Abnormally invasive placentation: diagnosis and management

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Abstract

Abnormal placental invasion is associated with increased maternal morbidity and mortality. In an abnormally invasive placenta (AIP), the placental villi are not confined by the innate barrier of the uterine endometrium and invade the uterine myometrium and potentially even the uterine serosa. During the antenatal period, signs of abnormal invasion can be seen on ultrasound from as early as the first trimester. Typically, placental lacunae, a thin myometrium, abnormal blood flow in the placenta and myometrium, and/or an interrupted bladder edge should raise the clinical suspicion of AIP. Women with suspected AIP should be referred to centres with appropriate experience in the management of these cases, to optimize outcomes. Women are at significant risk of haemorrhage and other surgical complications. Therefore, skilled surgeons, anaesthetists and interventional radiologists should be involved in the planning and conduct of delivery of the baby. Some cases are not detected antenatally, only being recognized at the time of delivery. Appropriate assistance should be sought to plan and complete the delivery in these cases.

Keywords Abnormally invasive placenta; increta; morbidly adherent placenta; percreta; placenta accreta

Introduction

An abnormally invasive placenta (AIP) demonstrates abnormal adherence to the uterine wall and does not separate spontaneously during delivery. This represents a serious clinical condition which can lead to massive haemorrhage and even maternal death. Torrential bleeding can occur when there is forceful separation of the placenta from the uterine wall. The mean estimated blood loss in patients with AIP ranges from 2000 to 7800 ml, with an average of five units of blood needing to be transfused. The majority of all emergency peripartum hysterectomies and massive obstetric haemorrhages occur in the setting of an AIP. The condition occurs as a consequence of deficiency in the decidua basalis layer of the uterus. Variable degrees of placental invasion can occur, and will be discussed later. With increasing depths of invasion morbidity and mortality rates increase. Paralleling the increasing numbers of women giving birth by caesarean section, a significant rise in the prevalence of abnormal placental invasion has occurred over the last decade.

This review will focus on the epidemiology, demographics, diagnosis, planning and management of delivery in abnormal invasive placentation.

Epidemiology

In 1977 the reported incidence of placenta accreta was approximately 1 in 7000 pregnancies, which increased to 1 in 2500 pregnancies between 1985 and 1994. Another study documented a rise of AIP to 1 in 533 pregnancies between 1982 and 2002. The latest Italian observational data suggest an incidence of AIP of 1 in 322 pregnancies in 2013.

A one year UKOSS prospective obstetric surveillance study investigated the epidemiology of placenta accreta/increta/percreta in the UK between 2010 and 2011. The incidence was 1.7 (95th CI 1.4 −2.0) per 10,000 maternities overall, corresponding to 133 cases in one year in the UK. In this study the risk of AIP for women with a previous Caesarean section and a placenta praevia was 1 in 17.

Risk factors

Knowing the risk factors for abnormal placental invasion is fundamental knowledge for clinicians, and clinical risk assessment helps to identify women at elevated risk and facilitates early diagnosis.[3] The two main risk factors for AIP are placenta praevia in the current pregnancy (where the placenta covers the internal cervical os, occurring in approximately 1 in 200 pregnancies) and a history of a previous caesarean section. The two factors may be combined together to increase the risk. The risk increases with the number of prior caesarean sections.[5] Observational data suggest that in women with a placenta praevia, the risk for AIP is 3% for no prior caesarean section, 11% for one prior, 40% for two prior, 61% for three prior, and 67% for four or more prior caesarean sections. In the same study, in the absence of placenta praevia the risk was less than 1% for those with up to two caesarean sections, 2% for those with three or four previous caesarean sections, and 6% for those with a history of six previous caesarean sections.

Additional risk factors for AIP include other forms of uterine surgery which may damage the endometrial lining and/or superficial myometrium, such as myomectomy, uterine curettage, endometrial ablation and manual removal of placenta. Radiation treatment may also cause uterine damage and increase the risk. Prior placenta accreta or prior adherent placenta are also known risk factors; in a cohort of women with presumed AIP, 16% had a previous adherent placenta. There is also increasing evidence that a 'caesarean scar' pregnancy identified in the first and early second trimester may evolve into an intrauterine pregnancy with AIP in the second half of pregnancy.

