Journal of Biosciences and Medicines, 2024, 12, 397-406
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

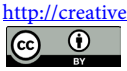
One Case of Successful Rescue of Ruptured Placenta Previa with Vascular Previa and Literature Review

Weihua Yang*, Huanqin Zhang*, Shujuan Luo*, Li Tang*, Qiuping Wang#

Department of Obstetrics, Shenzhen Guangming District People's Hospital, Shenzhen, China
Email: #58839530@qq.com

How to cite this paper: Yang, W.H., Zhang, H.Q., Luo, S.J., Tang, L. and Wang, Q.P. (2024) One Case of Successful Rescue of Ruptured Placenta Previa with Vascular Previa and Literature Review. *Journal of Biosciences and Medicines*, **12**, 397-406.
https://doi.org/10.4236/jbm.2024.1211033

Received: October 16, 2024
Accepted: November 19, 2024
Published: November 22, 2024



Abstract

Vasa previa is a rare obstetric complication, characterized by fetal umbilical cord blood vessels being unprotected by Wharton's jelly or placental tissue and located within 20 mm of the internal cervical os. This case describes a late pregnancy antepartum hemorrhage that was promptly treated with a cesarean section. During the surgery, a ruptured vasa previa was found, and fortunately, the rupture was blocked by a clot, resulting in minimal blood loss. Both mother and baby had a good outcome. The case is used to elaborate on the high-risk factors, classification, diagnostic methods, and treatment plans for vasa previa, aiming to increase the detection rate of this condition and manage it systematically, ultimately improving perinatal outcomes.

Keywords

Prenatal Hemorrhage, Previa of Blood Vessels, Velamentous Placenta, Case Reports, Neonatal Outcomes

1. Introduction

Velamentous cord insertion refers to the umbilical cord attaching to the fetal membranes, with the umbilical vessels passing through the amnion and chorion to enter the placenta. In cases of sail-shaped placentas, the umbilical cord is attached to the fetal membrane rather than the typical position on the placenta itself. The attachment sites of the umbilical cord at the placental inlet are predominantly situated at the central or slightly off-center regions of the placental parenchyma. However, there exists a limited number of umbilical cord placental inlets that

*Co-first author.
#Corresponding author.

directly connect to the fetal membrane in close proximity to the placenta. The umbilical blood vessels may branch out into multiple pathways, traversing between the amniotic membrane and the chorionic villus before attaching to the periphery of the placenta and ultimately penetrating into the placental tissue, contributing to the formation of anterior vessels. Hence, the anterior vessel is characterized as the umbilical blood vessel traversing the amniotic and chorionic membranes, traversing the lower segment of the uterus, and approaching the cervical opening anterior to the fetal presentation, devoid of umbilical cord adhesion or placental tissue support. The prevalence of placenta previa is approximately 1 in 2500, but with *in vitro* fertilization and multiple pregnancies, the incidence can increase to between 1 in 250 and 1 in 500. Spontaneous or iatrogenic rupture of the fetal membranes during the peripartum period may result in the rupture of anterior blood vessels, leading to acute fetal blood loss and a significantly elevated neonatal mortality rate. Sail-shaped placenta and placenta previa are uncommon obstetric complications characterized by painless vaginal bleeding, which can be confused with other conditions such as preterm labor, placental abruption, and placenta previa bleeding, thus complicating timely diagnosis and treatment. This can lead to acute fetal hemorrhaging, a high rate of neonatal mortality, and significant harm to the perinatal infant. Therefore, the integration of prenatal diagnostics into high-risk management and the timely termination of pregnancy are crucial to improve the outcomes of perinatal infants. Herein, we present a successful case of prenatal hemorrhaging at our institution, which was identified during surgery for a ruptured placenta previa and blood vessels.

2. Case Report

A 35-year-old multiparous woman with one previous live birth presented to our hospital at 40 weeks of gestation with complaints of vaginal bleeding. Throughout her pregnancy, she received routine prenatal care, and all examinations were unremarkable. At 22 weeks of pregnancy, a level three color ultrasound reveals the following: The lower edge of the placenta is positioned 17 mm away from the internal os of the cervix, the umbilical cord insertion point is situated at the lower edge of the placenta near the fetal membrane, and a fetal membrane vessel is visible at the edge of the internal os of the cervix. Upon rotating the probe to alter the section, the fetal membrane vessel appears to traverse the internal os of the cervix, indicating a previa of the umbilical vessels (**Figure 1**). Subsequent ultrasound examinations at 30 and 37 weeks gestation did not reveal any placental abnormalities or vascular previa. Vaginal bleeding began approximately one hour prior, characterized by a dark red color more intense than menstrual flow, accompanied by mild lower abdominal discomfort, yet without any associated vaginal discharge. The emergency ultrasound examination revealed a late pregnancy with a single live fetus in the cephalic presentation, an amniotic fluid index (AFI) of 116 mm, a grade II placenta located in the upper middle section of the posterior wall of the uterus with a thickness of 30 mm, and a pulsatility index (S/D) of 2.30

