/or posterior walls of the lower uterine segment. The latter technique of cervical inversion was successful in stopping bleeding in 38 out of 40 patients [41].

Nonconservative Surgical Management of Placenta Accreta Spectrum

Preparation for the Operative Management of Invasive Placentation

Cesarean hysterectomy in the setting of PAS disorders can be challenging because multiple cesarean deliveries often present with pelvic adhesions, a thin and hypervascular lower uterine segment, a bulky in-situ placenta, and deep pelvis neovascularization, as well as possible invasion to the bladder, bowel, cervix, and parametrium in cases of placenta percreta. The main risk associated with any form of PAS disorder is massive obstetric hemorrhage, which leads to secondary complications, including coagulopathy, multisystem organ failure, and death [42].

Surgical risks increase with the depth of placental invasion, with women presenting with placenta percreta more likely to require additional blood products, have urologic injury, and require intensive care unit admission than women with placenta accreta (vera or adherenta) [43]. Accurate prenatal diagnosis, careful planning, and close communication are essential, including the creation of specialized surgical teams to execute a safe care plan for patients with PAS disorders.

Multidisciplinary Team Care

Multiple retrospective cohort studies of PAS disorders have documented reduced maternal morbidity when care is provided in centers of excellence (CoE) [44]. The hallmark features of a CoE consist of:

Radiologic expertise for diagnosis in Ultrasound and/or MRI.

Experienced obstetrician/maternal-fetal medicine specialist for prenatal diagnosis, prepartum, intrapartum, and postpartum management.

Surgical expertise for complex surgery (Gynecologic oncology, pelvic surgeon, urogynecologist) with skills for retroperitoneal dissection, ureterolysis, internal iliac artery ligation, ureteral stent placement.

Anesthetist experienced in management of massive hemorrhage, as well as perioperative management of pregnant women.

Neonatal intensive care unit and neonatologists to manage both planned late preterm delivery and unplanned preterm delivery.

Adult intensive care unit: surgical and medical intensive care unit for postoperative care as required.

Massive transfusion capacity access to blood products/bank, massive transfusion protocol, transfusion medicine specialists/blood bank pathologists.

Additional surgical expertise when required: urology, vascular surgery, general surgeon, trauma surgeon for management of complications: ureteral reimplantation, bowel resection, vascular injury.

Interventional radiology [45].

Timing of Delivery

Studies reporting actual timing of delivery are conflicting, and the optimal timing of delivery for women with suspected PAS disorders remains uncertain. At present, there remains insufficient evidence to determine the exact optimal age for planned delivery. Different centers have published varying protocols with recommendations ranging from 34 to 36 weeks to 36–38 weeks of gestational age for planned delivery [46].

Minimizing Unintended Urologic Injury

In a systematic review of surgical techniques used for PAS disorders, the overall rate of unintentional urinary tract injury at peripartum hysterectomy was 29% (83/285) higher than rates for hysterectomies for other gynecologic indications. Seventy-eight percent of injuries involve the bladder, whereas 17% involve the ureter. Modification of surgical technique can reduce urinary tract injury compared with standard hysterectomy. In particular, placement of ureteric stents preoperatively can reduce the risk of urinary tract injury from 33% to 6%. At ureteric stent placement, cystoscopy can also evaluate for evidence of bladder invasion by the placenta [47].

Intraoperative Considerations

The choice of anesthesia technique for cesarean delivery where there is a suspected PAS disorder with a high risk of significant hemorrhage must be made by the attending anesthesia team. This decision between general and neuraxial/regional anesthesia can be aided through active consultation with the wider MDT. The international literature reports an 8%-45% risk of the need to convert from regional to general anesthesia for cases of PAS disorders [48].

Type of Incisions for Access

Avoiding the placenta at planned cesarean hysterectomy reduces blood loss; therefore, the abdominal incision must allow sufficient access to the uterus to choose a location for hysterotomy above the upper placental margin. Preoperative or intraoperative ultrasound can allow the team to visualize the upper placental margin, which facilitates planning both the abdominal and uterine incision [49].