Other demographic factors associated with AIP include advancing maternal age, high gravity, parity, IVF and multiple terminations of pregnancy. Maternal age over 35 years doubles the baseline risk.

Pathology

In AIP the decidua of the basal membrane between the myometrium and placenta is thinned or absent, leaving the placental trophoblast to lie in direct contact with the myometrium. There is

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no natural separation plane and the placenta is thus firmly adherent to the myometrium. The placental villi may even invade and penetrate through the entire myometrium and serosa. The lack of decidua can involve the whole placenta, or may be localized and affecting only part of the placental myometrial surface. Even a limited adherent area creates a problem if the placenta is forcefully separated from the myometrium at birth. In some cases of AIP the placental villi may also invade extra-uterine structures such as the bladder wall, making the removal of the uterus and placenta difficult and necessitating partial surgical resection of the bladder. The placenta may also invade other structures in the parametrium, e.g. broad ligament, cervix, or uterine artery. The exact pathogenesis of AIP is unknown. Proposed hypotheses include maldevelopment of the decidua, excessive trophoblastic invasion, or a combination of both. Depending on the depth of invasion, AIP can be graded into:

- Placenta accreta; the chorionic villi attach to the myometrium rather than being confined by the decidua basalis (78% of cases).
- Placenta increta; the chorionic villi invade into the myometrium (17% of cases).
- Placenta percreta; the chorionic villi fully penetrate through the myometrium into uterine serosa (parametrium) and in some cases adjacent structures (5% of cases).

Diagnosis

Antenatal diagnosis of AIP is important as it allows:

- Early identification of pregnant women at risk of AIP and definitive diagnosis
- Multidisciplinary planning of delivery
- Care and delivery in an appropriately experienced and equipped unit
- Appropriate counselling of the patient and family

As a consequence of antenatal detection of AIP, affected pregnancies can receive optimal management, associated with reduced maternal morbidity and mortality, including less bleeding and less need for further surgery.

Ultrasound is the primary imaging modality for the diagnosis of AIP, especially when performed at a specialist unit.[1] To aid identification of potential cases the RCOG have recommended that placental location should be documented during the detailed anomaly scan between 18 and 20 + 6 weeks' gestation. If the leading edge of the placenta is less than 20 mm away from the internal cervical os it is considered low-lying and if it is covering the internal cervical os it is a placenta praevia. If a low-lying placenta or a placenta praevia is suspected a transvaginal scan should be performed as this is safe and more accurate in confirming the diagnosis.

From the UKOSS surveillance data only 50% of cases were suspected before delivery and 97% of cases occurred in women with placenta praevia. Improving antenatal detection requires clinicians to have a high index of suspicion, perform a risk assessment to consider if there is increased risk of AIP, and arrange specialized imaging to aid diagnosis. In certain areas of the UK there are tertiary referral centres that will provide expertize to aid diagnosis; they encourage the use of specific referral criteria based upon risk factors. These referral criteria have not been agreed nationally; an example is given in Table 1.

Antenatal diagnosis can be challenging, is subjective and accuracy varies with operator experience. The International Abnormally Invasive Placenta Expert Group have written a protocol for the ultrasound examination and certain key features are listed below and illustrated in Figures 1 and 2.

- abnormality of the uterine–bladder interface (bladder wall interruption or placental bulge into bladder),
- abnormality of the myometrial-placental border (loss or irregularity of the myometrial placental border or myometrial thinning)

Example of risk stratification and referral criteria for abnormally invasive placenta: classification as either major, intermediate or minor risk factor

