Vasa Previa in Singleton Pregnancies: Diagnosis and Clinical Management Based on an International Expert Consensus

Yinka OYELESE, MD, Ali JAVINANI, MD, Ms. Brittany GUDANOWSKI, MSc., Eyal KRISPIN, MD, Andrei REBARBER, MD, Ranjit AKOLEKAR, MD, Val CATANZARITE, MD, PhD, Rohan D'SOUZA, MD, PhD, FRCOG, Richard BRONSTEEN, MD, Anthony ODIBO, MD, MSCE, Matthias A. SCHEIER, MD, MSc, Junichi HASEGAWA, MD, PhD, Eric JAUNIAUX, MD, PhD, FRCOG, Dr.hc, Christoph LEES, MD, Deepa SRINIVASAN, MBBS, DGO, MD, MRCOG, Ms. Elizabeth DALY-JONES, MSc., Gregory DUNCOMBE, MBBS CSCT(FMP) FRANZCOG, DDU, CMFM, Grad Cert App Law, GAICD, Yaacov MELCER, MD, Ron MAYMON, MD, Robert SILVER, MD, Federico PREFUMO, MD, PhD, Daisuke TACHIBANA, MD, PhD, Wolfgang HENRICH, MD, Robert CINCOTTA, MBBS, FRANZCOG, DDU, CMFM, Scott A. SHAINKER, DO, MS, Angela C. RANZINI, MD, Ashley S. ROMAN, MD, MPH, Ramen CHMAIT, MD, Edgar A. HERNANDEZ-ANDRADE, MD, Daniel L. ROLNIK, MD, PhD, MPH, Waldo SEPULVEDA, MD, FISUOG, Alireza A. SHAMSHIRSAZ, MD

PII: S0002-9378(24)00442-3

DOI: https://doi.org/10.1016/j.ajog.2024.03.013

Reference: YMOB 15544

To appear in: *American Journal of Obstetrics and Gynecology*

Received Date: 20 November 2023

Revised Date: 1 March 2024

Accepted Date: 9 March 2024

Please cite this article as: OYELESE Y, JAVINANI A, GUDANOWSKI B, KRISPIN E, REBARBER A, AKOLEKAR R, CATANZARITE V, D'SOUZA R, BRONSTEEN R, ODIBO A, SCHEIER MA, HASEGAWA J, JAUNIAUX E, LEES C, SRINIVASAN D, DALY-JONES E, DUNCOMBE G, MELCER Y, MAYMON R, SILVER R, PREFUMO F, TACHIBANA D, HENRICH W, CINCOTTA R, SHAINKER SA, RANZINI AC, ROMAN AS, CHMAIT R, HERNANDEZ-ANDRADE EA, ROLNIK DL, SEPULVEDA W, SHAMSHIRSAZ AA, Vasa Previa in Singleton Pregnancies: Diagnosis and Clinical Management Based on an International Expert Consensus, *American Journal of Obstetrics and Gynecology* (2024), doi: https://doi.org/10.1016/j.ajog.2024.03.013.

Vasa Previa in Singleton Pregnancies: Diagnosis and Clinical Management Based on an International Expert Consensus

Yinka OYELESE, MD[1,2,3]*; Ali JAVINANI, MD[2,3]*; Ms. Brittany GUDANOWSKI, MSc.[2]; Eyal KRISPIN, MD[2]; Andrei REBARBER, MD[4,5,6]; Ranjit AKOLEKAR, MD[7,8]; Val CATANZARITE, MD, PhD[9]; Rohan D'SOUZA, MD, PhD, FRCOG[10,11]; Richard BRONSTEEN, MD[12]; Anthony ODIBO, MD,MSCE[13]; Matthias A. SCHEIER, MD, MSc[14]; Junichi HASEGAWA, MD, PhD[15]; Eric JAUNIAUX, MD, PhD, FRCOG, Dr.hc[16]; Christoph LEES, MD[17,18,19]; Deepa SRINIVASAN, MBBS, DGO, MD, MRCOG[17]; Ms. Elizabeth DALY-JONES, MSc.[17]; Gregory DUNCOMBE, MBBS CSCT(FMP) FRANZCOG, DDU, CMFM, Grad Cert App Law, GAICD[20]; Yaacov MELCER, MD[21,22]; Ron MAYMON, MD[21,22]; Robert SILVER, MD[23]; Federico PREFUMO, MD, PhD[24]; Daisuke TACHIBANA, MD, PhD[25]; Wolfgang HENRICH, MD[26,27]; Robert CINCOTTA, MBBS, FRANZCOG, DDU, CMFM [28]; Scott A. SHAINKER, DO, MS[1,2,3]; Angela C. RANZINI, MD[29]; Ashley S. ROMAN, MD, MPH[30]; Ramen CHMAIT, MD[31]; Edgar A. HERNANDEZ-ANDRADE, MD[32]; Daniel L. ROLNIK, MD, PhD, MPH[33]; Waldo SEPULVEDA, MD, FISUOG[34]; Alireza A. SHAMSHIRSAZ, MD[1,2,3]

*Co-First Authors.

1- Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, Beth Israel Deaconess Medical Center, Boston, MA, USA

2- Maternal Fetal Care Center (MFCC), Boston Children's Hospital, Boston, MA, USA

3- Harvard Medical School, Boston, MA, USA

4- Division of Maternal Fetal Medicine, Mount Sinai West, NY, USA

5- Icahn School of Medicine, Mt. Sinai University, NY, USA

6- Carnegie Imaging for Women, PLLC, NY, USA
7- Medway Fetal and Maternal Medicine Centre, Medway NHS Foundation Trust, Gillingham, UK
8- Institute of Medical Sciences, Canterbury Christ Church University, Chatham, Kent, UK
9- Maternal Fetal Medicine, Rady Childrens Specialists of San Diego, San Diego, CA, USA
10- Department of Obstetrics & Gynecology, McMaster University, Hamilton, Canada
11- Department of Health Research Methods, Evidence and Impact, McMaster University, Hamilton, Ontario, Canada
12- Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, William Beaumont University Hospital/Corewell Health, Royal Oak, MI, USA
13- Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, Washington University School of Medicine, St. Louis, MO, USA
14- Ambulatorium für Fetalmedizin, Feldkirch, Austria
15- Department of Perinatal Development Pathophysiology, St. Marianna University Graduate School of Medicine, Kawasaki, Japan
16- EGA Institute for Women's Health, Faculty of Population Health Sciences, University College London, UK
17- Queen Charlotte's and Chelsea Hospital, Imperial Healthcare NHS Trust, UK
18- Institute of Reproductive and Developmental Biology, Imperial College London, UK
19- Department of Development and Regeneration, KU Leuven, Belgium
20- Department of Obstetrics and Gynaecology, Logan Hospital, Metro South Health, Meadowbrook, Australia
21- Department of OB/GYN, Shamir Medical Centre, Zrifin, Israel.

22- Faculty of Medicine, Tel Aviv University, Israel

23- University of Utah, Salt Lake City, Utah, USA

24- Obstetrics and Gynecology Unit, IRCCS Istituto Giannina Gaslini, Genoa, Italy

25- Department of Obstetrics and Gynecology, Graduate School of Medicine, Osaka City University, Osaka, Japan.

26- Department of Obstetrics, Campus Virchow Klinikum, Campus Mitte Charité - Universitätsmedizin Berlin, Germany

27- Charité - University Medical Center, Berlin, Germany

28- Department of Maternal Fetal Medicine, Mater Mother's Hospital, South Brisbane, Australia

29- Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, The MetroHealth System/Case Western Reserve University, Cleveland, OH, USA.

30- Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, NYU Langone Health, New York, NY

31- Department of Obstetrics & Gynecology, Keck School of Medicine, University of South California, Los Angeles, CA, USA

32- Division of Maternal-Fetal Medicine, Department of Obstetrics, Gynecology, and Reproductive Sciences, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, TX, USA

33- Department of Obstetrics & Gynaecology, Monash University, Australia.

34- FETALMED--Maternal-fetal Diagnostic Center, Fetal Imaging Unit, Santiago, Chile

Disclosure:

RD has received funding through the International Vasa Previa Foundation for research unrelated to this study. The remaining authors report no conflict of interest.

Funding Sources:

None.

Paper Presentation: A preliminary abstract of this study was presented at the 33rd Annual World Congress of The International Society of Ultrasound in Obstetrics & Gynecology in Seoul, South Korea, 16-19 October, 2023.

Corresponding Authors:

1.Yinka Oyelese, MD, Division of Maternal Fetal Medicine, Department of Obstetrics & Gynecology, Beth Israel Deaconess Medical Center, 330 Brookline Avenue, KS3, Boston, MA 02215

Email: koyelese@bidmc.harvard.edu Phone: 732-236-6307

2. Alireza A. Shamshirsaz, MD, Maternal Fetal Medicine Care Center, Boston Children's Hospital, 300 Longwood Ave, Boston, MA 02215

Email: Alireza.shamshirsaz@childrens.harvard.edu Phone: 617-355-6512

Word counts: Abstract: 480. Manuscript: 3620.

