Urological Manifestations of Placenta Percreta

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Key Words

Abnormal placentation • Pregnancy • Hematuria • Placenta • Post postpartum hemorrhage • Shock • Placenta percreta • Pregnancy

Abstract

Placenta percreta is a condition of pregnancy associated with abnormal decidua placenta. It is characterized by invasion of chorionic villi past the myometrium and serosa, towards urogenital organs. Complications include massive hemorrhage, bladder dysfunction, and severe infections during delivery. Reports suggest an increasing prevalence of this condition. From a urological perspective, this review suggests how early diagnostic modalities, effective treatment plans, and appropriate surgical methods may aid in decreasing the morbidity and mortality of placenta percreta. The importance of maintaining bladder integrity during hysterectomy is emphasized.

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Introduction

Adherent placenta disorders represent potentially fatal conditions for pregnant women. Branching villi of the placenta are important for nutrient exchange between mother and fetus. If villi from the fetal component (chorionic placenta) abnormally attach to the myometrium instead of the endometrium (decidua), pathologies known as placenta accreta, placenta increta, or placenta percreta can result [1]. This review focuses on placenta percreta, which is more severe than the other classifications. In placenta percreta, chorionic villi breach the uterine serosa and adhere to surrounding organs (bladder, ureters, or rectum).

Techniques for optimal management of placenta percreta remain controversial due to a lack of studies on treatment and long-term outcomes of this condition [2]. This review aims to synthesize available diagnostic and treatment methods for placenta percreta. It highlights the importance of early detection in avoiding complications, adoption of multidisciplinary surgical teams and patient counseling, and maintenance of the bladder during hysterectomy. Damage to the bladder results in sexual and urinary dysfunction, which can significantly reduce the patient's quality of life.

Anatomy, incidence, etiology, risk factors, clinical manifestations, early detection procedures, and different treatment options are discussed with a unique urological approach integrated into the traditional obstetrical approach to placenta percreta.

Fig. 1. Normal and abnormal placentation.

Anatomy

The anatomy of the uterus with respect to the bladder, ureter, and rectum provides a foundation for understanding the pathology of placenta percreta. The uterus lies posterior and superior to the bladder, and sits between the bladder and rectum [3, 4]. Due to its close proximity to the ureter, the bladder may suffer damage during hysterectomies if the surgeon does not aim to preserve its function.

The uterus is peritonealized by the broad ligament and is comprised of 3 parts: the fundus, the body and the cervix [5]. The uterine wall is composed of 3 layers: the endometrium, myometrium and serosa (perimetrium). The endometrium has a functional layer and a basal layer. The functional layer consists of uterine arteries and veins that become basal straight arteries or spiral endometrial arteries [5]. High levels of estrogen and progesterone lead to development of more spiral arteries, causing the endometrium's functional layer to thicken. The basal layer does not change with increases in hormone production. It is the deepest layer of the endometrium and contains tube-like uterine glands [5]. Damage to the basal layer may cause intrauterine scars referred to as Ashermans syndrome, which allows placental adhesions to occur [6].

The myometrium contains the origin of spiral and straight arteries, which are branches from the arcuate artery. The arcuate artery originates from the uterine artery [7]. Both the uterine artery and arcuate artery are located within the myometrium [7].

The serosa (perimetrium) is the outermost layer of the uterus. The ureters collect urine and run anteriorly to the bifurcation of the common iliac artery and pass under the uterine vessels. As the fetus becomes larger, the positioning of the uterus will impact the bladder, leading to an

Fig. 2. Placenta percreta invading pelvic organs.

increase in voiding. Figures 1, 2, and 3 demonstrate the different positions that the infant may be inappropriately placed in.

The placenta develops after implantation [8]. During implantation, the cytotrophoblast gives rise to the syncytiotrophoblast. The syncytiotrophoblast invades the endometrium and develops into the fetal portion of the placenta [8]. By the end of the second week of gestation, fetal components of the placenta come into contact with maternal blood [8]. Fetal components form branching villi, which are surrounded by an intervillous space, allowing reception of maternal blood [8]. This is important for nutrient exchange between mother and fetus. If villi from the fetal component (chorionic placenta) abnormally attach to the myometrium instead of the endometrium (decidua), pathologies known as placenta accreta, or placenta increta or placenta percreta [1] can result. Disorders are shown in table 1 which relate to placenta disorder.

Fig. 3. Placenta invasion towards the bladder resulting in placenta percreta.