and resistance index (RI) of 0.57. Endoscopic examination revealed an unobstructed vagina with visible dark red blood accumulation, cleared blood clots, an uncleared cervical canal, and an unopened uterine opening, accompanied by a small amount of persistent bleeding from the uterine cavity. Fetal heart monitoring indicated non-reactivity in non-stress testing, suggesting a likelihood of fetal distress due to anterior blood vessel rupture. An urgent cesarean section in the lower uterine segment with combined spinal anesthesia is recommended, resulting in the delivery of a live male infant weighing 2980 g with an Apgar score of 10 - 10. Intraoperatively, examination reveals the placenta situated on the posterior uterine wall, with its lower margin positioned 20 mm from the cervical os. The umbilical cord was situated at the basal plate of the placenta on the fetal membrane. Three prominent blood vessels were identified on the fetal membrane, with one traversing the cervical os and penetrating the placenta. Approximately 10 grams of clots were present surrounding the blood vessels, and upon their removal, active bleeding was noted. Subsequently, the placenta and fetal membrane were successfully extracted. The placental detachment surface surrounding the cervical opening exhibited notable hemorrhaging, necessitating suturing of the bleeding point and prompt uterine compression with a balloon to achieve hemostasis. The total volume of blood loss amounted to 800 ml, with successful surgical outcomes. Postoperatively, the umbilical cord measured approximately 60 cm in length and was secured to the fetal membranes, which exhibited three prominent blood vessels. One of these vessels traversed the cervical opening and extended approximately 2 cm into the placenta, as illustrated in Figure 2. During the postoperative period, a blood vessel was observed to have ruptured, as depicted in Figure 3. The postoperative diagnosis indicated fetal distress and a sail-shaped placenta with a rupture of the anterior blood vessels. After a six-day recovery period, both the mother and baby were discharged from the hospital. At 42 days postpartum, the uterus showed satisfactory recovery, and the newborn demonstrated positive development.

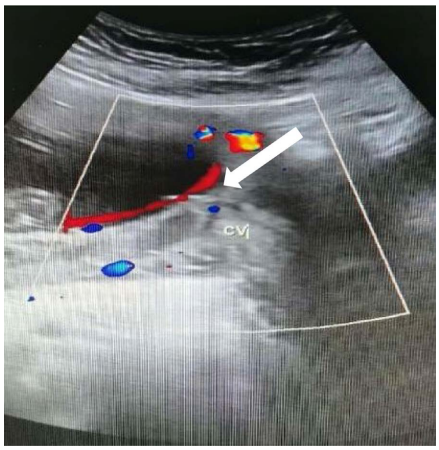


Figure 1. Color Doppler ultrasound examination reveals placental previa vessels.

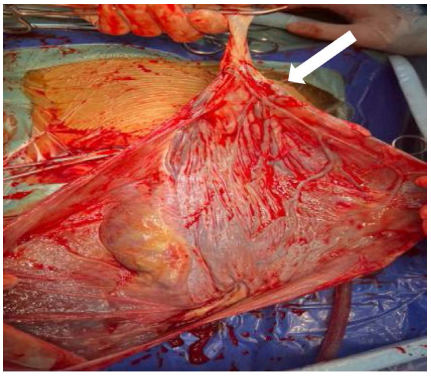


Figure 2. The umbilical cord remains attached to the fetal membranes during a cesarean section.

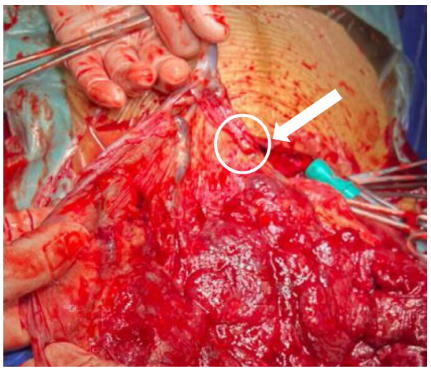


Figure 3. The site of the rupture of the anterior blood vessel.

