



Royal College of
Obstetricians &
Gynaecologists

Placenta Praevia, Placenta Praevia Accreta and Vasa Praevia: Diagnosis and Management

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Placenta Praevia, Placenta Praevia Accreta and Vasa Praevia: Diagnosis and Management

This is the third edition of this guideline. The first, published in 2001, was entitled *Placenta Praevia: Diagnosis and Management*; the second, published in 2005, was entitled *Placenta Praevia and Placenta Praevia Accreta: Diagnosis and Management*.

1. Purpose and scope

The purpose of this guideline is to describe the diagnostic modalities used for placenta praevia, vasa praevia and a morbidly adherent placenta and how they are applied during the antenatal period. Clinical management will be described in the antenatal and peripartum period with specific reference to the anticipation, planning and timing of surgery, as well as to the advanced techniques and interventions available for managing placenta accreta. This guideline does not address the problems of a suspected morbidly adherent placenta before fetal viability.

2. Background and introduction

2.1 *Placenta praevia and placenta praevia accreta*

Maternal and fetal morbidity and mortality from placenta praevia and placenta praevia accreta are considerable¹⁻¹¹ and are associated with high demands on health resources. With the rising incidence of caesarean sections combined with increasing maternal age, the number of cases of placenta praevia and its complications, including placenta accreta, will continue to increase,^{7,8,12-24} and updating the guideline for this condition is timely. In addition, vasa praevia, while rare, is nonetheless associated with high perinatal morbidity and mortality²⁵ and is therefore included in this guideline for the first time.

Placenta praevia exists when the placenta is inserted wholly or in part into the lower segment of the uterus. It is classified by ultrasound imaging according to what is relevant clinically: if the placenta lies over the internal cervical os, it is considered a major praevia; if the leading edge of the placenta is in the lower uterine segment but not covering the cervical os, minor or partial praevia exists.

A morbidly adherent placenta includes placenta accreta, increta and percreta as it penetrates through the decidua basalis into and then through the myometrium, but for ease of description the term accreta will be used in this guideline as a general term for all of these conditions.

2.2 *Vasa praevia*

Vasa praevia describes fetal vessels coursing through the membranes over the internal cervical os and below the fetal presenting part, unprotected by placental tissue or the umbilical cord.²⁶ This can be secondary to a velamentous cord insertion in a single or bilobed placenta (vasa praevia type 1), or from fetal vessels running between lobes of a placenta with one or more accessory lobes (vasa praevia type 2).²⁷ The reported incidence varies between one in 2000 and one in 6000 pregnancies,²⁷⁻³⁰ but the condition may be under-reported in the literature.³¹ Unlike placenta praevia, vasa praevia carries no major maternal risk, but is associated with significant risk to the fetus. When the fetal membranes are ruptured, either spontaneously or artificially, the unprotected fetal vessels are at risk of disruption with consequent fetal haemorrhage. Vasa praevia therefore often presents with fresh vaginal bleeding at the time of membrane rupture and fetal heart rate abnormalities such as decelerations, bradycardia, a sinusoidal trace or fetal demise.^{28,32,33} The mortality rate in this situation is around 60%,^{25,28,34} although significantly improved survival rates of up to 97% have been reported where the

diagnosis has been made antenatally.^{25,34} More rarely, bleeding can occur in the absence of membrane rupture. Because the fetal blood volume is around 80–100 ml/kg, the loss of relatively small amounts of blood can have major implications for the fetus, thus rapid delivery and aggressive resuscitation including the use of blood transfusion if required are essential.³⁵ Very rarely, fetal heart rate abnormalities in the absence of bleeding may be present secondary to compression of the fetal vessels by the fetal presenting part.³⁶

Risk factors for vasa praevia include placental anomalies such as a bilobed placenta or succenturiate lobes where the fetal vessels run through the membranes joining the separate lobes together, a history of low-lying placenta in the second trimester,^{37,38} multiple pregnancy³⁹ and in vitro fertilisation,^{40,41} where the incidence of vasa praevia has been reported to be as high as one in 300. The reasons for this association are not clear, but disturbed orientation of the blastocyst at implantation, vanishing embryos and the increased frequency of placental morphological variations in in vitro fertilisation pregnancies have all been postulated.^{42,43}

3. Identification and assessment of evidence

To update this guideline the Cochrane Library, Embase and Medline were searched for relevant randomised controlled trials, systematic reviews and meta-analyses: for placenta praevia and accreta the search dated from 2004 to 2009 (the search for the previous guidelines was up to May 2004); the search for vasa praevia was dated from 1950 to August 2009. The searches were performed using MeSH headings placenta praevia and placenta accreta and vasa praevia. As with the previous editions of this guideline, the majority of publications on placenta praevia and accreta are retrospective studies, case reports and reviews, with a paucity of prospective studies and randomised trials or meta-analyses. This was also the case for vasa praevia. In addition to the above the National Patient Safety Agency (NPSA), the RCOG and the Royal College of Midwives (RCM) ran a pilot care bundle for placenta praevia and caesarean section during 2008 and information from this has been included, although publication from this work postdated the end of the literature search.⁴⁴

4. Screening and diagnosis for placenta praevia/accreta

4.1 *Can we diagnose placenta praevia clinically?*

Clinical suspicion should be raised in all women with vaginal bleeding after 20 weeks of gestation. A high presenting part, an abnormal lie and painless or provoked bleeding, irrespective of previous imaging results, are more suggestive of a low-lying placenta but may not be present, and the definitive diagnosis usually relies on ultrasound imaging.



While clinical acumen remains vitally important in suspecting and managing placenta praevia, the definitive diagnosis of most low-lying placentas is now achieved with ultrasound imaging. Clinical suspicion should, however, be raised in any woman with vaginal bleeding (classically painless bleeding, or bleeding provoked by sexual intercourse) and a high presenting part or an abnormal lie, irrespective of previous imaging results.

4.2 *Should we screen for placental localisation?*

Routine ultrasound scanning at 20 weeks of gestation should include placental localisation.



The UK National Screening Committee does not recommend a national screening programme for placenta praevia, but it supports the current local practices of identifying at the routine 20-week antenatal screening ultrasound scan women whose placenta encroaches on the cervical os. This practice is not supported by evidence from randomised controlled trials but is supported by the RCOG and the National Institute for Health and Clinical Excellence (NICE).⁴⁵

Evidence level 4

4.3 How should we image for placental localisation?

Transvaginal scans improve the accuracy of placental localisation and are safe, so the suspected diagnosis of placenta praevia at 20 weeks of gestation by abdominal scan should be confirmed by transvaginal scan.

C

In the second trimester transvaginal sonography (TVS) will reclassify 26–60% of cases where the abdominal scan diagnosed a low-lying placenta,^{46,47} meaning fewer women will need follow-up. In the third trimester, TVS changed the transabdominal scan diagnosis of placenta praevia in 12.5% of 32 women.⁴⁸ Leerentveld et al.⁴⁹ demonstrated high levels of accuracy of TVS in predicting placenta praevia in 100 women suspected of having a low-lying placenta in the second and third trimester (sensitivity 87.5%, specificity 98.8%, positive predictive value 93.3%, negative predictive value 97.6% and false negative rate 2.33%).

Evidence level 2+

Numerous prospective observational trials have used TVS to diagnose placenta praevia and none has experienced any haemorrhagic complications, thus confirming the safety of this technique.^{46–50} There is still only one small randomised controlled trial (n=38)⁵¹ comparing transabdominal scan and TVS for placenta praevia, which supports this safety profile and reports superior views, especially for posteriorly situated placentas.

Evidence level 1-

4.4 Which women need further imaging if the placenta is low at 20 weeks of gestation?

All women require follow-up imaging if the placenta covers or overlaps the cervical os at 20 weeks of gestation.

C

Women with a previous caesarean section require a higher index of suspicion as there are two problems to exclude: placenta praevia and placenta accreta. If the placenta lies anteriorly and reaches the cervical os at 20 weeks, a follow-up scan can help identify if it is implanted into the caesarean section scar.

C

Placental ‘apparent’ migration, owing to the development of the lower uterine segment, occurs during the second and third trimesters,^{52–54} but is less likely to occur if the placenta is posterior⁵⁵ or if there has been a previous caesarean section.⁵⁵ In one study, only five of 55 women with a placenta reaching or overlapping the cervical os at 18–23 weeks of gestation (diagnosed by TVS) had placenta praevia at birth and in all cases the edge of the placenta had overlapped 15 mm over the os at 20 weeks of gestation.⁵⁶ A previous caesarean section influences this: a large retrospective review of 714 women with placenta praevia found that even with a partial ‘praevia’ at 20–23 weeks (i.e. the edge of the placenta reached the internal cervical os), the chance of persistence of the placenta praevia requiring abdominal delivery was 50% in women with a previous caesarean section compared with 11% in those with no uterine scar.⁵³

Evidence level 2+

Conversely, although significant migration to allow vaginal delivery is unlikely if the placenta substantially overlaps the internal os (by over 23 mm at 11–14 weeks of gestation in one study,⁵⁴ by over 25 mm at 20–23 weeks of gestation in another⁵² and by over 20 mm at 26 weeks of gestation in a third study⁵⁷), such migration is still possible and therefore follow-up scanning should be arranged.

4.5 When should further imaging occur?

Women who bleed should be managed individually according to their needs.

✓

In cases of asymptomatic women with suspected minor praevia, follow-up imaging can be left until 36 weeks of gestation.

D

In cases with asymptomatic suspected major placenta praevia or a question of placenta accrete, imaging should be performed at around 32 weeks of gestation to clarify the diagnosis and allow planning for third-trimester management, further imaging and delivery. D

D

Asymptomatic women without a previous caesarean section whose placenta has just reached but not covered the cervical os at the 20-week scan and in whom pregnancy is progressing normally can be managed expectantly, with further imaging at 36 weeks of gestation.⁴⁵

Women with major placenta praevia or placenta accreta are at high risk of preterm delivery and severe morbidity^{58,59} and therefore clarification of the diagnosis earlier than 36 weeks is beneficial. When the placenta has completely covered the cervix at the 20-week scan, making major placenta praevia more likely, or if the placenta is anteriorly placed and reaching the os in a woman with a previous caesarean section, making placenta accreta more likely, earlier follow-up imaging is advised. Of those women in whom the placenta is still low at 32 weeks of gestation, the majority (73%) will remain so at term, but 90% of major praevias at this gestation will persist.⁵³ Imaging at 32 weeks therefore seems timely in enabling a fairly definitive diagnosis to be made alongside a plan for further care, including follow-up imaging for possible accreta, counselling for delivery and planning delivery.⁴⁴

Evidence level 4

4.6 How can a morbidly adherent placenta be diagnosed?

Women who have had a previous caesarean section who also have either placenta praevia or an anterior placenta underlying the old caesarean section scar at 32 weeks of gestation are at increased risk of placenta accreta and should be managed as if they have placenta accreta, with appropriate preparations for surgery made.