Major Risk Factors	History of: • Previous abnormally invasive placenta • Caesarean section • Previous trachelectomy (removal of cervix) • Suspected scar ectopic in this pregnancy
Intermediate Risk Factors	History of: • ≥ 2 episodes of endometrial curettage (including ERPC and STOP) • Uterine surgery involving the endometrium (e.g. myomectomy which breached the cavity or resection of uterine septum) • Endometrial ablation • MROP with significant PPH requiring blood transfusion • Asherman's syndrome
Minor Risk Factors	History of: • 1 episode of endometrial curettage (including ERPC and STOP) • IVF • MROP not requiring blood transfusion • Previous postnatal endometritis or septic miscarriage
Placenta Covering Os *Plus* One Major Risk Factor	Placenta covering os *plus* one intermediate or two or more minor risk factors Placenta <20 mm from os with a risk factor
Following completed detailed scan refer to regional AIP centre for imaging	Rescan 26–28 weeks locally. If placenta <20 mm from os refer to regional AIP centre

ERPC: evacuation of retained products of conception, STOP: surgical termination of pregnancy, MROP: manual removal of placenta, IVF: in vitro fertilization

Table 1

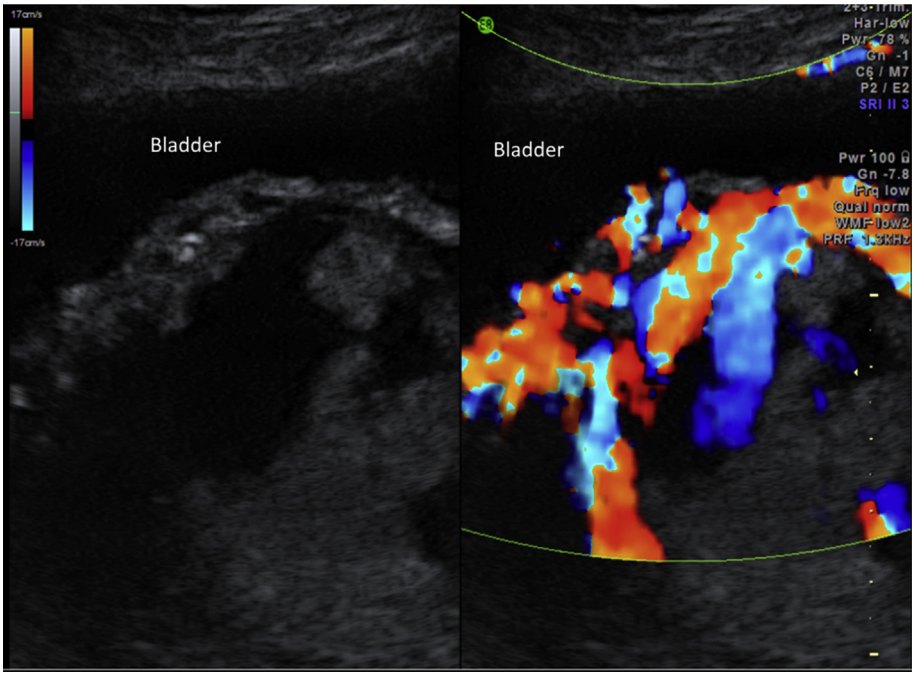

Figure 1 Large vascular lacunae on grey-scale ultrasound with increased vascularity on Colour Doppler mapping.

- placental structural abnormalities (lacunae which give the placenta a moth-eaten appearance often with turbulent flow within)
- abnormal vascularity demonstrated on Doppler (hypervascularity, bridging vessels extending from placenta across myometrium, placental lacunae feeder vessels).

Doppler ultrasound abnormalities have the best diagnostic performance.

Magnetic resonance imaging (MRI) is an alternative imaging modality and ideally its role is to complement specialist ultrasound imaging.[2] MRI may be superior to ultrasound in identifying the extent of abnormal invasion and involvement of surrounding parametrial structures. It may also be of value for posterior placenta praevia and suspicion of AIP, or history of myomectomy, as the ultrasound beam may be impeded by fetal tissue and scar tissue, making diagnosis more difficult. Diagnostic features on MRI include uterine bulging, heterogeneous signal intensity within the placenta, dark intra-placental bands on the maternal side of the placenta (T2-weighted), focal interruption of myometrium and tenting of bladder (Figure 3).

