Is ultrasound screening for vasa praevia clinically justified and a financially viable screening test? A literature review

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Abstract

Vasa praevia is an obstetric complication currently not screened for within the United Kingdom, which if undetected prenatally can lead to fetal death when the membranes rupture. Internationally, guidelines are available providing guidance on the best screening policy and management pathways. However, the UK National Screening Committee and Royal College of Obstetricians and Gynaecologists do not support screening due to a lack of evidence. Recent studies explore the ability of ultrasound to detect vasa praevia prenatally in both the general and high-risk populations. Whilst there is no consensus on the 'best' screening strategy, the majority of authors note that targeted screening of the high-risk population is the most achievable and cost-effective strategy. Although not infallible, a standard screening protocol could identify the majority of cases in the high-risk group. Introduction of a screening strategy would affect training needs of professionals within the UK and would have implications on the need to produce guidelines on management and quality assurance. Further research is also needed to define a relevant high-risk population and explore how this would impact on service provision. This review explores the current evidence base for systematic screening and the implications for service.

Keywords

Vasa praevia, ultrasound, screening, bilobed placenta, velamentous cord insertion, antepartum haemorrhage

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Introduction

Vasa praevia occurs when fetal vessels run through the chorioamniotic membranes, unsupported by the umbilical cord or Wharton's jelly, close to or over the internal cervical os.¹ If undiagnosed prenatally, vasa praevia can result in rupture of the fetal blood vessels and exsanguination of the fetal blood volume when the membranes rupture, ultimately resulting in fetal death.² As fetal blood volume towards term is so small, even the loss of a small amount can be disastrous. In fetuses that survive delivery, fetal anaemia requires immediate rectification on emergency delivery.³ If undetected the associated fetal mortality rate is 44% whereas if antenatally detected, the fetal survival rate is noted as 97%.⁴

The condition is rare with reported incidence rates in the literature varying between one in 2500⁵ to one in

6000.⁴ However, the incidence rates may be under-reported due to the difficulty in prenatal diagnosis and the inability to accurately diagnose once delivered.¹ Vasa praevia can be diagnosed prenatally with ultrasound; however, current guidelines within the UK do not support screening for this condition.⁶

There are two types of vasa praevia, type 1 (velamentous cord insertion) and type 2 (bilobed placenta) which are reported within the literature as being associated with certain risk factors, namely low lying placenta/

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placenta praevia, bilobed placenta, twin gestations, assisted reproduction techniques, antepartum haemorrhage (APH) and velamentous cord insertion.⁷

Within the UK there is a current focus on improving pregnancy outcomes, reducing the stillbirth and neonatal death rate through the 'saving babies lives'⁸ care bundle and the MBRRACE report.⁹ As vasa praevia undiagnosed is known to be associated with adverse outcomes, this review was conducted to assess the current evidence on vasa praevia detection to assess whether screening is clinically justified or financially viable.

National and international guidelines

United Kingdom guidelines

The Royal College of Obstetricians and Gynaecologists (RCOG)⁶ Green-top guideline number 27 states placenta localisation should be assessed at the anomaly scan, commenting that transvaginal scanning is safe and should be performed to assess the leading edge of the placenta when placenta praevia is suspected. It also confirms that vasa praevia can be diagnosed using transvaginal ultrasound and this diagnosis is accurate. Although ultrasound screening is possible, little is known of the natural history and epidemiology with little research having been done into the accuracy of a screening test in a general population.⁶ Subsequently, the RCOG comment that introduction of a screening test for vasa praevia does not currently meet the criteria for a screening programme. Introduction of any screening strategy would have an impact on training of staff and students as this is not something that is currently routinely taught in training centres. They also make note that currently there is no agreed management strategy for these patients.

The UK National Screening Committee conducted a review of the screening for vasa praevia and placenta praevia in pregnancy in 2013. The review did not support the implementation of screening for vasa praevia, leaving the standard screening at the anomaly scan to locate the leading edge of the placenta.¹⁰ This evidence was reviewed again in 2017 and the recommendations were unchanged with the current UK position still being to not screen for vasa praevia.¹¹

International guidelines

Internationally, the Society of Obstetricians and Gynaecologists of Canada (SOGC)¹² guidelines on the management of vasa praevia recommend all women with a suspected low lying placenta or at high risk for vasa praevia should undergo further examination and transvaginal ultrasound examination to

assess for velamentous cord insertion. The SOGC¹² guideline based on a study by Oyelese et al.¹³ provided valuable detail on the management of patients with the condition and thus provided guidance to clinicians. This is important as there needs to be clear guidance for the process for managing a suspected case if the screening is successful in diagnosing a case of vasa praevia.