Incidence

There have been many reports on the incidence of placenta percreta. Although the literature suggests that there is an increase in the incidence of placenta percreta, the exact value is hard to determine. Reports assessed that in the 1950's United States, 1 in 30,000 deliveries were reported with placenta accreta, while in the 1990's 1 in 533 deliveries were reported with placenta accreta [9, 10]. In 138 histologically confirmed samples of adherent placentas, placenta accreta was the most commonly reported finding of all adherent placenta disorders representing 79% of all cases; meanwhile placenta increta was estimated at 14% and placenta percreta was estimated at 7% [9, 10]. Pohl [11] estimates the incidence of placenta percreta as between 1:1000 to 1:70,000 births.

The incidence of placenta percreta still remains unclear, as it is a subset of adherent placenta pathologies. The exact incidence is difficult to determine as the invasiveness of the placenta is not always established, making it challenging to distinguish between placenta percreta, increta, and accreta.

Many institutions have conducted case control studies evaluating the incidence of placenta percreta within their healthcare networks. The following discusses the results of each study. In a 12-year study from 1986 to 1998, there were 250 cases reporting adherent placen-

Table 1. Adherent placenta disorders

Classification	Presentation	Ref.
Placenta accreta	chorionic villi adheres to superficial myometrium	[1]
Placenta increta	chorionic villi adheres to body of myometrium	[1]
Placenta percreta	chorionic villi breaches uterine serosa adheres to surrounding organs (bladder, ureters, or rectum)	[1]

tas, 2 (0.008%) of which were placenta percreta out of 25,254 births [12]. In Japan, within 8 tertiary centers, a 10-year case control study was conducted from 1994 to 2004. Amongst the 59,008 reported deliveries, 5 were associated with placenta percreta [13]. These findings suggest that incidence of placenta percreta is uncertain at this time.

Etiology

Although the etiology of adherent placenta remains uncertain, the most widely accepted theory is that this pathology arises due to one or more of the following conditions: a defective decidua, maternal vascular remodeling, or excessive trophoblastic invasion [14]. Excessive trophoblastic growth may lead to uncontrolled invasion towards the myometrium resulting in placenta accreta, while dehiscence of a scar allows chorionic villi greater access to invade past the superficial myometrium resulting in placenta increta or placenta percreta [14]. These changes are thought to arise from operative procedures leading to the alteration of the deciduas basalis [15]. Eighty percent of adherent placenta disorders are most commonly found in Parity scores of greater than one, with a minimum of one pervious cesarean delivery [14]. Using a literature search, in 37 case studies reporting on placenta percreta, the maximum age was 43, the minimum age was 24, and the average age was 33. The average number of cesarean deliveries amongst those cases was 2.

Diagnosis

Risk Factors

There are various risk factors associated with placenta percreta. The most important risk factor is the observation of placenta previa (low lying placenta) after a cesar-

ean delivery. Maternal age of 33 or greater, and multiple cesarean deliveries increase the risk for adherent placenta disorders, therefore a detailed past medical history is essential to determine the overall risk and to anticipate complicated placental implantation disorders [10, 16–18]. Other risk factors for placenta percreta include, submucous myoma, previous curettage, Asherman's syndrome, advanced maternal age, gandumultiparity, smoking, chronic hypertension as well as a previous history with adherent placenta disorders [18, 19].

Placenta percreta being the most severe form of all implantation disorders requires aggressive evaluation and management to decrease patient morbidity [16]. Literature suggests that placenta percreta can be diagnosed as early as the 11th week of gestation, however the mode diagnosis of placenta percreta was observed at 35 weeks of gestation. This value illustrates a need for earlier diagnosis, as in the later stages of pregnancy a higher risk for painful obstetric hemorrhage exists [20]. Furthermore, an early diagnosis allows adequate preparation for delivery, thus optimizing patient safety and outcomes.

Clinical Manifestations of Placenta Percreta

Placenta percreta is a result of chorionic villi invading surrounding organs, such as the bladder, ureters, rectum [21]. Hematuria is a rare occurrence comprising 25% of all placenta percreta cases [1]. Multiparous women with a history of cesarean deliveries with placenta previa and hematuria should be suspected with placenta percreta [1]. Women who have any of the aforementioned risk factors should undergo a pelvic ultrasound with high suspicion for adherent placenta disorders [22]. If there are no incidental findings, placenta percreta should not be ruled out, as presentation in the ultrasound may be uncertain. Patients with placenta percreta may also complain of a dull, prolonged lower abdominal pain that is unusual during pregnancy [1]. Vaginal bleeding has been reported in presentation of placenta percreta [23]. If there are suspicions, development of a team-based delivery plan involving a blood bank team, obstetricians, interventional radiologists, anesthesiologists, vascular surgeons, neonatologist and urologists will help reduce the risk of massive hemorrhaging, and other complications during delivery [22]. The benefits of a multidisciplinary team will be discussed in detail later in this review.

