

Review Article

Prediction of hemorrhage in placenta previa

Junichi Hasegawa^{*}, Masamitsu Nakamura, Shoko Hamada, Ryu Matsuoka, Kiyotake Ichizuka, Akihiko Sekizawa, Takashi Okai*Department of Obstetrics and Gynecology, Showa University School of Medicine, Tokyo, Japan*

Accepted 18 October 2011

Abstract

Placenta previa poses a high risk for massive hemorrhage, from the antenatal period until after Cesarean section. This condition increases the risk of maternal and neonatal mortality and morbidity. In cases of placenta previa, the prenatal prediction of sudden bleeding during pregnancy and blood loss during Cesarean section, and the assessment of risk for adherence of the placenta using an ultrasound examination, can improve the perinatal outcome. Therefore, ultrasonographic findings associated with the prediction of massive bleeding in cases of placenta previa are reviewed in this article.

Copyright © 2012, Taiwan Association of Obstetrics & Gynecology. Published by Elsevier Taiwan LLC. All rights reserved.

Keywords: placenta previa; Cesarean section; bleeding; ultrasound; placenta accreta

Introduction

Placenta previa increases the risk of maternal and neonatal mortality and morbidity due to massive hemorrhage. Problems of massive bleeding associated with placenta previa occur not only during pregnancy, but also at and shortly after the Cesarean operation. The morbidities associated with placenta previa include hysterectomy [relative risk (RR) = 33.26, 95% confidence interval (CI) = 18.19–60.89], antepartum bleeding (RR = 9.81, 95% CI = 8.92–10.79), intrapartum (RR = 2.48, 95% CI = 1.55–3.98), and postpartum (RR = 1.86, 95% CI = 1.46–2.36) hemorrhages, as well as the need for blood transfusion (RR = 10.05, 95% CI = 7.45–13.55) [1].

Prenatal assessment of factors associated with a high risk of excessive blood loss during pregnancy, and around the Cesarean section, would improve the preparation and management of surgery, including the necessity for admission to hospital, preservation of autologous blood, and the timing of the Cesarean section. Therefore, in this article, we review and discuss the

ultrasonographic findings that can be used to predict a massive hemorrhage associated with placenta previa.

Hemorrhage during pregnancy

The mechanisms of hemorrhage resulting from placenta previa during pregnancy are not clearly known. However, when the placenta is present in a low uterine segment, it can be easily detached from the decidua basalis, even when only slight uterine contraction and effacement occur. Abnormal placentation and a poor blood supply from the uterine wall at the lower segment of the uterus, may lead to active hemorrhage during pregnancy.

In our experience, an emergency Cesarean section was needed due to uncontrollable hemorrhage in 66.7% of patients who had antenatal bleeding. An emergency Cesarean section was performed in 3.2% of patients who had no episode of antenatal bleeding, due to uncontrollable uterine contractions before the date of the planned Cesarean section [2]. Thus, it would improve the antenatal management of patients with placenta previa if the risk of bleeding during pregnancy could be predicted.

Saitoh et al [3] demonstrated that the risk of antenatal massive hemorrhage is higher (83.3%) in cases with an echo-free space in

^{*} Corresponding author. Department of Obstetrics and Gynecology, Showa University School of Medicine, 1-5-8 Hatanodai, Shinagawa-ku, Tokyo 142-8666, Japan.

E-mail address: hasejun@oak.dti.ne.jp (J. Hasegawa).

the placental edge overlying the internal os compared to the other locations (7.7–10%). They suggested that the echo-free space in the marginal area of the placenta (an area associated with a turbulent blood flow) was either a placental sinus or varices that developed in the decidual tissue. Our previous retrospective study also demonstrated that in ultrasonographic findings at 20 weeks of gestation, the frequency of a marginal sinus (similar to the findings reported by Saitoh et al [3]) was slightly higher (16%) in cases with bleeding episodes compared to those without (0%) [2]. Although the pathophysiological changes associated with the marginal sinus have not been well clarified, we hypothesized that an expanded marginal sinus indicates the retention of maternal blood flow in the intervillous space and decidual tissue, which may collapse occasionally due to uterine contraction, thus resulting in a large amount of hemorrhage during pregnancy.