3. Discussion

The umbilical cord functions as a critical pathway for gas exchange, nutrient supply, and waste elimination between the fetus and the mother, creating an essential link between them. Generally, the umbilical cord is attached centrally or off-center to the placenta. However, in instances where the umbilical cord is attached to the fetal membranes, the umbilical cord blood vessels penetrate the placenta via the amniotic membrane and chorionic villi, a condition referred to as velamentous cord insertion or velamentous placenta. When umbilical cord blood vessels, lacking protection from Huatong glue or placental tissue, traverse the fetal membrane within 2 cm of the cervical opening, positioned beneath the fetal presentation or intersecting the cervical opening, they are classified as anterior vessels [1]. The etiology of placenta previa remains uncertain and may be associated with risk factors such as multiple pregnancies, placenta previa, double or multi-lobed placenta, accessory placenta, and *in vitro* fertilization (IVF) [2]. In this case study, the patient's gestational age was determined to be 22 weeks through four-dimensional ultrasound imaging, which revealed a distance of 17 mm between the lower edge of the placenta and the cervical opening. The insertion point of the placental umbilical cord was observed at the lower edge of the placental membrane, with a fetal

membrane blood vessel visible at the edge of the cervical opening. The rotational probe indicated the presence of a fetal membrane blood vessel crossing the cervical opening, suggesting a potential diagnosis of umbilical cord vessel previa. The diagnosis suggested a low-lying placenta with previa. Placenta previa can be classified into four types based on abnormal placental morphology: type 1 (single lobed placenta, also known as sail-shaped placenta) and type 2 (multi-lobed placenta, including double-lobed placenta or accessory placenta). In cases of placenta previa or low-lying placenta previa during early pregnancy, the continuous maturation or degeneration of the placental edge may lead to fetal blood vessels in the fetal membranes approaching the cervical opening, a condition referred to as type 3 placenta previa. On rare occasions, the umbilical cord may be observed to insert in a sail-like shape above or within 20 mm of the cervical opening. This specific presentation can be classified into four distinct types of anterior vessels. Within the categorization of placental abnormalities, this instance is classified under the designation of type 4 anterior vessels [3]. Anterior vasculature represents a rare obstetric complication during pregnancy. Literature reports indicate that the incidence rate of placenta previa in natural pregnancies is approximately 1/2500, whereas in pregnancies resulting from assisted reproductive technologies such as *in vitro* fertilization (IVF) and multiple pregnancies, the incidence rate has risen to 1/250-1/500. Despite its relatively low incidence, placenta previa poses a significant risk during the third trimester and labor. The descent of the fetal presentation may lead to umbilical cord compression, intrauterine fetal distress, and potentially fatal outcomes due to compression of the anterior blood vessels. The occurrence of a ruptured anterior blood vessel can result in fetal bleeding and a heightened neonatal mortality rate. In a typical full-term pregnancy, the fetal blood volume is approximately 80 - 100 ml/kg. Once blood loss surpasses 20% - 25%, exceeding 100 ml, the fetus may be at risk of hemorrhagic shock or fatality. Anterior blood vessels are a critical determinant in the survival prospects of perinatal infants [4]. In this case study, a four-dimensional ultrasound was conducted at 22 weeks of gestation to identify anterior blood vessels and placenta previa. Subsequent color ultrasound assessments at 30 and 37 weeks of gestation revealed no anomalies in anterior blood vessels or placenta. The absence of anterior blood vessels noted in the late pregnancy ultrasound report may be attributed to the obstetrician's oversight in documenting their presence during the mid-pregnancy ultrasound examination. The ultrasound physician did not conduct a comprehensive assessment of the umbilical cord insertion into the placenta, and the descent of the fetal head obscured the visualization of anterior blood vessels, leading to the late pregnancy ultrasound missing any abnormalities in the placental structure. Obstetricians failed to include pregnant women in high-risk management protocols, resulting in delayed termination of pregnancy until emergency admission was required due to antepartum hemorrhage. During the subsequent operation, a clot was observed obstructing the ruptured blood vessel, which led to the cessation of bleeding and ultimately minimized adverse outcomes for both mother

and child. This fortunate outcome highlights the significance of timely and effective medical intervention in obstetric emergencies. In clinical practice, anterior blood vessels often lack distinctive characteristics and typically present as painless vaginal bleeding. This manifestation generally does not have a significant impact on the mother, and distinguishing whether the blood originates from the mother or the fetus can be challenging, potentially leading to misdiagnosis as "redness". When the fetal membrane ruptures during delivery, resulting in tears in the anterior blood vessels, the fetus is at risk of experiencing acute blood loss, shock, and potentially death, which is a significant contributor to perinatal mortality. Research indicates that the mortality rate of newborns with undiagnosed prenatal blood vessel tears is approximately 60%, and survivors may face long-term complications due to ischemia and hypoxia (HIE).

