Morbidly adherent placenta (MAP) includes the spectrum of placenta accreta, increta, and percreta and is a cause of major morbidity and mortality in pregnant women. Abnormal vascularization results from the scarring process following uterine surgery with secondary localized hypoxia, leading to defective decidualization and excessive trophoblastic invasion.

In the last century, the incidence of MAP has risen dramatically. Planned cesarean hysterectomy at the time of cesarean delivery is the standard recommended treatment in the United States. Recently, interest in conservative management has resurfaced, especially in Europe. The aims of this review are the following: (1) to provide an overview of methods used for conservative management, (2) to discuss clinical implications for both clinicians and patients, and (3) to identify areas in need of further research.

**Key words:** accreta, conservative management, increta, percreta

Over the last century, the incidence of placenta accreta, increta, and percreta, collectively referred to as morbidly adherent placenta, has risen dramatically. Planned cesarean hysterectomy at the time of cesarean delivery is the standard recommended treatment in the United States. Recently, interest in conservative management has resurfaced, especially in Europe. The aims of this review are the following: (1) to provide an overview of methods used for conservative management, (2) to discuss clinical implications for both clinicians and patients, and (3) to identify areas in need of further research.

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of hemorrhage or adjacent tissue injury that may be mitigated by leaving the placenta in situ.16–18 Uterine preservation may be attractive to women who desire future child-bearing or whose fertility is inextricably linked with societal status and self-esteem.21 Some authors endorse conservative management for highly motivated, appropriately counseled women who are willing to adhere to close follow-up in centers equipped to manage potential complications.22

We aim to provide an overview of conservative management approaches, discuss implications for both physicians and patients, and identify areas for future research.

**Uterine-sparing techniques**

**Leaving the placenta in situ: expectant management**

The earliest described conservative technique is a hands-off approach,3 whereby the umbilical cord is ligated close to its placental insertion after delivery without any attempt to remove the placenta. Contemporary expectant management includes the use of adjunctive measures to reduce blood loss and expedite placental resorption.22–24 The placenta is left in situ after high ligation of the cord, with all or part of the placenta remaining adherent to the myometrium. After a cesarean delivery, the hysterotomy is closed in the routine fashion. Uterotonics, compression sutures, balloon tamponade, uterine artery embolization, and/or uterine artery ligation may reduce uterine perfusion, decrease postpartum hemorrhage, and hasten placental resorption or sloughing and expulsion.

The time to a spontaneous resolution ranges from 4 weeks24 to 9–12 months, with a mean of 6 months.6,26,31 Delayed hemorrhage, disseminated intravascular coagulopathy, endomyometritis, and sepsis were reported as major complications of placental retention.6,24,25,32,33 Rare morbidities included uterocutaneous fistula20 and choriocarcinoma with arteriovenous fistula formation.24

In one of the largest retrospective reviews (n = 167), Sentilhes et al24 reported that 78% of women retained their uterus. More than half (52%) were given postpartum prophylactic antibiotics over 5 days. A majority (65%) required additional procedures, including pelvic artery embolization (n = 62), hypogastric artery ligation (n = 23), other vessel ligation (n = 45), and uterine compression sutures (n = 16). Half (51%) had postpartum hemorrhage, and 36 of those (22%) required subsequent hysterectomy (18 within 24 hours, 18 within 3 months of delivery). When successful, resolution occurred at a median of 13.5 weeks’ postpartum. Ten patients suffered severe morbidity, including septic shock, vesicouterine fistula, and uterine necrosis. There was 1 maternal death associated with complications following the use of methotrexate.

More than half of the previously mentioned cases (55%) had no diagnostic imaging. Only 18 patients had placenta percreta and histological confirmation of the depth of invasion was available only when hysterectomy was performed. This raises the question of bias toward cases involving only partial or focal involvement.

Pather et al23 reviewed 57 cases of placenta percreta that were diagnosed by antenatal imaging and managed conservatively. They showed that 60% of patients required further surgery (40% as emergent hysterectomy) and that up to 42% experienced major morbidity including sepsis, disseminated intravascular coagulopathy, hemorrhage, pulmonary embolism, and fistula and arteriovenous malformation.23 Clausen et al26 systematically reviewed 52 studies involving 119 cases of placenta percreta diagnosed by antenatal imaging or at the time of delivery. Of these, 36 cases were managed by leaving the placenta in situ and were associated with hemorrhage, infection, and a 58% risk of delayed hysterectomy as late as 9 months after the delivery, emergently 85% of the time.

