BJOG An International Journal of Obstetrics and Gynaecology
Royal College of Obstetricians & Gynaecologists

The placenta and umbilical cord in prenatal care: unseen, overlooked and misunderstood

Journal:	*BJOG: An International Journal of Obstetrics & Gynaecology*
Manuscript ID	BJOG-24-0354.R1
Wiley - Manuscript type:	Commentary
Date Submitted by the Author:	n/a
Complete List of Authors:	Jauniaux, Eric; University College London Elizabeth Garrett Anderson Institute for Women's Health Lees, Christoph; Queen Charlotte's & Chelsea Hospital West London Gynaecological Cancer Centre Bhide, Amarnath; St George's Hospital E, Daly-Jones; Queen Charlotte's & Chelsea Hospital West London Gynaecological Cancer Centre Srinivasan, Deepa; Queen Charlotte's & Chelsea Hospital West London Gynaecological Cancer Centre; Imperial College London Institute of Reproductive and Developmental Biology Oyelese, Yinka; Harvard Medical School
Keywords:	PLACENTAL PATHOLOGY, FETAL MEDICINE: PERINATAL DIAGNOSIS□ULTRASOUND
Methodology:	Other
Manuscript Category:	
Clinical Category:	FETAL MEDICINE
Abstract:	Not required for this type of article

COMMENTARY

The placenta and umbilical cord in prenatal care: unseen, overlooked and misunderstood

Eric Jauniaux[1] | Christoph Lees[2] | Amar Bhide[3] | Elizabeth Daly-Jones[2] | Deepa Srinivasan[2,4] | Yinka Oyelese[5]

[1]EGA Institute for Women's Health, Faculty of Population Health Sciences, University College London (UCL), London, UK.

[2]Queen Charlotte's and Chelsea Hospital, Imperial Healthcare NHS Trust, London, UK.

[3]Fetal Medicine Unit, Department of Obstetrics and Gynecology, St George's Hospital, London.

[4]Institute of Reproductive and Developmental Biology, Imperial College London, London, UK.

[5]Division of Maternal Fetal Medicine, Department of Obstetrics and Gynaecology, Beth Israel Deaconess Medical School, Harvard Medical School, Boston, MA, USA.

ORCID: EJ: https://orcid.org/0000-0003-0925-7737

Corresponding author: Professor Eric Jauniaux *MD, PhD, FRCOG*
Institute for Women's Health, *University College London, 86-96 Chenies Mews, London WC1E 6HX, UK.*
e.jauniaux@ucl.ac.uk

Funding*:* No funding was obtained for this study.

Conflict of interest: The authors report no conflict of interest.

Short title: Placenta and cord imaging

Word count: 1762

1 | INTRODUCTION

The prenatal diagnosis of placental anomalies was one of the first use of ultrasound imaging in obstetrics from the end of the 1960s.[1,2] Conditions such as placenta praevia and hydatidiform mole had been known for centuries to be associated with a high maternal morbidity and mortality, when undiagnosed before labour for placenta praevia or when presenting with severe anaemia and eclampsia for a hydatidiform mole. Previous attempts at imaging the placenta in utero included soft tissue radiography with radioactive isotopes injected into the maternal circulation or the amniotic cavity and pelvic angiography using radio-opaque dyes injected into the femoral artery.

Ultrasound imaging rapidly proved more practical and safer than other radiology techniques as it did not expose both mother and fetus to radiation. Rapid improvements in ultrasound resolution over the following decade made it possible to diagnose major fetal anomalies such as spina bifida[3], and a decade later, with the development of colour Doppler imaging, it became possible to adequately identify small fetal vessels such as vasa praevia.[4]