However, the survival rate of newborns can be increased to 97% through prenatal diagnosis and detection of pre-existing blood vessels, as well as appropriate management during delivery [5]. Currently, the diagnosis of anterior vessels primarily relies on prenatal identification, utilizing diagnostic methods such as ultrasound Doppler, magnetic resonance imaging, amnioscopy, and laboratory tests to differentiate the origin of maternal vaginal blood. The overwhelming majority (95%) of routine prenatal ultrasound examinations are able to efficiently assess the placenta and umbilical cord population. Presently, ultrasound examination is widely regarded as the predominant, straightforward, and dependable method for prenatal detection of placenta previa [6] [7]. The diagnostic accuracy of transvaginal color ultrasound in identifying placenta previa is high, as it effectively detects abnormal blood vessels and assesses their proximity to the cervical opening with enhanced precision and consistency [8]. A prospective study has shown that transvaginal ultrasound has a sensitivity and specificity of approximately 100% and >99%, respectively, for the detection of pre-existing blood vessels. Moreover, three-dimensional, four-dimensional ultrasound, and magnetic resonance imaging do not provide superior diagnostic capabilities compared to transvaginal color ultrasound. The optimal timing for prenatal ultrasound assessment of pre-existing blood vessels is generally regarded as the second trimester of pregnancy. Several studies [9]-[11] have demonstrated that the optimal method for prenatal ultrasound evaluation of anterior vessels entails performing regular transabdominal two-dimensional and color Doppler ultrasound examinations of the placental umbilical cord insertion site and cervical sagittal sections during the mid-pregnancy period. In instances where the ultrasound image is unclear or indicates abnormalities, perineal or vaginal ultrasound may be utilized. The two-dimensional ultrasound diagnostic criteria for anterior blood vessels encompass the identification of echogenic, flat, tubular vessels located above or surrounding the cervical opening, a paucity of umbilical cord spirals, thin and delicate vessel walls, a fixed position, and convergence towards the placenta. Color Doppler (CDFI) is adept at clearly visualizing blood flow signals, whereas Pulse Doppler (PW) is capable of displaying the spectrum of fetal umbilical blood flow. When anterior blood vessels

are detected in pregnant women during the early stages of pregnancy, it is advisable to conduct further evaluation. It is recommended that ultrasound diagnosis be reassessed at 32 weeks of gestation or later to determine the appropriate mode and timing of delivery. As gestational age advances, there are significant changes in the position of the placenta, the extension of the lower segment of the uterus, and the fluctuation in the distance between fetal blood vessels and the cervical opening. Consequently, blood vessels that were pre-positioned in early pregnancy may undergo regression or develop into fetal vascular hypoplasia. In cases where gestational age is less than 26 weeks, the disappearance rate of anterior vessels can be as high as 60%. After 26 weeks of gestation, cases in which the color Doppler ultrasound reveals anterior vessels may still exhibit regression or fluctuations in the distance from the cervical opening. When the proximity between the fetal blood vessels and the cervical opening measures less than 2 centimeters, it is categorized as anterior vessels; between 2 - 5 centimeters, it is classified as low fetal blood vessels. Minor variations in distance may necessitate reevaluation of classification and adjustments in management strategies, delivery methods, and timing. Hence, it is advisable for pregnant women with vascular previa to undergo additional examinations within 1 - 2 weeks prior to delivery. Magnetic resonance imaging is commonly employed when ultrasound imaging fails to yield a definitive diagnosis, as it offers superior multi-dimensional visualization of the placenta, umbilical cord blood vessels, and cervical opening, thereby enhancing the management of pregnancy complications associated with anterior vessels. Another direct diagnostic method for anterior vessels is amnioscopy, which permits direct observation of these vessels as they pass through the cervical opening via the cervix. Although amnioscopy is regarded as a dependable method for diagnosing anterior vessels, it carries the risk of iatrogenic rupture during its application, making it an invasive examination technique that is seldom used in clinical settings. Researchers have proposed several laboratory testing techniques, such as the collection of maternal vaginal blood, smear tests, and hemoglobin electrophoresis, as potential methods for differentiating fetal blood from maternal blood. This is based on the assumption that pre-rupture hemorrhage of fetal blood vessels contains immature or nearly mature red blood cells that can be distinguished from maternal blood cells. However, the diagnostic method is time-consuming and of limited clinical value due to the significant risk of harm to the fetus from violent bleeding caused by rupture of the anterior blood vessel, resulting in its infrequent use [12]. The predominant clinical presentation of anterior blood vessel involvement is prenatal bleeding. Upon rupture of the anterior blood vessel, symptoms typically include painless vaginal bleeding or mild lower abdominal distension. The most frequently encountered manifestation is vaginal bleeding resulting from premature rupture of membranes. In cases where bleeding is not profuse, differentiating it from vaginal bleeding associated with placenta previa or red degeneration can be challenging, leading to potential oversight [13]. However, it is important to note that typical symptoms may be followed by abnormal or absent