More recently, the Royal Australian and New Zealand College of Obstetricians and Gynaecologists¹⁴ issued a revised statement regarding vasa praevia and the Colleges' guidelines on screening and management in 2016. They acknowledge that even with a standard screening technique not all cases will be detected and that universal transvaginal screening is not a cost-effective method for screening for vasa praevia. They do however advocate the examination of the placental cord insertion site on all singleton pregnancies and the use of targeted screening of the lower uterine segment with colour flow Doppler to assess for vasa praevia in those pregnancies in the high-risk category.¹⁴ This group of women is defined as anyone with a low lying placenta or placenta praevia, bilobed or succenturiate lobe placenta, velamentous cord insertion, IVF pregnancies and multiple gestations.

A stark point observed by all these national and international guidelines is that even with the most standardised screening protocol, cases of vasa praevia will be missed and so it would not prevent all deaths.

Literature search

A literature search was conducted using the University of Derby EBSCOhost multiple databases, ScienceDirect and the Cochrane library. The search was restricted to English language and to articles published after 2000. These restrictions were placed due to time restrictions of the review and also to ensure the most recent relevant literature was included. The search terminology used included variations on vasa praevia, ultrasound and Doppler (including pulsed wave and colour flow Doppler).

The literature search identified a total of 44 articles across the databases. After duplicates were removed, articles were reviewed for relevance by initially reading the abstract to assess the content of the literature. If the article was not assessing the ultrasound detection of vasa praevia then it was rejected. After further review of the literature content for quality of the research conducted, a total of 13 research articles remained. Figure 1 demonstrates the process of identifying articles and exclusions to reach the final group of literature for review.

Of the remaining 13 articles there was one prospective review, four were retrospective cohort reviews and

Figure 1. Results of the literature search.

five case reviews which although they do not provide primary research data, do provide some insight into specific cases. Two further articles were also included which specifically examined the identification of a velamentous cord insertion. Only one article was identified which focussed on cost-effectiveness and so this was included but reviewed separately due to the difference in information provided.

Review

Four retrospective and one prospective study of prenatal diagnosis of vasa praevia are included in this review.^{13,15–18} Table 1 provides a summary of the studies included and how cases were identified.

A total of 265 cases of vasa praevia were identified across the four retrospective studies ranging between 18 cases¹⁵ and 155.¹³ With all four retrospective reviews the purpose of the studies was to assess the prenatal detection of vasa praevia and how this affected the patient outcome and management. In all four studies, the diagnosis was confirmed on visual and/or pathologic examination of the placenta and membranes post-delivery.

Three of the retrospective studies described the ultrasound technique used within the centres to identify vasa praevia present.^{15–17} Two studies routinely used

transabdominal scanning of the lower uterine segment with the use of colour flow Doppler to assess for fetal blood vessels in the lower segment however only used transvaginal ultrasound if there was a clinical need to assist in the view of the cervix.^{15,17} The study by Rebarber et al.¹⁶ however, used a standard screening protocol which incorporated the routine use of transvaginal ultrasound if the patient had a defined risk factor for vasa praevia.

In two studies the natural progression of vasa praevia was also examined through serial scans to assess the resolution of the condition through gestations.^{15,16} The resolution of vasa praevia was seen in three of 18¹⁵ cases and five of 32¹⁶ cases showing the need for serial scans after diagnosis. Further to this, Rebarber et al.¹⁶ noted that the resolution of vasa praevia was seen in 23.8% of cases diagnosed during the second trimester; however, if the vasa praevia was diagnosed in the third trimester then no resolution was identified.

Catanzarite et al.¹⁸ conducted a prospective cohort study with selection of vasa praevia cases to assess follow-up, outcome and management of prenatal diagnosis. The study was conducted on a cohort of women who were already identified as high risk due to being referred to the authors' centre with a placental abnormality.¹⁸ Sonographic findings were used to identify 11 prenatally diagnosed cases of vasa praevia from a cohort of 33,208. Throughout the course of this study, the technique used with ultrasound to detect the condition evolved as technology advanced from using colour flow Doppler over the cervix in the early days of the study to identification of the placental cord insertion site and sweep of the lower segment with colour flow Doppler in the latter stage.¹⁸ Transvaginal ultrasound was only used when needed to confirm the vasa praevia as noted by the authors but never in the presence of vaginal bleeding.¹⁸ As was described by the retrospective studies, Catanzarite et al.¹⁸ noted the surveillance of vasa praevia and scanning in the third trimester to confirm the diagnosis. There is no mention of any cases of resolution though during the course of the study.