Contractions, cervical effacement, and dilatation during the third trimester, may cause the separation of the placenta, leading to unavoidable abnormal antenatal bleeding in cases with placenta previa [4]. It is common practice to measure the cervical length using transvaginal ultrasound to predict preterm delivery. It is interesting to note that Ghi et al reported a possible association between the cervical length and the risk of preterm hemorrhage in patients with complete placenta previa [5]. Although the cervical length did not differ significantly between cases with and without prepartum bleeding, it was significantly shorter among patients who underwent an emergency Cesarean section at <34 weeks, due to massive hemorrhage compared with patients who underwent an elective Cesarean section. In our previous study [2], we found that the cervical length just prior to delivery was not different between the cases, with and without an emergency Cesarean section in subjects with complete, partial and marginal placenta previa. Stafford et al [6] recently demonstrated that a third trimester cervical length of 30 mm or less was associated with an increased risk for hemorrhage (76% vs. 28%) in pregnancies with placenta previa, and that tocodynamometer evidence of regular uterine contractions was more common in subjects with a short cervix (69%) than in those with a longer cervix (21%).

It was reported by Ghourab that patients who had a low-lying placenta with a thick edge, had a significantly higher rate of antepartum hemorrhage (88.2%) compared with those who had a thin edge (40.7%), and who required an emergency Cesarean section before 36 weeks of gestation (64.7% vs. 29.6%) [7]. Ghourab speculated that this might be explained by the abundant vasculature of the lower placental edge and the sub-placental zone, and interference of a thick-edged placenta with the descent of the fetal head. On the other hand, although the placenta generally grows preferentially toward a better vascularized field (trophotropism), a placenta overlying a less vascularized cervix may undergo atrophy [8]. Because some vascular and placental structural abnormalities, such as velamentous cord insertions (vasa previa), abruptio placentae, placenta accretae, accessory placentas, and placental infarctions, are frequently seen in cases with cord insertion or when the placenta is located on the lower uterus [9–15], we hypothesized that placentas coexisting with such placenta

abnormalities were more likely to detach from the decidua basalis, resulting in frequent antenatal bleeding. However, the frequencies of bleeding were not different between subjects with and without such placental complications [2].

Oyelese and Smulian have mentioned that contractions and cervical effacement and dilatation during the third trimester, can cause separation of the placenta, which leads to small amounts of bleeding. This bleeding may stimulate further placental separation and unavoidable bleeding [4]. However, these placental separations are not clearly predictable using ultrasonography, because the adaptation of the placenta at the uterine isthmus may vary from case to case in advancing gestation. Though some ultrasonographic findings, such as a short uterine cervix and marginal sinus, are associated with antenatal bleeding from placenta previa, these findings were evaluated in the third trimester. Therefore, the obstetrician should be aware that sudden bleeding during pregnancy may occur in patients with placenta previa, even if no such ultrasonographic findings are detected during the second trimester.

Hemorrhage during Cesarean section

Patients with placenta previa often have a risk of massive bleeding during Cesarean section. According to a univariate analysis of predisposing factors for massive hemorrhage during Cesarean section in patients with placenta previa in our institution [16], advanced maternal age (OR = 3.1, 95% CI = 1.3–7.5) and a history of a previous Cesarean section (OR = 7.3, 95% CI = 1.9–28.2) were associated with massive bleeding. The frequencies of massive bleeding were higher in cases in which the placentas were located on the anterior wall (OR = 3.5, 95% CI = 1.1–11.2) and/or were located on the previous Cesarean wound. The presence of lacunae in the placenta (OR = 2.8, 95% CI 1.0–7.6), sponge-like findings in the cervix (OR 4.6, 95% CI 1.7–11.9) and a lack of a clear zone were also associated with massive bleeding during the Cesarean operation. Adherence of the placenta diagnosed at Cesarean was also associated with massive bleeding, and had the highest odds ratio among these variables (OR 18.2, 95% CI 1.9–170.7).

Placenta accreta is one of the leading reasons for performing a Cesarean hysterectomy [17]. The risk of placenta accreta is related to maternal age and to the number of previous Cesarean deliveries [18–20]. The risk of having placenta accrete increased from 24% in patients with one prior Cesarean section to 67% in those with 3 or more prior Cesarean sections [20]. Numerous reports have addressed the antenatal ultrasonic prediction of placental adherence [3,7,18,21]. Irregularly-shaped placental lacunae within the placenta, thinning of the myometrium overlying the placenta, loss of the retroplacental clear zone, protrusion of the placenta into the bladder, and increased vascularity of the uterine serosa/bladder interface were reported to be sonographic features suggestive of placental adherence [4,21,22]. Placenta accreta is thought to be due to an absence or deficiency of Nitabuch's layer or the spongiosus layer of the decidua. Histology usually shows that the trophoblasts have invaded the myometrium without any