Keywords: Vasa previa. Expert consensus. Delphi. Prenatal diagnosis. Clinical management. Survey. Clinical Guideline. Practice Guideline. Ultrasound.

Tweetable statement:

An international expert panel reached consensus for the diagnosis and management of vasa previa.

Short Title:
Vasa Previa Delphi Consensus

AJOG at a Glance:

Why was the study conducted?

There are limited and conflicting data to guide the diagnosis and management of vasa previa.

What are the key findings?

Expert consensus is that all pregnancies should be screened for vasa previa at the second trimester anatomy scan.
Screening should be by identification of placental cord insertion and using color Doppler over the cervix.
The definition of vasa previa should not be limited to vessels 2 cm from the internal os.
Outpatient management is reasonable for asymptomatic low-risk patients with vasa previa.
Patients with vasa previa should be delivered by cesarean between 35^{w} 0^{d} and 37^{w} 0^{d} weeks gestation.

What does this study add to what is already known?
An international panel of experts achieved consensus on the diagnosis and overall management of vasa previa.

Abstract:

Background: There are limited data to guide the diagnosis and management of vasa previa. Currently, what is known is largely based on case reports or series and cohort studies.

Objective(s): To systematically collect and classify expert opinions and achieve consensus on the diagnosis and clinical management of vasa previa using focus group discussions (FGD) and a Delphi technique.

Study Design: A four-round FGD and a three-round Delphi survey of an international panel of experts on vasa previa were conducted. Experts were selected based on their publication record on vasa previa. First, we convened an FGD panel of 20 experts and agreed on which issues were unresolved in the diagnosis and management of vasa previa. A three-round anonymous electronic survey was then sent to the full expert panel. Survey questions were presented on the diagnosis and management of vasa previa that the experts were asked to rate on a 5-point Likert scale (from strongly disagree = 1 to strongly agree = 5). Consensus was defined as a median score of 5. Following responses to each round, any statements that had median scores of 3 or less were deemed to have had no consensus and excluded. Statements with a median score of 4 were revised and re-presented to the experts in the next round. Consensus and non-consensus statements were then aggregated.

Results: Sixty-eight international experts were invited to participate in the study, of which 57 participated. Experts were from 13 countries on five continents and have contributed to over 80% of published cohort studies on vasa previa, as well as national and international society guidelines. Completion rates were 84%, 93%, 91% for the first, second, and third rounds, respectively, and 71% completed all three rounds. The panel reached a consensus on 26 statements regarding the diagnosis and key points of management of vasa previa, including: 1) While there is no agreement on a distance between the fetal vessels and the cervical internal os to

define vasa previa, the definition should not be limited to a 2 cm distance; 2) All pregnancies should be screened for vasa previa with routine examination for placental cord insertion and a color Doppler sweep of the region over the cervix at the second-trimester anatomy scan; 3) When a low-lying placenta or placenta previa is found in the second trimester, a transvaginal ultrasound with Doppler should be performed at around 32 weeks to rule out vasa previa; 4) Outpatient management of asymptomatic patients without risk factors for preterm birth is reasonable; 5)Asymptomatic patients with vasa previa should be delivered by scheduled cesarean between 35- and 37-weeks of gestation; and 6) There was no agreement on routine hospitalization, avoidance of intercourse, or use of 3-dimensional ultrasound for diagnosis of vasa previa.

Conclusions: Through FGD and a Delphi process, an international expert panel reached consensus on the definition, screening, clinical management, and timing of delivery in vasa previa, which could inform the development of new clinical guidelines.

Introduction

Vasa previa, defined as unprotected fetal vessels that traverse the amniotic membranes over the cervix, is associated with a substantial risk of perinatal death when undiagnosed prenatally.[1-10] It affects approximately 1:1200 pregnancies.[11] There are 3 types of vasa previa; in type 1, there is a velamentous cord insertion, while in type 2, unprotected fetal vessels run over the cervix between the main placenta and an accessory placenta lobe.[4,12-14] In type 3, unprotected fetal vessels exit the placental edge to run through the membranes, and then "boomerang" to reinsert into the placental edge at another location.[15-18] In type 3, there is usually not a velamentous cord insertion, and there is a single placental mass. When the membranes rupture in late pregnancy or in labor, fetal exsanguination often occurs, with a reported perinatal mortality of approximately 56% and substantial morbidity in survivors in vasa previa not diagnosed prenatally.[7,8] Ultrasound has made it possible to diagnose the condition prenatally and to deliver the patients by cesarean prior to the rupture of the membranes thereby avoiding this high perinatal mortality.[8,19-28] This approach has, in recent years, changed the outcome of patients with vasa previa in many countries with advanced healthcare resources, and survival rates in prenatally diagnosed vasa previa are excellent.[29-33]

However, there are limited data to guide the diagnosis and management of vasa previa.[1-3] In particular, there are no randomized controlled trials, and studies on vasa previa consist almost exclusively of cohort studies, case series, and case reports, with the largest of these having approximately 150 patients.[4] Thus, there is a paucity of information and a lack of consensus on criteria to use in clinical practice for the definition of vasa previa, whether the condition should be screened for, how and when the diagnosis should be made, and the optimal management for

vasa previa. There are also controversies about who should be screened, whether patients should be hospitalized, administration of steroids and their timing, and the optimal gestational age for delivery. The accurate diagnosis, monitoring, and management of vasa previa continue to pose daily challenges for clinicians due to these unresolved issues. Furthermore, current national societal guidelines are based on a few retrospective cohort studies and thus, the guideline authors' interpretations of those studies, leading to bias.[1-3]

The aim of this study was to achieve, through focus group discussion (FGD) and a Delphi process, expert consensus on the essential clinical issues in the diagnosis and clinical management of vasa previa.

Materials and methods

For this study, we used two strategies to formulate the statements for the first round of the Delphi survey. The first entailed a comprehensive literature review, and the second involved a focus group discussion (FGD) with a core panel of experts. We then carried out a Delphi study of a larger group of international experts on vasa previa to aim at consensus recommendations on the diagnosis and clinical management of the condition.

Literature Review

We performed a comprehensive literature review of all publications on the PubMed database using the keywords "Vasa Previa" and "Vasa Praevia"[Mesh].

Expert definition

Experts were selected primarily based on their publication record, following a comprehensive literature search for publications on vasa previa, including the databases PubMed, UpToDate, and national societal guidelines. Individuals with more than two publications as the first or senior author were preliminarily identified as experts. Additionally, some experts were recommended by their peers due to their extensive clinical expertise and established national/international reputation in diagnosis and management of vasa previa.

Focus group discussion

The primary aim of the FGD was to create a comprehensive list of statements for the first round of the Delphi process, capturing expert opinions that might not have been addressed in the literature review. Based on our criteria (*See* Expert Definition), those with the highest number of publications were identified as the core group.

Each expert was personally contacted and invited for an online FGD. Due to differences in time zones and to ensure effective discussions, four separate group discussions were held. The FGDs were conducted by videoconferencing on the Zoom platform (Zoom Video Communications, Qumu Corporation, San Jose CA, USA), and each lasted one hour. Each session was led by two moderators (YO and AAS) who posed open and undirected questions focused on the diagnosis and management of vasa previa. All sessions were both video and audio recorded. Transcriptions were made post-session and cross-checked with notes of the note-taker (AJ).

For analysis, the transcripts were reviewed, and primary areas of discussion were identified using thematic analysis.[34] To formulate the statements for the Delphi survey, these transcripts were segmented, coded, and then categorized based on the identified themes. These

254 statements were then validated (YO, AAS, EK, AJ, RD) before being used in the first round of
255 the Delphi process.
256
257 **The Delphi Process**
258 The Delphi method, a qualitative research technique, addresses questions that existing literature
259 might fail to answer.[35] This method seeks consensus across an expert panel through multiple
260 iterative rounds.[36,37] The structured format of the Delphi technique facilitates the quantitative
261 collection and categorization of expert opinions. This technique allows for the inclusion of an
262 unlimited number of experts and employs an iterative process where each round is adapted based
263 on feedback from the previous round. This process continues until consensus is achieved. The
264 Delphi process collects responses anonymously and is based on consensus (agreement by the
265 overwhelming majority), thereby removing the influence of strongly opinionated or dominant
266 individuals that would usually occur when discussions were held face-to-face.
267
268 **Data Collection**
269 The Delphi study consisted of three distinct rounds, all carried out using an anonymous
270 electronic survey using the SurveyMonkey online platform (SurveyMonkey Inc., San Mateo,
271 California, USA). In the first round, experts were asked to rate each statement on a Likert scale,
272 which ranged from 1 (completely disagree) to 5 (completely agree). Alongside each statement, a
273 comment box was made available, offering experts the opportunity to provide feedback or
274 propose modifications to the statement. To ensure maximum participation, automatic reminder
275 emails were sent out on a weekly basis, totaling three reminders before the round's closure. Once
276 the first round concluded, the median score of each statement was determined. Statements that

277 achieved a median score of 5, and for which no further modifications were proposed, were
278 considered to have reached consensus. In contrast, those with a median score of 3 or lower were
279 deemed non-consensus and subsequently excluded from further consideration. Statements with a
280 median score of 4 were adjusted based on the experts' feedback and subsequently incorporated
281 into the second round. Notably, for three pivotal questions concerning gestational age at routine
282 hospital admission, routine administration of steroids, and delivery in asymptomatic patients, a
283 survey format was opted for instead of the conventional Likert scale, allowing the research team
284 to better gauge the spread of expert responses. For these three questions, the survey format
285 consisted of answers stratified by gestational age (eg 28-29$^{6/7}$ weeks, 30-31$^{6/7}$ weeks etc)
286 (Supplemental Table 2). The questionnaires in each round are available in supplemental tables
287 1-3. Only those who completed a round were advanced to the next round. No other experts were
288 invited to replace those who did not respond to any round of the survey.

