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ABERRANT PLACENTATION: CONTEMPORARY MANAGEMENT OF PLACENTA ACCRETA (E JAUNIAUX)

Conservative vs. Radical Management of Placenta Accreta Spectrum (PAS)

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Abstract

Purpose of Review We review the advantages, disadvantages, and possible risks of current therapeutic alternatives for placenta accreta spectrum (PAS). Details and proper indications may change from one case to another, especially depending on the available resources, practitioner skill, and patient preference. Many treatments are routinely performed without appropriate analysis, which could result in a high rate morbidity. In contrast, undesirable outcomes are typically not reported in the literature, which may lead obstetricians to follow dangerous procedures without accurate information on possible consequences.

Recent Findings The proper use of the topography of invasion, and the knowledge of which pedicles are involved and why, is necessary to determine the best method for vascular control. In other words, prenatal evaluation is not entirely accurate, so the use of suitable intra-surgical staging could contribute to the correct diagnosis in the non-invaded uterus.

Summary Appropriate knowledge of the involved pedicles and their correct access after opening of the pelvic fascia will help in tailoring methods to stop the bleeding and do not depend of high-cost equipment. Complications associated with the use of handmade hemostasis have not been published, in contrast to serious complications caused by unwanted arterial embolization. As happens with other complicated surgeries, the proper management of pedicles and access results in better results. Acquiring new skills is necessary and possible; meanwhile, the use of low-risk techniques is advisable.

Keywords Placenta accreta spectrum · Abnormal invasive placenta · Placenta accreta · Placenta in situ · Conservative resective procedure · Surgical morbidity

Introduction

Invasive placenta was a virtually unknown condition until the first review appeared in 1937 [1]. At the beginning of the twentieth century, the number of reported cases began to increase, reaching epidemic proportions nowadays [2]. The invasive placenta, now called placenta accreta spectrum (PAS), causes severe bleeding during pregnancy [3]. The bleeding is frequently massive and difficult to control for many reasons:

- The amount of the blood loss may reach 800 ml/min at term.
- The bleeding comes from multiple pedicles, which are located mainly in the subperitoneal space and originate from different sources.
- Deeper origins of blood, such as the lower bladder, low-parametrial, or low-posterior uterine body, present multiple high-flow vessels located within a narrow space.
- Adhesion processes among infiltrated organs make it almost impossible to dissect structures.

The topography of invasive placenta must be considered to plan for accurate vascular control, especially in resective or reconstructive procedures [5]. A discussion of the surgical plan, treatment alternatives, and clinical support before treatment will increase patient confidence and reduce the

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possibility of complications [6]. When establishing the main surgical plan, the discussion should involve alternatives, unexpected scenarios, and false-positive or false-negative cases in order to improve the response when plan B is needed. A conservative approach with an untouched placenta is less complicated initially, but increases the possibility of later complications during follow-up. For this reason, when the placenta is left untouched, the hospital needs to be prepared to address any complications 24 h a day, 7 days a week [7]. By contrast, in the case of conservative-resective procedures, surgery is more complex at first, but outpatient control is similar to a cesarean procedure, although a resective-conservative technique requires the evaluation of proper uterine healing before a new pregnancy is attempted [8].

Conservative and resective techniques both have advantages and disadvantages [9], and their appropriate use will reduce problems. Nevertheless, surgical techniques and preferences can be determined or modified after the surgical field is exposed.

General Management

The standard approach to PAS includes diagnosis, treatment planning, accurate vascular control, and surgical staging. Ultrasound (US) is the gold-standard method for diagnosis of PAS. US study has high sensitivity and specificity [10] when performed by a specialist [11]. In contrast, PAS disorders can remain undiagnosed before cesarean in 50 to 70% of cases [12], likely because studies in a high-risk patient are inaccurate when performed by non-specialized groups [13].