**Hysteroscopic resection of retained adherent placenta**

Hysteroscopic resection of placental remnants has been described to expedite resolution or treat delayed bleeding and/or pelvic pain.25,35 Potential advantages of using a hysteroscopic approach include the ability to visually confirm absence of a cleavage plane, continually visualize tissues during resection, and reduce risk of adhesion formation.36

In 1 series, 4 women who were managed conservatively underwent hysterectomy caused by severe pain, at a mean of 209 days (range, 65–362 days).37 Pain resolved within 1 week of the procedure. Two of the 4 subsequently conceived and delivered via cesarean delivery, with no evidence of recurrence of placenta accreta.

In a second series, 12 women underwent hysteroscopic resection of retained accreta using bipolar cautery with ultrasound guidance.28 Complete resolution occurred after a single procedure in 5 patients (42%), after 2 attempts in 2 patients (17%), and after 3 attempts in 4 patients (30%). One required hysterectomy because of a hemorrhage after the first resection. Nine patients had a return of menses after treatment, and in 4 subsequent pregnancies, there were 2 live births. It is important to note that in this series, the mean size of retained tissue (not defined clearly as length, width, or depth) was only 54 mm on magnetic resonance imaging (range, 13–110 mm). Median time from delivery to first resection was 75 days (range, 51–179 days). Pathological examination confirmed accreta in all cases.

Prior to hysteroscopic resection, the depth of placental invasion must be considered. Concurrent use of ultrasound or laparoscopic guidance is prudent to avoid inadvertent injury. There is no evidence to suggest that patients with placenta increta or percreta are candidates for hysteroscopic resection.

**Placental-myometrial en bloc excision and repair**

En bloc resection of placenta percreta was first described by Palacios et al,20 in 2004, in a series of 68 cases. This technique permitted resection of invaded myometrium when 50% or less of the anterior uterine circumference was involved. An important proviso is that bleeding had to be controlled by dissection and ligation of any neovascularization. Complete placental excision was performed after delivery of the fetus. Fibrin glue, uterine artery ligation, and
brace or box sutures were used for local hemostasis. After excision, the resulting defect in the myometrium was repaired with myometrial pulley sutures, similar to horizontal mattress sutures. The defect was then covered with absorbable mesh. Uterine conservation was completed in 50 of the 68 women (74%). Of these, 42 had 3 year follow-up, and 10 became pregnant and were delivered at 36 weeks by scheduled cesarean delivery. Even with this technique, 18 of 68 patients (26%) still required hysterectomy, and adequate long-term data about the safety of pregnancy or subsequent surgery after use of mesh are lacking.

Chandrarahanan et al19 described the Triple P procedure in 2006 in a case series of 4 patients with central, anterior placenta percreta. This procedure involves 3 steps: (1) preoperative placental localization using transabdominal ultrasound to identify the superior border of the placenta, with transverse hysterotomy planned 2 fingerbreadths above the uppermost placental edge; (2) preoperative placement of intraarterial balloon catheters with inflation after delivery or ligation of the uterine arteries when catheterization is unavailable; and (3) no attempt to remove the placenta with en bloc myometrial excision and uterine repair. During the excision, a 2 cm margin of myometrium is preserved above the bladder edge to allow hysterotomy closure.

In cases involving bladder invasion or low-lying placenta, hemostatic clamps are placed along the incision edges, the lower segment is everted, placental fragments are removed piecemeal, and compression sutures are placed as needed for hemostasis. The resulting myometrial defect is then closed in the same way as a hysterotomy made at the time of cesarean delivery. All patients opted for bilateral tubal ligation at the time of delivery; thus, no follow-up data with regard to subsequent pregnancy are available.

The authors reported remarkably low blood loss, ranging from 800 to 1500 mL per patient. A follow-up cohort study by the same group28 showed reduction in estimated blood loss, the need for delayed hysterectomy, and length of inpatient stay when compared with leaving the placenta in situ plus arterial occlusion. The potential benefit of this procedure, in appropriately selected patients, may be in minimizing the surgical dissection necessary to attain adequate hemostasis while removing all or most of the placenta. The authors stated that lateral extension of a percreta into the broad ligaments, or deep infiltration into the cervix or the ureters, preclude safe employment of this technique.19

Clausen et al41 reported 17 cases of placenta percreta treated with balloon occlusion and either hysterectomy or local resection. Mean estimated blood loss was lower in 9 patients in whom en bloc resection of the percreta was successful (2770 mL; range, 1300–6000 mL), compared with 8 women who underwent hysterectomy (5490 mL; range, 450–16,000 mL). The authors attributed the markedly higher blood loss in a single patient (16,000 mL) to extensive bladder adhesions and failure of timely inflation of an occlusion balloon. Even excluding this patient, the mean estimated blood loss and transfusion requirements remained higher in the hysterectomy group compared with the local resection group (3985 mL vs 2770 mL estimated blood loss; 1792 mL vs 1078 mL packed red blood cells transfused). Local resection relies heavily on the need for uterine artery occlusion, the utility of which remains controversial.

