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Value of Ultrasonography in the Diagnosis of Placental Abruption

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Abstract

Placental abruption is a serious cause of fetal mortality. We retrospectively reviewed 24 patients with placental abruption who underwent cesarean section to evaluate ultrasonographic images with reference to the clinical findings and fetal and maternal prognosis. Fourteen of these patients presenting with placental edge separation and persistent hematoma showed a significantly smaller area of abruption, a smaller amount of intraoperative bleeding, a smaller incidence of disseminated intravascular coagulation, and a higher Apgar score as compared to the 10 patients with a thickened placenta. The patients with thickened placenta tended to have a typical clinical presentation, whereas those with plancental edge separation and hematoma appeared to have an atypical and mild clinical manifestation. It was concluded that ultrasonography is useful in the diagnosis of mild and atypical placental abruption. (J Nippon Med Sch 2003; 70: 227–233)

Key words: placental abruption, ultrasonography, placental edge separation, apgar score, disseminated intravascular coagulation

Introduction

Ultrasonographic examination has recently been recognized as a useful adjunct in the diagnosis and evaluation of placental abruption. The major ultrasonographic findings in placental abruption are visualization of retroplacental hematoma and increased thickening of the placenta[1].

Ultrasonographic findings of placental abruption may depend on the degree of abruption and on the time elapsed after the onset of disease, demonstrating variable images of abnormally thickened amorphous tissues with hyperechoic, hypoechoic, and echo-free areas. The reasons are that ultrasonographically, echogenic images are initially produced due to the fresh blood, and a mixture of echoic and anechoic area is found with a progression of the resolving hematoma, and echo-free space becomes predominant with a complete resolution of blood clots[1].

Information is limited, however, on the relationship between the signs and symptoms of placental abruption and the ultrasonographic findings in cases that show typical clinical features[2].

In this study, we evaluated the clinical significance of ultrasonographic examination to explore the extent to which it is useful in cases in which the diagnosis of placental abruption is difficult by clinical examinations.

Materials and Methods

We reviewed the clinical records of a total of 10,722 delivery cases referred to the Department of Obstetrics and Gynecology, Nippon Medical School

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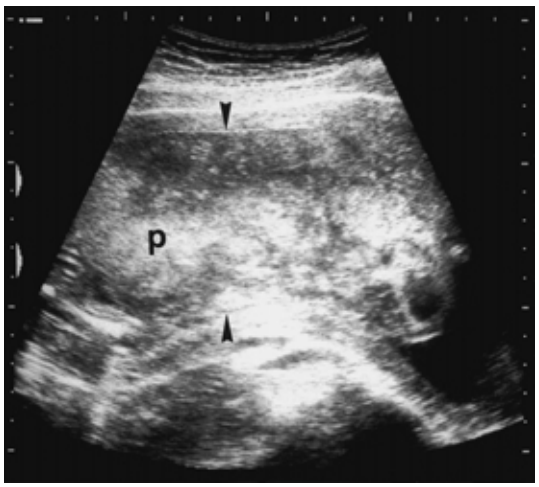

Fig. 1 Ultrasonogram of a 36-week pregnant woman with placental abruption, illustrating hyperechoic area at the side of the uterine wall and a mixture of hyperechoic and echo free area at the side of the amniotic membrane. The placenta is abnormally thickened to 9 cm in thickness (arrowheads). P: Placenta.

Fig. 2 Ultrasonogram of a 37-week pregnant woman with placental abruption, illustrating an amorphous placental image with a mixture of hyperechoic, hypoechoic, and echo-free areas. The placenta is abnormally thickened to 8.7 cm in thickness (arrowheads).

Fig. 3 Ultrasonogram of a 34-week pregnant woman with placental abruption, illustrating a separation of peripheral edge (arrowheads) and a mixture of hyperechoic and echo-free areas (H). P: Placenta

Second Hospital during a 10-year period between 1992 and 2001, and identified 45 patients (0.41%) with placental abruption who had undergone cesarean section. The current study included 24 patients who had ultrasonographic images of good quality obtained before operation. These patients were divided into three groups on the basis of clinical signs and symptoms and cardiotocographic findings. Group A (8 patients) presented with typical clinical features of placental abruption, including persistent abdominal pain, external bleeding, uterine tenderness and tetany, and hemorrhagic shock; Group B (8 patients) were clinically suspected to have placental abruption and a diagnosis was established with the ultrasonographic examination; Group C (8 patients) presented with threatened premature delivery (4 patients), premature rupture of the membranes (2 patients), onset of labor (1 patient), and external bleeding (1 patient), and were diagnosed to have placental abruption on ultrasonographic examination.