Of the 11 cases prenatally diagnosed, 10 were confirmed in the prospective study by examination of maternity records and pathological examination of the placenta and membranes at delivery.¹⁸ One case which was prenatally diagnosed, at delivery was found to be a marginal placenta praevia rather than vasa praevia.¹⁸ Catanzarite et al.¹⁸ also commented on two potential missed cases of vasa praevia which had normal prenatal ultrasounds; however, in both cases there was fetal demise at delivery after membrane rupture followed by blood. In both cases, a velamentous cord insertion was identified on examination of the placenta and membranes.

Table 1. Summary of the reviewed literature

Author	Design	Inclusion	Population	Cases of vasa praevia	Screening test	Reference
Lee et al. ¹⁵	Retrospective cohort study	All deliveries between January 1991 and December 1998	93,874	18	Standardised greyscale imaging of cervix. Transvaginal scan and colour Doppler if clinically indicated	Placental pathology on examination
Rebarber et al. ¹⁶	Retrospective cohort study	All referred patients between June 2005 and June 2012	27,573	32	Standardised greyscale imaging. Transvaginal imaging in suspected cases and high-risk group. Standard colour flow Doppler and pulsed wave Doppler	Confirmation at delivery and on placental pathologic reports
Bronsteen et al. ¹⁷	Retrospective cohort study	All deliveries with vasa praevia diagnosis between January 1990 and June 2010	Not stated	60	Transabdominal imaging of the lower segment. Placental cord insertion site imaged in twin gestations. Transvaginal and colour flow Doppler imaging utilised if clinically needed	Delivery confirmation and placental pathology reports
Oyelese et al. ¹³	Retrospective chart review	Cases registered with the Vasa Praevia Foundation and chart review of patients identified as discharged with vasa praevia diagnosis	Not stated	155	No standardisation of screening due to variety of case sources	Delivery record and placental pathology reports
Catanzarite et al. ¹⁸	Prospective cohort study	All deliveries between January 1991 and December 1998	33,208	10	Greyscale imaging over lower segment. Colour Doppler when vessels over cervix. From 1993 onwards identification of placental cord insertion site. Transvaginal sonography when clinically needed	Obstetrician's operative findings at caesarean section and placental pathological reports

Five articles were found discussing case reports of 10 cases of vasa praevia of which eight were prenatally diagnosed, two were discovered post-delivery and had resulted in neonatal death of the fetus.^{19–23} The case reports discuss differing techniques used to prenatally diagnose the vasa praevia; however, as these case reports describe individual cases, no standard protocol is discussed. The diagnostic technique used varied between transabdominal scanning with the use of colour flow Doppler in the uterine segment¹⁹ to transabdominal scanning with colour flow Doppler and three-dimensional imaging²¹ and then transabdominal, transvaginal and colour flow Doppler.^{19,20} Two of the authors discussing case reports do not discuss what ultrasound scanning protocol was used on each of the patients so no conclusion can be made.^{22,23}

Results from the retrospective reviews found that of the 265 cases reported, 59 intrapartum or neonatal deaths occurred due to the vasa praevia presence.^{13,15,17} Oyelese et al.¹³ also reported a pregnancy which resulted in a still birth; however, this was not thought to be linked to the diagnosis of vasa praevia. In the review by Rebarber et al.,¹⁶ all pregnancies resulted in live births of healthy fetuses; however, two cases had unknown outcomes due to loss of medical records. In the prospective review, all 10 cases of prenatally diagnosed vasa praevia resulted in the live birth of healthy fetuses.¹⁸ These findings are in keeping with the findings of the retrospective reviews by Rebarber et al.¹⁶ and Bronsteen et al.¹⁷ who found that when prenatal diagnosis was made, patient management subsequently led to earlier delivery of a healthy fetus. Likewise these echo the results by Oyelese et al.¹³ who found that when prenatal diagnosis was made, the survival rate was much greater at 97% whereas when not prenatally diagnosed the survival rate was greatly reduced at 44%.

Within the series of case reports, similar survival rates were identified with all cases which were prenatally diagnosed resulting in a live birth of a healthy fetus.^{19–22} In the two case reports where vasa praevia was not diagnosed, both authors report the rupture of membranes followed by vaginal bleeding and clots and fetal bradycardia. Emergency caesarean section was performed in both cases; however, due to loss of blood and pale floppy, anaemic fetus this resulted in the neonatal death on day 1 in both cases.^{22,23}

The selected studies were limited in the data available for review; therefore, no statistical analysis could be completed. It should also be acknowledged that of the studies reviewed, the authors note that there is likely to be some degree of bias present due to the motivation to conduct the research and case selection within a 'high risk population'.^{13,16} This combined with changing technology and ultrasound methods may therefore have affected the validity of the studies reviewed.