✓

Antenatal sonographic imaging can be complemented by magnetic resonance imaging in equivocal cases to distinguish those women at special risk of placenta accreta. D

D

Antenatal imaging techniques that can help to raise the suspicion of a morbidly adherent placenta should be considered in any situation where any part of the placenta lies under the previous caesarean section scar, but the definitive diagnosis can be made only at surgery. These techniques include ultrasound and magnetic resonance imaging (MRI). Numerous ultrasound imaging techniques have been reported over the years including greyscale, colour and/or three-dimensional power Doppler sonography.⁶⁰⁻⁶⁹

Most recently, Shih et al. compared prospectively 3D power Doppler with greyscale and colour Doppler techniques in 170 women of whom 72 had had a previous caesarean section.⁶⁹ Thirty-eight of the women with a previous caesarean section had placenta accreta identified at delivery. Considering just the 72 women with previous caesarean section, the diagnostic performance of the different ultrasound modalities are itemised in Table 1; in each case the results reported are when at least one diagnostic criterion was present. It can be seen that three-dimensional power Doppler gives the best overall results when an isolated criterion is found, but as multiple diagnostic criteria were commonly found in the women with placenta accreta, these predictions can be improved upon.⁶⁹

Evidence level 2+

Table 1. Diagnostic performance of different ultrasound modalities

	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Risk
Greyscale	95	76	82	93
Colour Doppler	92	68	76	89
Three-dimensional power Doppler	100	85	88	100

Ultrasound criteria for diagnosis were as follows:

Greyscale:

- loss of the retroplacental sonolucent zone
- irregular retroplacental sonolucent zone
- thinning or disruption of the hyperechoic serosa-bladder interface
- presence of focal exophytic masses invading the urinary bladder
- abnormal placental lacunae.

Colour Doppler:

- diffuse or focal lacunar flow
- vascular lakes with turbulent flow (peak systolic velocity over 15 cm/s)
- hypervascularity of serosa-bladder interface
- markedly dilated vessels over peripheral subplacental zone.

Three-dimensional power Doppler:

- numerous coherent vessels involving the whole uterine serosa-bladder junction (basal view)
- hypervascularity (lateral view)
- inseparable cotyledonal and intervillous circulations, chaotic branching, detour vessels (lateral view).

The role of MRI in diagnosing placenta accreta is still debated. Two recent comparative studies have shown sonography and MRI to be comparable: in the first study 15 of 32 women ended up having accreta⁷⁰ (sensitivity 93% versus 80% and specificity 71% versus 65% for ultrasound versus MRI); in the second study 12 of 50 women ended up having accreta and MRI and Doppler showed no difference in detection ($P=0.74$), although MRI was better at detecting the depth of infiltration in cases of placenta accreta ($P<0.001$).⁷¹ Many authors have therefore recommended MRI for women in whom ultrasound findings are inconclusive.⁷²⁻⁷⁴

Evidence level 2+

The main MRI features of placenta accreta include:⁷⁴

- uterine bulging
- heterogeneous signal intensity within the placenta
- dark intraplacental bands on T2-weighted imaging.

5. Antenatal management

Prevention and treatment of anaemia during the antenatal period is recommended.



5.1 Where should women with placenta praevia be cared for in the late third trimester?

Women with placenta praevia in the third trimester should be counselled about the risks of preterm delivery and obstetric haemorrhage, and their care should be tailored to their individual needs.



Any home-based care requires close proximity to the hospital, the constant presence of a companion and full informed consent by the woman.



The Cochrane systematic review, which has not been updated since November 2002,⁷⁵ only includes one randomised controlled trial comparing hospital versus home care.⁷⁶ The trial by Wing et al.⁷⁶ compared 26 women who were allowed home with 27 women kept in hospital and the only significant difference was a reduction in length of hospital stay.

Evidence level 1-

In the previous version of this guideline it was stated that those with major praevia who have previously bled should be admitted from approximately 34 weeks of gestation, while outpatient care can be considered for those with minor praevia or those who are asymptomatic. There remains a paucity of evidence to guide place of care. Since the last guidance, one retrospective observational review has been published that considered the care of 161 women with placenta praevia in the third trimester.⁷⁷ It demonstrated that neither the likelihood of bleeding nor the need for rapid

Evidence level 2+

delivery was associated with the degree of praevia. A small trial looking at whether cervical length might help in the prediction of those at risk of early delivery was too small to allow conclusions to be drawn.⁷⁸

Evidence level 2+

International opinion is similar, with the Royal Australian and New Zealand College of Obstetricians and Gynaecologists recommending that all women at risk of major antepartum haemorrhage should be encouraged to remain close to the hospital of confinement for the duration of the third trimester of pregnancy.⁷⁹

Evidence level 4

Where possible, home-based care should be conducted within a research context.

If women are managed at home, they should be encouraged to ensure they have safety precautions in place, including having someone available to help them should the need arise and, particularly, having ready access to the hospital.



It should be made clear to any woman being managed at home that she should attend immediately she experiences any bleeding, contractions or pain (including vague suprapubic period-like aches).



Decisions regarding blood availability during inpatient antenatal care should be based on clinical factors relating to individual cases as well as on local blood bank services. Women with atypical antibodies form a particularly high-risk group and discussions in these cases should involve the local haematologist and blood bank.



5.2 *Is there a place for cervical cerclage in these women?*

The use of cervical cerclage to reduce bleeding and prolong pregnancy is not supported by sufficient evidence to recommend this practice outside of a clinical trial.



There have been no new trials looking at this issue since the previous guidelines, which considered two studies on cervical cerclage^{80,81} included in the Cochrane review.⁷⁵ A total of 64 women were randomised and three women were lost to follow-up. Only one of these trials showed a possible benefit, with a reduction in the number of babies born before 34 weeks of gestation or weighing less than 2 kg, although randomisation was by birth date and analysis was by treatment received, not intention to treat.⁸⁰

Evidence level 1-

5.3.1 Is there a place for tocolytics in women who bleed?

Tocolysis for treatment of bleeding due to placenta praevia may be useful in selected cases. However, beta-mimetics were used in the studies to date and, as these are known to be associated with significant adverse effects, the agent and optimum regime are still to be determined: further research is needed in this area.



The aetiology of bleeding in placenta praevia is due to the dynamics of the development of the lower uterine segment, but may also be triggered by uterine activity. This has prompted obstetricians to try 'conservative aggressive management' of placenta praevia using tocolysis in this situation.^{82,83} The previous version of these guidelines considered evidence from a prospective randomised controlled trial of 60 women who presented with bleeding due to placenta praevia between 28 and 34 weeks of gestation.⁸⁴ Tocolysis using 10 mg of ritodrine every 6 hours by intramuscular injections for 7 days was compared with no treatment. Treatment was associated with prolongation of pregnancy (25.33±17.7 days compared with 14.47±20.33 days, $P<0.05$) and an increased birth weight (2.27±0.59 kg compared with 1.95±0.55 kg). No adverse effects to mother or baby were shown, and particularly no increased risk of bleeding was found. There have been no new trials to consider for this guideline update.

Evidence level 1+

Previous observational studies have reported similarly encouraging results. Besinger et al.⁸⁵ conducted a prospective study on 112 women with acute vaginal bleeding and known placenta praevia and gave tocolysis to 72 women who had significant uterine activity (85%). This group of women had a prolongation of the interval from admission to delivery (39.2 days versus 26.9 days, $P<0.02$) and an increase in birth weight (2.520 kg versus 2.124 kg, $P<0.03$) compared with the 40 women who were not given tocolysis. The largest series of cases where tocolysis was used for bleeding in the third trimester, including in 76 of 105 women with placenta praevia, is reported in a retrospective review by Towers et al.⁸⁶ and has suggested no increased morbidity or mortality associated with such use in a tertiary setting.

Evidence level 2+

5.3.2 Is there a place for the use of prophylactic tocolytics in women to prevent bleeding?

Prophylactic terbutaline to prevent bleeding has not been found to benefit women with placenta praevia.⁸⁷

Evidence level 2+

5.4 What precautions should be taken against venous thromboembolism for inpatients?

Prolonged inpatient care can be associated with an increased risk of thromboembolism; therefore, mobility should be encouraged together with the use of thromboembolic deterrent stockings and adequate hydration.



Prophylactic anticoagulation in women at high risk of bleeding can be hazardous and the decision to use it should be taken on an individual basis considering the risk factors for thromboembolism. Limiting anticoagulant thromboprophylaxis to those at high risk of thromboembolism seems reasonable.⁸⁸



In the postnatal period, immobility, massive haemorrhage and operative delivery are all risk factors for postnatal thromboembolism. Thromboprophylaxis should be considered according to Green-top Guideline No. 37: *Reducing the risk of thrombosis and embolism during pregnancy and the puerperium*.⁸⁸

6. Preparations for delivery

Prior to delivery, all women with placenta praevia and their partners should have a discussion regarding delivery, indications for blood transfusion and hysterectomy should be reviewed, and any concerns, queries or refusals of treatment should be dealt with effectively and documented clearly.



6.1 In what situations can vaginal delivery be contemplated for women with a low-lying placenta?

The mode of delivery should be based on clinical judgement supplemented by sonographic information. A woman with a placental edge less than 2 cm from the internal os in the third trimester is likely to need delivery by caesarean section, especially if the placenta is thick, but the evidence for this is poor and further research in this area is needed.



As the lower uterine segment continues to develop beyond 36 weeks of gestation, there is a place for TVS if the fetal head is engaged prior to an otherwise planned caesarean section.



No new trials addressing this question have been published since the last guidelines. Making a recommendation for a specific mode of delivery based on reports of ultrasound findings is difficult because studies have largely been retrospective and observational, with the decisions being influenced by knowledge of the ultrasound scan findings rather than being blind to them. Oppenheimer et al.⁵⁰ performed TVS in the third trimester on 127 women and 52 had placenta praevia. In 31 cases there was major placenta praevia and only 21 were partial praevias. Of these the mean distance from the leading placental edge to the cervical os was significantly different in

Evidence level 2-

those delivered by caesarean section than those aiming for and achieving vaginal delivery, with a cut-off distance of 2 cm ($P=0.0004$), but there was a 28% caesarean section rate in those in whom the leading placental edge was over 2 cm from the os and 12.5% of those in whom the leading placental edge was less than 2 cm away delivered vaginally.

Evidence level 2-

In another retrospective study⁸⁹ of 121 cases, two of 40 women with placentas within 0.1–2.0 cm of the cervical os delivered vaginally, while 22 of 39 with placentas further than 2 cm from the internal os achieved vaginal delivery. No mention is made in this paper of whether the placentas were anterior or posterior.

Decisions regarding the mode of delivery take into account clinical factors as well as ultrasound findings and the woman's preferences, especially if the fetal head has entered the pelvis. Ultrasound can add to this information in terms of where the fetal head is relative to the leading edge of the placenta, and the thickness of the encroaching tongue of the placenta has been shown to influence outcome: the thicker the placenta (over 1 cm), the greater the likelihood of abdominal delivery ($P=0.02$).⁹⁰

Evidence level 2+

6.2 *At what gestation should elective delivery occur?*

Elective delivery by caesarean section in asymptomatic women is not recommended before 38 weeks of gestation for placenta praevia, or before 36–37 weeks of gestation for suspected placenta accreta.

D

Although placenta praevia and placenta accreta are associated with preterm delivery, with 40% of women delivering before 38⁺⁰ weeks of gestation,^{58,59} cases requiring delivery are unpredictable and could only be avoided by a policy of delivery at 32 weeks of gestation. This would be unacceptable due to neonatal morbidity,⁹¹ but equally waiting too long can increase the chance of neonatal mortality.⁷ Individual characteristics should be considered, but with the planning needed for the especially high-risk cases suspected of having placenta accreta, planned delivery at around 36–37 weeks of gestation (with corticosteroid cover⁹²) is a reasonable compromise, while in those with uncomplicated placenta praevia delivery can be delayed until 38–39 completed weeks of gestation.^{44,93}

Evidence level 4

6.3 *What preparations should be made before surgery?*

Placenta praevia without previous caesarean section carries a risk of massive obstetric haemorrhage and hysterectomy and should be carried out in a unit with a blood bank and facilities for high-dependency care.

✓

The care bundle for suspected placenta accreta should be applied in all cases where there is a placenta praevia and a previous caesarean section or an anterior placenta underlying the old caesarean scar scar.