intervening deciduas [8]. Pasto et al [23] made the first suggestion that a lack of retroplacental clear space detected using ultrasonography might be an abnormal sign in patients with placenta accreta. This area is seen beginning in week 12 and was thought to correspond to the dilated vessels of the decidua basalis [22]. A lack of a clear zone has often been suggested as one of the ultrasonographic findings which may prompt suspicion of the pathological adherence of the placenta [4,16,22–24]. In regard to the ultrasonic findings, the lack of a clear zone was found to have a sensitivity of only 57% and a false-positive rate of 48.4% [22]. After 20 weeks of gestation, the sensitivity of this finding increased, with values of 80% [22].

Placenta lacunae have also been discussed as one of the ultrasonographic findings for predicting placenta accreta [4,16,21,22,25–28]. Intraplacental lacunae are vascular lakes of various sizes and shapes seen within the placental parenchyma. Comstock et al [22] found that at 15 to 20 weeks of gestation, the presence of lacunae in the placenta was the most predictive sonographic sign of a placenta accreta, with a sensitivity of 79% and a positive predictive value of 92%. Finberg and Williams [25] demonstrated that the number of lacunae was associated with complications related to placental adherence. Yang et al [27] classified the sonographic findings of intraplacental lacunae into one of four grades, and demonstrated that the presence of Grade 2+ lacunae (defined as four to six larger or more irregular lacunae present) was strongly associated with placental adherence.

For such ultrasonographic findings, our multivariable analysis showed that a placenta located on the previous Cesarean section wound (OR = 123.1, 95% CI = 4.5–3395.2) and the lack of a clear zone (OR = 48.0, 95% CI = 3.8–604.7) were associated with placental adherence [16]. On the other hand, Hamada et al. demonstrated that placenta lacunae were observed in 31.4% and 9.7% of cases with and without placenta previa (OR = 4.2, 95% CI = 2.3–7.9). The lack of a clear zone was observed in 5.7% and 0.9% of cases with and without placenta previa (OR = 7.0, 95% CI = 1.5–32.0). Since the decidua basalis is thinner in the lower uterine segment than in the uterine body, the finding of the lack of a clear zone would be more frequently observed in cases with placenta previa, even without adherence. The contraction and cervical effacement and dilatation that occur in the third trimester cause separation of the placenta, which leads to a small amount of bleeding in placenta previa cases [4]. Such bleeding might also cover the presence of the retro-placental clear zone.

A logistic regression analysis in our previous study revealed that advanced maternal age, previous Cesarean section and sponge-like findings of the cervix were associated with massive bleeding during Cesarean section [16]. Sponge-like findings are defined at our institution when five or more hypo-echoic areas >5 mm in diameter are detected in the cervix. Additionally, the correlation between sponge-like findings and perinatal maternal massive hemorrhage has been reported previously [3,29,30]. Both the incidence of preterm delivery, due to sudden massive hemorrhage, and the amount of bleeding during Cesarean section, were significantly higher in cases in which two-thirds of the placenta covered the internal os and a sponge-like

echo were found [3]. Hurton et al [31] reported that the areas with sponge-like echoes were most likely composed of clusters of richly-developed blood vessels (presumably varices with various degrees and patterns of dilatation). Two reports presumed that the sponge-like findings were cervical varices [29,30]. The sponge-like findings seems to be associated with massive intraoperative hemorrhage in cases with placenta previa, regardless of the placental adherence.

Mimura et al [32] demonstrated a significant negative correlation between the amount of bleeding and the cervical length ($r = -0.344$, $p < 0.001$), regardless of the existence of placental adherence. The odds ratio for massive bleeding (>2500 mL) in cases with short cervical lengths (<25 mm) was 7.6 (95% CI = 2.4–23.8) in comparison to cases with long cervical lengths. Postpartum hemorrhage is caused by uterine atony, contributing to about 80% of the cases, and other causes include genital tract trauma, pathological placentation, and so on [33]. Reynolds et al noted that contractions start in the fundus and progressively propagate toward the cervix, and that the strength of contractions was greatest at the fundus and least at the cervix [34]. Margono et al. reported the relationship between the upper and lower uterine contractions in different subsets of patients [35]. They noted that the contraction of the uterine low segment after placenta removal may be weaker than that of upper part of the uterus [34]. Most of the hemorrhage during Cesarean section is uterine incisional bleeding and bleeding from the surface of the placental separation. In cases with placenta previa, because the placenta is located on the lower uterine segment, the bleeding during surgery may be greater due to uterine atony around the cervical os, than in cases where the placenta is on the uterine body. Furthermore, when the cervix is shortened, this could mean that the lower segment is widely extended, making the contraction weaker. It is plausible that a short cervical length in cases with placenta previa is associated with the massive bleeding during the operation.