289 During the initial round of the Delphi survey, participants were asked about their years of
290 experience in diagnosing and treating vasa previa, the estimated annual number of vasa previa
291 patients assessed at their respective institutions, and their academic degree to further validate and
292 represent their expertise.

293 The second round of the Delphi study closely mirrored the first in its methodology.
294 Statements that were presented in this round and achieved a median score of 4 underwent further
295 refinements based on expert suggestions and were then advanced to the third round. In the third
296 round, experts were provided with the revised statements and were simply asked to either agree
297 or disagree with each one. Consensus was recognized for any statement that garnered agreement
298 from over 75% of participating experts.[38] As a final measure to ensure the integrity and
299 acceptance of the findings, all 57 participants who responded to the survey were presented with

the consolidated list of both consensus and non-consensus statements, seeking their confirmation prior to finalizing the results. This was in the form of an agree/disagree statement with comments allowing open feedback.

Ethical consideration

The protocol of this study received exemptions from the Institutional Review Board at both Beth Israel Deaconess Medical Center (IRB approval P2022P000981; approval date 11/26/2022) and Boston Children's Hospital (IRB approval IRB-P00044255; approval date 01/22/2023). Prior to recording the FGDs, verbal consent was obtained from all participants. For the Delphi process, the consent of participants was sought through the invitation email.

Results

We identified 68 experts. Of these, eighteen experts from eight countries participated in the FGD. Fifty-seven experts participated in the first round of the Delphi survey. These 57 respondents reported a median of 20 years (interquartile range (IQR): 12-25) of experience diagnosing and treating vasa previa. Additionally, they reported evaluating a median of 10 patients (IQR): 5-15 with vasa previa annually at their respective institutions. Thematic analysis of the FGD transcripts revealed the following categories that the experts felt needed addressing:

1. Vasa previa definition
2. Screening and diagnosis:
    - Universal vs. targeted screening
    - Imaging modalities and screening techniques
    - Timing of screening
3. Management:

3a. Monitoring and ultrasound frequency:

- Outpatient management in asymptomatic patients from the time of diagnosis to 32 weeks

- Outpatient management in asymptomatic patients after 32 weeks until delivery/admission
- Cervical length monitoring
- Biophysical profile assessment
- Growth scan
- Cardiotocography

3b. Hospitalization:

- Admission indication in asymptomatic patients after 32 weeks
- Gestational age at admission for asymptomatic patients
- Steroids administration

3c. Miscellaneous:

- Sexual intercourse
- Physical activity
- Fetoscopic laser photocoagulation of vasa previa

4. Timing of delivery in asymptomatic patients

In the first Delphi round, 44 statements and 8 multiple-choice questions were sent to the 68 experts. No experts declined to participate. A response rate of 84% (57 experts) was achieved. Thus, 11 of the invited experts did not respond, and responses of 57 experts were analyzed. This round saw consensus on 12 statements, non-consensus on 14, and 18 statements received a median score of 4.

The second Delphi round involved 24 statements and 4 multiple-choice questions, sent to the 57 experts who responded to the first round. 53 experts (93%) completed the survey. Consensus was reached on 11 statements, 5 did not achieve consensus, and 8 received a median score of 4.

In the third Delphi round, three statements were presented to the experts. Of the 53 expert sent surveys, 47 (91%) responded. All three third-round statements achieved agreement levels exceeding 75% (Supplemental Table 3). Overall, consensus was achieved on 26 statements, while we failed to reach consensus on 10 statements (Tables 1 and 2). Both consensus and non-consensus statements were ratified by the entire expert panel of 57 respondents before this manuscript's publication and are given in Tables 1 and 2, while responses to multiple choice questions are given in Figures 1-3.

Comment

Principal findings

Expert panelists reached consensus regarding several aspects of the definition, screening, clinical management, and timing of delivery for vasa previa (Table 1). The main findings included: 1) While there is no consensus regarding a distance definition for vasa previa, its definition should not be limited to vessels within 2 cm. of the internal os; 2) universal screening for vasa previa should be performed at the time of the second trimester anatomy scan via examination of the placental cord insertion and a color flow Doppler sweep of the area over the cervix in all pregnant patients; 3) outpatient management of vasa previa in asymptomatic patients without risk factors for spontaneous preterm birth is reasonable with careful counseling and consent; and 4) asymptomatic patients with vasa previa should be delivered between $35^{0/7}$ and $37^{0/7}$ weeks gestation by scheduled cesarean.

Results in the Context of What is Known

Definition

A distance of 2 cm. between the unprotected fetal vessels and the internal os has been used by some authors to define vasa previa.[1,19,21,39] This was derived from the definition of a low-lying placenta and has never been shown to be a safe distance for vasa previa, and using this distance for defining vasa previa has previously been challenged.[3,4,9,30,39] This controversy was recently addressed in a commentary that argued that assumptions on which some have used the 2 cm distance to define vasa previa are flawed.[39] The Delphi process in the present study resulted in a consensus that while no clear distance has been agreed on to define vasa previa, it should not be limited to 2 cm. Thirty-four percent of respondents used a 2 cm definition, while 32% used a 5

cm definition and 21% used no distance definition. The remaining 13% used distances between 2.5 and 4 cm (Figure 1).

Screening

There has been much controversy regarding who should be screened or if screening for vasa previa should be performed at all.[9,30,31,40-48] The panelists agreed that all pregnancies should be screened for vasa previa and that this should be performed at the time of second trimester anatomy scan and through both identification of the placental cord insertion[49] and a routine color flow Doppler sweep of the region overlying the cervix. While some guidelines recommend identification of the placental cord insertion when feasible,[49,50] none currently recommend a color Doppler flow sweep of the region overlying the cervix. Placental cord insertion alone will identify most cases of type 1 vasa previa but will fail to identify types 2 and 3 vasa previa.[13,15,16,18] Several national guidelines state that there is insufficient evidence to recommend routine screening for vasa previa.[1-3] However, there are data supporting universal vasa previa screening, as it is feasible without requiring extra personnel, time, and equipment beyond what is used in routine obstetrical ultrasound.[31,51,52] Given the high perinatal mortality associated with vasa previa undiagnosed before birth, the high detection rate of ultrasound for the condition, and the dramatic reduction in perinatal mortality accompanying prenatal diagnosis, several authors have argued for universal screening for the condition.[4,8,23,31,53]

The panel also agreed that transvaginal ultrasound screening should be performed routinely in patients with risk factors for vasa previa (second trimester low-lying placenta and placenta previa, velamentous cord insertion, multifetal pregnancies, pregnancies with accessory lobes). This is in keeping with several guidelines that recommend targeted screening in patients with

these risk factors.[3,41,54] In addition, our experts concurred that when vasa previa diagnosis is made in the second trimester, it should be confirmed in the third trimester. Previous studies have indicated that between 15 and 40% of cases of vasa previa diagnosed in the second trimester will resolve by the time of delivery.[21,55]

Clinical management

There is ongoing debate about whether patients with vasa previa should routinely be admitted to the hospital in the third trimester.[1,3,4,56,57] There was consensus that in symptomatic patients or those at high risk for preterm delivery, hospitalization should be recommended (Table 1). The experts in this study did not reach a consensus that patients with prenatally diagnosed vasa previa should be routinely admitted to hospital, and agreed that asymptomatic patients (without bleeding, regular painful uterine contractions, or loss of fluid) without risk factors for spontaneous preterm delivery (short cervix, history of prior spontaneous preterm delivery, positive fetal fibronectin) could be managed as outpatients until delivery. Nearly a third of the experts said they admit patients only for delivery without routine steroid administration (Figure 2). Of those who reported routinely admitting asymptomatic patients, 30% reported admitting patients between $32^{0/7}$ and $33^{6/7}$ weeks and 26% reported admitting between $34^{0/7}$ and $35^{6/7}$ weeks (Figure 2).