Ultrasonographic examination was performed with commercially available real-time equipment (SONOVIST-if, SONOVIST A-EX, Color II, Mochida Pharmaceutical Co. Ltd., Tokyo, Japan) using a 3.5 MHz transabdominal ultrasonic probe. Ultrasonographic images of the placentas were grouped into thickened type (type T) and edge-hematoma type (type EH). The type T ultrasonogram was defined as a placenta with 6.0 cm or larger thickness having a mixture of echogenic, hypoechoic and echo-free area (**Figs. 1 and 2**). The type EH was defined as a placenta with a peripheral edge separation and presence of hematoma (**Figs. 3, 4, and 5**). Some cases were also examined using a color Doppler

Fig. 4 Ultrasonogram of 34-week and 3-day pregnant woman with premature rupture of membrane on admission, illustrating separation of the placental margin (arrowheads) and formation of hematoma (H). The hematoma lesion is imaged as an amorphous structure with a mixture of hyperechoic and hypoechoic areas, judged as early-stage hematoma. P: Placenta

Fig. 5 Ultrasonogram of the same case as in Fig. 4 at 35-week 1-day pregnancy, illustrating that the hematoma lesion has changed to an echo-free space (H) during resolution. Color Doppler ultrasonogram shows the presence of blood flow in the intervillous space at the site of implantation and absence of blood flow in the separated space. This case presented with normal fetal heart rate by cardiotocogram, but 2 days later underwent emergency cesarean section because of the development of loss of variability in cardiotocogram. P: Placenta

method to distinguish the placental edge from the hematoma (**Fig. 6**).

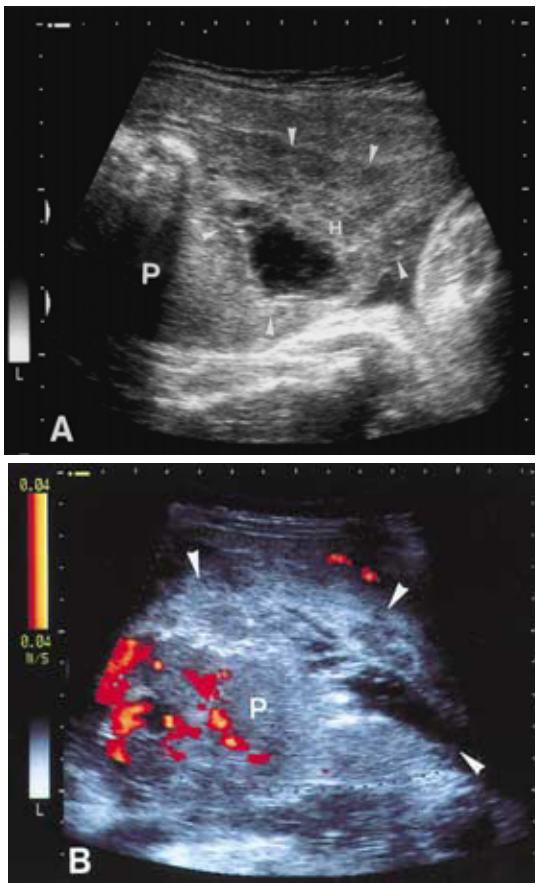

Fig. 6 Ultrasonogram (A) and color Doppler image (B) from a 39-week pregnant woman with placental abruption, illustrating formation of hematoma (H, arrowheads) posterior to the separated edge of the placenta on ultrasound, and distinction of blood flow-rich placental substance from blood flow-deficient hyperechoic area and echo-free space on color Doppler. P: Placenta.

Clinical data included maternal hemoglobin (Hb) value, abnormal fetal heart rate on cardiotocogram such as loss of variability, late deceleration, prolonged bradycardia and prolonged deceleration, time interval between the onset of symptom and the cesarean section, percentage of abrupted area of placenta, amount of intraoperative bleeding, presence of disseminated intravascular coagulation, neonatal birth weight, and Apgar score at 1 minute and 5 minutes. The diagnosis of disseminated intravascular coagulation was based on clinical symptoms indicating abnormal bleeding or coagulopathy, and laboratory data such as thrombocytopenia, prolongation of Prothrombin

Time and Activated Partial Thromboplastin Time, decreased Anti-Thrombin III, and increased blood Fibrin Degradation Product.

The median and range or the proportion of cases were determined for each clinical feature. The statistical analyses were performed using the chi-square test for independence, Fisher's exact test, and Mann Whitney U test. The statistical significance level was set at $p<0.05$.

Results

In the 24 parturient patients, the mean values and standard deviations of age and gestational weeks were 29.5±4.6 year old and 34.8±3.9 weeks, and the numbers of multipara were 11. There were no systemic or obstetric complications, except for toxemia of pregnancy.