**Adjunctive procedures**

**Arterial occlusion**

Two primary methods of uterine artery occlusion have been described to reduce blood loss in cases of MAP: temporary use of intraarterial balloon catheters40,41 and uterine artery embolization.40,42 In the cohort study by Clausen et al41 noted in the previous text, 15 of 17 women had balloon occlusion catheters placed as part of a local protocol. It is important to note that the patient with the lowest estimated blood loss in this cohort underwent hysterectomy, and was one in whom balloon catheters were not placed. The authors noted only a “small change in bleeding when balloons were inflated in the internal iliac arteries.” This may be due to rich collateral feeding vessels arising from cervicovaginal branches of the uterine arteries, superior vesical, inferior epigastric, or femoral and deep circumflex iliac arteries.41

Routine intravascular occlusion remains controversial because of the lack of adequately powered randomized clinical trials demonstrating benefit. The contribution toward hemostasis that can be attributed to intrarterial occlusion is also difficult to evaluate because it is seldom used in isolation.41,42 Reported complications include iliac thrombosis,38 inadvertent embolization of the external iliac arteries, uterine necrosis,13 leg ischemia,44 and necrosis of the buttocks.45

**Methotrexate**

The use of methotrexate in the management of placenta accreta was first described in 1986.46 Methotrexate is a dihydrofolate reductase inhibitor that targets rapidly dividing cells, most commonly for the treatment of ectopic pregnancy and gestational trophoblastic disease. Some experts have used methotrexate as an adjunct to conservative management of placenta accreta47,51; however, the decrease in placental cell division in the third trimester limits the biological plausibility of purported benefits.

Some authors suggest that methotrexate is associated with rapid placental expulsion,52 yet there is significant overlap in the time to resolution with or without its use, and outcomes do not appear to differ significantly.53,54 Methotrexate is contraindicated during breast-feeding,55 which is widely accepted to promote neonatal short- and long-term health outcomes, maternal bonding, and neonatal attachment and may mitigate the risk of postpartum depression or perceived stress related to a traumatic delivery.56 Notably, the authors reporting the largest cohort of conservatively managed patients commented that “no convincing evidence currently supports the efficacy of methotrexate in cases of placenta accreta left in situ, and methotrexate-related pancytopenia and nephrotoxicity are possible adverse effects.”57
Delayed hysterectomy

Delayed hysterectomy is largely described as an emergent procedure performed as a consequence of delayed complications after attempted conservative management. Planned delayed hysterectomy is not truly a conservative approach in the sense of being a fertility-sparing method. Rather, it is a hybrid approach aimed at the prevention of complications that may occur with either immediate hysterectomy or prolonged placental retention. By allowing spontaneous regression of some of the placental bulk, it is believed that the risk of hemorrhage at the time of hysterectomy can be reduced. Published data to support this practice are scarce, and the optimal timing of planned delayed hysterectomy is unclear.

Long-term considerations

Risk of recurrence after conservative management

The risk of recurrence of MAP likely depends on the type and number of treatments rendered. In a retrospective, multicenter cohort, Sentilhes et al identified 21 of 96 women who had undergone conservative management of accreta and later conceived. Of these, 6 (29%) had a recurrence of accreta. Severe uterine synechiae and amenorrhea were identified in 3 patients (14%). We identified at least 1 case report of uterine rupture in a pregnancy following conservative management of MAP. Whereas limited cases of successful pregnancy have been reported, these reports are subject to publication bias and more data are needed.

Cost of planned hysterectomy vs conservative management

Early hospitalization, planned cesarean hysterectomy, massive transfusion, and multidisciplinary and intensive care unit care are expensive. However, conservative management likely involves substantial direct and indirect financial cost. A systematic review of 119 placenta percreta cases compared outcomes based on initial mode of treatment: planned hysterectomy, local resection, or leaving the placenta in situ. Of the 36 women in whom the placenta was left in situ, 61% had late complications (defined as occurring later than 24 hours after delivery), compared with 12% in those who initially had hysterectomy or local resection. In 21 of these 36 women (58%), a hysterectomy was required. Repeated attempts at hysteroscopic resection of placental tissue (up to 3) may also be needed.