To understand the entire setup, it is necessary to visualize the changes induced by PAS, as follows:

- In most cases, there is an anterior defect associated with disruption of a previous cesarean scar.
- The placenta invades this defect, and causes enlargement of microscopic anastomosis by the effects of vascular growth factors that favor the placental attachment to other organs (especially the bladder).
- The invasive blood supply is connected to extrauterine pedicles, and the adhesions increase the possibility of massive bleeding or organ damage.
- Inadequate hysterotomy through the invaded area could result in severe morbidity by massive bleeding.

Although preoperative staging is highly accurate when US, Doppler, and placental magnetic resonance imaging (pMRI) are performed by a specialist, it is not exact in 100% of cases [14••]. Because a simple mistake can result in a massive bleeding [5], a simple and reversible surgical staging is recommended. This could be performed by cutting the visceral peritoneum inside and along the round ligament, a maneuver that enables access to the parametrium. After cutting of the serosa, blunt dissection is performed by introduction of the two index fingers in the cephalic and caudal ligament direction, and placement of a retractor inside the round ligament, which permits direct visualization of the parametrium. In most cases, parametrial involvement is seen as purple-blue tissue covered by a thin membrane. This feature has completely different importance based on whether the invaded tissues have vessels. The presence of vessels necessitates a change in surgical strategy [15], because the presence of anastomotic vessels from multiple sources is a major cause of uncontrollable bleeding [16] during dissection. The ventral index finger is extended down to pass behind the bladder until it touches the contralateral finger [17]. The presence of vessels up to the vesical-cervical space is easy to separate among ligatures. After that, it is necessary to assess the posterior lower bladder, as the presence of intense fibrosis will require a change in the surgical strategy. Because of vessels coming from multiple sources, any vascular damage to fibrous tissue is quite impossible to stop and could result in a massive and uncontrollable bleeding.

All considerations described above illustrate the main problems during the operative management of PAS and why a high qualified team is necessary to manage all alternatives and serious complications [18].

Conservative Procedures

Conservative treatment in PAS means uterine conservation, which is possible through the use of various procedures that can solve specific problems, although they all present some advantages and disadvantages [19]. Complications can be related to the method itself, the invasion type, the topography of the invasion, and the training and expertise of the medical team and the resources available.

Untouched Placenta, Placenta Left In Situ

At the beginning of the twentieth century, hysterectomy was associated with a higher risk of massive bleeding and death. At that time, there were no intensive care unit, transfusions, or a complete understanding of the pelvic and uterine circulation, so leaving the placenta untouched and in situ (ISP) was considered the best treatment option for PAS. The first reported successful treatment leaving the placenta in situ was published in 1933 in Italy [20]. Although this is an excellent strategy for avoiding primary dissection, bleeding, and other

complications, it is not free of complications. Because all or part of the placenta is retained inside the uterus, infection, bleeding, coagulation disorders, and other complications can appear later [21–24]. Recent publications emphasize that patient adherence to strict follow-up and full-time medical team availability is essential for improving outcomes [25]. Various alternatives have been proposed to reduce complications, such as the use of methotrexate (MTX) and the prophylactic use of uterine artery embolization. Antimetabolic therapy with MTX, as used in the treatment of ectopic pregnancy, has been suggested, but mitosis in a term placenta is less than 1%; consequently, cytotoxic effects do not involve non-proliferative tissue, and therefore destruction of the remaining placental tissue seems unlikely. It was also suggested that methotrexate could reduce the vascularity of invaded tissues and may reduce [26] risk in the case of delayed surgery, but there is no basis for this assertion, and this change is likely attributable more to the natural process of placental involution than to a pharmacological effect. There are a few reported cases of PAS successfully treated with methotrexate [27], although the number of cases was limited, and the true value of methotrexate treatment was uncertain; MTX has also been associated with death [28] and other complications. For all of these reasons, and based on the available data [29], the use of MTX is not recommended in PAS. Prophylactic use of uterine embolization (UAE) in the placenta left in situ does not always protect against subsequent bleeding, and could lead to other complications such as secondary bleeding and uterine or bladder necrosis [30]. Until 2006, experts believed that after uterine artery embolization, the upper pedicle (ovary and round artery) replaced uterine blood flow to preserve uterine vitality, but this is not really true. In 2006 it was demonstrated that the use of a compression uterine device [31] for more than 6 h led to uterine necrosis even when the upper pedicle was open. At the same time, a report was published describing the lower uterine anastomotic system [32], which is anatomically able (thick, wide, and interconnected) to replace the uterine blood flow when the uterine artery is occluded or blocked. This system explained why uterine necrosis occurs when the uterine artery and the lower anastomotic system are occluded simultaneously (by a compression device). Because most of the invaded placentas is supplied by extrauterine vessels (pudendal branches), it is expected that the use of uterine artery embolization will not prevent bleeding in placentas left in situ. In addition, devascularization of retained tissue could promote tissue infection by underflow, as seen in other parts of the body, but this is only clinical speculation.