Patient management

Management of a pregnancy with vasa praevia is discussed across the retrospective and prospective reviews with varying strategies identified as having occurred. Elective admission at a mean gestational age of 33 weeks was found in the study by Rebarber et al.¹⁶ so that antenatal steroids could be administered to enable elective early delivery by caesarean section. This study also noted that twin gestations were admitted at an earlier stage of 28–30 weeks; however, this was not quantified with an explanation of the reasoning. Emergency admission and delivery was also noted as significant with six of the 32 cases resulting in this due to APH and preterm labour.¹⁶ None of the other retrospective reviews discuss elective admission or timing of admission prior to delivery. Elective caesarean section is noted as being significant for improving outcomes when prenatally diagnosed in the further two studies with the mean gestational age of elective delivery by caesarean being 35.4 weeks and 34.9 weeks.^{13,15} The prenatal diagnosis does not, however, stop the need for emergency admission and delivery with Bronsteen et al.¹⁷ noting seven emergency deliveries, 11 urgent deliveries and 11 cases of spontaneous labour prompting the need for delivery and in the series by Oyelese et al.¹³ noting that 80 emergency caesareans were performed in the case series described. In the prospective review by Catanzarite et al.,¹⁸ similar findings on elective delivery are noted with two deliveries being emergency prior to confirmation of lung maturity and overall the deliveries being between gestational age of 31.5 and 37.8 weeks. No detail is, however, provided on the optimum management strategy for admission and elective delivery in prenatally diagnosed cases. This is also in keeping with the current UK guidelines which acknowledge that there is no agreed management strategy where vasa praevia is detected and this could lead to more patient anxiety and unnecessary early caesarean deliveries.¹¹

Lee et al.¹⁵ discussed the possibility of missed cases within the review, noting that 81 sets of patient notes which were reviewed identified the pregnancy as having either vasa praevia or a velamentous cord insertion; however, only one case is identified by the authors as being possibly a missed vasa praevia. Two missed cases are discussed by Catanzarite et al.¹⁸ which resulted in fetal demise and in both cases the authors reviewed the ultrasound imaging and found that the vasa praevia was identifiable on the ultrasound videotape. False positive diagnosis is discussed by two authors reporting five cases and one case of false positive; however, no further information is provided on the nature of the false positive so this cannot be expanded further.^{16,17}

Table 2. Summary of the incidence of risk factors

Author	Low lying/ placenta praevia	Bilobed/ succenturiate lobe	Twin gestation	Velamentous/ marginal cord insertion	IVF	Antepartum haemorrhage
Lee et al. ¹⁵	✓ (44%)	✓	✓ (17%)	✓		✓ (33%)
Rebarber et al. ¹⁶	✓ (78%)	✓ (17%)	✓ (24%)	✓ (72%)	✓ (41%)	✓
Bronsteen et al. ¹⁷	✓ (62%)		✓	✓		✓
Oyelese et al. ¹³	✓ (61%)	✓ (32%)	✓ (5%)		✓ (10%)	✓ (36.1%)
Catanzarite et al. ¹⁸	✓	✓		✓		✓ (80%)

IVF: in-vitro fertilisation.

Risk factors

Throughout the literature, various risk factors are identified as being highly indicative for vasa praevia with placenta praevia and APH as being the most supported risk factors.^{13,15–18} Table 2 provides a summary of the incidence of risk factors reported in the literature.

Placenta praevia

Placenta praevia or low lying placenta is discussed as being the most significant risk factor for vasa praevia with reports in the literature of the high incidence amongst the cases of vasa praevia with rates of between 44 and 78%.^{15,16} Catanzarite et al.¹⁸ echoed this finding with eight out of the 10 cases of vasa praevia reporting a low lying placenta or placenta praevia at some stage prior to the diagnosis of vasa praevia. The presence of a low lying placenta or placenta praevia is thought to be linked to vasa praevia due to the potential for the placenta to atrophy when over the internal os leading to the development of a bilobed placenta with the fetal vessels exposed over the internal os connecting the two lobes.²⁴