Table 1 summarizes the distribution of patients with each ultrasonographic type of placenta in the three clinical groups. Clinically typical cases had ultrasonograms characterized by an increased thickness of the placenta (type T placenta), whereas atypical cases presented with ultrasonograms characterized by separation of the edge and formation of hematoma (type EH placenta); the difference between the two groups was statistically significant ($p=0.0018$). Seven of the 8 patients in the Group A had type T placenta and all of the 8 patients in Group C presented with Type EH placenta, demonstrating a statistically significant difference in ultrasonographic images between the two groups ($p=0.0014$). Group B patients showed a mixture of the two types of placental ultrasonograms; Group B could not be differentiated ultrasonographically from Group A ($p=0.1189$) or Group C ($p=0.2$).

Tables 2 and 3 show the maternal characteristics between the two ultrasonografic findings and the relationship between ultrasonographic findings and clinical data. There were no significant differences in maternal characteristics between type T and type EH ultrasonograms. A comparison of the maternal status between type T and type EH ultrasonograms revealed that cases with type T placental abnormalities had a significantly lower Hb value ($p=0.03$), a larger amount of bleeding on cesarean section ($p=0.003$), a wider area of placental abruption ($p=0.0291$), and a higher incidence of disseminated intravascular coagulation ($p=0.0324$). Regarding the fetal conditions, patients with type T placenta as compared with those with type EH placenta had a higher incidence of abnormal fetal heart rate ($p=0.0333$) and a lower Apgar score at 1 minute ($p=0.0014$) and at 5 minutes ($p=0.002$). Numbers of fetal death were 5 in type T and 1 in type EH. The neonatal birth weight ($p=0.9505$) and the time elapsed from the onset of symptoms to the cesarean section ($p=0.2623$) did not differ significantly between patients with type T placenta and those with type EH placenta.

Table 1 Distribution of patients in each clinical group in relation to the ultrasonographic findings

Clinical Group*	Ultrasonographic finding		Total
	Thickened Type	Edge-Hematoma Type	
Group A	7	1	8
Group B	3	5	8
Group C	0	8	8
Total	10	14	24

*Group A, typical; group B, suspected; and group C, atypical.
Chi-square test for independence or Fisher's exact probablity test: Correlation between ultrasonographic fiding and clinical group was significant ($p=0.0018$). Ultrasonographic findings were significantly different between group A and C ($p=0.0014$).

Table 2 Maternal characteristics and the placental types on ultrasonography

	Placental Type		P Value*
	Thickened (n = 10)	Edge-Hematoma (n = 14)	
Age (year old)	28 (24—37)	31 (20—38)	0.2515
Gestational weeks	35.5 (26.1—39)	35.7 (24.2—39.3)	0.5383
Primipara/Multipara	7/3	6/8	0.2397
Premature Rupture Of Membranes; +/−	0/10	3/11	0.2391
Toxemia; +/−	4/6	3/11	0.3926

Values are expressed as median and range, or proportion of the subjects.
*Mann-Whitney U test or Fisher's exact probability test.

Table 3 Comparison of the clinical data and the placental types on ultrasonography

	Placental Type		P Value*
	Thickened (n = 10)	Edge-Hematoma (n = 14)	
Preoperative Hb (g/dl)	8.7 (7.3—12.2)	11 (9.6—13.3)	0.03
Abnormal FHR; +/−	9/1	6/8	0.0333
Time; Diagnosis—Operation (hr)	4 (2—24)	5 (1—686)	0.2623
Total Amount of Bleeding (g)	1,825 (1,000—4,200)	765 (400—2,660)	0.003
Area of Abruption (%)	50 (30—100)	25 (10—80)	0.0291
DIC; +/−	6/4	2/12	0.0324
Birth Weight (g)	2,198 (276—3,000)	2,256 (654—2,770)	0.9505
Apgar Score (1 min)	0.5 (0—7)	8 (0—9)	0.0014
Apgar Score (5 min)	2.5 (0—9)	9 (0—10)	0.002

Values are expressed as median and range, or proportion of the subjects. *Mann-Whitney U test or Fisher's exact probability test.
Hb; hemoglobin, FHR; fetal heart rate, DIC; disseminated intravascular coagulation.

Discussion

The incidence of placental abruption and the resultant fetal mortality rate is reported to be about 0.5% and 20%, respectively[3,4]. In our hospital, the corresponding values were 0.41% for the incidence of placental abruption and 15% (7/45) for the fetal mortality rate, which were in agreement with those of previous reports. The incidence of disseminated intravascular coagulation in our hospital was 31% (14/45), but there was no maternal death.