Similar to placenta previa, a low-lying placenta is also associated with massive bleeding around delivery, due to atony in the lower uterine segment. However, we recommend vaginal delivery even in cases with a low-lying placenta, to reduce the amount of bleeding during delivery, especially from uterine incisional bleeding, based on the report from Nakamura et al [36] who demonstrated that 86.9% of cases with a low-lying placenta and non-reassuring fetal status had successful transvaginal deliveries without increased bleeding during labor.

Conclusion

Although sudden massive bleeding during pregnancy may occur in patients with placenta previa, regardless of the presence or absence of any abnormal ultrasonographic findings, a short uterine cervical length in the third trimester and sinus venosus at the margin of the placenta may predict an increased risk of antenatal bleeding in pregnant women demonstrating placenta previa.

During a Cesarean section, advanced maternal age, a history of a previous Cesarean section, and the presence of

sponge-like findings, are risk factors for massive bleeding in patients with placenta previa, regardless of the existence of placental adherence. The ultrasound findings of a placenta located on the previous Cesarean section wound, and a lack of a clear zone, are serious risk factors for placental adherence.

References

- [1] Crane JM, Van den Hof MC, Dodds L, Armson BA, Liston R. Maternal complications with placenta previa. *Am J Perinatol* 2000;17:101–5.
- [2] Hasegawa J, Higashi M, Takahashi S, Mimura T, Nakamura M, Matsuoka R, et al. Can ultrasonography of the placenta previa predict antenatal bleeding? *J Clin Ultrasound* 2011;39:458–62.
- [3] Saitoh M, Ishihara K, Sekiya T, Araki T. Anticipation of uterine bleeding in placenta previa based on vaginal sonographic evaluation. *Gynecol Obstet Investig* 2002;54:37–42.
- [4] Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. *Obstet Gynecol* 2006;107:927–41.
- [5] Ghi T, Contro E, Martina T, Piva M, Morandi R, Orsini LF, et al. Cervical length and risk of antepartum bleeding in women with complete placenta previa. *Ultrasound Obstet Gynecol* 2009;33:209–12.
- [6] Stafford IA, Dashe JS, Shivvers SA, Alexander JM, McIntire DD, Leveno KJ. Ultrasonographic cervical length and risk of hemorrhage in pregnancies with placenta previa. *Obstet Gynecol* 2010;116:595–600.
- [7] Ghourab S. Third-trimester transvaginal ultrasonography in placenta previa: does the shape of the lower placental edge predict clinical outcome? *Ultrasound Obstet Gynecol* 2001;18:103–8.
- [8] Benirschke K, Kaufmann P. In: *Pathology of the human placenta*. New York: Springer; 2000.
- [9] Hasegawa J, Matsuoka R, Ichizuka K, Otsuki K, Sekizawa A, Farina A, et al. Cord insertion into the lower third of the uterus in the first trimester is associated with placental and umbilical cord abnormalities. *Ultrasound Obstet Gynecol* 2006;28:183–6.
- [10] Hasegawa J, Matsuoka R, Ichizuka K, Sekizawa A, Farina A, Okai T. Velamentous cord insertion into the lower third of the uterus is associated with intrapartum fetal heart rate abnormalities. *Ultrasound Obstet Gynecol* 2006;27:425–9.
- [11] Schachter M, Tovbin Y, Arieli S, Friedler S, Ron-El R, Sherman D. In vitro fertilization is a risk factor for vasa previa. *Fertil Steril* 2002;78:642–3.
- [12] Oyelese KO, Turner M, Lees C, Campbell S. Vasa previa: an avoidable obstetric tragedy. *Obstet Gynecol Surv* 1999;54:138–45.
- [13] Francois K, Mayer S, Harris C, Perlow JH. Association of vasa previa at delivery with a history of second-trimester placenta previa. *J Reprod Med* 2003;48:771–4.
- [14] Lee W, Lee VL, Kirk JS, Sloan CT, Smith RS, Comstock CH. Vasa previa: prenatal diagnosis, natural evolution, and clinical outcome. *Obstet Gynecol* 2000;95:572–6.