✓

In response to the findings of the confidential enquiry¹⁰ and the recognition of the severe morbidity associated with placenta praevia and previous caesarean section,²³ the NPSA in collaboration with the RCOG and the RCM set up an expert working group to develop a care bundle for placenta praevia accreta.⁴⁴ Six elements of good care that were considered to be uncontroversial were agreed. The care bundle was then tested in six units over a 5-month pilot study period and it was found to be both achievable and practical. Clinical outcomes were monitored, confirming the high morbidity associated with this condition. The six elements considered to be reflective of good care were:

- consultant obstetrician planned and directly supervising delivery
- consultant anaesthetist planned and directly supervising anaesthetic at delivery
- blood and blood products available
- multidisciplinary involvement in pre-op planning
- discussion and consent includes possible interventions (such as hysterectomy, leaving the placenta in place, cell salvage and intervention radiology)
- local availability of a level 2 critical care bed.

The reasoning behind the choices for these elements of care together with relevant references were compiled into a supportive document given to all pilot units and available on the NPSA/RCOG website.⁹³ The view regarding place of delivery is that women who decline blood products should be transferred to a centre where cell salvage and interventional radiology are available.⁹³

The unpredictable nature of this potentially high-risk surgery means that the need for a level 2 critical care bed should be confirmed before an elective procedure is embarked upon.¹⁰

Evidence level 4

6.4 What blood products are needed?

6.4.1 Placenta praevia

Blood should be readily available for the peripartum period; whether ready cross-matched blood is required and in what amount will depend on the clinical features of each individual case and the local blood bank services available. When women have atypical antibodies, direct communication with the local blood bank should enable specific plans to be made to match the individual circumstance.



The RCOG guidance on blood transfusion in obstetrics⁹⁴ recommends red cells, fresh frozen plasma and cryoprecipitate are all kept by blood banks supplying obstetric units.

There is no evidence to support the use of autologous blood transfusion for placenta praevia.



Dinsmoor et al.⁹⁵ retrospectively reviewed 88 women who had placenta praevia and only 12 (14%) would have been eligible for autologous blood donation/transfusion. Of the 12, only two were transfused at delivery but required a total of 12 units and 18 units. Current European Union legislation only permits blood establishments to perform this procedure⁹⁶ and it is not supported by the RCOG.⁹⁴

Evidence level 2+

Cell salvage may be considered in women at high risk of massive haemorrhage and especially in women who would refuse donor blood. D



Cell salvage in obstetrics has increased in use since the early studies⁹⁷⁻¹⁰¹ and a NICE guideline¹⁰² has been published since the previous version of this guideline. It has been used with success in placenta praevia¹⁰³ and in the USA anticipated difficulties with placenta praevia/accreta surgery are an indication for considering the use of cell salvage technology, where available.¹⁰⁴ The Obstetric Anaesthetists' Association (OAA) supports its use,¹⁰⁵ as does the RCOG, which suggests it is appropriate when anticipated blood loss exceeds 1500 ml.⁹⁴

Evidence level 4

6.4.2 Suspected placenta accreta

Cross-matched blood and blood products should be readily available in anticipation of massive haemorrhage. Where available, cell salvage should be considered and if the woman refuses donor blood it is recommended that she be transferred to a unit with a cell saver.



The use of cell salvage in obstetric units is increasing in the UK. During the pilot study for the NSPA/RCOG/RCM care bundle, all units included had a cell saver on the labour ward. This had not been a requirement for inclusion in the study. This study was too small to draw any conclusions or comment on any effect on maternal morbidity.⁴⁴ As more units acquire a cell saver and then become familiar with its use more information will become available as to its usefulness, but its availability does not remove the need to arrange for cross-matched blood.

Evidence level 4

6.5 *When is interventional radiology indicated?*

Interventional radiology can be life saving for the treatment of massive postpartum haemorrhage, and therefore having this facility available locally is desirable. If a woman is suspected of having placenta accreta and she refuses donor blood, it is recommended that she be transferred to a unit with an interventional radiology service.

D

The place of prophylactic catheter placement for balloon occlusion or in readiness for embolisation if bleeding ensues requires further evaluation.

D

The treatment of severe postpartum haemorrhage using interventional radiology techniques and selective embolisation has been well reported in case series,¹⁰⁶⁻¹¹⁰ but is unlikely to be subjected to a randomised controlled trial. Uterine artery embolisation in cases of uncontrolled haemorrhage can be life saving and uterus sparing and should be considered.

Evidence level 3

Less clear is the value of prophylactic placement of arterial catheters in cases where placenta accreta is suspected antenatally. This has not been subjected to a randomised controlled trial and the evidence comprises a number of case series with variable results, from beneficial¹¹¹⁻¹¹³ through equivocal^{107,114} to no benefit.^{115,116} Most recently, some case-control series have compared prophylactic catheter placement with controls: Shrivastava et al.¹¹⁷ compared 19 cases of balloon occlusion combined with hysterectomy with 50 cases of hysterectomy alone and found no difference in outcome; Tan et al.¹¹⁸ compared 11 cases of prophylactic balloons with 14 historic controls and found a reduction in operative time, blood loss and blood transfusion rates; a study from Edinburgh¹¹⁹ found that six of 12 prophylactic catheter placements were unnecessary, four of the remaining six women needed hysterectomy anyway, one woman bled after the catheter had been removed post-delivery and the catheter may have been useful in one case.

Evidence level 2+

There is a case report of a popliteal arterial thrombus requiring thromboembolectomy complicating common iliac balloon catheterisation at caesarean hysterectomy.¹²⁰ The current RCOG opinion is that further work is required to establish the risks and benefits of this technique as a prophylactic measure before it can be recommended.¹²¹

6.6 *What anaesthetic is most appropriate for delivery of the baby?*

The choice of anaesthetic technique for caesarean sections for placenta praevia and suspected placenta accreta must be made by the anaesthetist conducting the procedure. There is insufficient evidence to support one technique over another.



The data available on choice of anaesthetic technique for these cases has previously demonstrated differing opinions from UK obstetric anaesthetists,¹²² while evidence from the USA has supported regional anaesthesia.¹³ There have been no new trials since the previous guidelines, which considered two trials adding to the evidence in support of regional anaesthesia. The first was a large retrospective study of 350 cases of placenta praevia¹²³ where 210 women who received regional blockade were compared with 140 women who received general anaesthesia. There was more blood loss and more transfusion requirements in those having a general anaesthetic, and the two women who experienced major morbidity (one pulmonary embolus and one cerebral embolus) both had general anaesthetics. Of the five women with placenta accreta, four had regional anaesthesia initially, but two required conversion to general anaesthesia. In this trial, general anaesthetics were more commonly used in emergency situations and consultants were more likely to give regional anaesthesia than their junior colleagues, especially in emergencies.

Evidence level 2-

The second trial was a small randomised controlled trial of regional versus general anaesthesia for placenta praevia¹²⁴ where 12 women received general anaesthetic and 13 women received regional

Evidence level 1-

blockade. The numbers were small and more women in the general anaesthetic group had placenta praevia accreta (two versus one) or anterior praevia (four versus one), but outcomes were similar for the babies. Blood transfusion requirements (although not estimated blood loss) were greater in the general anaesthetic group.

6.7 What should be included in the consent form for caesarean section?

Any woman giving consent for caesarean section should understand the risks associated with caesarean section in general and the specific risks of placenta praevia in terms of massive obstetric haemorrhage, the need for blood transfusion and the chance of hysterectomy.



General procedures for discussing and obtaining consent for caesarean section are described in detail in RCOG Consent Advice No.7: *Caesarean section*,¹²⁵ but the risk of massive haemorrhage is approximately 12 times more likely with placenta praevia.¹²¹ This should be explained together with the possibility of needing a blood transfusion. The risk of hysterectomy is also increased¹²⁶ and rises when associated with previous caesarean section.¹¹ In the pilot series of the care bundle, of the 21 women with a low placenta and a previous caesarean section, seven (33%) required a hysterectomy.⁴⁴

Counselling women preoperatively before the diagnosis of placenta accreta is confirmed or dismissed can be difficult, but a useful guide can be taken from Silver et al., who reported on over 30 000 women of whom 723 had placenta praevia, 143 had placenta accreta and 216 required hysterectomy.¹²⁷ The risk of hysterectomy increased with the number of previous caesarean sections the women had had, as shown in Table 2.

Table 2. Link between number of previous caesarean sections and risk of placenta accreta, placenta praevia and hysterectomy¹²⁷

Number of previous caesarean section(s)	Number of women	Number of women with placenta accreta	Chance of placenta accreta if placenta praevia	Number of hysterectomies
0	6201	15 (0.24%)	3%	40 (0.65%)
1	15 808	49 (0.31%)	11%	67 (0.42%)
2	6324	36 (0.57%)	40%	57 (0.9%)
3	1452	31 (2.13%)	61%	35 (2.4%)
4	258	6 (2.33%)	67%	9 (3.49%)
5	89	6 (6.74%)	67%	8 (8.99%)

Any woman with suspected placenta praevia accreta should be reviewed by a consultant obstetrician in the antenatal period. The different risks and treatment options should have been discussed and a plan agreed, which should be reflected clearly in the consent form. This should include the anticipated skin and uterine incisions and whether conservative management of the placenta or proceeding straight to hysterectomy is preferred in the situation where accreta is confirmed at surgery. Additional possible interventions in the case of massive haemorrhage should also be discussed, including cell salvage and interventional radiology when available.



The anticipation and planning of surgery for suspected placenta accreta enables logical and timely decisions to be made without the element of surprise and often without the urgency of massive haemorrhage.¹⁰ These are described in section 7 on surgery for suspected placenta praevia accreta. To mention and gain consent for the use of balloons, cell salvage and interventional radiology is recommended^{94,102,121} and is much easier done before needed.

6.8 What grade of obstetrician should attend?

A junior doctor should not be left unsupervised when caring for these women and a senior experienced obstetrician should be scrubbed in theatre.

As a minimum requirement during a planned procedure for placenta praevia, a consultant obstetrician and anaesthetist should be present within the delivery suite. When an emergency arises, consultant staff should be alerted and attend as soon as possible.



Any woman going to theatre electively with suspected placenta praevia accreta should be attended by a consultant obstetrician and anaesthetist. If the delivery is unexpected, out-of-hours consultant staff should be alerted and attend as soon as possible.



The most recent Confidential Enquiry into Maternal and Child Health stresses the importance of a consultant-led multidisciplinary team at delivery in women at risk of placenta accreta.¹⁰ This approach is the same as that in Australia and New Zealand and in the USA, where the respective Colleges of Obstetrics and Gynaecology have issued a committee statement⁷⁹ and an opinion¹⁰⁴ that, when hysterectomy is anticipated, consent should include that for hysterectomy and delivery should involve specialised multidisciplinary personnel and occur where there are facilities for high-volume blood transfusion and availability of other blood products.

Evidence level 4

7. Surgery in the presence of placenta accreta, increta and percreta

7.1 What surgical approach should be used for suspected placenta praevia accreta?

Surgeons delivering the baby by caesarean section in the presence of a suspected placenta praevia accreta should consider opening the uterus at a site distant from the placenta, and delivering the baby without disturbing the placenta, in order to enable conservative management of the placenta or elective hysterectomy to be performed if the accreta is confirmed. Going straight through the placenta to achieve delivery is associated with more bleeding and a high chance of hysterectomy and should be avoided.



Conservative management of placenta accreta when the woman is already bleeding is unlikely to be successful and risks wasting valuable time.



The choice of skin and uterine incision needed to avoid the placenta will depend on the location of the placenta. A low transverse skin incision allows access to the lower half of the uterus and is reasonable if the upper margin of the anterior aspect of the placenta does not rise into the upper segment of the uterus. If, however, the placenta is anterior and extending towards the level of the umbilicus, a midline skin incision may be needed to allow for a high upper-segment longitudinal uterine incision. It is therefore useful for the surgeon to perform an ultrasound scan before surgery to plot out the extent of placenta before starting. This is surgical logic and not evidence based.