Placenta praevia was originally defined using transabdominal sonography (TAS) as a placenta developing within the lower uterine segment and graded according to the relationship between the lowest placental edge and the internal cervical os.[5] The use of high-resolution transvaginal ultrasound (TVS) has revolutionised the diagnosis and follow-up of placenta praevia by allowing accurate measurements of the distance between the presenting placental edge or vasa praevia and the internal os and measuring the cervical length to identify patients at higher riak of premature delivery.[5,6] TVS has proven safe in patients suspected of having a placenta praevia on transabdominal ultrasound[6] and the majority of

pregnant patients in the UK who have TVS reported finding the experience acceptable.[7]

Overall, ultrasound imaging has changed the management and outcome of patients presenting with fetal congenital defects, abnormal fetal growth and maternal obstetric disorders such as pre-eclampsia and gestational diabetes, and has led to the development of the subspeciality in materno-fetal medicine (MFM). However, during this process, detailed ultrasound examination of the placenta and the umbilical cord has been left behind and is only superficially included in obstetric ultrasound training programs.[8] Furthermore, hyper-specialisation in fetal medicine and obstetric scanning has limited the exposure of both MFM and sonographer trainees to the use of TVS, which is mainly used in the evaluation of patients with gynaecologic disorders or presenting with early pregnancy complications in specialised gynaecology clinics and early pregnancy units. In the present commentary, we address these issues and the need for the examination of the placenta and umbilical cord to be included in the UK national training program on obstetric ultrasound imaging.

2 | SCREENING AND DIAGNOSING CONGENITAL ANOMALIES OF THE PLACENTA

The incidence of placenta praevia and placenta praevia accreta has increased exponentially worldwide following a rise in the number of caesarean deliveries (CD) and in the use of artificial reproduction techniques (ART), in particular the use of in-vitro fertilisation (IVF).[5,8] However, the UK National Screening Committee (UK NSC) has never recommended a national screening program for placenta praevia and there is currently no systematic screening program for placenta accreta spectrum

(PAS). The NHS England fetal anomaly screening program (FASP), last updated on the 4th of May 2023, states that the examination of placental position and amniotic fluid at the routine mid-pregnancy (18^{+0}–20^{+6} weeks of gestation) scan is not part of the NHS England FASP but is considered to be good clinical practice (https://www.gov.uk/guidance/fetal-anomaly-screening-programme-overview).

The 2021 National Institute for Health and Care Excellence (NICE) recommends offering all pregnant patients a screen for fetal anomalies and determining placental location at the routine mid-pregnancy scan (https://www.nice.org.uk/guidance/ng201). However, it does not recommend the use of a standardised protocol for the ultrasound examination technique nor the gestational age for follow-up examinations. A decade ago, the executive summary of a consortium of US professional societies specialised in medical imaging and perinatal care recommended that the term "placenta praevia" is only used when the placenta lies directly over the internal os and should be described as "low-lying" when its edge is within 2 cm of the internal os.[9] For pregnancies greater than 16 weeks of gestation, the placenta should be reported as 'low-lying' when the placental edge is less than 20 mm from the os and as normal when the placental edge is 20 mm or more from the os on transabdominal or TVS. This protocol has been recommended by Royal College of Obstetricians and Gynaecologists (RCOG) Green-top Guideline No. 27a on the diagnosis and management of placenta praevia and placenta accreta[5] but not implemented in routine practice as many centres in the UK and worldwide continue to used variable ultrasound criteria for diagnosis of placenta praevia.[8]

PAS is a clinical diagnosis where the placenta is abnormally attached to the uterine wall at birth requiring surgical resection of the accreta area or a hysterectomy

in case of extended lesions.[10] When unsuspected at the time of delivery, attempts to manually remove accreta placental tissue can be associated with major and uncontrollable bleeding and thus ultrasound imaging plays a major role in identifying pregnant patients with a high probability of PAS at birth.[5,8] CD increase the risk of both placenta praevia and placenta accreta in subsequent pregnancies and the risk increases with the number of previous cesarean sections.[5,8] The CD rate has increased 2-3 fold since the end of the last century in most medium and high resources countries and over 90% of PAS are now found in patients with a history of previous CD, presenting with an anterior low-lying placenta or placenta praevia.[5,8] Patients with a placenta praevia accreta are at high risk of intra-operative complications, in particular massive obstetric hemorrhage and should managed by an expert multidisciplinary team.[5,8]