The predictive value of any test is dependent upon the prevalence of the disease in question, unlike the sensitivity and specificity which remain unaffected. Systematic review of test accuracy studies of USS or MRI have assessed different populations with the prevalence of AIP much higher in the MRI studies. We have therefore restricted comparison of test accuracy to the sensitivity and specificity of the imaging modalities. Overall, the diagnostic value of ultrasound and MRI in detecting AIP in experienced hands is similar. Ultrasound has a sensitivity of 91% (95% CI, 87–94%) and specificity of 97% (95% CI, 96–98%) in comparison to MRI which has a sensitivity of 94% (95% CI 86–98%) and specificity of 84% (95% CI 76–90%).

Counselling women with suspected AIP

It is optimal to involve both women and their families in any discussions to aid understanding, recall and decision making.

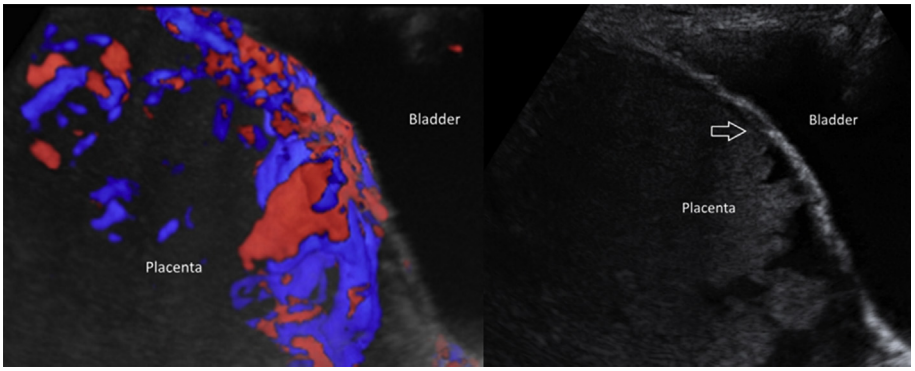

Figure 2 absent placental-bladder interphase (arrow) is a sign of abnormally invasive placenta. Increased vascularity in the placenta-bladder interphase in 3D ultrasound.

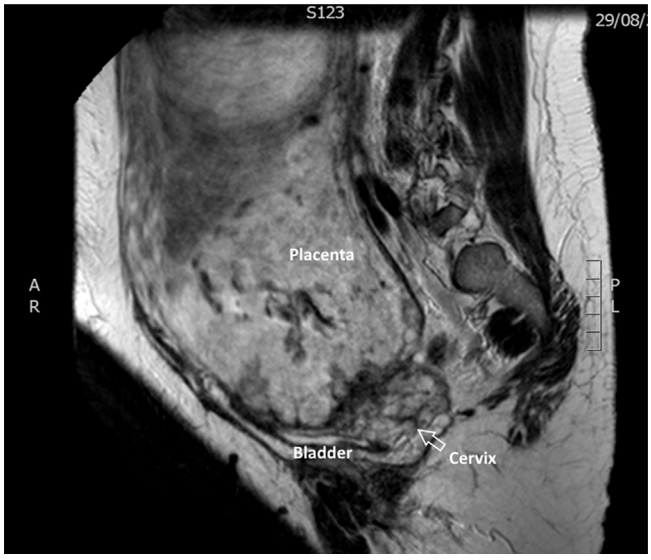

Figure 3 Magnetic resonance imaging. The placenta is localized above the cervix (placenta praevia). There are dark intra-placental bands and the placenta is heterogeneous in texture just above the bladder wall, however the bladder wall itself did not seem to be involved.

Women should understand that their baby will be delivered by mildly preterm caesarean section, as this provides the best balance between risk of unplanned delivery and prematurity of the baby. They must be counselled about the specific risk of massive haemorrhage and possible need for blood transfusion, cell salvage, interventional radiology and hysterectomy. There is an increased risk of surgical complications, particularly lower urinary tract damage (bladder and ureters) and a small risk of maternal death (up to 7% for placenta percreta). Women are usually admitted in advance of the delivery, particularly if they are resident at significant distance from the obstetric unit where they will be delivered. The exact timing of admission will also depend upon any history of vaginal bleeding. Such a history increases the risk of emergency delivery therefore admission should be considered at 32 weeks' gestation in those with a positive history and from 34 weeks' gestation in those with no history of vaginal bleeding.