Cervical surveillance with transvaginal ultrasound and fetal monitoring have been proposed for patients with vasa previa.[58] However, the panel concluded that while these interventions may have a clinical role, practice should be tailored to the individual institutional guidelines.

There was no consensus on avoiding sexual intercourse or recommending pelvic rest, nor on performing monitoring for contractions, routine administration of steroids, routine vascular mapping before surgery and routinely performing three-dimensional ultrasound for vasa previa. Fetoscopic laser ablation has been proposed as a potential treatment for selected cases of Types 2 and 3 vasa previa.[59,60] The panel's consensus opinion was that this intervention should be considered experimental at this time.

Timing of delivery

While some authors have recommended delivery as early as 32 weeks, our experts agreed that delivery in asymptomatic patients without risk factors for spontaneous preterm birth should occur between 35 and 37 weeks of gestation. Over half of experts chose between $36^{w}0^{d}$ to $36^{w}6^{d}$ weeks, with 30.19% opting for $35^{w}0^{d}$ to $35^{w}6^{d}$ weeks (Figure 3).This is in keeping with both a recent cohort study and systematic review and meta-analysis that found that best outcomes were achieved with delivery between 36 and $36^{w}6^{d}$ weeks in asymptomatic patients.[61,62]

Clinical Implications

Screening

The consensus that pregnant patients should routinely be screened for vasa previa will help reduce the preventable perinatal mortality arising from this condition.[30,31] It has been proposed that if vasa previa were to not be diagnosed, it would likely result in over 1,000 perinatal deaths in the USA each year. It is therefore important that all involved in obstetric imaging be aware of this condition, how to screen for and recognize it, and know which patients are at increased risk for vasa previa.[4,6,9,26,53] However, despite screening, even with experienced examiners, it is possible to miss some cases of vasa previa.[3,4,12,63,64]

Clinical management

The panelists agreed that outpatient management is reasonable for asymptomatic patients without risk factors for preterm birth. Thus, practitioners should not assume that hospitalization is mandatory for all patients with vasa previa, but that rather there should be individualization of care with careful consideration of risk and logistics (such as access to the hospital), and shared decision-making should determine whether patients are hospitalized or not. While no consensus was reached on steroid administration, we recommend that rather than routine administration of steroids, this should be based on an individual risk assessment of high likelihood of delivery within 7 days before $36^{w}6^{d}$.

Timing of delivery

The expert panel also provides guidance on timing of delivery. Prior studies have indicated substantial morbidity relating to preterm delivery in patients with prenatally diagnosed vasa previa. The recommendation to deliver asymptomatic patients without risk factors at $35^{w}0^{d}$ -37^{w} 0^{d} weeks will reduce the risks of preterm delivery to the newborn and will hopefully lead to improved neonatal outcomes. Timing of delivery should take into consideration individual patient circumstances, and detailed counseling and shared decision making are recommended.

Research Implications

Definition

While the panel has reached a consensus on many aspects of the diagnosis and management of vasa previa, several knowledge gaps still exist that could not be addressed adequately in our study. For example, consensus was not reached regarding a specific distance from the internal os

for making the diagnosis of vasa previa. In addition, the distance from the fetal vessels to the internal os at which patients may safely deliver vaginally remains unknown.

Screening

There is a need for more data on the true incidence of vasa previa in most countries, and the national impact of screening on reducing perinatal mortality rates. The cost-effectiveness of routine screening for vasa previa also needs to be examined more closely. There are ongoing studies examining routine transvaginal ultrasound cervical length assessment at the time of the anatomy scan for preterm birth prevention. This would be an ideal population to evaluate the cost-effectiveness of adding screening for vasa previa in these patients.

Clinical management

Further studies are necessary to examine the role of hospitalization for patients with vasa previa, and to determine which patients may be safely managed as inpatients or outpatients. There is a need to better determine optimal timing of steroid administration as well as the roles of cervical length surveillance and antenatal fetal monitoring. There is ongoing research into the potential role of fetoscopic laser ablation as a treatment for selected cases of vasa previa.[59,60] Further studies would be important to close these knowledge gaps.

Strengths and Limitations

Our study has several strengths. First, we were able to assemble an international group of experts with representation from 13 countries in five continents. Furthermore, our expert panel represents individuals who have considerable experience in diagnosing and managing patients with vasa previa and have contributed to greater than 80% of the published cohort studies on

vasa previa listed on PubMed. Our experts report managing an average of over 10 patients with vasa previa annually. Furthermore, included in our experts are those who have authored national society guidelines on vasa previa. Second, we were able to achieve consensus on several controversial issues surrounding vasa previa. Third, we achieved a high response rate, over 80% to each of the rounds, which significantly increases the validity of our methodology. Fourth, because of our extensive systematic review and focus group discussions prior to the Delphi study, we were able to identify the issues regarding vasa previa that needed to be addressed and the areas of debate in clinical practice. Fifth, based on the principles of the Delphi technique, all experts were blinded to responses of other experts, allowing their true opinions to be made known without influence from others.

A limitation is our exclusion of twin pregnancies, since those have a different risk profile and may be at higher risk for adverse outcomes.[65,66] Another limitation was that the panel could not reach consensus on best practice regarding steroid administration and the role of cervical surveillance and fetal monitoring.

Conclusions

Using a robust FGD and Delphi technique, international expert consensus opinion was achieved regarding the diagnosis and clinical management of vasa previa that will be helpful for both healthcare providers and patients and supports the development of new clinical guidelines.

Acknowledgment

The authors thank all the experts who participated in this Delphi study:

1. AKOLEKAR, Ranjit, MD, *Chatham, England, UK*
2. BARTAL, Michal Fishel, MD, *Houston, TX, USA*
3. BLUMENFELD, Yair, MD, *Palo Alto, CA, USA*
4. BRONSTEEN, Richard, MD, *Beverly Hills, MI, USA*

5. CATANZARITE, Val, MD, PhD, *San Diego, CA, USA*
6. CHAVEZ, Martin R., MD, *New York, NY, USA*
7. CHMAIT, Ramen, MD, *Los Angeles, CA, USA*
8. CHUEH, Jane, MD, *Palo Alto, CA, USA*
9. CINCOTTA, Robert, MBBS, FRANZCOG, DDU, CMFM*, South Brisbane, Australia*
10. D'SOUZA, Rohan, MD, PhD, FRCOG, MSc, *Hamilton, Ontario, Canada*
11. DALY-JONES, Elizabeth, MSc, *London, England, UK*
12. DEGIRMENCI, Yaman, MBBS, *Mainz, Germany*
13. DELABAERE, Amelia, MD, *Clermont-Ferrand, France*
14. DUNCOMBE, Gregory, MBBS CSCT(FMP) FRANZCOG, DDU, CMFM, Grad Cert App Law, GAICD, *Brisbane, Australia*
15. FRANCOIS, Karrie, MD, *Phoenix, AZ USA*
16. FURUYA, Natsumi, MD, *Kanagawa, Japan*
17. GAROFALO, Anna, MD, *Arezzo, Italy*
18. *GROBMAN,* William, MD, MBA*, Columbus, OH, USA*
19. HASEGAWA, Junichi, MD, PhD, *Tokyo, Japan*
20. HENRICH, Wolfgang, MD, *Berlin, Germany*
21. HERNANDEZ-ANDRADE, Edgar, MD, PhD, *Houston, TX, USA*
22. JAUNIAUX, Eric, MD, PhD, FRCOG, DHSc, *London, England, UK*
23. KRISPIN, Eyal, MD *Boston, MA, USA*
24. LEES, Christoph, MD, *London, England, UK*
25. LOCKWOOD, Charles, MD*, Tampa, FL, USA*
26. MATSUZAKI, Shinya, MD, *Osaka, Japan*
27. MAYMON, Ron, MD, *Petah Tikva, Israel*
28. MELCER, Yaakov, MD, *Tel Aviv, Israel*
29. ODIBO, Anthony, MD, MSCE, *St. Louis, MO, USA*
30. OYELESE, Yinka, MD, *Boston, MA, USA*
31. PAJKRT, Eva, MD, PhD, *Amsterdam, Netherlands*
32. PAPANNA, Ramesha, MD, MPH*, Houston, TX, USA*
33. POOH, Ritsuko, MD, PhD, LLB, MSc*, Osaka, Japan*
34. PREFUMO, Federico, MD, PhD, *Genova, Italy*
35. RANZINI, Angela C., MD, *Cleveland, OH, USA*
36. REBARBER, Andrei, MD, *New York, NY, USA*
37. ROLNIK, Daniel L., MD, PhD, MPH, *Melbourne, Australia*
38. ROMAN, Ashley S., MD, MPH, *New York, NY, USA*
39. SCHEIER, Matthias, A., MD, MSc, *Feldkirch, Austria*
40. SEPULVEDA, Waldo, MD, *Santiago, Chile*
41. SERRA, Bernat, MD, *Barcelona, Spain*
42. SHAINKER, Scott A., DO, MS, *Boston, MA, USA*
43. SHAMSHIRSAZ, Alireza A., MD, *Boston, MA, USA*
44. SHEINER, Eyal, MD*,* PhD, *Beersheba, Israel*
45. SILVER, Robert, MD, *Salt Lake City, UT, USA*
46. SINKEY, Rebecca, MD, *Birmingham, AL, USA*
47. SMULIAN, John C., MD, MPH, *Gainesville, FL, USA*