The main advantage in the use of conservative treatment with the placenta left in situ is that dissection of invaded tissues can be avoided [33], preventing massive bleeding and organ damage. The length of time for placental reabsorption varies, but spontaneous resolution ranges from 4 weeks to 9–12 months, with a mean of 6 months [34].

Indications: Method and Possible Complications

Some units have used ISP treatment as the primary treatment option for PAS, especially to avoid serious complications arising during hysterectomy [33]. ISP is an excellent solution for unexpected cases of PAS diagnosed at cesarean, where either the team or resources are not available. ISP is probably the best example of a bloodless surgery in PAS cases; classically, the abdomen is opened by a large infra-supraumbilical midline incision. Fetal delivery is then performed through transverse or longitudinal fundal incision [8]; in both variations, the obstetrician avoids any placental damage, and after delivery the umbilical cord is cut near the placental plate. Fundal incision is closed in one or two layers, according to preference, and laparotomy is closed. Although it is poorly described, with extensive infiltration of the lower uterus, especially with an early or repeated episode of vaginal bleeding, it is more likely that ISP treatment will fail or will be complicated by bleeding after delivery [35]. This is an important consideration in planning the surgical strategy, because conservative surgery with placenta in situ has been associated with emergency hysterectomy and major morbidity in 40 and 42% of cases, respectively [36]. Consequently, teams and resources must be immediately available to address uncontrollable bleeding or other serious complications. It is recommended that the team discuss the main alternatives before the surgery, because response time is shortened in the case of complications. In massive bleeding, an upper blockade (infrarenal aorta or common iliac arteries) is used to stop the bleeding from the main invaded anastomotic vessels without the risk of massive blind arterial embolization. Embolic material can be pushed through uterine anastomosis until the bleeding stops, but this procedure has a high risk of unwanted non-target embolization or even necrosis, not only of the uterus [37], but also of the gluteal artery [38•], bowel, bladder [39], and lower limbs [40]. Many times, but especially in emergency situations, the risk of tissue necrosis is underestimated because Spongostan is a resorbable material. However, Spongostan reabsorption takes 25 days [41], so if the main uterine pedicle and the anastomotic component are blocked, necrosis is a natural consequence of intense arterial devascularization.

In cases of massive and extremely difficult PAS invasion (lower bladder or parametrial), stopping the bleeding is not at all simple. Sometimes the appearance of the surgical field is threatening, and ISP is immediately

chosen to avoid further damage. When unexpected bleeding appears in massive PAS, however, the solution is extremely difficult. After blocking the main arterial trunks (infrarenal aorta or common iliac), a precise dissection of invaded tissues is needed. In contrast, the use of massive embolization seems to be the simplest solution, but could entail serious complications, and also does not always resolve the bleeding. Addressing the bleeding using bloodless procedures such as aortic compression will reduce the life-threatening consequences of massive blood loss such as hypotension, acidosis, and disseminated intravascular coagulation (DIC). All of these complications can happen suddenly, without time for clinical recovery. When precise strategies have not been practiced, discussed, and coordinated in advance, serious complications or even death can occur.