The antenatal diagnosis and surgical avoidance of the placenta, and its separation, may be associated with reduced maternal morbidity.^{128,129} It allows for conservative management of the placenta, reducing the risk of hysterectomy and of bleeding if the placenta is indeed found to be adherent. In cases of placenta percreta, avoiding the placenta and leaving it attached to proceed with either hysterectomy or conservative management is supported by current data described in more detail in sections 7.2 and 7.3 of this guideline;¹³⁰ evidence has been summarised in the next section.

7.2 What should be done if the placenta does not separate after delivery of the baby?

If the placenta fails to separate with the usual measures, leaving it in place and closing, or leaving it in place, closing the uterus and proceeding to a hysterectomy are both associated with less blood loss than trying to separate it.

C/D

There are no randomised controlled trials comparing different surgical approaches for suspected placenta praevia accreta, but a recent observational review of 57 cases of suspected accreta demonstrated significantly reduced short-term morbidity (intensive care unit admission, massive blood transfusion, coagulopathy, urological injury, re-laparotomy) if the placenta was left in place and hysterectomy performed electively compared with attempting to remove the placenta first (36% compared with 67%, $P=0.038$).¹²⁹

Evidence level 2++

Clearly, this approach of 'elective' hysterectomy would be unacceptable to women desiring uterine preservation and in such cases leaving the placenta in place is another option. Attempting placental separation risks hysterectomy in up to 100% of cases¹²⁹ and therefore is illogical. Timmermans et al. reviewed 60 case reports¹³⁰ with successful preservation of the uterus in all but 12 women, while six of a further 34 women who were conservatively managed also preserved their uterus,¹³¹⁻¹³⁶ supporting this practice.

The largest of these more recent case series reported on 26 patients receiving conservative management of the placenta, which failed in five cases (19%); three women went on to have a subsequent pregnancy.¹³¹ A further series of three cases on conservative management were successful,¹³² while a further two women had a planned delayed straightforward hysterectomy after having had arterial embolisation and conservative management of the placenta followed up with methotrexate treatment.¹³³ One case had a successful elective evacuation of retained products of conception after 4 months,¹³⁴ while two women had complications after conservative management: one had partial accreta and had heavy bleeding requiring hysterectomy on day 3 post-caesarean section,¹³⁵ while the other had recurrent problems with infection resulting in an evacuation of retained products of conception followed by severe sepsis on day 33.¹³⁶

Evidence level 3

7.3 What happens if the placenta separates, or partially separates?

If the placenta separates, it needs to be delivered and any haemorrhage that occurs needs to be dealt with in the normal way.

✓

If the placenta partially separates, the separated portion(s) need to be delivered and any haemorrhage that occurs needs to be dealt with in the normal way. Adherent portions can be left in place, but blood loss in such circumstances can be large and massive haemorrhage management needs to follow in a timely fashion.

D

The diagnosis of placenta accreta is made only if the placenta fails to separate at delivery; therefore, if it comes away it is delivered as usual. If, however, it partially separates and 'partial accreta' exists, the associated blood loss can be large. Adherent portions should be left attached as trying to separate them can cause severe bleeding.^{17,104} In the case review mentioned above,¹³⁰ 25 of the 60 cases had partial placental separation; three of these women needed hysterectomy for failed conservative treatment, and 12 others had secondary procedures to evacuate the uterus, which was conserved.

Evidence level 3

7.4 How is massive haemorrhage best managed?

The surgical manoeuvres required in the face of massive haemorrhage associated with placenta praevia caesarean sections should be performed by appropriately experienced surgeons. Calling for extra help early should be encouraged and not seen as 'losing face'.

D

Management of massive haemorrhage should occur in the normal way,¹²¹ including the use of uterotonic agents, which can be very helpful in reducing the blood loss associated with bleeding from the relatively atonic lower uterine segment.¹³⁷ Advanced techniques may also be employed and the use of bimanual compression or even aortic compression can buy time for extra help to arrive, or for the anaesthetist to 'catch up' haemodynamically in the unstable woman.

Evidence level 3

The most recent Confidential Enquiry into Maternal and Child Health has reiterated the importance of considering calling in another senior colleague(s) with superior gynaecological surgical skills early in the process.¹⁰

Evidence level 4

Specific techniques that have been described for accreta in retrospective reviews and case reports include uterine and vaginal packing with gauze, which was successful in 45 of 48 women,¹³⁸ balloon tamponade,^{139,140} the B-Lynch suture,¹⁴¹ vertical compression sutures¹⁴² and suturing an inverted lip of cervix over the bleeding placenta bed.¹⁴³ Uterine¹⁴⁴ and internal iliac artery ligation¹⁴⁵ have been reported but make subsequent access for intervention radiology techniques and embolisation extremely difficult or impossible.

Evidence level 3

8. Follow-up of the woman after part or all of the placenta has been retained following placenta accreta

8.1 How should the woman be managed after placental retention?

The woman should be warned of the risks of bleeding and infection postoperatively and prophylactic antibiotics may be helpful in the immediate postpartum period to reduce this risk. Neither methotrexate nor arterial embolisation reduces these risks and neither is recommended routinely.

D

A comprehensive review of all case reports published up to 2007 summarises the conservative management of 60 women with placenta accreta and quantifies the risks of haemorrhage and infectious complications.¹³⁰ The outcomes for those women who received no additional treatment was the same as those receiving either methotrexate or embolisation: of 26 women having no additional measures, four required hysterectomy; of 22 receiving methotrexate, five required hysterectomy; and of 12 having additional embolisation, three required hysterectomy. Infection occurred in 11 of the 60 women (18%), bleeding in 21 (35%) and disseminated intravascular coagulation in four (7%). Bleeding started a few hours after surgery up until 3 months post-delivery. A more recent case report described severe sepsis after an evacuation of retained products of conception on day 33.¹³⁶

Evidence level 3

Follow-up of the woman using ultrasound should supplement serum beta-human chorionic gonadotrophin measurements.

✓

The pattern of follow-up is not supported by randomised trials; however, owing to the protracted nature of recovery with complications occurring months after delivery, local arrangements need to be made to ensure regular review and, most importantly, ready access should the woman experience problems. Measuring serum beta-human chorionic gonadotrophin on a weekly basis to check it falls continuously can reassure to some extent, but low levels do not guarantee complete placental resolution and so this should be supplemented by imaging.¹³⁰

8.2 What chance of success can be quoted for a future pregnancy?

There are insufficient data at present to make any firm prognosis about future pregnancy. In two small series each reporting three women with subsequent pregnancies, one group had 100% recurrence¹⁴⁶ while the other had 0% recurrence.¹³⁰

9. Vasa praevia

9.1 Can we diagnose vasa praevia clinically?

In the antenatal period, in the absence of vaginal bleeding, there is no method to diagnose vasa praevia clinically.

In the intrapartum period, in the absence of vaginal bleeding, vasa praevia can occasionally be diagnosed clinically by palpation of fetal vessels in the membranes at the time of vaginal examination. This can be confirmed by direct visualisation using an amnioscope.

D

Without access to the fetal membranes, it is not possible to diagnose the intact vessels of vasa praevia clinically. Once the cervix has started to dilate, these vessels may be felt digitally during a vaginal examination. As the condition is rare, most clinicians will not be familiar with what they are feeling, and it is therefore important for clinicians to have a high index of suspicion if they feel something unusual and to confirm the diagnosis prior to membrane rupture if the consequences of fetal haemorrhage are to be avoided. Direct visualisation using an amnioscope has some use,¹⁴⁷ but this only gives visual access to the area of membranes exposed by the dilated cervix.

Evidence
level 3

Following delivery of the placenta, it is easy to confirm the presence of fetal vessels running through the membranes by simple clinical examination, but it is more difficult to diagnose vasa praevia as the orientation of the vessels in relation to the internal cervical os and fetal presenting part in utero is not certain after delivery.

In the presence of vaginal bleeding, especially associated with membrane rupture and fetal compromise, delivery should not be delayed to try and diagnose vasa praevia.

D

Because of the speed at which fetal exsanguination can occur and the high perinatal mortality rate associated with ruptured vasa praevia, delivery should not be delayed while trying to confirm the diagnosis if fetal wellbeing is compromised.

Evidence
level 4

9.2 Can we differentiate between fetal and maternal bleeding?

Various tests exist that can differentiate between fetal and maternal blood, but they are often not applicable in the clinical situation.

C

The Kleihauer-Betke test¹⁴⁸ and haemoglobin electrophoresis form part of routine obstetric practice to accurately identify fetal cells in the maternal circulation and fetal haemoglobin. Both can detect the presence of fetal haemoglobin in concentrations as low as 0.01%, and both can be used to identify fetal cells in vaginal blood loss. The disadvantage of both of these is that they are laboratory-based tests that take a significant amount of time before a result is obtained, thus rendering them of little use in this clinical situation. The resistance of fetal haemoglobin to denaturation with alkali has been used by various methods to identify fetal bleeding. The first of these was the Apt test,¹⁴⁹ but this requires the presence of at least 60% fetal haemoglobin to be positive, and requires centrifugation. Modifications of the Apt test have been tried,¹⁵⁰⁻¹⁵² but all have been too complicated or not sensitive enough for application in the clinical setting. Lindqvist and Gren¹⁵³ have recently described a much simpler bedside test using 0.14 M sodium hydroxide solution, which denatures adult haemoglobin, turning it a brownish-green colour, while fetal haemoglobin is resistant to denaturation and retains its red colour. This method may have some applicability in the clinical situation but requires further validation.

Evidence
level 2+

9.3 *Can vasa praevia be diagnosed using ultrasound?*

Vasa praevia can be accurately diagnosed with colour Doppler ultrasound, often utilising the trans-vaginal route.

C

The antenatal diagnosis of vasa praevia using standard real-time ultrasound was first described in 1987.¹⁵⁴ The ultrasound appearance of vasa praevia is of linear echolucent structures overlying the cervix.¹⁵⁵ In 1990, the use of colour Doppler in the diagnosis of vasa praevia was described,¹⁵⁶ which improved the diagnostic accuracy. Since then, there have been a few series published where ultrasound has been used to diagnose vasa praevia antenatally.^{25,27,41,155,157,158} Fung and Lau²⁵ reported three cases of vasa praevia and reviewed 48 cases reported between 1980 and 1997. In 22 cases the diagnosis was made antenatally, and this group had significantly better perinatal outcomes compared with those diagnosed acutely. Catanzarite et al.²⁷ described 11 cases of vasa praevia diagnosed antenatally out of 33 208 women scanned over an 8-year period. The diagnosis was confirmed in ten out of 11, giving a specificity of 91%, but the sensitivity could not be determined. Baulies et al.⁴¹ described a retrospective study of 12 063 deliveries between 2000 and 2005 in a single centre, during which nine cases were diagnosed with ultrasound in the antenatal period. All nine were confirmed at delivery. Again, sensitivity could not be determined from this study. Lee et al.¹⁵⁵ diagnosed 18 cases of vasa praevia out of 93 874 women scanned, 15 of which were confirmed, giving a specificity of 83%. Again, owing to the lack of outcome data in all cases scanned, sensitivity could not be determined. Smorgick et al.³⁰ described a retrospective study over 20 years on 110 684 women, in which 19 cases of vasa praevia were identified, ten of which were diagnosed prenatally. The authors deliberately do not comment on the sensitivity/specificity of the test or on perinatal outcome. It is clear that vasa praevia can be diagnosed with good specificity, but owing to the low prevalence of the condition, numbers are small and sensitivity has not been determined. Ultrasound diagnosis of vasa praevia is not without difficulty and factors such as maternal obesity, scarring and fetal position can influence accuracy, and care must be taken not to mistake cord presentation for vasa praevia.^{36,159} Using both the abdominal and vaginal routes of scanning and changing maternal position can improve diagnostic accuracy.