The ultrasound signs associated with PAS at birth have been investigated for over 3 decades. A recent modified Delphi study[10] of the ultrasound signs associated with PAS at birth has reported that a prior history of CD, myomectomy or PAS should be the indication for detailed PAS ultrasound assessment. Targeted antenatal screening including well-defined ultrasound signs and the precise placental position on TVS should therefore be implemented nationally for these patients so that they can be identified at the 20 weeks fetal detailed anatomy scan and referred to a specialist centre for further follow-up and management. The lack of formal training in ultrasound examination of patients at risk of PAS will lead to false negative cases with the corresponding higher morbidity associated with undiagnosed PAS before birth but also to false positive cases with unnecessary referral to specialist units and/or unnecessary additional surgical procedures.

3 | SCREENING AND DIAGNOSING CONGENITAL ANOMALIES OF THE UMBILICAL CORD

A single umbilical artery (SUA) cord is one of the most frequent anomalies in humans, affecting around 0.5% of pregnancies.[11] A SUA is often found in syndromes such as aneuploidies, acardiac fetuses or sirenomelia and can explain the high perinatal morbidity and mortality of SUA when associated with major fetal organ defects. Around two-thirds of fetuses with a SUA do not have other anatomical defects and are referred to as having an isolated SUA.[11] A higher incidence of fetal growth restriction has been reported among fetuses with an isolated SUA and may be present without any other congenital anomalies on ultrasound examination or at birth in 10 to 15% of cases.[11] A 2-vessel cord is included in NHS FASP handbook for the 20-week screening scan base menu which recommends that "if this finding is seen during the scan, then locally agreed pathways should be followed" (last updated 19 February 2024). We did not identify any recommendation for the routine examination of the umbilical cord for the number of vessels at birth on the NHS England nor NICE websites but it is included in the protocol of routine medical examination of the newborn in both in NHS Wales (https://www.wisdom.nhs/anurin-bevan-file) and in the ultrasound examination guidelines of a few local NHS trust in England (https://www.bfwh.nhs.uk and https://www.bsuh.nhs.uk).

Abnormalities of the cord insertion have never been included in any of the obstetric ultrasound screening programs in the UK and are only recorded at delivery in cases of stillbirth or acute intra-partum fetal complications as part of placental histopathologic examination. A velamentous cord insertion (VCI) refers to an umbilical cord that is inserted into the membranes.[8] VCI is found in approximately 1% of births. Around 3-4% of patients presenting with a VCI also have a vasa

praevia (VP) whereas around 2/3 of patients with a VP have a VCI.[4,8] VP has been reported to occur in around 1 in 2000 births but its prevalence is probably higher as it is often difficult to ascertain on a delivered placenta.[4] The incidence of VCI and thus of VP is increased in multiple pregnancies and in pregnancies resulting from IVF.[4,8] When undiagnosed before delivery, VP is associated a 55% perinatal mortality and high risk of long-term neurodevelopmental handicap in the survivors[4] and general screening for VCI and VP is recommended in the guidelines of many Western countries. In the UK, the June 2023 review by UK NSC recommends against screening for VP because it is not known how many babies are affected in the UK, how accurate the screening is, and because of the risks unnecessary early CD and false negative cases. (https://www.view-health-screening-recommendations.service.gov.uk/vasa-praevia). However, targeted screening of high-risk patients, such as those with pregnancies resulting from IVF and those presenting with a VCI or low-lying placenta, has been shown to be efficient in reducing the mortality and morbidity of VP.[12] The UK NSC recommendation is based on an external review published in 2017 by a private contractor (Costello Medical Consulting Ltd; www.costellomedical.cpm) and does not include data nor a discussion on targeted screening for high-risk patients.