APH

APH was reported within all four retrospectives and the prospective review as being a significant finding in a large proportion of cases.^{13,15,16,17,18} This was reported as high as 80% by Catanzarite et al.¹⁸ APH was noted as particularly significant as this was also the cause for emergency admission and delivery with one review noting that of 25 patients admitted with vaginal

bleeding in the third trimester, on average women were delivered an average of 21 days after admission (range between two and 73 days).¹⁷

Twin gestations

The UK National Screening Committee¹⁰ review identified multiple pregnancies as being one of the known risk factors for vasa praevia. The subsequent review which was completed in August 2017 concluded that multiple gestations were not recognised as a risk factor for vasa praevia which is a contradiction to the previous evidence review.¹¹ When assessing the research for this review, four retrospective reviews all report cases of twin gestations where the occurrence of vasa praevia was found in a total of 24 cases. Only Rebarber et al.¹⁶ discussed the chorionicity of the gestations with five dichorionic diamniotic gestations and two monochorionic monoamniotic gestations. In this series it was found that with the dichorionic gestations, no resolution of the vasa praevia occurred and so elective delivery by caesarean section was arranged whereas in the monochorionic gestations, resolution of the vasa praevia occurred in both cases.¹⁶ Lee et al.¹⁵ discussed the outcomes of the twin gestations noting that the deliveries were not favourable with the fetal demise of one twin and severe medical issues with a second twin alongside complications related to prematurity which was all related to premature delivery due to the vasa praevia. It could be argued that twin gestations would be delivered earlier than a singleton; however, in this case the twin gestation was delivered at 27 weeks causing the morbidity and mortality complications.

Within the case reviews identified, four twin cases are also discussed as being prenatally identified and managed.^{21,22} All twin gestations reported were identified as being dichorionic diamniotic gestations conceived by assisted reproduction techniques. Management of the patient was identified as being similar in all cases with early elective admission to hospital between 28 and 32 weeks for steroid administration and delivery between 34 and 36 weeks.^{21,22} Limited guidance from the authors is provided on the management of twin gestations with vasa praevia; however, Ghandi et al.²¹ noted that given a large proportion of twin gestations would deliver before 37 weeks, it would be prudent to be prepared for an early delivery in a twin gestation with vasa praevia by elective admission prior to 32 weeks and administration of steroids in the event that emergency delivery was required.

Assisted reproduction

Two retrospective studies comment on the incidence of vasa praevia being between 10 and 41% in cases which had been conceived by assisted reproduction techniques.^{13,16} Very little detail is provided, however, as to the outcomes in these cases discussed. The further retrospective and prospective studies do not discuss the proportion of pregnancies conceived by assisted reproduction techniques. This therefore means that no conclusion can be made on the significance of this risk factor. Given that assisted reproduction techniques are more frequently resulting in pregnancies and multiple gestations, it is worth noting that this may contribute to a higher risk of vasa praevia.

Cost effect

Only one piece of literature examined the cost effect of screening strategies based on population figures for a one-year cohort of women.²⁵ The results of this analysis concluded that in singleton pregnancies, a screening strategy of performing a transvaginal scan on all women with a high-risk indicator would result in 8726 extra women having at least one transvaginal ultrasound scan during the course of the pregnancy.²⁵ In the context of ultrasound departments, this would result in increased examination times, additional examinations and increase in the demand for ultrasound. The authors also note that this would result in 33 more caesarean sections but with a reduction in the number of emergency caesarean sections and would ultimately reduce the number of late fetal or neonatal deaths by 19, whereas universal screening would result in 23 fewer deaths.²⁵ The resultant cost effect of a screening strategy of high-risk singleton gestations is estimated as \$3.4 million, of which a majority (\$2.2

million) would be due to the cost of screening and training within the first year whereas universal screening for singletons would dramatically increase costs by \$10.6 million for each cohort.²⁵ This would result in substantial financial implications for hospitals due to the increased demand for ultrasound scans and through the management of the pregnancy, early delivery and possible involvement of the neonatal units.²⁵ Cipriano et al.²⁵ rightly noted that although this strategy would reduce the number of late fetal and neonatal deaths, the rate of maternal deaths and complications would potentially increase per year due to more interventions being performed and the increased rate of caesarean sections being completed. This is one consideration which is not noted by any of the authors previously discussed.