fetal heart rate after bleeding, particularly in cases of premature rupture of membranes, artificial rupture of membranes, compression of anterior blood vessels, or vaginal examination. In such instances, prompt diagnosis and immediate surgical intervention are crucial in order to ensure the well-being and survival of both the mother and child. For patients diagnosed with prevascular disease, it is recommended to enhance prenatal monitoring and incorporate it into the management of high-risk patients [14] [15]. Consensus recommendations from various sources suggest that prophylactic treatment with glucocorticoids to promote fetal lung development should be administered between 28 - 32 weeks of pregnancy. Patients may be hospitalized for close monitoring and delivery between 30 - 34 weeks of pregnancy, with cesarean section recommended for termination of pregnancy between 34 - 37 weeks. According to the 2023 SOGC Clinical Practice Guidelines on the Diagnosis and Management of Anterior Vasculature, pregnant women with anterior vessels may be advised to consider hospitalization at 32 weeks of gestation. For those at higher risk due to factors such as multiple pregnancies or cervical canal shortening, hospitalization prior to 32 weeks is recommended. Hospitalization observation allows for real-time evaluation of symptoms such as uterine contractions, bleeding, and fluid flow, facilitating timely intervention to reduce the incidence of emergency cesarean section deliveries and improve perinatal outcomes and newborn prognosis. For singleton pregnancies in women with pre-existing vascular conditions, cesarean section is recommended between 35 + 0 and 35 + 6 weeks of gestation. In cases involving other high-risk factors for preterm birth, cesarean section should be contemplated at an earlier stage. The rupture of the anterior blood vessel in the fetus leads to acute blood loss and subsequent fetal demise within a short timeframe. Therefore, it is advisable for pregnant individuals with an anterior blood vessel to undergo a scheduled cesarean section for delivery. The preferred delivery setting is a hospital equipped with a proficient neonatal resuscitation team and immediate access to blood transfusions to address fetal anemia and improve neonatal outcomes. During the cesarean section procedure, vigilance should be exercised regarding the positioning of fetal blood vessels and the placenta. If the location of fetal blood vessels is uncertain, it is recommended to avoid direct access to the amniotic cavity during the uterine incision in the surgical procedure. To prevent the rupture of anterior blood vessels following the delivery of the fetus, prompt clamping of the umbilical cord is advised. A postpartum evaluation of the placenta should be conducted to enhance the diagnostic accuracy of anterior vessels.

4. Conclusion

During the second trimester, enhanced monitoring and the use of transabdominal and transvaginal Doppler ultrasound are advised to improve the detection of abnormal vascular development before pregnancy. In the early stages of pregnancy, individuals with pre-existing vascular conditions should receive additional evaluations and a follow-up ultrasound at 32 weeks or later. Failing to perform this

prenatal ultrasound assessment could increase the false positive rate, potentially leading to negative outcomes for both mother and infant, such as premature delivery and a higher rate of cesarean sections due to undiagnosed vascular conditions. Patients with anterior placenta previa should be managed under a high-risk protocol and receive intensified monitoring throughout their pregnancy. Hospitalization may be considered at 32 weeks gestation. Pregnant individuals with anterior placenta previa who are at increased risk of multiple gestations or have a shortened cervical canal should be hospitalized before reaching 32 weeks of gestation. For pregnant women with pre-existing vascular conditions in a singleton pregnancy, a cesarean section is recommended between 35 + 0 and 35 + 6 weeks gestation. Furthermore, pregnant women with other high-risk factors for preterm birth should consider early hospitalization and prompt delivery to enhance perinatal outcomes. This includes proper preoperative preparation, multidisciplinary consultation, careful intraoperative positioning of fetal blood vessels and placenta, meticulous surgical techniques, and efforts to minimize intraoperative hemorrhage.

Ethical Approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent was obtained from all individual participants included in the study.

Informed Consent

The public release of this case has been granted informed consent from the patient.

Conflicts of Interest

The authors declare no conflicts of interest.

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