Evidence level 2+

9.4 *Should we screen for vasa praevia?*

At present, vasa praevia should not be screened for routinely at the time of the mid-trimester anomaly scan, as it does not fulfil the criteria for a screening programme.

D

As the occurrence of vasa praevia in the absence of a velamentous cord insertion or a succenturiate or bilobed placenta is minimal,³⁹ screening for vasa praevia would involve detailed ultrasound examination of the placenta and cord insertion to identify these placental and cord variants and low-lying placentas. If any of these are present, colour Doppler assessment of the lower pole of the uterus in the region of the internal cervical os should be carried out to identify any fetal vessels.^{36,159} This often requires TVS. Current recommendations from the RCOG and NICE²⁷ include identification of placental site and low-lying placenta only as part of routine ultrasound screening, and although vasa praevia is now detectable by ultrasound, there remains insufficient information on the case definition, natural history and epidemiology of the condition. The incidence of velamentous cord insertion in an unselected population is around 1%,¹⁵⁸ and that of bilobed or succenturiate placenta is around 1.7%, two-thirds of which have a velamentous cord insertion.¹⁶⁰ The reported coexistence of velamentous cord insertion and vasa praevia has been reported between at 2–6%.^{161,162} Adding the other groups thought to be at increased risk of vasa praevia, i.e. multiple pregnancies, in vitro fertilisation conceptions and those with a low-lying placenta, a significant minority of women will be identified as being at increased risk of vasa praevia and require further counselling and screening. The accuracy and practical application of the screening test has not been elucidated in the general pregnant population, although some centres with an interest have reported that identification of the cord insertion during the first or second trimester

Evidence level 4

is easy and accurate, takes less than 1 minute and requires no additional scanning skills.^{158,163} Scanning for velamentous cord insertion and vasa praevia is not routinely taught during ultrasound training courses in the UK, and the training implications of introducing such a screening programme require careful consideration. The potential psychological impact of being identified as being at high risk of vasa praevia and being diagnosed with vasa praevia must also be considered. Furthermore, there is currently no agreed management pathway for those with confirmed vasa praevia, although the Society of Obstetricians and Gynecologists of Canada has recently published guidelines.¹⁶⁴ Taking all of this into account, there is uncertainty about the balance of benefit versus harm to be derived from screening all pregnant women with a view to offering caesarean section to those at risk. The UK National Screening Committee has recently explored the topic and does not recommend a national screening programme for vasa praevia.¹⁶⁵

Evidence level 4

However, some centres may feel that, based on their case mix, screening those with risk factors is justifiable as recommended by some groups.^{31,36,159,166} This should be carefully audited and reported to expand the evidence base regarding the sensitivity and specificity of screening, as well as maternal and fetal/neonatal outcomes. For those who do wish to screen for vasa praevia, Jeanty's group have suggested a screening algorithm.³¹

Evidence level 3

9.5 How should vasa praevia be managed?

In the presence of bleeding vasa praevia, delivery should be achieved by category 1 emergency caesarean section.

C

Fetal wellbeing should be confirmed at the time of any antepartum or intrapartum haemorrhage, and this is currently best achieved using the cardiotocograph.¹⁶⁷ If signs of acute fetal compromise are present, delivery should be achieved as soon as possible, usually by category 1 caesarean section,¹⁶⁸ to minimise the risk of fetal exsanguination. Delay to facilitate ultrasound or transfer to another unit could result in fetal demise.

Evidence level 2+

In cases of suspected vasa praevia, transvaginal colour Doppler ultrasonography should be carried out to confirm the diagnosis.

C

If there is either an ultrasound or clinical suspicion of vasa praevia in the absence of fetal compromise, a formal systematic assessment of the region of the internal cervical os should be undertaken using transvaginal colour Doppler ultrasound.^{25,27,41,155,157,158,164}

Evidence level 2+

In confirmed cases of vasa praevia at term, delivery should be carried out by elective caesarean section in a timely manner.

C

In view of the risk of fetal haemorrhage with the onset of labour or membrane rupture and the minimal risks of neonatal lung disease, once vasa praevia has been confirmed at term, delivery should be carried out by elective caesarean section as soon as is practicable.

Evidence level 2+

In cases of vasa praevia identified in the second trimester, imaging should be repeated in the third trimester to confirm persistence.

✓

As gestation advances vasa praevia can resolve in up to 15% of cases.¹⁵⁶ To avoid unnecessary anxiety, admissions, prematurity and caesarean sections, it is essential to confirm persistence of vasa praevia in the third trimester.¹⁶⁵

Evidence level 3

In cases of confirmed vasa praevia in the third trimester, antenatal admission from 28 to 32 weeks of gestation to a unit with appropriate neonatal facilities will facilitate quicker intervention in the event of bleeding or labour.

D

In view of the increased risk of preterm delivery, administration of corticosteroids for fetal lung maturity should be considered.

A

In the presence of confirmed vasa praevia, elective caesarean section should be carried out prior to the onset of labour.

C

In confirmed cases of vasa praevia where there is no bleeding, no trials have been performed to identify optimal management, and numbers from individual centres will always be small. Suggested management includes admission to a unit with appropriate neonatal facilities between 28 and 32 weeks of gestation,¹⁶⁵ administration of corticosteroids for fetal lung maturity because of the risk of preterm delivery^{93,165} and elective caesarean section between 35 and 37 weeks of gestation, when the risks of prematurity have significantly decreased.^{36,37,160,165} Amniocentesis to establish fetal lung maturity is used in some centres, mainly in the USA, but this practice is not commonplace in the UK.^{37,160} Oleyese et al.³⁷ have suggested that outpatient management is possible if there is no evidence of cervical shortening on TVS and there are no symptoms of bleeding or preterm uterine activity.

Evidence level 3

Laser ablation in utero may have a role in the treatment of vasa praevia.

D

Quintero et al.¹⁶⁹ have described the successful use of in utero laser therapy to ablate the vessels of vasa praevia type 2 in a case where the cord inserted into the dominant lobe of a bilobed placenta, where the lobe being fed by the aberrant vessels accounted for 15% of the total placental mass. This treatment modality may have a place in the management of such cases in the future.

Evidence level 3

10. Clinical Governance

10.1 Debriefing

Postnatal follow-up should include debriefing with an explanation of what happened, why it happened and any implications for future pregnancy or fertility.

10.2 Training

All staff should receive local training for obstetric emergencies, which should include massive haemorrhage and acute fetal compromise.

Specific issues regarding raising the awareness of ultrasound staff to screen for placenta accreta are also worth pursuing locally, including organising policies/guidelines for flagging up women at risk and arranging for them to see a consultant after their 32-week scan.

Consideration should be given to ensuring appropriate training for ultrasound staff in the recognition of, diagnosis of and screening for placental and cord variants such as bilobed placenta, velamentous cord insertion and vasa praevia, particularly if screening is to be adopted locally.

10.3 Clinical incident reporting

Clinical incident forms should be completed for all adverse events. In the context of this guideline, this would include all cases of massive haemorrhage, any peripartum hysterectomy, any case of ruptured vasa praevia and any unexpected admission to the neonatal intensive care unit.

Any lack of compliance with the care bundle in a woman with a previous caesarean section and either placenta praevia or a low anterior placenta should also be reported locally.

10.4 Auditable standards

Surgical support at caesarean sections on women with placenta praevia and placenta accreta has been addressed in the reports of the Confidential Enquiries into Maternal Deaths.^{1,10} The substandard care associated with these reports focuses us on areas that may be suitable for audit in everyday working practice, with care given being compared with those standards identified in these reports.

Women with placenta praevia/placenta accreta could be subjected to clinical audit of the following:

- Was the diagnosis anticipated? If so:
 - Was there adequate work-up (e.g. avoiding/treating anaemia)?
 - Was the antenatal imaging performed according to hospital policy?
 - Was the delivery plan appropriate for the clinical situation?
- Were sufficiently experienced personnel present?
- Were appropriate surgical measures taken?
- Was resuscitation quick and effective?
- Were appropriate fluids infused?
- Was appropriate monitoring instituted?

Specifically for placenta accreta, were all elements of the care bundle satisfied before elective surgery?

- consultant obstetrician planned and directly supervising delivery
- consultant anaesthetist planned and directly supervising anaesthetic at delivery
- blood and blood products available
- multidisciplinary involvement in preoperative planning
- discussion and consent includes possible interventions (such as hysterectomy, leaving the placenta in place, cell salvage and interventional radiology)
- local availability of a level 2 critical care bed.

With regard to vasa praevia, further information is required to establish the true incidence, associated risk factors and the sensitivity and specificity of prenatal diagnosis with ultrasound. Any screening programme, whether selective or universal, should therefore be audited and reported, including maternal and fetal/neonatal outcomes. The following should be audited:

- incidence of vasa praevia
- sensitivity and specificity of ultrasound
- false positive and false negative rates
- incidence of antenatal admission
- use of corticosteroids for fetal lung maturity
- timing of delivery
- mode of delivery
- perinatal outcome
- maternal morbidity.

References

1. Hall MH. Haemorrhage. In: Lewis G, editor. *Why Mothers Die 2000–2002. The Sixth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom*. London: RCOG Press; 2004. p. 86–93.
2. Iyasu S, Saftlas AK, Rowley DL, Koonin LM, Lawson HW, Atrash HK. The epidemiology of placenta praevia in the United States, 1979 through 1987. *Am J Obstet Gynecol* 1993;168:1424–9.
3. Rossiter CE. Maternal mortality. *Br J Obstet Gynaecol* 1985;92 Suppl 5:100–15.
4. McShane PM, Heyl PS, Epstein ME. Maternal and perinatal morbidity resulting from placenta praevia. *Obstet Gynecol* 1985;65:176–82.
5. Sheiner E, Shoham-Vardi I, Hallak M, Hershkowitz R, Katz M, Mazor M. Placenta praevia: obstetric risk factors and pregnancy outcome. *J Matern Fetal Med* 2001;10:414–9.
6. Groom KM, Paterson-Brown S. Placenta praevia and placenta accreta: a review of aetiology, diagnosis and management. *Fetal Mat Med Review* 2001;12:41–66.
7. Gielchinsky Y, Rojansky N, Fasouliotis SJ, Ezra Y. Placenta accreta – summary of 10 years: a survey of 310 cases. *Placenta* 2002;23:210–4.
8. Ananth CV, Smulian JC, Vintzileos AM. The effect of placenta praevia on neonatal mortality: a population-based study in the United States, 1989 through 1997. *Am J Obstet Gynecol* 2003;188:1299–304.
9. Salihu HM, Li Q, Rouse DJ, Alexander GR. Placenta praevia: neonatal death after live births in the United States. *Am J Obstet Gynecol* 2003;188:1305–9.