In agreement with the UK National Screening committee review in August 2017 and 2013, Cipriano et al.²⁵ concluded that when all options are considered, the most cost-effective strategy would be to not screen at all; however, in their view this would be negligent.^{10,11} Targeted screening of twin gestations was found to be cost effective as it would reduce the number of late fetal and neonatal deaths per year.²⁵ Providing targeted screening for women with high-risk factors and all twin gestations would provide the optimum screening strategy as the majority of these women would already be accessing ultrasound services due to the risk factors and thus this would have the least impact financially.²⁵

Discussion

All studies discuss the routine use of greyscale imaging with the use of transvaginal imaging and colour flow Doppler appearing to be intermittent. Only one study discusses a standard protocol which utilises transabdominal, transvaginal and colour flow Doppler techniques.¹⁶ The use of colour flow Doppler does not appear to be a standard technique but this is likely due to changes in technology during the course of these studies which may have contributed to the lack of use of colour flow Doppler in earlier studies.^{14,15}

The two studies by Bronsteen et al. and Catanzarite et al. both comment on the identification of the placental cord insertion site but note that this is not standard practice.^{17,18} When discussing the techniques for screening for vasa praevia though, identification of the placental cord insertion site should be considered as this could be used to eliminate the possibility of a velamentous cord insertion. This is not specifically discussed by these studies though.

Sepulveda et al.²⁶ specifically discussed the detection of velamentous cord insertion as a screening method for vasa praevia. A prospective cross sectional study

reported successful identification of the placental cord insertion site in 99% of cases in less than 1 minute.²⁶ The authors used a standardised protocol using greyscale and colour flow Doppler techniques and suggested that this would be an effective technique which would not impact on the ultrasound examination time or method.²⁶ The study concluded that a velamentous cord insertion was present in 1% of cases reviewed; however, no cases of vasa praevia were identified even though placenta praevia was present in 2% of the cases examined.²⁶

The authors acknowledge that the rate of visualisation of the placental cord insertion site may have been higher as the single operator was a fetal medicine specialist who had training in umbilical cord sampling. The authors believe though that the visualisation of the placental cord insertion site does not require specialist training as long as the screening is performed in a systematic way.²⁶ It could be argued that within an obstetric ultrasound department within the UK, these detection rates may not be achievable as it is not an area that is routinely viewed during the ultrasound examination. This would need subsequent training of sonographers, obstetricians, fetal medicine specialists

and would also have a potential impact on a need to change theoretical and practical experience provided by university institutions to ultrasound students. Sepulveda et al.²⁶ acknowledged that a previous case of velamentous cord insertion with an adverse outcome had instigated this study being performed and so this may have influenced the study as the operator would most likely have been motivated to try and make every effort to identify the placental cord insertion due to previous experiences and the potential outcome if missed.

Ebbing et al.²⁷ conducted a retrospective population-based review of births registered as having a velamentous cord insertion present and found that a velamentous cord insertion was present in 1.5% of pregnancies which is in line with the previous study.²⁷ This figure increased to 5.9% in multiple gestations however was not found to increase in the case of pregnancies conceived by assisted reproduction techniques.²⁷ In patients who had experienced APH, this doubled the risk of there being an anomalous cord insertion present supporting the notion that APH should be seen as a warning sign for vasa praevia.^{1,27}

Table 3. Summary of recommendations

Author	Year	Recommendation
Lee et al. ¹⁵	2000	No recommendations made
Rebarber et al. ¹⁶	2014	Targeted screening for high-risk patients with transvaginal scanning, greyscale and colour flow Doppler
Bronsteen et al. ¹⁷	2013	Targeted transvaginal ultrasound of high-risk women
Oyelese et al. ¹³	2004	Placental cord insertion ultrasound should be included in second trimester scan. Targeted transvaginal ultrasound for high-risk patients
Catanzarite et al. ¹⁸	2001	Combined transvaginal ultrasound in second trimester with targeted screening for resolving placenta praevia or bilobed placenta
Sepulveda et al. ²⁶	2003	No recommendations made
Ebbing et al. ²⁷	2013	More investigation needed on ascertaining if identification of placental cord insertion site can reduce the risk of adverse outcome. No recommendations regarding ultrasound screening
Cipriano et al. ²⁵	2010	Targeted transvaginal screening in high-risk group (multiple gestation, low lying placenta, IVF, accessory lobes, velamentous or marginal cord insertion)
Al-Khaduri et al. ²²	2007	Targeted transvaginal ultrasound with colour flow Doppler for IVF gestations
Ghandi et al. ²¹	2008	Targeted screening for twins, low lying placenta or conceived with assisted reproduction techniques

IVF: in-vitro fertilisation.