564 *48.* SRINIVASAN, Deepa, MBBS, DGO, MD, MRCOG, *London, England, UK*
565 49. STONE, Joanne, MD, MS, *New York, NY, USA*
566 *50.* SWANK, Morgan, MD, *Denver, CO, USA*
567 51. TACHIBANA, Daisuke, MD, PhD, *Osaka, Japan*
568 52. USHAKOV, Fred, MD*, London, England, UK*
569 53. VILLE, Yves, MD, *Paris, France*
570 *54.* VINTZILEOS, Anthony M., MD*, New York, NY, USA*
571 *55.* VIORA, Elsa, MD, *Turin, Italy*
572 *56.* WESTCOTT, Jill, MD, MS, *Kansas City, MO, USA*
573 *57.* ZACONETA, Alberto, MD, PhD, MSc, *Brasilia, Brazil*
574

575

576

Legends

Table 1. List of consensus statements

Table 2. List of non-consensus statements

Figure 1. Reponses to distance between fetal vessels and internal os to constitute vasa previa.

Figure 2. Experts' recommendations regarding routine hospitalization for vasa previa.

Figure 3. Expert recommendations regarding timing of delivery.

Supplemental Tables

Supplemental Table 1. Survey Questions and Responses for the Delphi Round 1.

Supplemental Table 2. Survey Questions and Responses for the Delphi Round 2.

Supplemental Table 3. Survey Questions and Responses for the Delphi Round 3.

References

1. Society of Maternal-Fetal Publications C, Sinkey RG, Odibo AO, Dashe JS. #37: Diagnosis and management of vasa previa. *Am J Obstet Gynecol*. Nov 2015;213(5):615-9. doi:10.1016/j.ajog.2015.08.031
2. Jauniaux E, Alfirevic Z, Bhide AG, et al. Vasa Praevia: Diagnosis and Management: Green-top Guideline No. 27b. *BJOG*. Jan 2019;126(1):e49-e61. doi:10.1111/1471-0528.15307
3. Jain V, Gagnon R. Guideline No. 439: Diagnosis and Management of Vasa Previa. *J Obstet Gynaecol Can*. Jul 2023;45(7):506-518. doi:10.1016/j.jogc.2023.05.009
4. Oyelese Y, Javinani A, Shamshirsaz AA. Vasa Previa. *Obstet Gynecol*. Sep 1 2023;142(3):503-518. doi:10.1097/AOG.0000000000005287
5. Silver RM. Abnormal Placentation: Placenta Previa, Vasa Previa, and Placenta Accreta. *Obstet Gynecol*. Sep 2015;126(3):654-668. doi:10.1097/AOG.0000000000001005
6. Oyelese KO, Turner M, Lees C, Campbell S. Vasa previa: an avoidable obstetric tragedy. *Obstet Gynecol Surv*. Feb 1999;54(2):138-45. doi:10.1097/00006254-199902000-00024
7. Oyelese Y, Catanzarite V, Prefumo F, et al. Vasa previa: the impact of prenatal diagnosis on outcomes. *Obstet Gynecol*. May 2004;103(5 Pt 1):937-42. doi:10.1097/01.AOG.0000123245.48645.98
8. Zhang W, Geris S, Al-Emara N, Ramadan G, Sotiriadis A, Akolekar R. Perinatal outcome of pregnancies with prenatal diagnosis of vasa previa: systematic review and meta-analysis. *Ultrasound Obstet Gynecol*. May 2021;57(5):710-719. doi:10.1002/uog.22166
9. Ranzini AC, Oyelese Y. How to screen for vasa previa. *Ultrasound Obstet Gynecol*. May 2021;57(5):720-725. doi:10.1002/uog.23520
10. Hasegawa J, Arakaki T, Ichizuka K, Sekizawa A. Management of vasa previa during pregnancy. *J Perinat Med*. Nov 2015;43(6):783-4. doi:10.1515/jpm-2014-0047
11. Zhang W, Giacchino T, Chanyarungrojn PA, Ionescu O, Akolekar R. Incidence of vasa praevia: a systematic review and meta-analysis. *BMJ Open*. Sep 20 2023;13(9):e075245. doi:10.1136/bmjopen-2023-075245
12. 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*. Aug 2001;18(2):109-15. doi:10.1046/j.1469-0705.2001.00448.x
13. Matsuzaki S, Ueda Y, Matsuzaki S, et al. The Characteristics and Obstetric Outcomes of Type II Vasa Previa: Systematic Review and Meta-Analysis. *Biomedicines*. Dec 15 2022;10(12)doi:10.3390/biomedicines10123263
14. Tachibana D, Misugi T, Pooh RK, et al. Placental Types and Effective Perinatal Management of Vasa Previa: Lessons from 55 Cases in a Single Institution. *Diagnostics (Basel)*. Jul 29 2021;11(8)doi:10.3390/diagnostics11081369
15. Oyelese Y. Evolution from placenta previa to Type 3 vasa previa. *Ultrasound Obstet Gynecol*. Sep 28 2023;doi:10.1002/uog.27505
16. Suekane T, Tachibana D, Pooh RK, Misugi T, Koyama M. Type-3 vasa previa: normal umbilical cord insertion cannot exclude vasa previa in cases with abnormal placental location. *Ultrasound Obstet Gynecol*. Apr 2020;55(4):556-557. doi:10.1002/uog.20347
17. Takemoto Y, Matsuzaki S, Matsuzaki S, et al. Current Evidence on Vasa Previa without Velamentous Cord Insertion or Placental Morphological Anomalies (Type III Vasa Previa): Systematic Review and Meta-Analysis. *Biomedicines*. Jan 7 2023;11(1)doi:10.3390/biomedicines11010152

18. Pozzoni M, Sammaria C, Villanacci R, et al. Prenatal diagnosis and postnatal outcome of type III vasa previa: systematic review of literature. *Ultrasound Obstet Gynecol*. Jul 20 2023;doi:10.1002/uog.26315
19. Catanzarite V, Cousins L, Daneshmand S, et al. Prenatally Diagnosed Vasa Previa: A Single-Institution Series of 96 Cases. *Obstet Gynecol*. Nov 2016;128(5):1153-1161. doi:10.1097/AOG.0000000000001680
20. Daly-Jones E, Hollingsworth J, Sepulveda W. Vasa praevia: second trimester diagnosis using colour flow imaging. *Br J Obstet Gynaecol*. Mar 1996;103(3):284-6. doi:10.1111/j.1471-0528.1996.tb09720.x
21. Klahr R, Fox NS, Zafman K, Hill MB, Connolly CT, Rebarber A. Frequency of spontaneous resolution of vasa previa with advancing gestational age. *Am J Obstet Gynecol*. Dec 2019;221(6):646 e1-646 e7. doi:10.1016/j.ajog.2019.06.040
22. Bronsteen R, Whitten A, Balasubramanian M, et al. Vasa previa: clinical presentations, outcomes, and implications for management. *Obstet Gynecol*. Aug 2013;122(2 Pt 1):352-357. doi:10.1097/AOG.0b013e31829cac58
23. Gross A, Markota Ajd B, Specht C, Scheier M. Systematic screening for vasa previa at the 20-week anomaly scan. *Acta Obstet Gynecol Scand*. Sep 2021;100(9):1694-1699. doi:10.1111/aogs.14205
24. Westcott JM, Simpson S, Chasen S, et al. Prenatally diagnosed vasa previa: association with adverse obstetrical and neonatal outcomes. *Am J Obstet Gynecol MFM*. Nov 2020;2(4):100206. doi:10.1016/j.ajogmf.2020.100206
25. Swank ML, Garite TJ, Maurel K, et al. Vasa previa: diagnosis and management. *Am J Obstet Gynecol*. Aug 2016;215(2):223 e1-6. doi:10.1016/j.ajog.2016.02.044
26. Derbala Y, Grochal F, Jeanty P. Vasa previa. *J Prenat Med*. Jan 2007;1(1):2-13.
27. Ruiter L, Kok N, Limpens J, Derks JB, de Graaf IM, Mol BW, Pajkrt E. Systematic review of accuracy of ultrasound in the diagnosis of vasa previa. *Ultrasound Obstet Gynecol*. May 2015;45(5):516-22. doi:10.1002/uog.14752
28. Melcer Y, Maymon R, Jauniaux E. Vasa previa: prenatal diagnosis and management. *Curr Opin Obstet Gynecol*. Dec 2018;30(6):385-391. doi:10.1097/GCO.0000000000000478
29. Jauniaux E, Savvidou MD. Vasa praevia: more than 100 years in preventing unnecessary fetal deaths. *BJOG*. Jul 2016;123(8):1287. doi:10.1111/1471-0528.13869
30. Oyelese Y. Vasa previa: time to make a difference. *Am J Obstet Gynecol*. Dec 2019;221(6):539-541. doi:10.1016/j.ajog.2019.08.034
31. Oyelese Y, Lees CC, Jauniaux E. The case for screening for vasa previa: time to implement a life-saving strategy. *Ultrasound Obstet Gynecol*. Jan 2023;61(1):7-11. doi:10.1002/uog.26085
32. Sullivan EA, Javid N, Duncombe G, et al. Vasa Previa Diagnosis, Clinical Practice, and Outcomes in Australia. *Obstet Gynecol*. Sep 2017;130(3):591-598. doi:10.1097/AOG.0000000000002198
33. Furuya N, Sasaki T, Homma C, Hasegawa J, Suzuki N. Ultrasound screening and management of vasa previa in Japan. *J Obstet Gynaecol Res*. Jul 2020;46(7):1084-1089. doi:10.1111/jog.14254
34. Rabiee F. Focus-group interview and data analysis. *Proc Nutr Soc*. Nov 2004;63(4):655-60. doi:10.1079/pns2004399
35. Niederberger M, Spranger J. Delphi Technique in Health Sciences: A Map. *Front Public Health*. 2020;8:457. doi:10.3389/fpubh.2020.00457

