Anaesthesia for Patients With Abnormal Placentation

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Published 5 July 2023

KEY POINTS

- Abnormal placentation encompasses disorders of defective placental implantation in the uterus.
- The most common forms of abnormal placentation are placenta praevia and accreta spectrum disorders.
- Abnormal placentation is associated with increased maternal and neonatal morbidity and mortality, most commonly from massive obstetric haemorrhage.
- Previous caesarean delivery and assisted reproductive technology are risk factors for abnormal placentation.
- Early diagnosis and multidisciplinary team management within a specialist centre is recommended for safe management and delivery planning.

INTRODUCTION

Abnormal placentation is a broad term encompassing a wide variety of clinico-pathological conditions arising from defective implantation of the placenta in the uterus.

After conception, blastocysts implant in the endometrium by apposition and then invasion. Normal placentation involves invasion of the endometrial cells and stroma by the trophoblastic layer of the embryo,[1] allowing villi to lie adjacent to maternal spiral arteries. Implantation abnormalities can variably arise from placental shape abnormalities, velamentous cord insertion, defective remodelling of maternal spiral arteries, abnormally located placenta and morbidly adherent placenta.[2]

The most commonly encountered abnormalities in clinical practice are placenta praevia and placenta accreta spectrum (PAS).[2] Placenta praevia is defined as a placenta lying in the lower uterine segment and can be subdivided into major praevia when the cervix is covered by placenta and minor praevia when the placenta lies within 20 mm of the internal cervical os. PAS refers to a range of disorders from an abnormally adherent placenta through placental tissue that invades deep into or through the uterine wall.

This tutorial will focus on PAS and placenta praevia.

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DEFINITION AND CLASSIFICATION

The classification of abnormal placentation is based on invasion of the placenta into the uterine wall (as in PAS) and the distance between the placental edge and the internal cervical os (as in low-lying placenta and placenta praevia; see Table 1). The definitive identification of PAS depends on the histological depth of placental tissue invasion into uterine structures—this may be estimated on imaging but is not always accurate.

INCIDENCE

Due to the broad range of conditions that abnormal placentation encompasses, the reported incidence is variable and depends on the definition used. PAS disorders occur in 1:300 to 1:2000 pregnancies, depending on diagnostic criteria.[3] In the United Kingdom, the incidence of PAS is estimated at 1.7 per 10 000 pregnancies (95% confidence interval [CI] 1.4-2.0); however, this can be as high as 1:20 for patients with a history of at least 1 caesarean delivery (CD) or a history of placenta praevia.[4] The incidence of placenta praevia is reported as 1:200 pregnancies, with the incidence of major placenta praevia at 1:1000.[4,5]

MORBIDITY AND MORTALITY

Complications may occur during the pregnancy or in the postpartum period (see Table 2). Abnormal placentation is associated with increased maternal and neonatal morbidity and mortality[9]:

- Intrapartum haemorrhage: relative risk (RR) 2.6 (99% CI 2.1-3.3)
- Postpartum haemorrhage: RR 5.4 (99% CI 2.8-10.3)
- Blood transfusion: RR 17.8 (99% CI 17.2-25.9)
- Intensive care unit (ICU) admission: RR 19.1 (99% CI 15.6-23.3)
- Hysterectomy within 6 months of delivery: RR 234.9 (99% CI 191-285)
- Premature delivery:
  - ≤32 weeks gestation age: RR 5.8 (99% CI 4.9-7.0)
  - 33 to 36 weeks' gestational age: RR 3.2 (99% CI 2.8-3.8)
- Neonatal death prior to hospital discharge: RR 1.6 (99% CI 1.0-2.7)

RISK FACTORS ASSOCIATED WITH ABNORMAL PLACENTATION

Risk Factors for Low-Lying Placenta and Placenta Praevia[3,6]

- History of low-lying placenta or placenta praevia
- History of CD:
  - 1 prior CD: RR 4.5 (95% CI 3.6-5.5),
  - After ≥4 CDs: RR 44.9 (95% CI 13.5-149.5)
- Multiple gestation and placenta praevia:

Term	Definition
Placenta accreta spectrum (*PAS*)	A term used to include both the abnormally adherent and invasive forms of accreta placentation *Accreta or adherent*: villi adhere superficially to the myometrium without interposing the decidua *Increta*: villi penetrate deeply into the uterine myometrium through to the serosa *Percreta*: villi perforate through the entire uterine wall and may invade the surrounding pelvic organs, such as the bladder
Morbidly adherent placenta	A term previously used to describe the clinical complications associated with a retained placenta (it does not encompass the abnormally invasive end of the accreta spectrum)
Caesarean scar implantation	Placentation over the scar of a previous caesarean delivery
Placenta praevia (or *placenta praevia major*)	Placenta lying directly over the internal cervical os
Low-lying placenta (or *placenta praevia minor*)	Placental edge is less than 20 mm from the internal os on transabdominal or transvaginal ultrasound scanning performed after 16 weeks' gestation

Table 1. Definitions of Abnormal Placentation Disorders[2,3]

Early pregnancy
- Spontaneous termination of pregnancy with profuse bleeding
- Retained products of conception

Late pregnancy
- Antepartum haemorrhage
- Increased risk of thromboembolic events (4% of women with PAS)[6]
- Intrauterine growth restriction
- Spontaneous uterine rupture with massive haemorrhage[7]
- Increased incidence of preterm delivery and subsequent neonatal complications
- Increased incidence of caesarean delivery

Intrapartum and postpartum period
- Increased risk of blood loss and major obstetric haemorrhage
- Hysterectomy
- Risk of admission to ICU (40%-50%)[7,8]
- Associated complications of ICU admission and mechanical ventilation (eg, pneumonia, pyelonephritis)
- Prolonged bladder catheterisation
- Prolonged hospitalisation[7]

Long-term morbidity
- Posttraumatic stress disorder (up to 50% incidence)[7]
- Sexual dysfunction
- Fertility issues
- Risk of recurrence

Table 2. Complications Associated With Placenta Accreta Spectrum. ICU indicates intensive care unit; PAS, placenta accreta spectrum

  - Monochorionic twins: RR 3.29 (95% CI 1.32-8.21)
  - Dichorionic twins: Adjusted odds ratio (aOR) 1.54 (95% CI 1.15-2.06)
- Assisted reproductive technology (ART): RR 3.71 (95% CI 2.67-5.16), independent of the higher rate of multiple gestation
- Smoking: RR 1.08 (95% CI 1.07-1.09)
- Advanced maternal age (≥35 years)

Risk Factors for PAS[3,6]

- History of PAS
- Current placenta praevia, particularly if overlying a CD scar
- Previous surgical scarring of the uterus:
  - Previous CD:
    - 1 prior CD: OR 8.6 (95% CI 3.54-21.1)
    - ≥3 CDs: OR 55.9 (95% CI 25.0-110.3)
  - Dilatation and curettage, especially repeated
  - Manual removal of placenta
  - History of postpartum endometritis
  - Endometrial resection
  - Myomectomy
- Uterine pathology which has not undergone surgical intervention, including a bicornuate uterus, submucous fibroids, or myotonic dystrophy
- ART, most notably in vitro fertilisation
- Advanced maternal age (≥35 years)—increases the aOR by 1.30 (95% CI 1.13-1.50) for every 1-year increase

MANAGEMENT OF ABNORMAL PLACENTATION

The main principles of management include:

- Early identification of abnormal placentation
- Multidisciplinary team (MDT) management in a specialist facility
- Appropriate perinatal anaesthetic care
- Specialised obstetric care

Early Identification of Abnormal Placentation

A thorough review of a patient's history including screening for risk factors of abnormal placentation (see above), combined with routine imaging during the second trimester (eg, transabdominal foetal anomaly scan between 18 weeks 6 days and 21 weeks 6 days) should identify most patients with abnormal placentation.[3]