- [15] Fung TY, Lau TK. Poor perinatal outcome associated with vasa previa: is it preventable? A report of three cases and review of the literature. *Ultrasound Obstet Gynecol* 1998;12:430–3.
- [16] Hasegawa J, Matsuoka R, Ichizuka K, Mimura T, Sekizawa A, Farina A, et al. Predisposing factors for massive hemorrhage during Cesarean section in patients with placenta previa. *Ultrasound Obstet Gynecol* 2009;34:80–4.
- [17] Kastner ES, Figueroa R, Garry D, Maulik D. Emergency peripartum hysterectomy: experience at a community teaching hospital. *Obstet Gynecol* 2002;99:971–5.
- [18] Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol* 1997;177:210–4.
- [19] Wu S, Kocherginsky M, Hibbard JU. Abnormal placentation: twenty-year analysis. *Am J Obstet Gynecol* 2005;192:1458–61.
- [20] Clark SL, Koonings PP, Phelan JP. Placenta previa/accreta and prior cesarean section. *Obstet Gynecol* 1985;66:89–92.
- [21] Comstock CH. Antenatal diagnosis of placenta accreta: a review. *Ultrasound Obstet Gynecol* 2005;26:89–96.
- [22] Comstock CH, Love Jr JJ, Bronsteen RA, Lee W, Vettraino IM, Huang RR, et al. Sonographic detection of placenta accreta in the second and third trimesters of pregnancy. *Am J Obstet Gynecol* 2004;190:1135–40.
- [23] Pasto ME, Kurtz AB, Rifkin MD, Cole-Beuglet C, Wapner RJ, Goldberg BB. Ultrasonographic findings in placenta increta. *J Ultrasound Med* 1983;2:155–9.
- [24] Khong TY, Robertson WB. Placenta creta and placenta praevia creta. *Placenta* 1987;8:399–409.
- [25] Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients with placenta previa and prior cesarean section. *J Ultrasound Med* 1992;11:333–43.
- [26] Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. *Ultrasound Obstet Gynecol* 2000;15:28–35.
- [27] Yang JI, Lim YK, Kim HS, Chang KH, Lee JP, Ryu HS. Sonographic findings of placental lacunae and the prediction of adherent placenta in women with placenta previa totalis and prior Cesarean section. *Ultrasound Obstet Gynecol* 2006;28:178–82.
- [28] Sumigama S, Itakura A, Ota T, Okada M, Kotani T, Hayakawa H, et al. Placenta previa increta/percreta in Japan: a retrospective study of ultrasound findings, management and clinical course. *J Obstet Gynecol Res* 2007;33:606–11.
- [29] Kumazawa Y, Shimizu D, Hosoya N, Hirano H, Ishiyama K, Tanaka T. Cervical varix with placenta previa totalis. *J Obstet Gynecol Res* 2007;33:536–8.
- [30] Yoshimura K, Hirsch E, Kitano R, Kashimura M. Cervical varix accompanied by placenta previa in twin pregnancy. *J Obstet Gynecol Res* 2004;30:323–5.
- [31] Hurton T, Morrill H, Mascola M, York C, Bromley B. Cervical varices: an unusual etiology for third-trimester bleeding. *J Clin Ultrasound* 1998;26:317–9.
- [32] Mimura T, Hasegawa J, Nakamura M, Matsuoka R, Ichizuka K, Sekizawa A, et al. Correlation between the cervical length and the amount of bleeding during cesarean section in placenta previa. *J Obstet Gynecol Res* 2011;37:830–5.
- [33] Oyelese Y, Scorza WE, Mastrolia R, Smulian JC. Postpartum hemorrhage. *Obstet Gynecol Clin North Am* 2007;34:421–41. x.
- [34] Reynolds SR, Hellman LM, Bruns P. Patterns of uterine contractility in women during pregnancy. *Obstet Gynecol Surv* 1948;3:629–46.
- [35] Margono F, Minkoff H, Chan E. Intrauterine pressure wave characteristics of the upper and lower uterine segments in parturients with active-phase arrest. *Obstet Gynecol* 1993;81:481–5.
- [36] Nakamura M, Hasegawa J, Mimura T, Matsuoka R, Ichizuka K, Sekizawa A, et al. Amount of hemorrhage during vaginal delivery correlates with the length from placental edge to external os in low-lying placenta. *J Obstet Gynecol Res*, in press.