36. Barrett D, Heale R. What are Delphi studies? *Evid Based Nurs*. Jul 2020;23(3):68-69. doi:10.1136/ebnurs-2020-103303

37. Krispin E, Javinani A, Odibo A, et al. Consensus protocols for management of early and late twin-twin transfusion syndrome: Delphi study. *Ultrasound Obstet Gynecol*. Aug 8 2023;doi:10.1002/uog.27446

38. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, Wales PW. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol*. Apr 2014;67(4):401-9. doi:10.1016/j.jclinepi.2013.12.002

39. Oyelese Y. A 2 cm Distance Should Not be Used to Define Vasa Previa. *J Ultrasound Med*. Jan 31 2024;doi:10.1002/jum.16420

40. McQueen V, Speed M, Rutter S, Gray T. Vasa praevia: Should we routinely screen high-risk women for this rare but serious condition? *Ultrasound*. May 2018;26(2):127-131. doi:10.1177/1742271X17747137

41. Melcer Y, Jauniaux E, Maymon S, Tsviban A, Pekar-Zlotin M, Betser M, Maymon R. Impact of targeted scanning protocols on perinatal outcomes in pregnancies at risk of placenta accreta spectrum or vasa previa. *Am J Obstet Gynecol*. Apr 2018;218(4):443 e1-443 e8. doi:10.1016/j.ajog.2018.01.017

42. Sinkey RG, Odibo AO. Vasa previa screening strategies: decision and cost-effectiveness analysis. *Ultrasound Obstet Gynecol*. Oct 2018;52(4):522-529. doi:10.1002/uog.19098

43. Antenatal Screening Programme. Vasa Praevia (2023).

44. Committee. NS. National Screening Committee. Screening for Vasa Praevia in the second trimester of pregnancy. External review. Accessed September 1, 2023. legacyscreening.phe.org.uk/vasapraevia

45. Cipriano LE, Barth WH, Jr., Zaric GS. The cost-effectiveness of targeted or universal screening for vasa praevia at 18-20 weeks of gestation in Ontario. *BJOG*. Aug 2010;117(9):1108-18. doi:10.1111/j.1471-0528.2010.02621.x

46. Ruban-Fell B, Attilakos G, Haskins-Coulter T, et al. The impact of ultrasound-based antenatal screening strategies to detect vasa praevia in the United Kingdom: An exploratory study using decision analytic modelling methods. *PLoS One*. 2022;17(12):e0279229. doi:10.1371/journal.pone.0279229

47. Leonard S, Buchanan-Hughes A, Bobrowska A, Visintin C, Marshall J. Case report: a rapid review approach used by the UK National Screening Committee to inform recommendations on general population screening for vasa praevia. *Syst Rev*. Dec 29 2019;8(1):340. doi:10.1186/s13643-019-1244-9

48. Nishtar A, Wood PL. Is it time to actively look for vasa praevia? *J Obstet Gynaecol*. Jul 2012;32(5):413-8. doi:10.3109/01443615.2012.673038

49. Reddy UM, Abuhamad AZ, Levine D, Saade GR, Fetal Imaging Workshop Invited P. 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. *Am J Obstet Gynecol*. May 2014;210(5):387-97. doi:10.1016/j.ajog.2014.02.028

50. American Institute of Ultrasound in M. AIUM practice guideline for the performance of obstetric ultrasound examinations. *J Ultrasound Med*. Jun 2013;32(6):1083-101. doi:10.7863/ultra.32.6.1083

51. Nomiyama M, Toyota Y, Kawano H. Antenatal diagnosis of velamentous umbilical cord insertion and vasa previa with color Doppler imaging. *Ultrasound Obstet Gynecol*. Dec 1998;12(6):426-9. doi:10.1046/j.1469-0705.1998.12060426.x
52. 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*. Jun 2003;21(6):564-9. doi:10.1002/uog.132
53. Zhang W, Geris S, Beta J, Ramadan G, Nicolaides KH, Akolekar R. Prevention of stillbirth: impact of two-stage screening for vasa previa. *Ultrasound Obstet Gynecol*. May 2020;55(5):605-612. doi:10.1002/uog.21953
54. Silver RM. Vasa praevia: improved diagnosis through recognition of risk factors. *BJOG*. Jul 2016;123(8):1288. doi:10.1111/1471-0528.13870
55. Erfani H, Haeri S, Shainker SA, et al. Vasa previa: a multicenter retrospective cohort study. *Am J Obstet Gynecol*. Dec 2019;221(6):644 e1-644 e5. doi:10.1016/j.ajog.2019.06.006
56. Villani LA, Al-Torshi R, Shah PS, Kingdom JC, D'Souza R, Keunen J. Inpatient versus outpatient management of pregnancies with vasa previa: A historical cohort study. *Acta Obstet Gynecol Scand*. Aug 3 2023;doi:10.1111/aogs.14595
57. Fishel Bartal M, Sibai BM, Ilan H, et al. Prenatal Diagnosis of Vasa Previa: Outpatient versus Inpatient Management. *Am J Perinatol*. Mar 2019;36(4):422-427. doi:10.1055/s-0038-1669396
58. Maymon R, Melcer Y, Tovbin J, Pekar-Zlotin M, Smorgick N, Jauniaux E. The Rate of Cervical Length Shortening in the Management of Vasa Previa. *J Ultrasound Med*. Mar 2018;37(3):717-723. doi:10.1002/jum.14411
59. Chmait RH, Monson MA, Chon AH, Masri MJ, Korst LM, Incerpi MH. Third trimester fetoscopic ablation therapy for types II and III vasa previa. *Am J Obstet Gynecol*. Sep 21 2023;doi:10.1016/j.ajog.2023.09.015
60. Ibirogba ER, Shazly SA, Chmait RH, Ruano R. Is there a role for fetoscopic laser ablation therapy in Type-2 vasa previa? *Ultrasound Obstet Gynecol*. Nov 2019;54(5):696. doi:10.1002/uog.20251
61. Mitchell SJ, Ngo G, Maurel KA, et al. Timing of birth and adverse pregnancy outcomes in cases of prenatally diagnosed vasa previa: a systematic review and meta-analysis. *Am J Obstet Gynecol*. Aug 2022;227(2):173-181 e24. doi:10.1016/j.ajog.2022.03.006
62. Kulkarni A, Powel J, Aziz M, Shah L, Lashley S, Benito C, Oyelese Y. Vasa Previa: Prenatal Diagnosis and Outcomes: Thirty-five Cases From a Single Maternal-Fetal Medicine Practice. *J Ultrasound Med*. Apr 2018;37(4):1017-1024. doi:10.1002/jum.14452
63. Kagan KO, Hoopmann M, Sonek J. Vasa previa: easy to miss. *Ultrasound Obstet Gynecol*. Feb 2018;51(2):283-284. doi:10.1002/uog.17532
64. Oyelese Y, Reforma L, Sewell McGough R, O'Brien B. Manual elevation of fetal head as potential cause of missed vasa previa. *Ultrasound Obstet Gynecol*. Sep 2022;60(3):429-431. doi:10.1002/uog.24982
65. Jauniaux E, Melcer Y, Maymon R. Prenatal diagnosis and management of vasa previa in twin pregnancies: a case series and systematic review. *Am J Obstet Gynecol*. Jun 2017;216(6):568-575. doi:10.1016/j.ajog.2017.01.029
66. Conyers S, Oyelese Y, Javinani A, et al. Incidence and causes of perinatal death in prenatally diagnosed vasa previa: a systematic review and meta-analysis. *Am J Obstet Gynecol*. Jun 13 2023;doi:10.1016/j.ajog.2023.06.015