To aid decision making as to the most appropriate surgical option there should be a conversation about whether the family is complete or whether future pregnancies are desired. The discussion should also consider the option of sterilization if the uterus is conserved and the risk of AIP in future pregnancy.

Because of the risk of antepartum bleeding, women are advised to avoid sexual intercourse. Additionally, any vaginal bleeding she should prompt her to contact the hospital and admission arranged. Patient information leaflets are helpful aids to patient counselling and are available on the RCOG website.

Management

Women with suspected AIP should ideally be cared for by a multidisciplinary team with appropriate expertize.[4] The National Patient Safety Agency, together with the RCOG and Royal College of Midwives, established the following six elements ('Care Bundle'), reflective of good care:

- Consultant obstetrician planning and directly supervising delivery
- Consultant anaesthetist planning and directly supervising anaesthesia at delivery
- Blood and blood products available at the time of delivery
- Preoperative planning by a multidisciplinary team
- Discussion and consent
- Local availability of a level 2 critical bed

Multidisciplinary planning

Elements of the planning will be discussed and include:

- Pre-operative investigations and management
  - FBC and ferritin: ensure anaemia corrected
    - Blood group and presence of antibodies: red cell antibodies may make cross-matching more difficult and time consuming.
    - Establish whether a patient would accept blood products if required
    - Further imaging- USS or MRI
    - Timing of admission
- Surgical planning:
  - Timing of elective surgery: The RCOG recommend 35 + 0 to 36 + 6 weeks for uncomplicated AIP whereas the ACOG recommend delivery between 34 and 35 weeks. Emergency delivery is associated with more bleeding than elective delivery.
  - Planning anaesthesia (general or regional); General anaesthesia is associated with increased bleeding but allows better access to the upper abdomen and is more suitable for long operative procedures. Regional anaesthesia is associated with less postoperative drowsiness and less neonatal morbidity. The decision should be made by the anaesthetist following consultation with the surgical team and the patient.
  - Urological support: there is no RCT evidence supporting routine ureteric stenting in cases of AIP however preoperative cystoscopy and/or ureteric stenting is considered in cases of suspected bladder involvement.
  - Interventional radiology: This aims to temporarily occlude the blood supply to the uterus thereby reducing blood loss. This is usually performed by the inflation of an intra-arterial balloon. There is also the possibility of embolization distal to the balloon if the former is not effective in reducing blood loss. There is a lack of evidence of benefit for interventional radiology with only one randomized controlled trial of internal iliac artery catheterisation in 27 patients which demonstrated no difference in blood loss, volume of blood transfusion, duration of surgery or need for hysterectomy. There is debate on the optimal artery for catheterisation (uterine, internal iliac, common iliac, aorta) as there is significant uterine blood supply through collateral circulation. There are also risks associated with the procedure including vascular ischaemia (limb and pelvic organs), puncture site problems (haematoma, false aneurysm or dissection) and arterial thrombus formation.
  - Anticipated transfusion requirements
  - Cell salvage availability: to allow autologous transfusion and reduce allogenic (from a compatible donor) blood use.

- Patient positioning (supine or lithotomy)
- Planned skin incision (Pfannenstiel or midline)
- Operative plan-removal of placenta, surgical resection, hysterectomy or conservative (placenta left in situ)
- Uterotonics: to be given or avoided
- Anticipated parametrial or paravesical dissection

- Team members to be present for delivery (elective and emergency)

Surgical approach

Uterine preservation may be requested by women in order that they may retain their fertility. It is appropriate if intra-operative bleeding is not excessive, the extent of the AIP is limited in depth and surface area, and the placenta is fully accessible. It is generally accepted that uterine incision should avoid the placenta as increased blood loss for both mother and baby is observed when it is incised. Ultrasound either immediately pre-operatively or on the table may assist in deciding where to make the uterine incision.