10. Confidential Enquiry into Maternal and Child Health. *Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer - 2003-2005. The Seventh Report of the Confidential Enquiries into Maternal Deaths in the UK*. London: CEMACH; 2007.
11. Knight M; UKOSS. Peripartum hysterectomy in the UK: management and outcomes of the associated haemorrhage. *BJOG* 2007;114:1380-7.
12. Ananth CV, Smulian JC, Vintzileos AM. The association of placenta previa with history of cesarean delivery and abortion: a meta-analysis. *Am J Obstet Gynecol* 1997;177:1071-8.
13. Frederiksen MC, Glassenberg R, Stika CS. Placenta previa: a 22-year analysis. *Am J Obstet Gynecol* 1999;180:1432-7.
14. Gilliam M, Rosenberg D, Davis F. The likelihood of placenta previa with greater number of cesarean deliveries and higher parity. *Obstet Gynecol* 2002;99:976-80.
15. Lyndon-Rochell M, Holt VL, Easterling TR, Martin DP. First-birth cesarean and placental rupture or previa at second birth. *Obstet Gynecol* 2001;97:765-9.
16. Faiz AS, Ananth CV. Etiology and risk factors for placenta previa: an overview and meta-analysis of observational studies. *J Matern Fetal Neonatal Med* 2003;13:175-90.
17. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta praevia-placenta accreta. *Am J Obstet Gynecol* 1997;177:210-4.
18. Clark SL, Koonings PP, Phelan JP. Placenta praevia/accreta and prior cesarean section. *Obstet Gynecol* 1985;66:89-92.
19. Zaki ZM, Bahar AM, Ali ME, Albar HA, Gerias MA. Risk factors and morbidity in patients with placenta previa accreta compared to placenta previa non-accreta. *Acta Obstet Gynecol Scand* 1998;77:391-4.
20. Usta IM, Hobeika EM, Musa AA, Gabriel GE, Nassar AH. Placenta previa-accreta: risk factors and complications. *Am J Obstet Gynecol* 2005;193:1045-9.
21. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* 2006;107:1226-32.
22. Yang Q, Wen SW, Oppenheimer L, Chen XK, Black D, Gao J, et al. Association of caesarean delivery for first birth with placenta praevia and placental abruption in second pregnancy. *BJOG* 2007;114:609-13.
23. Grobman WA, Gersnoviez R, Landon MB, Spong CY, Leveno KJ, Rouse DJ, et al.; National Institute for Child Health and Human Development Maternal-Fetal Medicine Units Network. Pregnancy outcomes for women with placenta previa in relation to the number of prior cesarean deliveries. *Obstet Gynecol* 2007;110:1249-55.
24. Knight M, Kurinczuk JJ, Spark P, Brocklehurst P; United Kingdom Obstetric Surveillance System Steering Committee. Cesarean delivery and peripartum hysterectomy. *Obstet Gynecol* 2008;111:97-105.
25. Fung TY, Lau TK. Poor perinatal outcome associated with vasa previa: is it preventable? A report of three cases and review of the literature. *Ultrasound Obstet Gynecol* 1998;12:430-3.
26. Evans GM. Vasa praevia. *Br Med J* 1952;2:1243.
27. Catanzarite V, Maida C, Thomas W, Mendoza A, Stanco L, Piacquadio KM. Prenatal sonographic diagnosis of vasa previa: ultrasound findings and obstetric outcome in ten cases. *Ultrasound Obstet Gynecol* 2001;18:109-15.
28. Oleyese KO, Turner M, Lees C, Campbell S. Vasa previa: an avoidable obstetric tragedy. *Obstet Gynecol Surv* 1999;54:138-45.
29. Stafford IP, Neumann DE, Jarrell H. Abnormal placental structure and vasa previa: confirmation of the relationship. *J Ultrasound Med* 2004;23:1521-2.
30. Smorgick N, Tovbin Y, Ushakov F, Vaknin Z, Barzilay B, Herman A, et al. Is neonatal risk from vasa previa preventable? The 20-year experience from a single medical center. *J Clin Ultrasound* 2010;38:118-22.
31. Derbala Y, Grochal F, Jeanty P. Vasa previa. *J Prenat Med* 2007;1:2-13.
32. Antoine C, Young BK, Silverman F, Greco MA, Alvarez SP. Sinusoidal fetal heart rate pattern with vasa praevia in twin pregnancy. *J Reprod Med* 1982;27:295-300.
33. Cordero DR, Helfgott AW, Landy HJ, Reik RF, Medina C, O'Sullivan MJ. A non-hemorrhagic manifestation of vasa praevia: a clinicopathologic case report. *Obstet Gynecol* 1993;82:698-700.
34. Dougall A, Baird CH. Vasa praevia - report of three cases and review of the literature. *Br J Obstet Gynaecol* 1987;94:712-5.
35. Oyelese Y, Catanzarite V, Prefumo F, Lashley S, Schachter M, Tovbin Y, et al. Vasa previa: the impact of prenatal diagnosis on outcomes. *Obstet Gynecol* 2004;103:937-42.
36. Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. *Obstet Gynecol* 2006;107:927-41.
37. Oleyese Y, Spong C, Fernandez MA, McLaren RA. Second trimester low-lying placenta and in-vitro fertilization? Exclude vasa previa. *J Matern Fetal Med* 2000;9:370-2.
38. Francois K, Mayer S, Harris C, Perlow JH. Association of vasa previa at delivery with a history of second-trimester placenta previa. *J Reprod Med* 2003;48:771-4.
39. Duenhoelter JH. Survival of twins after acute fetal hemorrhage from ruptured vasa previa. *Obstet Gynecol* 1989;73:866-7.
40. Schachter M, Tovbin Y, Arieli S, Friendler S, Ron-El R, Sherman D. In vitro fertilization is a risk factor for vasa previa. *Fertil Steril* 2002;78:642-3.
41. Baulies S, Maiz N, Muñoz A, Torrents M, Echevarría, Sierra B. Prenatal ultrasound diagnosis of vasa praevia and analysis of risk factors. *Prenat Diagn* 2007;27:595-9.
42. Englert Y, Imbert MC, Van Rosandael E, Belaisch J, Segal L, Feichtinger W, et al. Morphological anomalies in the placenta of IVF pregnancies: preliminary report of a multicentric study. *Human Reprod* 1987;2:155-7.
43. Jauniaux E, Englert Y, Vanesse M, Hiden M, Wilkin P. Pathologic features of placentas from singleton pregnancies obtained in vitro fertilization and embryo transfer. *Obstet Gynecol* 1990;76:61-4.
44. Paterson-Brown S, Singh C. Developing a care bundle for the management of suspected placenta accreta. *The Obstetrician & Gynaecologist* 2010;12:21-7.
45. National Collaborating Centre for Womens and Childrens Health. *Antenatal care: routine care for the healthy pregnant woman. Clinical Guideline*. London: RCOG Press; 2003.
46. Smith RS, Lauria MR, Comstock CH, Treadwell MC, Kirk JS, Lee W, et al. Transvaginal ultrasonography for all placentas that appear to be low-lying or over the internal cervical os. *Ultrasound Obstet Gynecol* 1997;9:22-4.
47. Lauria MR, Smith RS, Treadwell MC, Comstock CH, Kirk JS, Lee W, et al. The use of second-trimester transvaginal sonography to predict placenta praevia. *Ultrasound Obstet Gynecol* 1996;8:337-40.
48. Oyelese KO, Holden D, Awadh A, Coates S, Campbell S. Placenta praevia: the case for transvaginal sonography. *Contemp Rev Obstet Gynaecol* 1999;11:257-61.
49. Leerentveld RA, Gilberts EC, Arnold MJ, Wladimiroff JW. Accuracy and safety of transvaginal sonographic placental localisation. *Obstet Gynecol* 1990;76:759-62.
50. Oppenheimer LW, Farine D, Ritchie JW, Lewinsky RM, Telford J, Fairbanks LA. What is a low-lying placenta? *Am J Obstet Gynecol* 1991;165:1036-8.
51. Sherman SJ, Carlson DE, Platt LD, Mediaris AL. Transvaginal ultrasound: does it help in the diagnosis of placenta previa? *Ultrasound Obstet Gynecol* 1992;2:256-60.
52. Becker RH, Vonk R, Mende BC, Ragosch V, Entezami M. The relevance of placental location at 20-23 gestational weeks for prediction of placenta previa at delivery: evaluation of 8650 cases. *Ultrasound Obstet Gynecol* 2001;17:496-501.
53. Dashe JS, McIntire DD, Ramus RM, Santos-Ramos R, Twickler DM. Persistence of placenta previa according to gestational age at ultrasound detection. *Obstet Gynecol* 2002;99:692-7.
54. Mustafá SA, Brizot ML, Carvalho MH, Watanabe L, Kahhale S, Zugaib M. Transvaginal ultrasonography in predicting placenta previa at delivery: a longitudinal study. *Ultrasound Obstet Gynecol* 2002;20:356-9.