Morbidity and Mortality of Placenta Percreta

Placenta percreta is a highly morbid condition as it can result in massive hemorrhaging causing maternal and prenatal death. Urological complications of placenta per-

creta include ureteral dilation [23] and fistula between the bladder and cervix [24]. Most cases of placenta percreta are diagnosed only at the time of delivery, requiring aggressive treatment [25, 26]. This requires the need for extensive surgery that may result in massive blood transfusions, urological injury and infections [25]. A recent study measuring women with morbidly adherent placenta disorders recorded that out of 20 case records with incidence of bleeding complications, the average blood loss was 2.71 units, with a high of 19 units [25]. Takai et al. [27] reports an extreme placenta percreta case in which the patient lost 11,130 ml of blood, requiring 59 units to be transfused. Hemorrhaging can prove fatal as it may cause hemorrhagic shock and coagulopathy. Due to the large volume of blood loss it is important for clinicians be prepared to supply adequate amount of blood volume during delivery [28], in addition to identifying patients who may be at risk for placenta previa. As discussed earlier, certain risk factors including placenta previa and several cesarean sections should alert clinicians to screen for this condition. Next section will explain diagnostic procedures currently available to screen for placenta percreta.

Radiological Findings and Imaging Techniques

Ideal diagnosis of adherent placenta disorders should be done during the antenatal stage [29]. Grayscale ultrasound exam is an imaging technique that can display critical features during the first trimester including, low-lying gestational sacs attached to a uterine scar. The myometrium was observed as being thin in the area of the scar [30]. During second and third trimester, ultrasound may reveal multiple placental lakes (“Swiss cheese” appearance adjacent to the placenta), a thin myometrium, loss of decidua placental layer, and an irregular border between the bladder and myometrium [1, 31]. Three-dimensional color flow Doppler can help support grayscale ultrasonography by helping detect angioarchitecture of the basal and lateral views of the placenta, helping assess the placenta condition [32, 33].

If grayscale ultrasound provides inconclusive results, a magnetic resonance imaging (MRI) technique should be performed using gadolinium contrast intravenously [19]. An MRI may reveal absence of the inner layer of the myometrium, the mass effect of the placenta extending beyond normal zones or into the underlying bladder, and beading nodularity within the placenta [30, 34]. Cystoscopy may be used to display the condition of the posterior bladder wall and reveal associated abnormalities [27].

Table 2. Placenta percreta diagnostic methods for early detection

Technique	Features of clinical significance	Ref.
Grayscale ultrasound	low-lying gestational sacs attached to a uterine scar during 1 st trimester multiple placental lakes, a thin myometrium, loss of decidua placental layer, and an irregular border between the bladder and myometrium during 2 nd and 3 rd trimester	[1, 30, 31]
Color doppler	help support a gray-scale ultrasonography via detection of angioarchitecture of the placenta and the myometrium	[32, 33]
MRI w/gadolinium contrast	reveal the absence of the inner layer of the myometrium, the mass effect of the placenta into the underlying bladder or if it extends beyond the normal zones, and beading nodularity within the placenta	[30, 34]
Cystoscopy	reveals the condition of the posterior wall of the bladder and if abnormalities are present	[27]

Table 3. Multidisciplinary team and treatment modalities

Specialty	Pre-operative	Intra-operative	Post-operative	Ref.
Obstetrician	patient counseling physical exam early diagnosis with different imaging modalities	laparoscopic Cesarean hysterectomy emergency hysterectomy	methotrexate therapy postpartum hysterectomy postoperative follow-up	[1, 29, 30, 32, 33, 36, 39-41]
Interventional radiologist		angiography guided balloon occlusion of uterine arteries prophylactic internal iliac embolization bilateral internal iliac artery catheters	postoperative follow-up	[19, 37, 41]
Neonatologist		assess the condition the newborn neonatal resuscitation if needed		[19, 37, 41]
Anesthesiologist		general anesthesia spinal anesthesia epidural anesthesia		[19, 37]
Urologist	assess gestational hematuria if present	ureter stent placement partial bladder resection bladder cystotomy bilateral ureteral catheters bladder reconstruction	post surgical follow-up	[1, 19, 36, 41]
Blood bank physician	blood typing and Rh screening cross and check blood products 8 units of packed red blood cells and 4 units of fresh frozen plasma are recommended	provide adequate blood for blood transfusion have rapid infusion device on hand		[25, 41]

CT scans and X-rays are not recommended because they expose the fetus to unnecessary radiation. Although these methods may provide insight on the possible presence of adherent placenta disorders, there is no early definitive diagnostic method that exists for clinicians. Diagnosis is often made via postpartum hemorrhage [19]. However, early detection allows for clinicians to formulate an interventional plan and adequate perpetration if placenta percreta were to occur. Some early detection techniques are outlined in table 2.