Broadly, there are four surgical approaches that can be considered:

1. Caesarean section hysterectomy: A primary hysterectomy performed following the delivery of the baby with the placenta left in situ, as any attempt to separate the placenta from the uterine wall is associated with increased risk of bleeding.
2. Partial excision of the myometrium around the abnormal placentation and repair of the uterus: This is possible if there is an area of normal myometrial tissue to allow repair above and below the abnormal invasion.
3. Leaving the placenta in situ: The uterine incision is closed and the placenta left in utero to reabsorb over the subsequent months. This option is only possible if bleeding is not excessive and the placenta does not partially separate. The risk of subsequent hysterectomy is about 30% in women where the placenta is left in situ; half occur within the first 24 h of the primary surgery and the rest are delayed. It can take up to 12 months (median 4 months) for the placenta to be entirely resorbed and the women are at risk of delayed haemorrhage, sepsis and fever due to tissue necrosis. It is important during counselling that women understand this and are able to attend for regular review during this time. The risk of AIP in subsequent pregnancies has been estimated at 10–30%. Oral antibiotics are usually recommended for one week post-delivery, however, uterine artery embolization and methotrexate have no proven benefit and are not routinely recommended. Placental reabsorption can be assessed with regular human chorionic gonadotrophin (β-HCG) and ultrasound examination.
4. Delayed hysterectomy: The uterine incision will be repaired, and the placenta left in utero. An elective secondary hysterectomy will be performed as a second procedure after an interval of approximately 1 week.

Surgical complications are related to the invaded anatomical area, its associated blood supply and the dissection of any organs involved with the AIP. Post-operative complications include:

- Massive haemorrhage.
- Transfusion reaction.
- Disseminated intravascular coagulation.
- Urinary tract injuries: cystotomy 6–29 %, ureteric 7%.
- Injury to the bowel, large vessels, and pelvic nerves.
- Urinary stasis, infection.
- Febrile illness.
- Pelvic or renal abscess.
- Renal impairment/acute kidney injury.
- Respiratory distress syndrome.
- Multi-organ failure.
- Ileus.
- Fistula formation.
- Ureteral stricture.
- Thromboembolism.
- Return to theatre: 20–30%.
- Mortality 1–7 %.

Postoperatively, the woman will be managed on delivery suite, a surgical high dependency unit or critical care setting depending on blood loss, acid-base balance and haemodynamic stability. A post caesarean section protocol should be followed for observations, or as modified by the multidisciplinary team. If there has been significant blood loss, transfusion or long operative duration there are risks of coagulopathy, hypocalcaemia, acidosis and hypothermia which require correction. Women are at increased risk of postoperative venous thromboembolism in view of prolonged operative time, heavy blood loss, extensive pelvic dissection, reduced mobility and possible blood product use. Therefore, low molecular weight heparin should be considered but it is important that the timing of the first dose is confirmed by the surgical team in case of any concerns of ongoing bleeding.

Emergency management

Emergency caesarean section in women with suspected AIP is mostly performed in the presence of vaginal bleeding, ruptured membranes and/or uterine contractions. Persistent pain may be a sign of imminent uterine rupture. If a woman has a pre-operative plan, it should be followed in an emergency situation. The on-call team of appropriate personnel, should undertake the delivery, including on call consultant obstetrician, obstetric anaesthetist, gynaecologist, interventional radiologist, and possibly vascular surgeon, and urologist. The neonatal team, the theatre coordinator, blood bank and critical care should also be alerted to the case and involved as required.

Some cases of AIP will not be diagnosed antenatally and it is important to recognize features of AIP at the time of surgery (Figure 4), which include:

- Abnormal vascularity on the serosal surface of the uterus.
- Bluish colour of the uterine wall.
- Bulging of uterine wall.

If these features are recognized, then it is important to ensure that the right team is present for the delivery and blood products are available. If a trainee has commenced the operation they should not continue until the on-call consultant obstetrician and anaesthetist is present. The consultant has to consider whether or not to transfer the patient to the AIP centre or to continue with the surgery locally. Delivery at the AIP centre is likely to result in less blood loss and morbidity but may increase the risk of fetal compromise and is only suitable if the patient is clinically stable. If surgery is performed locally it should involve delivery of the baby followed by a hysterectomy, leaving the placenta in situ.