Table 1. List of consensus statements

Definition
• In my routine practice, I make the diagnosis of VP at any gestational age but it should be confirmed later in the pregnancy. • The diagnosis of vasa previa made in the second trimester should be confirmed during the third trimester or before delivery. • While there is no consensus regarding a distance definition for vasa previa, I feel the definition of vasa previa should not be limited to vessels within 2 cm of the internal os.
Screening
• I recommend screening for vasa previa in all pregnant persons. • I recommend screening at the time of the anatomy scan. • I recommend a follow-up transvaginal sonography/color Doppler imaging at about 32 weeks in patients with a previous diagnosis of placenta previa, low-lying placenta, or VP at the time of anomaly scan. • I recommend routine identification of the umbilical cord insertion into the placenta by transabdominal ultrasound at the time of the mid-trimester anatomy scan in all pregnant individuals. • In all pregnant individuals, including those without risk factors, I recommend routine transabdominal ultrasound with color Doppler sweep of the lower uterine segment. • I recommend that when vasa previa is suspected on transabdominal ultrasound, the diagnosis should be confirmed with transvaginal ultrasound with Doppler. • In pregnant persons with any risk factors, I recommend routine screening with transvaginal sonography and color Doppler imaging for vasa previa. • In the evaluation of suspected VP by transvaginal sonography/color Doppler imaging, I recommend examining the region over the cervix in multiple planes (i.e., sagittal, coronal, etc.). • During the evaluation for suspected vasa previa, whenever possible, the fetal presenting part should not be applied on the cervix to avoid compressing the vessels. Techniques such as manual displacement or positioning the patient in a Trendelenburg position may be used to achieve this.
Management and monitoring
• I recommend admission to VP patients with variable decelerations on the outpatient NST/CTG. • I recommend admission to VP patients with bleeding or rupture of the membranes.

• I offer admission according to the special social circumstances of the pregnant person (including their willingness to become admitted, their anxiety, difficult access to the medical center, etc.). • I recommend admission to patients with progressive cervical shortening in the third trimester. • I recommend admission to patients with premature symptomatic uterine contractions. • I offer/recommend admission to patients with limited access to medical centers in the third trimester. • Transvaginal ultrasound measurements of cervical length have a role in the management of vasa previa. This may be individualized according to institutional protocols and resources. • In patients with vasa previa, fetal surveillance, including biophysical profile examinations and growth scans, plays a role in management and should be conducted in accordance with institutional protocols and available resources. • In asymptomatic patients without risk factors for preterm birth or rupture of the membranes, outpatient management is reasonable after appropriate counseling, if the patient desires this, and has easy access to the hospital. • I do not recommend complete bed rest for patients with VP. • I believe that fetoscopic laser ablation for VP should be considered experimental and is not routinely recommended.
Time of delivery
• I do not recommend routine delivery earlier than 34 + 0 weeks. • I do not recommend delivery later than 38 + 0 weeks. • In asymptomatic patients with vasa previa and a normal cervical length, I recommend routine delivery between 35 + 0 and 36 + 6.

NST: Non-stress test, CTG: Cardiotocography, VP: Vasa previa

Risk factors: placenta previa, low-lying placenta, IVF pregnancies, bilobed and succenturiate lobed placenta

Asymptomatic patients: pregnant patients without vaginal bleeding, regular painful uterine contractions, or loss of fluid.

Risk factors of for preterm birth or rupture of membranes: history of preterm birth, short cervix, positive fetal fibronectin

Table 2. List of non-consensus statements

• I routinely recommend an NST/CTG to detect contractions.
• I routinely recommend admission to all patients with VP.
• I do not suggest pelvic rest during pregnancy for asymptomatic patients with VP with normal CL.
• I believe that the caliber and type (main umbilical cord vs. peripheral vessels) of VP could affect our general recommendation for the time of delivery.
• I recommend routine delivery whenever estimated fetal weight exceeds 2500 grams.
• There is no safe distance from the vessels to the internal os, and any vessels seen running through the membranes on transvaginal ultrasound should be considered vasa previa.
• I routinely recommend using three-dimensional ultrasound for vasa previa diagnosis and/or follow-up.
• I suggest routinely performing ultrasound for vascular mapping before delivery to guide the uterine incision during cesarean delivery.
• If you do not routinely admit your patients: in the outpatient management of asymptomatic patients after 32 weeks until delivery/admission, I recommend routine weekly biophysical profile examinations.
• In patients with vasa previa, I recommend routinely giving steroids at the time of admission, regardless of the reason for admission and gestational age.

NST: Non-stress test, CTG: Cardiotocography, VP: Vasa previa

AJOG American Journal of Obstetrics & Gynecology

American Journal of Obstetrics & Gynecology

STATEMENT OF AUTHORSHIP

Each author is required to submit a signed Statement of Authorship upon submission. This applies to all submission types including Editorials, Letters to the Editor, etc.

Date: 10/27/2023 **Manuscript # (if available):**

Manuscript title: Vasa Previa in Singleton Pregnancies: Diagnosis and Clinical Management Based on an International Expert Delphi Consensus

Corresponding author: Yinka Oyelese, MD

Authors may either sign the same form or submit individually

I am an author on this submission, have adhered to all editorial policies for submission as described in the Information for Authors, attest to having met all authorship criteria, and all potential conflicts of interest / financial disclosures appears on the title page of the submission.

Signatures are required - typed signatures are unacceptable.

Typed or CLEARLY Printed Name: Andrei Rebarber

Signature:

Typed or CLEARLY Printed Name: Angela C. Ranzini

Signature:

Typed or CLEARLY Printed Name: **Robert M. Silver**

Signature:

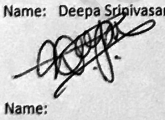
Formatted: Space Before: 18 pt

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name: Deepa Srinivasan

Signature:



Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Figure 1. Reponses to distance between fetal vessels and internal os to constitute vasa previa.

Phrase
I consider vasa previa to include unprotected fetal vessels (artery or vein) running through the membranes within what distance of the internal cervical os? (please specify in centimeters or put an "x" for no distance criteria)

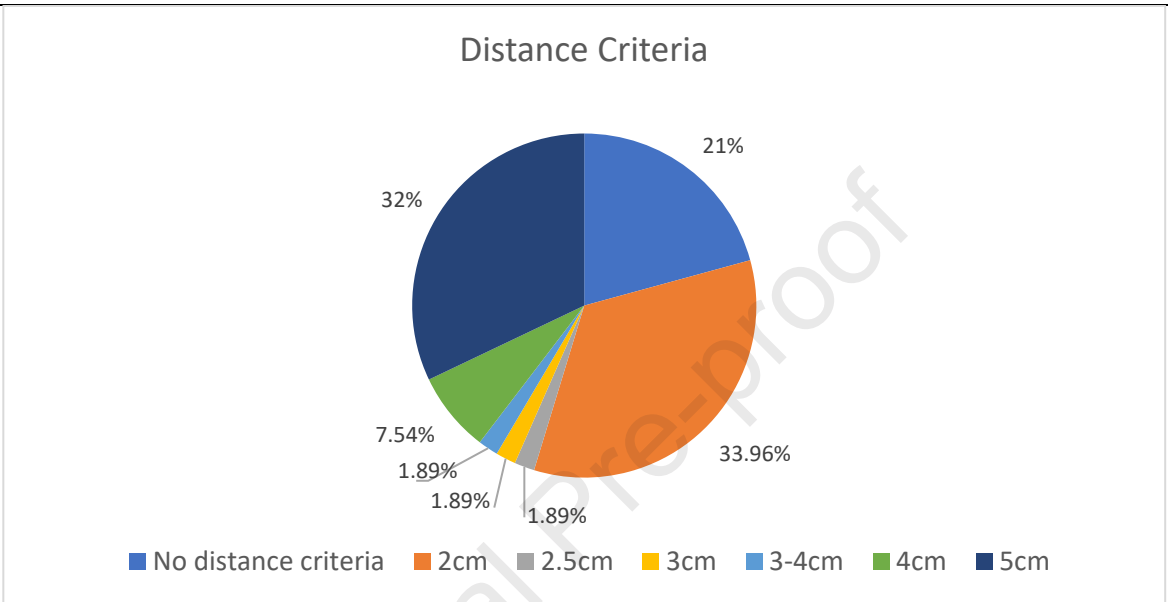


Figure 2. Experts' recommendations regarding routine hospitalization for vasa previa.