Patient Counseling and the Multidisciplinary Team Approach

For patients at high risk or with suspected diagnosis for adherent placenta disorders, patient counseling and interventional surgical plans should be discussed. During the counseling session, the patient should be made aware of the increased risk of maternal death, likelihood for a hysterectomy, need for blood transfusion, and risk associated with removing parts of the bladder or invaded ureters [35]. Reports indicate that there is a greater ben-

efit and decrease in mortality for planned hysterectomy versus an emergent peripartum hysterectomy [19, 36].

In addition to counseling, a multidisciplinary team should be constructed. A team comprising an obstetrician experienced in pelvic surgery, a blood bank team, an anesthesiologist, a urologist skilled in pelvic reconstruction, an interventional radiologist, and an experienced neonatologist is advised [19, 37]. Table 3 signifies the roles of each specialty in the treatment plan. Eller et al. [37] report significant reduction in morbidity and mortality with utilization of a multidisciplinary team. This signifies the importance of patient counseling and the development of a multidisciplinary team towards successful treatment of placenta percreta.

In summary, an individualized care plan should be tailored to the patient's wishes, risk factors, and invasion extent and positioning of placenta [38].

Treatment

Treatment Options

Currently there are two main therapeutic options for treatment of placenta percreta: cesarean hysterectomy and the conservative approach. The extirpative approach is another method that is seldom administered with placenta percreta [42, 43]. The conservative approach does not remove the placenta with an aim towards preventing further hemorrhaging [19]. The placenta is left in situ post-delivery and adjunct therapy is administered such as methotrexate, angiography guided balloon occlusion, uterine artery embolization, internal iliac artery ligation/embolization, dilatation and curettage, and/or hysteroscopic loop resection [42, 44]. The extirpative approach removes the placenta, leaving the uterine cavity empty at the time of delivery and is theorized to elevate the risk of postpartum hemorrhage [42, 43]. Adopting a urological perspective to this obstetrical condition, we emphasize the importance of maintaining the integrity of a bladder if a hysterectomy is performed.

Endovascular Treatment

Literature suggests that angiography guided balloon occlusion and embolizations are the most effective conservative therapeutic methods for placenta percreta. The purpose of these 2 methods is to control hemorrhaging during or after cesarean delivery [45, 46]. The process of balloon occlusion involves insertion of balloon catheters prior to delivery in each of the femoral arteries up toward the internal iliac arteries [45, 47]. Once the balloons are

placed, they can be inflated causing temporary occlusion of the internal iliac arteries followed by a cesarean section reducing blood loss and preventing massive hemorrhaging [44, 47]. Prophylactic internal iliac embolization assisting cesarean delivery can be used intraoperatively to prevent intraoperative hemorrhage or it can be used post delivery to eliminate the need of reopening and closing the abdomen as the patient is transported between departments [2, 48]. This process can be utilized after a balloon occlusion has been performed. Although these treatments are arguably the most favored conservative method approaches, opinions on their efficiency is mixed [44]. The literature suggests that outcomes with balloon occlusion alone have reduced risk than when assisted by arterial embolization [49]. Repeat embolizations of uterine arteries show that when used, they potentially increase the risk of developing bladder ischemia, sepsis, and pelvic abscesses [50]. In cases where reduced blood loss does not occur or hemorrhaging occurs, alternative therapies need to be in place to limit complications.

Methotrexate: A Controversial Therapy

Methotrexate is a drug therapy that aids in the detachment of the placenta when left in situ. Methotrexate is a chemotherapeutic and immunosuppression agent that acts via inhibition of DNA synthesis of rapidly dividing cells such as trophoblasts [39, 51]. DNA synthesis inhibition affects the rapid replication of chorionic villi resolving adherence of the placenta [39]. The use of methotrexate for the treatment of placenta percreta has been questioned, as outcomes of its use are unclear. Two reports illustrate that when the placenta is left in situ with controlled bleeding, methotrexate had positive therapeutic outcomes [52]. Conversely, two other reports have suggested that when methotrexate has been used as a conjunction therapy, serious morbidities occurred [53, 54]. The administration of methotrexate as a therapeutic aid for placenta percreta should be utilized with caution, as the therapeutic benefit has not been fully determined and it may lead to complications such as delayed bleeding, placing the patient at risk for hemorrhaging at a later period [1, 52]. For pregnant patients unable or unwilling to undergo blood transfusion for excessive intraoperative blood loss acute normovolemic hemodilution is a viable treatment option [55].