Diagnosis of Low-Lying Placenta and Placenta Praevia

Diagnosis is facilitated by both transvaginal and transabdominal ultrasound scanning. The foetal anomaly scan includes placental localisation, which identifies patients at risk of placenta praevia. For this cohort, a follow-up scan including transvaginal ultrasound at 32 weeks' gestation is scheduled to identify placenta praevia. An additional transvaginal ultrasound scan at 36 weeks may follow to inform discussion around delivery planning. Transvaginal ultrasound scans are safe and superior to transabdominal and transperineal ultrasound scans.[3]

Diagnosis of PAS

The foetal anomaly scan will often detect signs suggestive of PAS. Signs on ultrasound include abnormalities of the uterine-bladder interface, abnormal vasculature on colour Doppler imaging and placental 'lacunae', whereby large feeder vessels give the appearance of 'moth-eaten' areas. Patients with such signs should be referred to a specialist unit for further imaging. In addition, any patient with a history of CD and current placenta praevia should also be referred.

Ultrasonographic imaging is unable to effectively identify the depth of placental penetration or differentiate between adherent and more invasive placental tissue, and it cannot define the extent of lateral myometrial invasion. Magnetic resonance imaging is increasingly used to complement ultrasound imaging to identify the depth of invasion, extent of lateral spread and any parametrial invasion. It has a sensitivity of 94.4% (95% CI 86.0%-97.9%) and specificity of 84% (95% CI 76.0%-89.8%).[3,10,11]

MDT Management in a Specialist Facility

Involvement of an MDT (see Table 3) is critical to ensure optimal maternal and neonatal outcomes for PAS cases. Key requirements include the following:

- On-site blood bank with immediate access
- Adult ICU
- Neonatal ICU
- Interventional radiology (IR)

Patients with a known or high suspicion for PAS who present to centres that lack the above services should be transferred to a specialised centre, if clinically safe to do so. In nonspecialised centres when PAS is detected intraoperatively and the uterus has not yet been incised and the patient and foetus are stable, it is advised that the abdomen should be closed and the patient urgently transferred to a specialised centre.[3]

Studies comparing outcomes of specialised care provided by an experienced MDT compared with nonspecialised care have reported improved outcomes, with a reduction in the complication rate from 74% to 47% ($P = .026$) and a lowered maternal morbidity OR to 0.22 (95% CI 0.07-0.70).[12,13]

• Maternal-foetal medicine specialist
• Obstetrician
• Gynaecologist with experience in complex pelvic surgery
• Urologist
• General surgeon
• Obstetric anaesthetist
• Interventional radiologist
• Vascular surgeon
• Haematologist
• Intensivist
• Neonatologist

Table 3. Example of Multidisciplinary Team Members for a High-Risk Obstetric Patient. The Royal College of Obstetricians and Gynecologists' Green Top Guideline 27a recommends direct consultant care and specifically that a 'call if needed' approach is not acceptable for these complex cases[3]

Anaesthetic Management

Perioperative anaesthetic considerations require significant preparations to optimise maternal and foetal outcomes (see Table 4).

Key factors to consider when planning CD for a patient with placenta praevia or PAS include the following (see Tables 5 and 6):