If you recommend routinely admitting asymptomatic* patients with vasa previa and a normal cervical length, at what gestational age do you typically recommend admission:

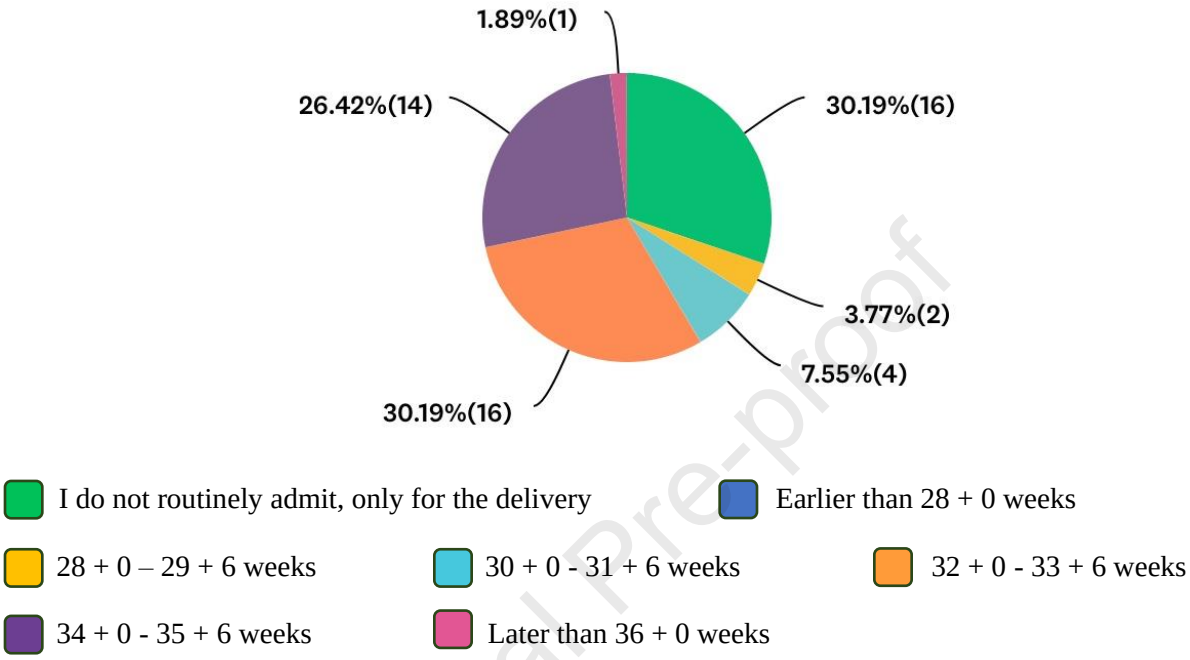
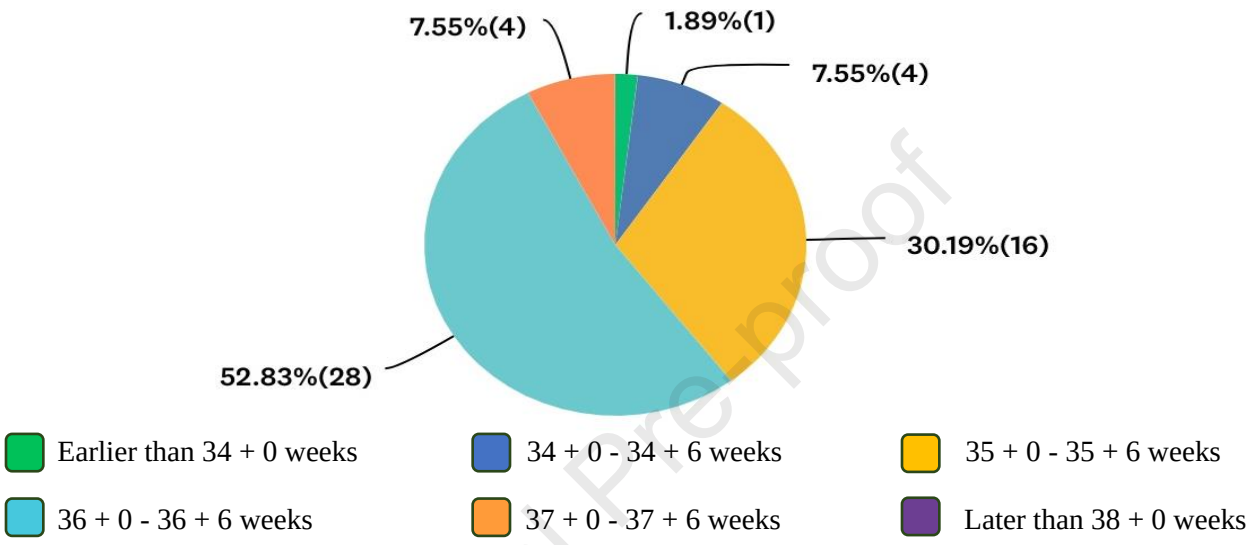


Figure 3. Expert recommendations regarding timing of delivery.

Phrase
Based on your expertise, at what gestational age do you recommend delivering asymptomatic* patients with a normal cervical length?



AJOG American Journal of Obstetrics & Gynecology

American Journal of Obstetrics & Gynecology

STATEMENT OF AUTHORSHIP

ach author is required to submit a signed Statement of Authorship upon submission. This applies to all submission types ncluding Editorials, Letters to the Editor, etc.

ate: 10/27/2023 **Manuscript # (if available): ____**

Manuscript title: Vasa Previa in Singleton Pregnancies: Diagnosis and Clinical Management Based on an International Expert Delphi Consensus

Corresponding author: Yinka Oyelese, MD

Authors may either sign the same form or submit individually

I am an author on this submission, have adhered to all editorial policies for submission as described in the Information for Authors, attest to having met all authorship criteria, and all potential conflicts of interest / financial disclosures appears on the title page of the submission.

Signatures are required - typed signatures are unacceptable.

Typed or CLEARLY Printed Name:

Signature: HAYMOR ROU

Typed or CLEARLY Printed Name:

Signature: MELCER Yaakov

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Signature:

Typed or CLEARLY Printed Name:

Signature:

Journal Pre-proof

Yinka OYELESE: conceptualization, data curation, formal analysis, methodology, project administration, resources, validation, writing/review & editing, writing/original draft

Ali JAVINANI: conceptualization, data curation, formal analysis, methodology, resources, software, validation, writing/review & editing, writing/original draft

Brittany GUDANOWSKI: data curation, formal analysis, software, validation, writing/review & editing

Eyal KRISPIN: conceptualization, data curation, methodology, validation, writing/review & editing, writing/original draft

Andrei REBARBER: conceptualization, validation, writing/review & editing

Ranjit AKOLEKAR: conceptualization, methodology, validation, writing/review & editing

Val CATANZARITE: conceptualization, supervision, validation, writing/review & editing

Rohan D'SOUZA: conceptualization, methodology, validation, writing/review & editing, writing/original draft

Richard BRONSTEEN: conceptualization, supervision, validation, writing/review & editing

Anthony ODIBO: conceptualization, supervision, validation, writing/review & editing

Matthias A. SCHEIER: conceptualization, validation, writing/review & editing

Junichi HASEGAWA: conceptualization, supervision, validation, writing/review & editing

Eric JAUNIAUX: conceptualization, methodology, supervision, validation, writing/review & editing, writing/original draft

Christoph LEES: conceptualization, methodology, supervision, validation, writing/review & editing

Deepa SRINIVASAN: conceptualization, validation, writing/review & editing

Elizabeth DALY-JONES: conceptualization, validation, writing/review & editing

Gregory DUNCOMBE: conceptualization, supervision, validation, writing/review & editing

Yaacov MELCER: conceptualization, validation, writing/review & editing

Ron MAYMON: conceptualization, validation, writing/review & editing

Robert SILVER: conceptualization, supervision, validation, writing/review & editing

Federico PREFUMO: conceptualization, validation, writing/review & editing

Daisuke TACHIBANA: conceptualization, validation, writing/review & editing

Wolfgang HENRICH: project administration, validation, writing/review & editing

Robert CINCOTTA: conceptualization, validation, writing/review & editing

Scott A. SHAINKER: investigation, methodology, supervision, validation, writing/review & editing, writing/original draft

Angela C. RANZINI: investigation, resources, validation, writing/review & editing

Ashley S. ROMAN: investigation, methodology, project administration, validation, writing/review & editing

Ramen CHMAIT: investigation, supervision, validation, writing/review & editing

Edgar A. HERNANDEZ-ANDRADE: project administration, validation, writing/review & editing

Daniel L. ROLNIK: validation, writing/review & editing, writing/original draft

Waldo SEPULVEDA: investigation, validation, writing/review & editing

Alireza A. SHAMSHIRSAZ: conceptualization, data curation, formal analysis, methodology, project administration, validation, writing/review & editing, writing/original draft