A low transverse skin incision that allows access to the lower half of the uterus may be adequate if the upper margin of the placenta does not rise into the upper segment of the uterus and no hysterectomy is planned. However, it may not provide sufficient exposure in cases of placenta percreta. If the placenta is anterior and extending toward the level of the umbilicus, and/or a hysterectomy is planned, a midline skin incision allows for a high upper-segment transverse uterine incision above the upper margin of the placenta, or more commonly a fundal transverse hysterotomy for delivery of the infant. Thus, a midline incision is recommended by most authors for PAS disorders diagnosed prenatally or at the time of cesarean delivery [50].

Blood Conservation Techniques:

Tranexamic Acid:

A recent meta-analysis of nine trials involving 2365 patients confirmed these findings, demonstrating that the administration of tranexamic acid before cesarean delivery significantly reduces intra and postoperative blood loss and blood transfusion without an increase in thromboembolic events [51].

Prophylactic Placement of Balloon Occlusion Catheters:

Placement of balloon occlusion catheters into the aorta, common iliac, internal iliac, or uterine arteries under fluoroscopic guidance and are inflated when hemorrhage is encountered [52].

Internal Iliac Artery Ligation:

When interventional radiology is not available, results similar to those for balloon occlusion devices [53].

Cell Salvage:

Outcome of Placenta Accreta Spectrum

Morbidity of Placenta Accreta Spectrum

Although rare, early pregnancy complications have been described in association with PAS disorders. Several case reports can be found in the scientific literature, describing spontaneous uterine rupture during the first and second trimesters, there are reports of this complication occurring as early as the 7th week of pregnancy [54].

In late pregnancy or during delivery, PAS disorders are an important risk factor for adverse maternal outcomes related to delivery [55]. A population-based study from Australia reported a nearly 18-fold increase in maternal morbidity [56]. Attempts to separate the placenta after delivery usually lead to severe bleeding from the uteroplacental circulation and disruption of the deep uterine vasculature extending to other organs [19].

Additional blood loss may arise from inadvertent surgical injury and coagulopathy. Estimated blood loss in PAS disorders has been reported to range from 2000 mL to 7800 mL [57].

A recent meta-analysis including data from over 7000 cases of PAS disorders reported a 46.9% incidence of hemorrhage requiring transfusion [58]. Cesarean hysterectomy, with no attempt to detach the placenta from the uterine wall, has become the recommended treatment for placenta increta and percreta, when preservation of fertility is not an issue. However, this operation is technically challenging, and the adjusted odds ratio (OR) for adjacent organ injury is 8.2 [59].

Unintentional urinary tract injuries are described in 29% of cesarean hysterectomies, with 76% of these being bladder lacerations, 17% ureteral injuries, 5% genitourinary fistulas, and 2% combined bladder and ureteral injuries [47]. The adjusted OR for bladder repair or cystotomy is 38.5 (95%CI 21.8-68.1) [59].

The depth and extension of placental invasion, intraoperative blood loss, and the number of previous cesarean sections all seem to be risk factors for urinary tract injury. On the other hand, bilateral ureteral stenting appears to reduce the risk of urinary tract injury [47]. Other abdominal organs, such as the bowel, pelvic vessels, and nerves, can also be injured, but these complications are rarer. Recent data suggest that delaying hysterectomy by a few days is associated with better maternal outcomes, lower estimated blood loss, and a reduction in transfusion needs [60].

Long-term Morbidity

Studies on the psychological impact of severe postpartum hemorrhage and emergency postpartum hysterectomy show significant morbidity, including sexual dysfunction and changes in socio-professional life, with over half of women reporting symptoms suggestive of post-traumatic stress disorder [61].

Mortality of Placenta Accreta Spectrum

Maternal mortality in PAS disorders is largely a consequence of massive bleeding, coagulopathy, and multi-organ failure [62]. Earlier reports on maternal mortality in the setting of PAS disorders estimated mortality rates of around 7%, reaching 30% in the absence of antenatal diagnosis [63]. Recent data suggest that rates in the range of 0.05% are achievable when prenatal diagnosis and multidisciplinary team management are available [64].

Mortality rates are mostly dependent on the depth and extension of invasion, the availability of antenatal diagnosis, and the ability to plan management in an expert center. Management by a multidisciplinary team was shown to improve outcomes when compared with standard care [65]. An OR of 0.22 (95% CI) was reported for composite early morbidity when comparing a multidisciplinary team approach with standard care [66].

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