Hysterectomy

Hysterectomy is the most common therapeutic method applied in conjunction with or without the conservative method. Most case reports that applied the conservative method have detailed that a postpartum hysterectomy

was performed [43]. With placenta percreta cases, using laparoscopic hysterectomy over laparotomy is recommended as it improves visualization allowing for more dissection precision decreasing the risk of hemorrhage [43].

If diagnosis of placenta percreta is not determined or if conservative method is not applied, an emergency hysterectomy is often performed. An emergency hysterectomy presents a significant challenge, as there is greater risk for hemorrhage [56]. Matsubara et al. [36] report standard surgical methodologies for decreasing challenges associated with emergency hysterectomy. Ureter stent placement requires approximately 5 minutes for an experienced urologist and helps in assisting the obstetrician during the hysterectomy procedure [36].

Most placenta percreta cases report the presence of bladder wall invasion. It is important to note that even in a situation in which uterine bleeding is uncontrolled, every attempt to preserve bladder integrity should be made [1]. If the placenta invades the bladder wall, then opening the bladder for a cesarean hysterectomy is recommended [57]. The bladder should not be separated as it can cause severe blood loss. Because the bladder is a neurogenic organ, all efforts should be made to preserve its integrity. Potential long-term consequences of bladder damage include incontinence and sexual dysfunction. The posterior bladder wall, i.e. the trigone, the detrusor muscle and the ureter orifices, should remain intact. It is highly recommended that a urologist specializing in pelvic reconstruction be present during hysterectomy [1]. If the bladder is partially resected, it should be done with an automatic stapling/cutting tool to maintain the structural components of the bladder [1, 36]. The surgeon must use discretion in times of severe blood loss accounting for the appropriate steps for the preservation of the bladder. Bladder cystotomy is recommended as it can detail the extent of the invading placenta and aid the surgeon in defining dissecting patterns recommended for optimal therapeutic benefit [1].

Conclusion

Defects of decidua lead to proliferation of chorionic villi. Placenta percreta is a morbid condition that involves infiltration of chorionic villi of the placenta past the myometrium of the uterus towards urogenital organs. The uterus lies posterior and superior to the bladder [5]. Thus, particular care must be taken to prevent bladder damage in case of hysterectomy.

Although exact values of placenta percreta incidence are unknown, it is believed that incidence of placenta percreta is increasing due to an increased number of cesarean deliveries. Placenta percreta is reported as having the lowest incidence of all placenta adherent disorders, though it may be most severe.

Obstetricians as well as urologists need to be aware of risk factors and clinical manifestations of placenta percreta. Placenta previa with previous cesarean deliveries increases the likelihood of adherent placenta disorders. Clinicians should recognize that hematuria is not a definitive clinical manifestation of placenta percreta. Other indications for the possibility of placenta percreta include complaints of a dull lower abdominal pain.

Placenta percreta requires early diagnosis and treatment. Effective planning for severe blood loss needs to be considered. Imaging modalities such as grayscale ultrasound, color Doppler, an MRI with gadolinium contrast and cystoscopy, have all shown to be effective tools in the early detection of this condition.

Patient counseling and multidisciplinary team involvement have shown strong successive treatment for placenta percreta. Early planning can ensure optimal outcomes for the patient. Patient counseling allows for patient autonomy in making decisions such as possible termination of the pregnancy, early delivery via cesarean section, or planned hysterectomy.

The main treatment options include the conservative surgical approach, which leaves the placenta in situ during a cesarean delivery or a cesarean hysterectomy during delivery. The conservative approach often utilizes endovascular treatments such as balloon occlusion and/or embolization to isolate the placenta during a cesarean delivery. The placenta is removed later, either via methotrexate or surgical innervation. A hysterectomy is the most common form of treatment for placenta percreta and can be performed during the cesarean delivery or after a cesarean has been performed using the conventional approach. Emergency hysterectomies have higher mortality outcomes than planned hysterectomies, further illustrating the need for early diagnosis and patient counseling. If a hysterectomy is performed with a patient with placenta percreta all efforts towards maintaining the integrity of the bladder should be made.

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