Several authors discuss various techniques of screening for vasa praevia and due to the variation with no standardisation between them, this makes it impossible to provide any comparative data or even sensitivity or specificity for the techniques used.^{15–18,26} The majority of studies discussed do advocate some form of targeted screening should be adopted to try and improve outcomes. The recommendations of each study can be seen in Table 3. Universal screening is also recommended by several authors; however, it should be considered the financial impact that this would have, not just for the patient management but also the large impact on staff and student training and implementation of some form of quality assurance programme. The most cost-effective strategy as identified by Cipriano et al.²⁵ would be to provide targeted screening as this would cost the least per cohort whilst still preventing more late fetal or neonatal deaths than performing no screening at all.

What should also be noted at this point is the results of a systematic review conducted by Ruiter.²⁸ The aim of the review was to assess the accuracy of ultrasound diagnosis of vasa praevia and covered some of the same research as this review. The authors found that there were similar concerns over the bias within the literature and validity of results as has been found in this review. What was concluded though was that ultrasound can be accurate in detection of vasa praevia if a transvaginal scan is performed with the addition of colour Doppler.²⁸ No consideration is given to the process of screening and whether this should be universally provided to all pregnant women or targeted to the patients who are at high risk. It is acknowledged that further research is needed to provide evidence on the risk factors as well as the potential of whether an early caesarean section is the correct management pathway.²⁸

Conclusion

Within the UK, screening for vasa praevia is not supported as there is uncertainty regarding the epidemiology of the condition.^{6,10,11,20,29} This together with discrepancies between authors over what is classed as a high risk makes it difficult to find a consensus on screening strategy and patient pathways.^{25,30} It is evident that placenta praevia and APH are particularly important risk factors for the condition.^{15,17,18}

Consideration has to be given to the point that screening for vasa praevia is an emotive subject and people are likely to be motivated to implement screening if they have been personally affected by a case with an adverse outcome. It is also difficult to conduct thorough research within this field as randomised controlled trials would not be ethical.³¹ Consequently, it is difficult

to conclude whether it is clinically justified to perform screening for vasa praevia as a technique and management strategy is not clearly defined. What is apparent though is that when a prenatal diagnosis is made, follow-up is important to assess for resolution of the condition.

When acknowledging that screening can help save lives, even with the most standard protocol cases would still be missed. Therefore, further research is needed to assess any impact that implementation of screening for vasa praevia would have and clarification is also needed of the proportion of 'high-risk pregnancies' that are present in within a general UK population.¹⁸

It is clear from the evidence reviewed that prenatal diagnosis is crucial in order to improve outcomes and fetal deaths are mostly preventable with timely management and delivery.^{29,32} Given that there is a current focus in the UK to improve the stillbirth and neonatal death rate with care strategies being implemented such as the 'saving babies lives'⁸ care bundle and the MBRRACE report,⁹ it could be argued that research should be conducted to understand the cause and identification of this condition in pregnancy.

With awareness of vasa praevia increasing over recent years, there will inevitably be incidental findings where no screening or management strategy is in place. This therefore warrants discussion. If prenatal diagnosis can make a significant impact on pregnancy outcomes, then professionals, sonographers and ultrasound departments have a duty of care to be doing what they can to detect this condition and potentially change the outcome for the fetus and mother.

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Contributors

GC conducted the full literature search, review and write up of the manuscript. HV supervised the work involved in the Masters study and reviewed the draft manuscript.