4 | CONCLUSION

Anomalies of the placenta and umbilical cord can be easily screen for antenatally at the 20-week detailed fetal ultrasound examination and their diagnosis before birth are among those most likely to prevent perinatal morbidity and mortality for both mothers and their baby. To reduce the impact that these anomalies have on pregnancy outcomes, it is essential that placental and cord anomalies are given the

the same status as other fetal anomalies by national and international health care providers, in respect of routine screening, diagnosis and management but also by professional bodies providing training and continuing professional development. This training needs to be integrated into the MFM and obstetric sonographer curriculum, including the use of TVS. To limit the harmful effect of overdiagnosis and underdiagnosis, standardised international protocols should be used to screen and manage for these anomalies and for the reporting of data in the corresponding medical publications.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and writing up of this commentary.

ACKNOWLEDGEMENTS

We acknowledge contributions made by the numerous authors whom we were unable to cite due to limitations in the commentary format.

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

None declared. Completed disclosure of interest forms are available to view online as supporting information.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

ETHICS APPROVAL

None.

References

1. Campbell S, Kohorn EI. Placental localization by ultrasonic compound scanning. J Obstet Gynaecol Br Commonw. 1968;75:1007-13.
2. Kohorn EI, Blackwell RJ. The diagnosis of hydatidiform mole by ultrasonic B-scanning. Obstet Gynaecol Br Commonw. 1968;75:1014-8.
3. Campbell S, Pryse-Davies J, Coltart TM, Seller MJ, Singer JD. Ultrasound in the diagnosis of spina bifida. Lancet. 1975;7915:1065-8.
4. Oyelese Y, Lees CC, Jauniaux E. The case for screening for vasa previa: time to implement a life-saving strategy. Ultrasound Obstet Gynecol. 2023;61:7-11.
5. Jauniaux E, Alfirevic Z, Bhide AG, Belfort MA, Burton GJ, Collins SL, Dornan S, Jurkovic D, Kayem G, Kingdom J, Silver R, Sentilhes L; Royal College of Obstetricians and Gynaecologists. Placenta Praevia and Placenta Accreta: Diagnosis and Management: Green-top Guideline No. 27a. BJOG. 2019;126:e1-e48.
6. Timor-Tritsch IE, Yunis RA. Confirming the safety of transvaginal sonography in patients suspected of placenta previa. Obstet Gynecol. 1993;81:742-4
7. Clement S, Candy B, Heath V, To M, Nicolaides KH. Transvaginal ultrasound in pregnancy: its acceptability to women and maternal psychological morbidity. Ultrasound Obstet Gynecol. 2003;22:508-14.
8. Jauniaux E, Silver RM. Rethinking prenatal screening for anomalies of placental and umbilical cord implantation. Obstet Gynecol 2020;136:1211-1216.
9. Reddy UM, Abuhamad AZ, Levine D, Saade GR; Fetal Imaging Workshop Invited Participants. Fetal imaging: Executive summary of a joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, American Institute of Ultrasound in Medicine, American College of Obstetricians and Gynecologists, American College of Radiology, Society for Pediatric Radiology, and Society of Radiologists in Ultrasound Fetal Imaging Workshop. J Ultrasound Med 2014;33:745–57.
10. Jauniaux E, D'Antonio F, Bhide A, et al; Modified Delphi study of ultrasound signs associated with placenta accreta spectrum. Ultrasound Obstet Gynecol 2023;61:518-25.
11. Dagklis T, Siargkas A, Apostolopoulou A, Tsakiridis I, Mamopoulos A, Athanasiadis A, Sotiriadis A. Adverse perinatal outcomes following the prenatal diagnosis of isolated single umbilical artery in singleton pregnancies: a systematic review and meta-analysis. J Perinat Med. 2021;50:244-252.
12. Melcer Y, Jauniaux E, Maymon S, et al. Impact of targeted scanning protocols on perinatal outcomes in pregnancies at risk of placenta accreta spectrum or vasa previa. Am J Obstet Gynecol 2018; 218:443.e1-443.e8.