Ultrasonographic examination is widely used as a powerful tool for the diagnosis and evaluation of placental abruption[5]. The placental ultrasonographic images during the normal gestation period are characterized by hyperechoic placental substance with homogeneous echo texture of 4.0 cm or less in thickness and in the third-trimester by conglomeration of high level echoes[6]. In cases of placental abruption, a series of hemorrhagic events occurs so that blood migrates into the retroplacental space and placental substance, forms clots and hematoma, and finally resolves. Ultrasonographically, echogenic images are initially produced due to the fresh blood, and a mixture of echoic and anechoic areas is found with a progression of the resolving hematoma, and echo-free space becomes predominant with a complete resolution of blood clots. Thus, ultrasonographic findings of placental abruption may depend on the degree of abruption and on the time elapsed after the onset of disease, demonstrating variable images of abnormally thickened amorphous tissues with hyperechoic, hypoechoic, and echo-free areas[1,7−10]. In this study, the actual changes in the ultrasonographic images of

the hematoma in placental abruption were recordable from the hyperechoic area to the echo-free area. Although echographic differentiation of the abrupted placental substance from hematoma lesion was difficult by a conventional method because of the similar level of echoes, it was achievable by the use of the color doppler method in which the blood flow is defined[11].

Comparative analyses of ultrasonograms with laboratory data revealed that cases with predominantly thickened placenta (type T) had a lower level of Hb at presentation, a larger abrupted area, a larger intraoperative hemorrhage, and a higher incidence of disseminated intravascular coagulation. In addition, the cases with type T ultrasonogram had a higher incidence of abnormal fetal heart rate and a lower fetal Apgar score. In fact, 5 of the 6 patients with fetal death had the type with abnormally thickened placenta (type T).

The present findings are also consistent with a view that the severity of placental abruption is related to the size of the abrupted area and indicate that the incidence of a typical clinical picture and the fetal mortality rate become higher with an increase in the size of the abrupted area[2,12]. A typical clinical picture is usually seen in those patients who present with ultrasonographically proven abrupted, hemorrhagic areas of more than 30% with a markedly thickened and amorphous substance[1]. In this study, 7 of the 8 patients (Group A) presenting with a typical clinical picture had an abnormally thickened placenta that was filled with a mixture of hyperechoic, hypoechoic, and echo-free areas, with the median area abrupted being 50% and the median amount of intraoperative bleeding being 1,825 g. These findings demonstrate that patients with advanced stage of placental abruption show a thickened type of placental abruption associated with typical clinical signs and symptoms. It is emphasized, however, that a definite diagnosis of typical cases is usually achievable solely based on clinical signs and symptoms and cardiotocographic findings, and placental abruption will be established when the thickened type of placenta is shown in ultrasonography.

Patients presenting with an atypical clinical picture are likely to have a mild form of placental abruption or an early stage of the disease, in which less than 30% of the total size of the placenta is affected[2,12]. In this study, all of the 8 patients (Group C) who did not show signs and symptoms and cardiotocographic changes compatible with placental abruption and had an initial diagnosis of threatened premature delivery, premature rupture of the membranes, onset of labor or external bleeding showed placental edge separation and hematoma (type EH placenta) on ultrasonographic images. Corresponding to the mild features of placental abruption, the type EH ultrasonogram may provide a key finding in the early and definite diagnosis of mild, atypical cases of placental abruption.

Eight patients (Group B) who had probable placental showed a mixture of type T and type EH ultrasonogram. The mixture of the two types may indicate the existence of an intermediate clinical form of placental abruption between the severe and mild clinical picture.

Typical patients with type T ultrasonogram and atypical patients with type EH ultrasonogram showed no statistically significant difference in the time interval between the onset of symptom and the cesarean section. These observations indicate that ultrasonographic examinations play a role in rapid diagnosis and treatment of mild or atypical cases. Patients with type T ultrasonogram more commonly had abnormal fetal heart rate, often with absence of fetal heart tone or bradycardia. In most of these patients, cardiotocograms were not performed because emergency cesarean section was immediately performed. Although we could not evaluate any statistical correlation between uterine contractions on cardiotocograms and ultrasonographic findings, it seemed that patients presenting with type T ultrasonogram were more likely to have uterine hypertonicity.

In conclusion, patients presenting with a typical clinical picture of placental abruption can be easily diagnosed by clinical examinations and ultrasonographic examination only confirms the clinical diagnosis. In contrast, ultrasonographic examination provides valuable information for an accurate diagnosis of placental abruption in patients

who present with atypical or mild clinical manifestation.

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