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References

- Derbala Y, Grochal F and Jeanty P. Vasa previa. *J Prenatal Med* 2007; 1: 2–13.
- Tuffnell D. Obstetric haemorrhage. In: Magowan BA, Owen P and Thomson A (eds) *Clinical obstetrics and gynaecology*, 3rd ed. London: Saunders Elsevier, pp. 275–282.
- Oyelese Y and Smulian JC. Placenta previa, placenta accreta and vasa praevia. *Obstet Gynecol* 2006; 107: 927–940.
- Mukherjee S and Bhide A. Antepartum haemorrhage. *Obstet Gynaecol Reprod Med* 2008; 18: 335–339.
- Donnolley N, Halliday LE and Oyelese Y. Vasa praevia: a descriptive review of existing literature and the evolving role of ultrasound in prenatal screening. *AJUM* 2013; 16: 71–76.
- Royal College of Obstetricians and Gynaecologists. *Placenta praevia, placenta praevia accreta and vasa praevia: diagnosis and management*. Green-top guideline no. 27. London: RCOG, 2011.
- Daly-Jones E, John A, Leahy A, et al. Vasa praevia; a preventable tragedy. *Ultrasound* 2008; 16: 8–14.
- NHS England. *Saving babies' lives. A care bundle for reducing stillbirth*. Report. NHS England, UK, 2016.
- MBRRACE-UK. *Perinatal mortality surveillance report*. University of Leicester, UK, 2017.
- UK National Screening Committee. *Vasa praevia and placenta praevia screening in pregnancy*. Version 1. Exeter: UKNSC, 2013.
- UK National Screening Committee. *Screening for vasa praevia in the second trimester of pregnancy*. Version date – Final June 2017. London: UKNSC.
- Society of Obstetricians and Gynaecologists of Canada. *Clinical practice guideline no. 231: guidelines for the management of vasa praevia*. Ottawa: SOGC, 2009.
- Oyelese Y, Catanzarite V, Prefumo F, et al. Vasa previa: the impact of prenatal diagnosis on outcomes. *Obstet Gynecol* 2004; 103: 937–942.
- The Royal Australian and New Zealand College of Obstetricians and Gynaecologists. *C-Obs 47: vasa praevia*. Melbourne: RANZCOG, 2016.
- Lee W, Lee VL, Kirk JS, et al. Vasa previa: prenatal diagnosis, natural evolution, and clinical outcome. *Obstet Gynecol* 2000; 95: 572–576.
- Rebarber A, Dolin C, Fox NS, et al. Natural history of vasa previa across gestation using a screening protocol. *J Ultrasound Med* 2014; 33: 141–147.
- Bronsteen R, Whitten A, Balasubramanian M, et al. Vasa previa. Clinical presentations, outcomes and implications for management. *Obstet Gynecol* 2013; 122: 352–357.
- Catanzarite V, Maida C, Thomas W, et al. Prenatal sonographic diagnosis of vasa previa: ultrasound findings and obstetric outcome in ten cases. *Ultrasound Obstet Gynecol* 2001; 18: 109–115.
- Japaraj RP, Amaraddio D and Fung Yee C. Antenatal diagnosis of vasa praevia – need for a high index of suspicion. *ANZJOG* 2002; 2: 213–216.
- O'Brien J and Sheehan K. Prenatal diagnosis of a velamentous cord insertion associated with a vasa previa. *JDMS* 2001; 17: 94–98.
- Ghandi M, Cleary-Goldman J, Ferrara L, et al. The association between vasa previa, multiple gestations and assisted reproductive technology. *Am J Perinatol* 2008; 25: 587–590.
- Al-Khaduri M, Kadoch IJ, Courrier B, et al. Vasa praevia after IVF: should there be guidelines? Report of two cases and literature review. *Reprod Biomed Online* 2007; 14: 372–374.
- PerezRodriguez MJ, de Frutos Moneo E, Nieto Llanos S, et al. Vasa praevia rupture in a velamentous insertion of the umbilical cord: the importance of prenatal diagnosis. *An Pediatr* 2014; 81: 393–395.
- Atkinson A and Oyelese Y. Vasa previa: the case for routine screening. *FMMR* 2013; 24: 277–288.
- Cipriano LE, Barth WH Jr and Zaric GS. The cost-effectiveness of targeted or universal screening for vasa praevia at 18–20 weeks of gestation in Ontario. *BJOG* 2010; 117: 1108–1118.
- Sepulveda W, Rojas I, Robert JA, et al. Prenatal detection of velamentous insertion of the umbilical cord: a prospective color Doppler ultrasound study. *Ultrasound Obstet Gynecol* 2003; 21: 564–569.
- Ebbing C, Kiserud T, Johnsen SL, et al. Prevalence, risk factors and outcomes of velamentous and marginal cord insertions: a population-based study of 634,741 pregnancies. *PLoS One* 2013; 8: 1–9.
- Ruiter L, Kok N, Limpens J, et al. Systematic review of accuracy of ultrasound in the diagnosis of vasa previa. *Ultrasound Obstet Gynecol* 2015; 45: 516–522.
- Oyelese Y. Placenta previa and related placental disorders. In: Queenan JT, Spong CY and Lockwood CJ (eds) *Management of high-risk pregnancy. An evidence-based approach*, 5th ed. Oxford: Blackwell Publishing, 2007, pp. 362–372.
- Ioannou C and Wayne C. Diagnosis and management of vasa previa: a questionnaire survey. *Ultrasound Obstet Gynecol* 2010; 35: 205–209.
- Tuuli MG and Odibo AO. Ultrasound imaging and Doppler studies of the placenta. In: Kay HH, Nelson DM and Wang Y (eds) *The placenta from development to disease*, 1st ed. London: Wiley-Blackwell, 2011, pp. 122–130.
- Nishtar A and Wood PL. Is it time to actively look for vasa praevia? *J Obstet Gynaecol* 2012; 32: 413–418.