1. Location of surgery
   - In many hospitals, the labour ward and obstetric operating rooms are geographically isolated from other specialised services.
   - The preferred location should allow rapid access by other necessary personnel.
   - It is a multifactorial location-specific decision to identify an appropriate operating room to enable rapid access to additional anaesthetic and/or surgical staff if help is urgently requested, fast access to a blood bank and close proximity to adult and neonatal ICU facilities.
2. Coagulopathy—identification and management
   - Maternal morbidity from abnormal placentation is mostly associated with massive peripartum haemorrhage, which may consume fibrinogen and coagulation factors and lead to disseminated intravascular coagulopathy.
   - Blood loss $\geq$1.5 L can be associated with major coagulopathy, especially when $\geq$3 units of packed red blood cells have been administered, likely due to administration of cooled red blood cells anticoagulated with citrate.[14]
   - Patients with placenta praevia undergoing a CD under general anaesthesia have a greater blood transfusion requirement that those under neuraxial anaesthesia according to a randomised controlled trial, likely due to tocolytic effects of volatile anaesthetic agents.[15]
   - Blood products should be present in the operating room prior to the start of surgery in anticipation of massive haemorrhage.
   - Blood product administration should be initiated due to clinical status and ongoing requirements assessed by the clinical status and trend data from regular blood sampling for anaemia, coagulopathy and hypofibrinogenaemia.
   - Cell salvage systems should be considered, alongside a clearly defined plan for aspiration of amniotic fluid from the surgical field with a separate suction system.
   - Point-of-care thromboelastometry or thromboelastography are useful to target blood product replacement.
   - Considerations during blood product administration decisions:
     - Conservative haemoglobin targets should be used to minimize transfusion-associated risk (eg, haemoglobin $>$70 g/L), but caution should be taken in the acute setting.
     - Thrombocytopenia should be managed with a platelet transfusion, especially if $<70 \times 10^9$/L.
     - Coagulopathy should be corrected with fresh frozen plasma (consider a formula-driven resuscitation).
     - Isolated hypofibrinogenaemia ($<$2 g/L) should be corrected with cryoprecipitate (or synthetic fibrinogen concentrate, if available).
   - Maintaining homeostasis: normal maternal core temperature and normocalcaemia are paramount.

Patient
- Detailed preoperative anaesthetic assessment
- Risk assessment for general anaesthesia: airway, associated medical and surgical comorbidities, aspiration risk
- Involvement of a senior anaesthetist
- Discuss the risks and benefits of neuraxial and general anaesthesia; if neuraxial anaesthetic is planned, the potential requirement for conversion to general anaesthesia should be discussed[3]
- Appropriate fasting guidelines with antacid prophylaxis
- Venous thromboembolic prophylaxis (appropriately timed with neuraxial techniques)

Equipment and logistics
- Review of obstetric plan for caesarean delivery and any additional planned procedures, eg, insertion of iliac catheters, aortic balloon, hysterectomy
- Liaise with the MDT to confirm the availability of specialists
- Liaise early with blood bank and confirm appropriate product availability as per local protocol for massive obstetric haemorrhage (specialist units may have separate protocols for abnormal placentation)
- Review of imaging to assess the depth of invasion and persistence of placental position
- Operating room planning:
  - Senior consultant-led procedure
  - Role allocation in case of emergent conversion to general anaesthesia
  - Availability of cell salvage, invasive monitoring, rapid fluid infuser
  - Consider invasive cardiac output monitoring and ability to administer vasopressors and inotropes
  - Discuss bed availability in the intensive care unit

Table 4. Key Features of Preoperative Assessment and Preparation for Caesarean Delivery of Patients With Placenta Praevia and Placenta Accreta Spectrum

World Health Organisation surgical safety checklist performed with particular attention to:
- Management of intraoperative blood loss—preoperative planning, availability of blood products, blood loss measurement techniques and consideration of cell salvage (especially in patients who refuse blood transfusion)
- Maternal and neonatal resuscitation equipment
- Immediate availability of additional specialists; consultant obstetricians, anaesthetists, general surgeons, urologists, and interventional radiologists
- Monitoring and equipment
- Pressure bags and rapid fluid transfuser
- Core temperature monitoring
- Forced air warmer and intravenous fluid-warming devices to maintain maternal core temperature >36°C
- Invasive monitors, eg, arterial line for haemodynamic monitoring and intraoperative blood sampling

Vascular access
- Vasopressors (eg, phenylephrine, ephedrine and noradrenaline)
- A minimum of 2 large-bore intravenous cannulas (16 or 14 gauge) prior to incision to facilitate rapid blood and fluid administration
- An introducer sheath and/or central venous catheter should be considered in patients with difficult vascular access, for anticipated rapid large-volume resuscitation and/or administration of vasopressors