The costs of long-term follow-up, repeat imaging, outpatient visits and/or hospital readmissions, and emergent hysterectomy could foreseably accumulate to far more than that for planned cesarean hysterectomy. The actual direct and indirect costs of either type of management remain to be compared systematically.

Comment

Conservative management of MAP, much like a planned cesarean hysterectomy, should be considered only with appropriate counseling in centers equipped to manage the initial procedure and any subsequent complications. Candidates for conservative management must be carefully chosen, and to date, there are few data to guide the individualization of care. Patients contemplating a conservative approach must be thoroughly counseled about short- and long-term risks and the need for close, potentially lengthy monitoring.

One must consider compounding of risk whenever multiple adjunctive measures are performed. Data regarding the use of arterial occlusion support their use as part of a protocol, only in which experienced interventional radiology support is readily available. These procedures may best be performed in centers equipped to bring a C-arm into the operating room to reduce the risk of catheter migration or treatment delay should a patient rapidly decompensate. Arterial occlusion appears to be more effective when combined with a surgical approach rather than leaving the placenta in situ. The risks of the use of methotrexate outweigh potential benefits and it should not be used for MAP.

Clear guidance about eligibility and contraindications for conservative management are needed. En bloc resection may not be suitable in patients with extensive lateral or cervical invasion. It seems that in women with a clearly delineated, focal area of involvement and an accessible border of healthy tissue, placental bulk could be reduced. Published data would support this practice are scarce, and the optimal timing of planned delayed hysterectomy is unclear.

TABLE

Proposed criteria to identify failed trial of conservative management

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<td>Ongoing hemorrhage despite conservative management (no time limit; may occur hours to weeks after delivery)</td>
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<tr>
<td>Cardiovascular instability or signs of hemorrhagic shock (hypotension, tachycardia, decreased urine output)</td>
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<td>Disseminated intravascular coagulopathy (immediate or delayed)</td>
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<td>Identification at the time of delivery of any contraindications to conservative management (lateral or deep cervical invasion)</td>
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<td>Development of complications as a result of conservative techniques requiring abandonment of the approach (ie, arterial injury after attempted intraarterial balloon occlusion or embolization)</td>
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<td>Severe pain following conservative management</td>
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<td>Maternal request for definitive surgical management (hysterectomy) after attempted conservative management</td>
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myometrium, local resection is reasonable. In these cases, an initial, gentle attempt at placental removal is also acceptable but only when sufficiently confident that any remaining placenta and/or myometrium can be removed en bloc or bleeding stopped with compression sutures.

Attempts to remove the placenta are best avoided in any patient with deep invasion and in whom the placenta invades behind the bladder, cervix, broad ligaments, or retroperitoneal regions inaccessible to immediate hemostatic control. Conservative methods should be considered only with preparations for immediate conversion to hysterectomy.

The clinical team must be willing to abandon conservative management efforts, and clear endpoints must be established a priori. Criteria defining a failure of conservative management or a reasonable number of consecutive treatments are lacking; however, a list of proposed criteria are listed in the Table. Because a large proportion of conservatively managed patients require delayed hysterectomy, we propose that all cases be considered a trial of conservative management and monitored accordingly.

One must distinguish the 2 distinct goals of conservative management when counseling patients: avoiding immediate complications vs fertility preservation. An uncomplicated pregnancy cannot be guaranteed, and a subsequent pregnancy may place patients at an increased risk of recurrence or uterine rupture. Objective data regarding long-term outcomes are needed before we can endorse conservative management as a safe fertility-sparing measure.

Finally, improved transparent reporting with patient-level obstetric detail is needed to facilitate meaningful comparisons and metaanalysis. Without standard criteria to confirm depth of invasion (with histology or sophisticated imaging) and clear reporting, it is difficult (if not impossible) to confidently compare outcomes. No studies could be identified that directly address the following: (1) psychological impact of the diagnosis of MAP and/or treatment rendered; (2) cost by severity of invasion and/or chosen treatment, and (3) appropriate timing and impact on the resumption of normal activity levels.

In Europe, efforts are underway to develop working groups to facilitate multicenter studies, such as those by the European Working Group on Abnormally Invasive Placenta. A prospective cohort study involving 182 centers in France (Clinical Situations at High Risk of Placenta Accreta/Percreta) aims to identify the following: individual risk factors for accreta and hemorrhage; current prevalence; predictive values of ultrasound and magnetic resonance imaging; the psychological impact and physical implications of treatment; and maternal complications during the year after delivery. Although these efforts hold promise, better still would be the development of an international database comprised of standardized, patient-level information to promote meaningful comparison of outcomes.

REFERENCES