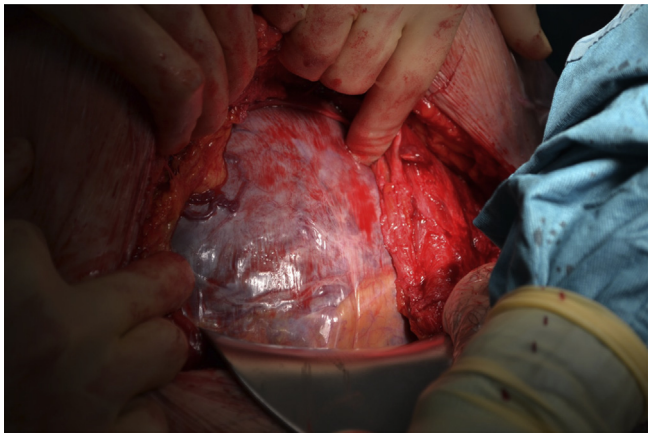

Figure 4 Intraoperative picture of a uterus with suspected abnormally invasive placenta. The bluish colour of the uterus with the large vessels can be seen.

Delivery of the placenta should not be attempted as it can be associated with severe bleeding. In extremis, aortic compression can be performed to try and control bleeding (it may be necessary to extend a vertical incision above the umbilicus to achieve this); it can be maintained for up to 4 h if necessary whilst further assistance is sought to control any bleeding.

Case discussion

A 38 year old para 6 with 3 prior low-transverse caesarean sections has a scan at 29 weeks' gestation with an obstetric consultant specializing in abnormal placental invasion. This demonstrates an anterior placenta praevia with large vascular lacunae, abnormal uterine–bladder interface with increased vascularity and suspicion of bladder involvement (Figures 1 and 2). The placental appearance is highly suspicious of abnormally invasive placenta (AIP). The subsequent MRI confirms a placenta praevia covering the internal cervical os and agrees that there is an area of localized placenta accreta with large placental lacunae, and intra-placental bands on T2 image in an area just above the bladder, but with no clear vesical involvement (Figure 3). There is no history of ante-partum haemorrhage, and an elective caesarean section is planned for 36 weeks' gestation, after administration of corticosteroids for fetal lung maturation. In view of the suspicion of bladder involvement urology presence is sought for the caesarean section. To minimize the risk of bleeding, interventional radiology pre-operatively site internal iliac artery balloons for inflation post-delivery of the baby. Before starting the caesarean section cystoscopy reveals no evidence of aberrant vasculature or placenta penetrating into the bladder dome. Ureteric stents are then placed. Figure 4 shows an intra-operative image of the uterus. A classical uterine incision away from the placenta is performed and a baby girl is born in good condition. The internal iliac artery balloons are inflated and embolization is not required. As the placenta does not separate spontaneously the uterine incision is closed (to minimize bleeding) and a primary total hysterectomy performed. Intra-operatively it is recognized that the placenta is adherent to the bladder wall, however careful dissection avoids vesical injury. The total estimated blood loss is 1700 ml. Pre-operative haemoglobin falls from 136 g/l to 122 g/l post-operatively, the decline being minimized by an autologous transfusion of 700 ml of cell-salvaged blood. No allogenic blood transfusion is required. The histology confirms that placental tissue was extending into the myometrial wall reaching the serosal surface consistent with a placenta percreta. ◆

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Practice points

- A high index of suspicion for women with risk factors is key in establishing high detection rates of AIP before birth.
- The two most important risk factors for abnormal invasive placentation are a placenta praevia in current pregnancy and a history of previous Caesarean section.
- Specialized ultrasound is the preferred diagnostic modality of choice, although MRI scanning may be superior in establishing the extent of involvement of adjacent structures, and in some cases of posterior AIP.
- Up to one third of cases may not have antenatal diagnosis. Remember the intra-operative features of AIP (abnormal vascularity on the serosal surface of the uterus, bluish colour and bulging of the uterine wall) and seek consultant assistance prior to delivery in these cases.
- Planned preterm elective delivery with a multi-disciplinary team minimises maternal morbidity and mortality, particularly if performed in a specialist centre.
- Use of interventional radiology has become standard practice in the management of AIP, however there is no high-quality evidence to support this.
- Surgical options include hysterectomy, excision of the affected myometrium and conservative management and the choice must be tailored to each individual case.