Induction of anaesthesia
- General, neuraxial or a combined anaesthetic technique as per preoperative discussion with the patient, taking into consideration the possibility of a prolonged procedure and haemorrhage potential

Fluids and transfusion
- Appropriate fluid administration (eg, balanced crystalloid solution) guided by clinical and haemodynamic monitoring
- Blood transfusion based on local protocols
- Intraoperative cell salvage
- Tranexamic acid 1 g intravenously[13]

Other considerations
- Potential need for interventional radiology
- May require repeated doses of prophylactic antibiotics due to surgical duration and/or high blood loss
- Uterotonic drugs as indicated
- Ongoing effective communication between the anaesthetic and obstetric teams

Table 5. Intraoperative Management of Caesarean Delivery for Patients With Placenta Praevia and Placenta Accreta Spectrum

3. Choice of mode of anaesthesia
   - Placenta praevia
     - Neuraxial anaesthesia is safe and associated with lower rates of major haemorrhage than general anaesthesia.[15]
     - It may be necessary to convert to a general anaesthetic due to a prolonged surgical duration, or massive haemorrhage, which should be included in the consent process (although the risk of haemorrhage is less with an isolated placenta praevia compared with PAS disorder).
   - Placenta accreta spectrum
     - Surgical plans are dependent on the expected level of infiltration of placental tissue and the potential for hysterectomy.
     - The mode of anaesthesia is recommended by the anaesthetist after being made aware of the anticipated surgical extent and finalised in a shared decision-making process with the patient.
       - Neuraxial anaesthesia alone (eg, combined spinal-epidural anaesthesia) can be an appropriate option as it enables the patient to be awake during delivery, avoids foetal exposure to general anaesthesia and has the ability to extend the duration of surgical anaesthesia.
       - Neuraxial anaesthesia and elective conversion to general anaesthesia postdelivery allow for a good risk balance for the mother and baby but includes the potential risks of airway manipulation (eg, difficult or failed intubation).
       - General anaesthesia has been used safely. Preoperative neuraxial techniques (eg, spinal or epidural) can be considered to manage postoperative pain.
4. Choice of uterotonic drugs
   - The use of uterotonic drugs in PAS should be included in the MDT discussion and in the time-out in the operating room prior to incision, as these drugs can contribute to partial separation of the placenta and increase blood loss.
5. Postoperative pain management
   - Multimodal analgesic approach:
     - Consider neuraxial opioids (intrathecal or epidural)
     - Consider postoperative epidural analgesia

Immediate actions
- Determine the level of postoperative care required based on intraoperative events, ongoing haemodynamic stability, adequacy of resuscitation and potential need to return to the operating room
- Evaluate any potential effect of massive blood loss and transfusion and treat if indicated: hyperkalaemia, hypocalcaemia, metabolic acidosis, transfusion-related circulatory overload and hypothermia

Immediate considerations
- Use of Maternal Early Warning Scores to initiate early evaluation in case of deterioration[3]
- Awareness of potential ongoing blood loss if hysterectomy has not been performed

Later actions
- Review postoperative blood tests and associated investigations, if indicated (eg, radiologic imaging, electrocardiography, echocardiography)
- Determine the most appropriate time to remove the epidural catheter, if indicated (consider coagulation or platelet abnormalities secondary to massive haemorrhage)

Later considerations
- Administration of venous thromboembolism prophylaxis (pharmaceutical and/or mechanical)
- Consideration for postoperative antimicrobials
- Experienced critical care or cardiac nursing care