The use of updated protocols and continuous review of background cases and their complications will improve the use of ISP and other alternatives, as well as time management. ISP is an excellent procedure for use a in low-resource setting or in emergency situations, especially when a skilled team or resources are not available. PAS surgery requires a competent team and support. PAS resolution is not for beginners, and it is highly recommended that physicians acquire these skills by experience in many cases under senior supervision. Results are dependent not only on surgeon dexterity, but on the use of a multidisciplinary approach, with planning and tailored execution according to preoperative studies and management of different surgical alternatives [42].

Postoperative Controls (ISP): Secondary Hysterectomy

To minimize the possibility of complications and improve results, patients must adhere to a follow-up protocol to ensure that all clinical controls are performed until complete placenta reabsorption. The risk of massive hemorrhage is almost always unanticipated [43], even in patients with negative Doppler or human chorionic gonadotropin [44, 45]. To avoid the risk of complications, it is necessary to wait until complete placental reabsorption, which may require weeks or months [46]. Early detection of biochemical markers and minor clinical signs such as slight fever or spotting must be accurately evaluated to provide early treatment, which could include readmission, antibiotic treatment, endovascular procedures, or planned secondary hysterectomy [47]. Many authors report that surgery performed a short time after ISP is easier than a primary cesarean [48]. Vessels involute after the baby is released, although adhesions and some organ edema still cause some problems.

Infections with continuous pelvic pain caused by retained tissues can be resolved by trophoblastic hysteroscopic resection [49], open surgery, or laparoscopy [50], but mainly by hysterectomy.

Conservative-Resective Procedures

In this category it is possible to include two different techniques, the triple-P procedure [51] and one-step surgery [16]. The uterus is preserved in both procedures, but with two different goals. In the triple-P procedure, the technique is focused on reducing the morbidity associated with PAS hysterectomy, and in the one-step surgery, the procedure is focused on reducing bleeding and restoring the uterus anatomy for a subsequent pregnancy to minimize recurrence.

Triple-P Procedure

This technique was introduced in the United Kingdom in 2012 to reduce the risk of complications arising from obstetric hysterectomy in PAS treatment. The main steps of this procedure include (1) perioperative placental ultrasound localization of the superior edge of the placenta, (2) pelvic devascularization involving preoperative placement of intra-arterial balloon catheters (anterior division of the internal iliac arteries), and (3) no attempt to remove the entire placenta with myometrial excision and uterine repair. When the posterior bladder wall is involved, the invaded placental tissue is left in situ untouched to avoid cystotomy or further dissection. Hemostasis is performed by iliac internal ballooning, pelvic vessel embolization, and the use of local thrombin-based hemostatic agents. The authors do not recommend subsequent pregnancies, although a successful case was published recently [52].

One-step Conservative Surgery

This procedure was designed to solve all the problems caused by PAS in one surgical procedure. The technique uses a modified Pfannenstiel incision, which creates by dissection a dermo-cutaneous flap over the anterior rectus fascia up to the umbilicus. A midline incision is then performed between two rectus sheaths from the umbilicus to the pubic symphysis. At that point, the bladder is mobilized, and all the newly formed vessels (NFV) between the bladder and placenta are ligated until the upper vagina or cervix is seen. A horizontal hysterotomy is then performed in the upper uterine segment, after which the hand is placed between the placenta and the myometrium, as previously described by Dr. Ward [53]. After the baby is delivered, the uterus is exteriorized without moving the placenta. Posterior bladder dissection is completed to perform ligature of the colpo-uterine vessels that irrigate the invaded area [16]. The placenta is then completely removed with all invaded myometrium in one piece. After the uterine cavity is cleaned, the uterus is sutured in two layers using

healthy tissues. This procedure does not require ligation or embolization of the uterine artery. To date, 240 subsequent pregnancies have been recorded, with two partial recurrences, two partial dehiscence (twin pregnancies), and no cases of postpartum hemorrhage or placenta previa (personal unpublished data).