55. Ghourab S, Al-Jabari A. Placental migration and mode of delivery in placenta previa: transvaginal sonographic assessment during the third trimester. *Ann Saudi Med* 2000;20:382-5.
56. Taipale P, Hiilesmaa V, Ylöstalo P. Transvaginal ultrasonography at 18-23 weeks in predicting placenta praevia at delivery. *Ultrasound Obstet Gynecol* 1998;12:422-5.
57. Oppenheimer L, Holmes P, Simpson N, Dabrowski A. Diagnosis of low-lying placenta: can migration in the third trimester predict outcome? *Ultrasound Obstet Gynecol* 2001;18:100-2.
58. Zlatnik MG, Cheng YW, Norton ME, Thiet M-P, Caughey AB. Placenta previa and the risk of preterm delivery. *J Matern Fetal Neonatal Med* 2007;20:719-23.
59. Love CD, Wallace EM. Pregnancies complicated by placenta praevia: what is appropriate management? *Br J Obstet Gynaecol* 1996;103:864-7.
60. Chou MM, Ho ES. Prenatal diagnosis of placenta previa accreta with power amplitude ultrasonic angiography. *Am J Obstet Gynecol* 1997;177:1523-5.
61. Comstock CH, Love JJ Jr, Bronsteen RA, Lee W, Vettraino IM, Huang RR, et al. Sonographic detection of placenta accreta in the second and third trimesters of pregnancy. *Am J Obstet Gynecol* 2004;190:1135-40.
62. Megier P, Harmas A, Mesnard L, Esperandieu OL, Desroches A. Picture of the month. Antenatal diagnosis of placenta praevia using gray-scale ultrasonography, color and pulsed Doppler imaging. *Ultrasound Obstet Gynecol* 2000;15:268.
63. Fisher SJ, Zhou Y, Huang L, Winn VD. When is seeing believing? The use of color Doppler ultrasound to diagnose placenta accreta in the first trimester of pregnancy. *Ultrasound Obstet Gynecol* 2002;19:540-2.
64. Chen YJ, Wang PH, Liu WM, Lai CR, Shu LP, Hung JH. Placenta accreta diagnosed at 9 weeks' gestation. *Ultrasound Obstet Gynecol* 2002;19:620-2.
65. Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. *Ultrasound Obstet Gynecol* 2000;15:28-35.
66. Chou MM, Tseng JJ, Ho ES, Hwang JL. Three-dimensional color power Doppler imaging in the assessment of uteroplacental neovascularization in placenta previa increta/percreta. *Am J Obstet Gynecol* 2001;185:1257-60.
67. Chou MM, Tseng JJ, Ho ES. The application of three-dimensional color power Doppler ultrasound in the depiction of abnormal uteroplacental angioarchitecture in placenta previa percreta. *Ultrasound Obstet Gynecol* 2002;19:625-7.
68. Wong HS, Cheung YK, Zuccollo J, Tait J, Pringle KC. Evaluation of sonographic diagnostic criteria for placenta accreta. *J Clin Ultrasound* 2008;36:551-9.
69. Shih JC, Palacios JM, Su YN, Shyu MK, Lin CH, Lin SY, et al. Role of three-dimensional power Doppler in the antenatal diagnosis of placenta accreta: comparison with gray-scale and color Doppler techniques. *Ultrasound Obstet Gynecol* 2009;33:193-203.
70. Dwyer BK, Belogolovkin V, Tran L, Rao A, Carroll I, Barth R, et al. Prenatal diagnosis of placenta accreta: sonography or magnetic resonance imaging? *J Ultrasound Med* 2008;27:1275-81.
71. Masselli G, Brunelli R, Casciani E, Poletti E, Piccioni MG, Anceschi M, et al. Magnetic resonance imaging in the evaluation of placental adhesive disorders: correlation with color Doppler ultrasound. *Eur Radiol* 2008;18:1292-9.
72. Palacios Jaraquemada JM, Bruno CH. Magnetic resonance imaging in 300 cases of placenta accreta: surgical correlation of new findings. *Acta Obstet Gynecol Scand* 2005;84:716-24.
73. Warshak CR, Eskander R, Hull AD, Scioscia AL, Mattrey RF, Benirschke K, et al. Accuracy of ultrasonography and magnetic resonance imaging in the diagnosis of placenta accreta. *Obstet Gynecol* 2006;108:573-81.
74. Lax A, Prince MR, Mennitt KW, Schwebach JR, Budorick NE. The value of specific MRI features in the evaluation of suspected placental invasion. *Magn Reson Imaging* 2007;25:87-93.
75. Neilson JP. Interventions for suspected placenta praevia. *Cochrane Database Syst Rev* 2000;(1):CD001998.
76. Wing DA, Paul RH, Millar LK. Management of the symptomatic placenta previa: a randomized, controlled trial of inpatient versus outpatient expectant management. *Am J Obstet Gynecol* 1996;175:806-11.
77. Love CD, Fernando KJ, Sargent L, Hughes RG. Major placenta praevia should not preclude out-patient management. *Eur J Obstet Gynaecol Repr Biol* 2004;117:24-9.
78. Ghi T, Contro E, Martina T, Piva M, Morandi R, Orsini LF, et al. Cervical length and risk of antepartum bleeding in women with complete placenta previa. *Ultrasound Obstet Gynecol* 2009;33:209-12.
79. Royal Australian and New Zealand College of Obstetricians and Gynaecologists. College Statement: C-Obs 20. Placenta Accreta. Melbourne, Australia: RANZCOG; 2003 [www.ranzcog.edu.au/publications/statements/C-obs20.pdf].
80. Arias F. Cervical cerclage for the temporary treatment of patients with placenta previa. *Obstet Gynecol* 1988;71:545-8.
81. Cobo E, Conde-Agudelo A, Delgado J, Canaval H, Congote A. Cervical cerclage: an alternative for the management of placenta praevia? *Am J Obstet Gynecol* 1998;179:122-5.
82. Cotton DB, Read JA, Paul RH, Quilligan EJ. The conservative aggressive management of placenta previa. *Am J Obstet Gynecol* 1980;137:687-95.
83. Silver R, Depp R, Sabbagha RE, Dooley SL, Socol ML, Tamura RK. Placenta previa: aggressive expectant management. *Am J Obstet Gynecol* 1984;150:15-22.
84. Sharma A, Suri V, Gupta I. Tocolytic therapy in conservative management of symptomatic placenta previa. *Int J Gynaecol Obstet* 2004;84:109-13.
85. Besinger RE, Moniak CW, Paskiewicz LS, Fisher SG, Tomich PG. The effect of tocolytic use in the management of symptomatic placenta previa. *Am J Obstet Gynecol* 1995;172:1770-8.
86. Towers CV, Pircon RA, Heppard M. Is tocolysis safe in the management of third-trimester bleeding? *Am J Obstet Gynecol* 1999;180:1572-8.
87. Magann EF, Johnson CA, Gookin KS, Roberts WE, Martin RW, Morrison JC. Placenta praevia: does uterine activity cause bleeding? *Aust N Z J Obstet Gynaecol* 1993;33:22-4.
88. Royal College of Obstetricians and Gynaecologists. Green-top Guideline No. 37: *Reducing the risk of thrombosis and embolism during pregnancy and the puerperium*. London: RCOG; 2009. [http://www.rcog.org.uk/files/rcog-corp/GT37ReducingRiskThrombo.pdf].
89. Bhide A, Prefumo F, Moore J, Hollis B, Thilaganathan B. Placenta edge to internal os distance in the late third trimester and mode of delivery in placenta praevia. *BJOG* 2003;110:860-4.
90. Ghourab S. Third-trimester transvaginal ultrasonography in placenta previa: does the shape of the lower placental edge predict clinical outcome? *Ultrasound Obstet Gynecol* 2001;18:103-8.
91. Morrison JJ, Rennie JM, Milton PJ. Neonatal respiratory morbidity and mode of delivery at term: influence of timing of elective caesarean section. *Br J Obstet Gynaecol* 1995;102:101-6.
92. Royal College of Obstetricians and Gynaecologists. Green-top Guideline No. 7: *Antenatal corticosteroids to reduce neonatal morbidity and mortality*. London: RCOG; 2010 [http://www.rcog.org.uk/files/rcog-corp/GTG%207.pdf].
93. Royal College of Obstetricians and Gynaecologists (RCOG), Royal College of Midwives (RCM) and the National Patient Safety Agency (NPSA). Placenta praevia after caesarean section care bundle [http://www.nrls.npsa.nhs.uk/intrapartumtoolkit/?entryid45=66359].
94. Royal College of Obstetricians and Gynaecologists. Green-top Guideline No. 49: *Blood transfusions in obstetrics*. London: RCOG; 2008 [http://www.rcog.org.uk/files/rcog-corp/uploaded-files/GT49BloodTransfusions1207amended.pdf].
95. Dinsmoor MJ, Hogg BB. Autologous blood donation with placenta previa: is it feasible? *Am J Perinatol* 1995;12:382-4.
96. The Blood Safety and Quality Regulations 2005. Statutory Instrument 2005 No. 50. London: The Stationery Office; 2005 [http://www.opsi.gov.uk/SI/si2005/20050050.htm].


97. Catling SJ, Williams S, Fielding AM. Cell salvage in obstetrics: an evaluation of the ability of cell salvage combined with leucocyte depletion filtration to remove amniotic fluid from operative blood loss at caesarean section. *Int J Obstet Anaesth* 1999;8:79-84.
98. Waters JH, Biscotti C, Potter PS, Phillipson E. Amniotic fluid removal during cell salvage in the cesarean section patient. *Anesthesiology* 2000;92:1531-6.
99. Weiskopf RB. Erythrocyte salvage during cesarean section. *Anesthesiology* 2000;92:1519-22.
100. Catling S. Blood conservation techniques in obstetrics: a UK perspective. *Int J Obstet Anesth* 2007;16:241-9.
101. Allam J, Cox M, Yentis SM. Cell salvage in obstetrics. *Int J Obstet Anesth* 2008;17:37-45.
102. National Institute for Health and Clinical Excellence. Intra-operative blood cell salvage in obstetrics. Interventional Procedure Guidance No. 144. London: NICE; 2005 [http://www.nice.org.uk/nicemedia/live/11038/30690/30690.pdf].
103. De Souza A, Permezal M, Anderson M, Ross A, McMillan J, Walker S. Antenatal erythropoietin and intra-operative cell salvage in a Jehovah's witness with placenta praevia. *BJOG* 2003;110:524-6.
104. Committee on Obstetric Practice. ACOG committee opinion. Placenta accreta. Number 266, January 2002. American College of Obstetricians and Gynecologists. *Int J Gynecol Obstet* 2002;77:77-8.
105. The Association of Anaesthetists of Great Britain and Ireland Obstetric Anaesthetists' Association. *OAA/AAGBI Guidelines for Obstetric Anaesthetic Services Revised Edition 2005*. London: OAA/AAGBI; 2005 [http://www.aagbi.org/publications/guidelines/docs/obstetric05.pdf].
106. Pelage JP, Le Dref O, Mateo J, Soyer P, Jacob D, Kardache M, et al. Life-threatening primary postpartum hemorrhage: treatment with emergency selective arterial embolization. *Radiology* 1998;208:359-62.
107. Hansch E, Chitkara U, McAlpine J, El-Sayed Y, Dake MD, Razavi MK. Pelvic arterial embolization for control of obstetric hemorrhage: a five year experience. *Am J Obstet Gynecol* 1999;180:1454-60.
108. Doumouchtsis SK, Papageorghiou AT, Aris T, Arulkumaran S. Systematic review of conservative management of postpartum haemorrhage: what to do when medical treatment fails. *Obstet Gynecol Surv* 2007;62:540-7.
109. Boulleret C, Chahid T, Gallot D, Mofid R, Tran Hai D, Ravel A, et al. Hypogastric arterial selective and superselective embolization for severe postpartum hemorrhage: a retrospective review of 36 cases. *Cardiovasc Intervent Radiol* 2004;27:344-8.
110. Uchiyama D, Koganemaru M, Abe T, Hori D, Hayabuchi N. Arterial catheterization and embolization for management of emergent or anticipated massive obstetrical hemorrhage. *Radiat Med* 2008;26:188-97.
111. Alvarez M, Lockwood CJ, Ghidini A, Dottino P, Mitty HA, Berkowitz RL. Prophylactic and emergent arterial catheterization for selective embolization in obstetric hemorrhage. *Am J Perinatol* 1992;9:441-4.
112. Mitty HA, Sterling KM, Alvarez M, Gendler R. Obstetric hemorrhage: prophylactic and emergency arterial catheterization and embolotherapy. *Radiology* 1993;188:183-7.
113. Dubois J, Garel L, Grignon A, Lemay M, Leduc L. Placenta percreta: balloon occlusion and embolization of the internal iliac arteries to reduce intraoperative blood losses. *Am J Obstet Gynecol* 1997;176:723-6.
114. Ojala K, Perälä J, Kariniemi J, Ranta P, Raudaskoski T, Tekay A. Arterial embolization and prophylactic catheterization for the treatment for severe obstetric hemorrhage. *Acta Obstet Gynecol Scand* 2005;84:1075-80.
115. Levine AB, Kuhlman K, Bonn J. Placenta accreta: comparison of cases managed with and without pelvic artery balloon catheters. *J Matern Fetal Med* 1999;8:173-6.
116. Bodner LJ, Noshier JL, Gribbin C, Siegel RL, Beale S, Scorza W. Balloon-assisted occlusion of the internal iliac arteries in patients with placenta accreta/percreta. *Cardiovasc Intervent Radiol* 2006;29:354-61.
117. Shrivastava V, Nageotte M, Major C, Haydon M, Wing D. Case-control comparison of cesarean hysterectomy with and without prophylactic placement of intravascular balloon catheters for placenta accreta. *Am J Obstet Gynecol* 2007;197:402.e1-5.
118. Tan CH, Tay KH, Sheah K, Kwek K, Wong K, Tan HK, et al. Perioperative endovascular internal iliac artery occlusion balloon placement in management of placenta accreta. *Am J Radiol* 2007;189:1158-63.
119. Mok M, Heidemann B, Dundas K, Gillespie I, Clark V. Interventional radiology in women with suspected placenta accreta undergoing caesarean section. *Int J Obstet Anesth* 2008;17:255-61.
120. Sewell MF, Rosenblum D, Ehrenberg H. Arterial embolus during common iliac balloon catheterization at cesarean hysterectomy. *Obstet Gynecol* 2006;108:746-8.
121. Royal College of Obstetricians and Gynaecologists. Green-top Guideline No. 52: *Prevention and management of postpartum haemorrhage*. London: RCOG; 2009.
122. Bonner SM, Haynes SR, Ryall D. The anaesthetic management of Caesarean section for placenta praevia: a questionnaire survey. *Anaesthesia* 1995;50:992-4.
123. Parekh N, Husaini SW, Russell IF. Caesarean section for placenta praevia: a retrospective study of anaesthetic management. *Br J Anaesth* 2000;84:725-30.
124. Hong JY, Jee YS, Yoon HJ, Kim SM. Comparison of general and epidural anesthesia in elective cesarean section for placenta previa totalis: maternal hemodynamics, blood loss and neonatal outcome. *Int J Obstet Anaesth* 2003;12:12-6.
125. Royal College of Obstetricians and Gynaecologists. Consent Advice No. 7: *Caesarean section*. London: RCOG; 2009.
126. Brace V, Kernaghan D, Penney G. Learning from adverse clinical outcomes: major obstetric haemorrhage in Scotland, 2003-05. *BJOG* 2007;114:1388-96.
127. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* 2006;107:1226-32.
128. Wong HS, Hutton J, Zuccollo J, Tait J, Pringle KC. The maternal outcome in placenta accreta: the significance of antenatal diagnosis and non-separation of placenta at delivery. *N Z Med J* 2008;121:30-8.
129. Eller AG, Porter TF, Soisson P, Silver RM. Optimal management strategies for placenta accreta. *BJOG* 2009;116:648-54.
130. Timmermans S, van Hof AC, Duvekot JJ. Conservative management of abnormally invasive placentation. *Obstet Gynecol Surv* 2007;62:529-39.
131. Bretelle F, Courbière B, Mazouni C, Agostini A, Cravello L, Boubli L, et al. Management of placenta accreta: morbidity and outcome. *Eur J Obstet Gynecol Repro Biol* 2007;133:34-9.
132. Chan BC, Lam HS, Yuen JH, Lam TP, Tso WK, Pun TC, et al. Conservative management of placenta praevia with accreta. *Hong Kong Med J* 2008;14:479-84.
133. Lee PS, Bakelaar R, Fitzpatrick CB, Ellestad SC, Havrilesky IJ, Alvarez Secord A. Medical and surgical treatment of placenta percreta to optimize bladder preservation. *Obstet Gynecol* 2008;112:421-4.
134. Most OL, Singer T, Buterman I, Monteagudo A, Timor-Tritsch IE. Postpartum management of placenta previa accreta left in situ: role of 3-dimensional angiography. *J Ultrasound Med* 2008;27:1375-80.
135. Teo SB, Kanagalingam D, Tan HK, Tan LK. Massive postpartum haemorrhage after uterus-conserving surgery in placenta percreta: the danger of the partial placenta percreta. *BJOG* 2008;115:789-92.