Table 6. Key Features of Postoperative Management for Abnormal Placentation

    - If neuraxial analgesia is contraindicated, consider:
        - Intravenous patient-controlled analgesia
        - Regional anaesthetic techniques (eg, transverse abdominis plane blocks or quadratus lumborum blocks)—coagulopathy and thrombocytopenia should be excluded prior to commencement of regional anaesthesia[16]
        - Wound infiltration with local anaesthetic
- Challenges of postoperative analgesia:
    - Surgical management of abnormal placentation may require a relatively large incision and prolonged surgical time
    - Risk of coagulopathy associated with massive haemorrhage may preclude neuraxial blocks or limit the practicalities of epidural catheter insertion, manipulation or removal
    - Balance between opioid-induced side effects (eg, nausea, constipation, respiratory depression) and optimal postoperative analgesia in order for the patient to achieve good function and be able to care for their baby

Obstetric Management

Antenatal Counselling

The consent process should include discussing the risks associated with CD, in particular those specifically associated with PAS, including massive obstetric haemorrhage and preterm delivery.

Delivery Timing

PAS cases are considered as high risk and should have a detailed delivery plan for scheduled and emergency scenarios. The Royal College of Obstetricians and Gynaecologists recommend planned delivery between 35+0 to 36+6 weeks' gestation for patients with PAS in the absence of other risk factors for preterm delivery, to optimise the balance between foetal lung maturity and risks associated with unscheduled delivery.[3]

Surgical Approach for PAS

There are 4 surgical approaches that have been described depending on the depth of villous invasion, with the key unifying factor being that there is no attempt made to separate an adherent placenta from the uterine wall[3]:

1. Primary hysterectomy following delivery of the foetus
2. 'Uterus-conserving surgery', in which the foetus is delivered, followed by partial excision of the placental implantation site and associated uterine wall, followed by repair of the uterus
3. Delivery of the foetus leaving the placenta in situ with elective hysterectomy scheduled 3 to 7 days postpartum
4. 'Conservative management' involving delivery of the foetus but avoiding the placenta and repair of the incision, therefore leaving the placenta in situ with final management of the placenta involving 1 of the following:
    - Spontaneous placental reabsorption[17]
    - Spontaneous placental delivery[18]

- Hysteroscopic placental resection[19]
- Methotrexate administration in an attempt to suppress placental tissues and result in placental necrosis; however, this is not recommended as there is no reported benefit and high risk for side effects[3,18]

Interventional Radiology

IR is increasingly used to assist surgical and conservative management of abnormal placentation with variable success (available in only some surgical centres). Endovascular interventions include:

- Internal iliac artery balloon placement
- Infrarenal aortic balloon placement or resuscitative endovascular balloon occlusion of the aorta
- Uterine artery embolisation

Advantages of IR

- Reduced intraoperative haemorrhage
- Preserved fertility by avoiding hysterectomy
- Useful in the management of patients who decline blood transfusion (eg, Jehovah's witnesses)

Disadvantages of IR

- Contrast exposure and risk of renal damage
- Procedure-related complications, eg, accidental puncture of vessels, retroperitoneal haematoma, aneurysm formation
- Practical difficulties:
  - Different centres have different geographical and staffing setups—delivery of a neonate in the IR suite can raise potential patient safety issues due to the unfamiliar environment for the obstetric and midwifery or nursing teams and lack of appropriate neonatal resuscitation equipment
  - Attendance to IR before proceeding to the operating room may present logistical challenges, (eg, epidural insertion prior to transfer). If arterial balloons are placed in the operating room and the patient is transferred, there is the risk that the balloons may be displaced. This risks significant vascular trauma if the balloons are inflated in a wrong anatomical location.

Alternatives to IR

Some units place prophylactic internal iliac or uterine artery sutures prior to uterine incision. In the instance of uncontrolled intrauterine haemorrhage, these sutures may be tightened to provide rapid ligation.[20] Such techniques aim to avoid the potential complications and practical difficulties associated with intravascular balloon placement.

SUMMARY

PAS and other forms of abnormal placentation are becoming increasingly common with the global increase in CDs and use of ARTs. There is increased risk of maternal and neonatal morbidity and mortality, mainly due to increased risk of massive obstetric haemorrhage. Safe delivery planning involves an experienced MDT, which should include obstetricians, anaesthetists, interventional radiologists, haematologists and neonatologists with delivery performed in a specialised facility.

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