Radical Surgery: Obstetric Hysterectomy

Hysterectomy is standard treatment for PAS in many countries, but there are some publications describing a high rate of false-positives after histological analysis [54]. Thus it is possible that numerous unnecessary hysterectomy procedures are performed, causing irreversible damage and mutilation. For this reason, there is particular interest in validating prenatal findings by surgical staging [14••].

Despite wide resource availability and advanced medical technology, hysterectomy in PAS cases remains an issue, with high rates of morbidity and mortality. PAS produces many anatomical changes that make the dissection and access needed to safely perform surgery difficult. Uterine blood supply is simple—two pedicles (uterine and ovary artery) in an accessible space—but the vascular network in PAS is completely different: multiple pedicles, arteries, and veins that are widely interconnected [32], located deep in the pelvis within a narrow space, with a typical adhesion process among organs [4]. Obstetricians with limited experience in PAS may believe that performing a quick hysterectomy is an easy solution, but performing a hysterectomy in an anatomically preserved uterus (uterine atony) is vastly different from performing the same procedure in a distorted uterus (PAS).

Accurate vascular control, dissection maneuvers, and tissue invasion management are common problems in placental invasion surgery. In addition, the invasion topography will determine the inherent problems and possibility of bleeding for each case [55]. Because the ability to perform dissection is not uniform among obstetricians, the use of push-blunt maneuvers or lack of proper structure identification can lead to further damage and more bleeding. Individual differences in surgical dexterity with respect to tissue management can lead to wide variations in surgical results. Many times, a lack of aptitude for dissection has been compensated by massive ligatures or the use of grabbing or other devices, but such maneuvers may cause greater reduction in the space needed to identify vessels or elements such as the ureter. When the pelvic fascia is not open, the use of clamps or grabbing devices to pull the lateral structures to the midline increases the possibility of damage and impaired visualization of distal structures. Therefore, the keys to avoiding further bleeding or damage during hysterectomy include opening of the pelvic fascia [56••], accurate visualization of the invaded tissues [57], careful ligature of the connecting vessels [58], and proper dissection of surrounding tissues [16].

Because most placental invasions are anterior and secondary to placental invasion through the uterine defect, the most compromised organ is the bladder. Vessels between the bladder and the uterus can be separated by dissection and simple ligation. Although anatomical separation (bladder-uterus) can be performed using grabbing devices, this method may cause a significant reduction in bladder capacity and subsequent morbidity [59]. Even though newly formed vascularization in the vesico-uterine interphase is common in PAS, there is no anatomical description of the collateral vessels from the uterine artery to the bladder. During fetal development, a vascular sprout enters into a pelvis-like group or interanastomosed vessels. After organ development, these vessels are differentiated in pedicles from the different organs, although microscopic connections remain among them [8]. In the case of PAS, placental invasion releases a high amount of vascular growth factors, which stimulate the embryonic micro-connection to create NFV. This fact explains why there are no anatomy text descriptions of collateral vessels between the uterine artery and the bladder, although they are habitually seen in almost all cases of PAS. These NFV do not have a well-developed muscular tunica, because they have not been under the effect of arterial pressure during their life. In the upper bladder, these vessels are connected to the upper and lower vesical arteries and also the uterine artery. In the lower bladder, in addition to the described vessels in the upper bladder, the NFV vessels create connections with the cervical artery and the vaginal arteries [16]. All these connections establish a wide vascular net, which is prone to more bleeding than a single vessel. This is also the reason that target embolization in the placenta percreta is a nightmare [60].