136. Chiang YC, Shih JC, Lee CN. Septic shock after conservative management for placenta accreta. *Taiwan J Obstet Gynecol* 2006;45:64-6.
137. Olean MA, Mariano JP. Controlling refractory atonic postpartum haemorrhage with Hemabate sterile solution. *Am J Obstet Gynecol* 1990;162:205-8.
138. Al-Harbi NA, Al-Abra ES, Alabbad NS. Utero-vaginal packing. Seven years review in the management of post partum hemorrhage due to placenta previa/accreta at a maternity hospital in Central Saudi Arabia. *Saudi Med J* 2009;30:243-6.
139. Ferrazzani S, Guariglia L, Triunfo S, Caforio L, Caruso A. Successful treatment of post-cesarean hemorrhage related to placenta praevia using an intrauterine balloon. Two case reports. *Fetal Diagn Ther* 2006;21:277-80.
140. Frenzel D, Condous GS, Papageorghiou AT, McWhinney NA. The use of the "tamponade test" to stop massive obstetric haemorrhage in placenta accreta. *BJOG* 2005;112:676-7.
141. B-Lynch C, Coker A, Lawal AH, Abu I, Cowen MJ. The B-Lynch surgical technique for the control of massive postpartum haemorrhage: an alternative to hysterectomy? Five cases reported. *Br J Obstet Gynaecol* 1997;104:372-5.
142. Hwu YM, Chen CP, Chen HS, Su TH. Parallel vertical compression sutures: a technique to control bleeding from placenta praevia or accreta during caesarean section. *BJOG* 2005;112:1420-3.
143. Dawlaty B, Wong I, Khan K, Agnihotri S. Using the cervix to stop bleeding in a woman with placenta accreta: a case report. *BJOG* 2007;114:502-4.
144. O'Leary JA. Uterine artery ligation in the control of postcesarean hemorrhage. *J Reprod Med* 1995;40:189-93.
145. Clark SL, Phelan JP, Yeh SY, Bruce SR, Paul RH. Hypogastric artery ligation for obstetric hemorrhage. *Obstet Gynecol* 1985;66:353-6.
146. Kayem G, Clément D, Goffinet F. Recurrence following conservative management of placenta accreta. *Int J Gynaecol Obstet* 2007;99:142-3.
147. Young M, Yule N, Barham K. The role of light and sound technologies in the detection of vasa praevia. *Reprod Fertil Dev* 1991;3:439-45.
148. Kleihauer E, Braun H, Bethe K. [Demonstration of fetal hemoglobin in erythrocytes of a blood smear]. *Klin Wochenschr* 1957;35:637-8. Article in German.
149. Apt L, Downey Jr WS. Melena neonatorum: the swallowed blood syndrome; a simple test for the differentiation of adult and fetal hemoglobin in bloody stools. *J Paediatr* 1955;47:6-12.
150. Ogita S, Ishiko O, Matsumoto M, Hasegawa H, Sugawa T. A simplified method for measuring fetal hemoglobin. *Obstet Gynecol* 1976;48:237-8.
151. Loendersloot EW. Vasa praevia. *Am J Obstet Gynecol* 1979;135:702-3.
152. Jones KP, Wheeler AW, Musgrave W. Simple test for bleeding from vasa praevia. *Lancet* 1987;2:1430-1.
153. Lindqvist PG, Gren P. An easy-to-use method for detecting fetal hemoglobin - a test to identify bleeding from vasa praevia. *Eur J Obstet Gynecol Reprod Biol* 2007;131:151-3.
154. Gianopoulos J, Carver T, Tomich PG, Karlman R, Gadwood K. Diagnosis of vasa praevia with ultrasonography. *Obstet Gynecol* 1987;69:488-91.
155. Lee W, Lee VL, Kirk JS, Sloan CT, Smith RS, Comstock CH. Vasa praevia: prenatal diagnosis, natural evolution, and clinical outcome. *Obstet Gynecol* 2000;95:572-6.
156. Nelson LH, Melone PJ, King M. Diagnosis of vasa praevia with transvaginal and color flow Doppler ultrasound. *Obstet Gynecol* 1990;76:506-9.
157. Baschat AA, Gembruch U. Ante- and intrapartum diagnosis of vasa praevia in singleton pregnancies by colour coded Doppler sonography. *Eur J Obstet Gynecol Reprod Biol* 1998;79:19-25.
158. Sepulveda W, Rojas I, Robert JA, Schnapp C, Alcalde JL. Prenatal detection of velamentous insertion of the umbilical cord: a prospective color Doppler ultrasound study. *Ultrasound Obstet Gynecol* 2003;21:564-9.
159. Daly-Jones E, John A, Leahy A, McKenna C, Sepulveda W. Vasa praevia; a preventable tragedy. *Ultrasound* 2008;16:8-14.
160. Benirschke K, Kaufmann P. *Pathology of the human placenta. 4th ed.* New York: Springer-Verlag; 2000. p. 353-9, p. 401-5.
161. Quek SP, Tan KL. Vasa praevia. *Aust N Z J Obstet Gynaecol* 1972;12:206-9.
162. Paavonen J, Jouttunpää K, Kangasluoma P, Aro P, Heinonen PK. Velamentous insertion of the umbilical cord and vasa praevia. *Int J Obstet Gynecol* 1984;22:207-11.
163. Nomiyama M, Toyota Y, Kawano H. Antenatal diagnosis of velamentous umbilical cord insertion and vasa praevia with color Doppler imaging. *Ultrasound Obstet Gynecol* 1998;12:426-9.
164. Diagnostic Imaging Committee and Maternal Fetal Medicine Committee, Society of Obstetricians and Gynaecologists of Canada. SOGC Clinical Practice Guideline. Guidelines for the management of vasa praevia. *J Obstet Gynaecol Can* 2009;231:748-53. [<http://www.sogc.org/guidelines/documents/gui231CPG0908.pdf>].
165. UK National Screening Committee. The UK NSC policy on Placenta praevia screening in pregnancy [<http://www.screening.nhs.uk/placentapraevia>]. Accessed August 2010.
166. Al-Khaduri M, Kadoch IJ, Couturier B, Dubé J, Lapensée L, Bissonnette F. Vasa praevia after IVF: should there be guidelines? Report of two cases and literature review. *Reprod Biomed Online* 2007;14:372-4.
167. National Institute for Health and Clinical Excellence. NICE clinical guideline 55: *Intrapartum care: Care of healthy women and their babies during childbirth*. London: NICE; 2007.
168. National Institute for Clinical Excellence. Clinical Guideline 13: *Caesarean section*. London: National Institute for Clinical Excellence; 2004 [<http://www.gserve.nice.org.uk/nicemedia/pdf/CG013NICEguideline.pdf>].
169. Quintero RA, Kontopoulos EV, Bornick PW, Allen MH. In utero laser treatment of type II vasa praevia. *J Matern Fetal Neonatal Med* 2007;20:847-51.

APPENDIX

Clinical guidelines are: 'systematically developed statements which assist clinicians and patients in making decisions about appropriate treatment for specific conditions'. Each guideline is systematically developed using a standardised methodology. Exact details of this process can be found in Clinical Governance Advice No.1: *Development of RCOG Green-Top Guidelines* (available on the RCOG website at <http://www.rcog.org.uk/womens-health/clinical-guidance/development-rcog-green-top-guidelines-policies-and-processes>). These recommendations are not intended to dictate an exclusive course of management or treatment. They must be evaluated with reference to individual patient needs, resources and limitations unique to the institution and variations in local populations. It is hoped that this process of local ownership will help to incorporate these guidelines into routine practice. Attention is drawn to areas of clinical uncertainty where further research may be indicated.

The evidence used in this guideline was graded using the scheme below and the recommendations formulated in a similar fashion with a standardised grading scheme.

Classification of evidence levels	Grades of recommendations
1++ High-quality meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a very low risk of bias	A At least one meta-analysis, systematic review or randomised controlled trial rated as 1++ and directly applicable to the target population; or A systematic review of randomised controlled trials or a body of evidence consisting principally of studies rated as 1+ directly applicable to the target population and demonstrating overall consistency of results
1+ Well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias	B A body of evidence including studies rated as 2++ directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
1- Meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a high risk of bias	C A body of evidence including studies rated as 2+ directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++
2++ High-quality systematic reviews of case-control or cohort studies or high-quality case-control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal	D Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+
2+ Well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal	
2- Case-control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal	
3 Non-analytical studies, e.g. case reports, case series	
4 Expert opinion	
	Good practice point  Recommended best practice based on the clinical experience of the guideline development group

This guideline was produced on behalf of the Guidelines Committee of the Royal College of Obstetricians and Gynaecologists by:

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The final version is the responsibility of the Guidelines Committee of the RCOG.

The guidelines review process will commence in 2014 unless evidence requires an earlier review.

DISCLAIMER

The Royal College of Obstetricians and Gynaecologists produces guidelines as an educational aid to good clinical practice. They present recognised methods and techniques of clinical practice, based on published evidence, for consideration by obstetricians and gynaecologists and other relevant health professionals. The ultimate judgement regarding a particular clinical procedure or treatment plan must be made by the doctor or other attendant in the light of clinical data presented by the patient and the diagnostic and treatment options available.

This means that RCOG guidelines are unlike protocols or guidelines issued by employers, as they are not intended to be prescriptive directions defining a single course of management. Departure from the local prescriptive protocols or guidelines should be fully documented in the patient's case notes at the time the relevant decision is taken.