Dissection of the posterior bladder enables interruption of these connections by simple stitches; to do that, the retrovesical space needs to be opened widely. The visceral peritoneum is cut superficially between the two round ligaments, and the bladder is pulled out using two Allis clamps to open the retrovesical space. The dissection plane must be identified in order to safety separate and ligate the NFV. The surgical ligature suggests an advantage in the use of electrocautery, because the lack of vascular media tunica reduces the occlusion effect of electrical cautery [16], and consequently the possibility of rebleeding.

Dissection Problems

Adhesion and fibrosis are problems that complicate surgery for PAS, because they increase tissue fragility and consequently the possibility of unwanted vessel and organ injury. Damage to the adhesive and highly vascularized tissues increases the risk of sudden bleeding. Some adhesions, like those located in the posterior-upper bladder, can be dissected using a Pelosi [17] maneuver (passing the index finger behind the bladder), but when the adhesions are in the low bladder,

the Pelosi maneuver is not possible. For these cases, a number of solutions have been proposed. These include performing a subtotal hysterectomy, leaving a patch of sticky invaded myometrium in the posterior bladder wall untouched, and then using a tight circular hemostatic suture [61] over remaining myometrium. Another alternative is to perform a retrograde hysterectomy and to leave adhesive tissues untouched (anterior invaded myometrium-posterior bladder) in order to avoid further damage [62]. In both cases, leaving the invaded and strongly adhesive tissues untouched is a practical approach to avoid massive bleeding or organ damage.

Parametrial Involvement

As is the case with the posterior bladder, parametrial involvement is different when it is located above or below the peritoneal reflection. This is a direct consequence of the blood supply, the pelvic shape, and especially the relation between the pelvic wall and uterine invaded borders. Invasions that are located between the tube and the peritoneal reflection are generally not difficult to solve, because the space between the uterus and pelvic wall is large, and there is no close contact with the ureter or with the vessels that run over the pelvic wall [12••, 13, 14••, 15–55, 56••, 57–63]

In contrast, lower parametrial invasions are close to the iliac vessels (arteries and veins) and the ureter. Obstetricians typically avoid dissection through this complicated area and decide to leave the placenta in situ. Although this option is the best solution in most cases, when preoperative evaluation shows a deep infiltration of the cervix or the lower uterus, the risk of perioperative bleeding is high and unpredictable [5]. For this reason, lower parametrial PAS, especially in cases with evidence of vessel involvement, is a life-threatening condition. Because of the high risk of massive and unpredictable bleeding, it is advisable to plan a primary surgery with a full team and resources available. To reduce morbidity and mortality, achieving high, accurate vascular control [64] over the aortic infrarenal or bilateral common iliac is imperative; a wide opening of the pelvic spaces is then needed to visualize elements inside the small space and to perform an anatomical separation of invaded elements. The pelvic ureter needs to be identified, isolated, and properly disconnected from the NFV. The entire invaded placenta must be disconnected and removed, a process that can extend to the ischiorectal fossae. A list of such difficult steps may be overwhelming even for highly trained obstetricians, and thus the use of a "do not touch" approach is understandable. But it is necessary to consider that this location is one of the deadliest forms of PAS. Unfortunately, most serious parametrial complications are not reported, and only a few specialists are knowledgeable about the dangers involved in the management of this location [65]. Before making a preoperative decision, one must remember that parametrial involvement is the cause of unpredictable massive bleeding; thus it is probably better to a plan a complicated surgery first, instead of operating in emergency situations with massive bleeding, shock, and coagulopathy, without a fully prepared team or resources.

Conclusions

Both conservative treatment and resective surgery for PAS have advantages and disadvantages, and the choice of treatment must be determined based on preference, resources, skills, and circumstances. Prospective studies on surgical outcomes are especially problematic, because cases, training, and real-life situations are not always comparable for randomization. There is universal agreement, however, that diagnosis and treatment of PAS is considerably more successful in centers with a high level of training. Unexpected cases or births that occur in untrained units are really benefited by the use of a conservative approach leaving the placenta in situ untouched. The axiom "first, do no harm" still holds true today, as it has since the days of ancient Greece.

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