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Original Article

The clinical value of prenatal assessment of cervical length and placental thickness in pregnant women with placenta previa

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Abstract: Objective: This study was designed to investigate the clinical value of prenatal assessment of cervical length (CL) and placental thickness (PT) in pregnancy outcome and prognosis of pregnant women with placenta previa. Methods: Eighty pregnant women with placenta previa treated in our hospital were enrolled for prenatal assessment of CL and PT, and were grouped as CL ≤ 30 mm (n=32) and CL > 30 mm (n=48) groups and PT ≥ 10 mm (n=34) and PT < 10 mm (n=46) groups, respectively. The pregnancy and perinatal outcomes were compared in different groups. ROC curve of CL and PT on preterm delivery was drawn, and the diagnostic value of CL and PT in diagnosing preterm delivery was calculated. Results: The pregnancy and perinatal outcomes of CL ≤ 30 mm group were significantly inferior to those of CL > 30 mm group ($P < 0.05$). The pregnancy and perinatal outcomes of PT ≥ 10 mm group were also significantly inferior to those of PT < 10 mm group ($P < 0.05$). PT and CL had good predictive values for preterm delivery ($P < 0.05$), with high diagnostic sensitivity, specificity and accuracy. Conclusion: Prenatal assessment of CL and PT has practical clinical significance for pregnant women with placenta previa, which helps in assessing pregnancy and perinatal outcomes and is worthy of clinical application.

Keywords: Prenatal assessment, cervical length, placental thickness, placenta previa, pregnancy outcome, prognosis, clinical value

Introduction

Placenta previa refers to an abnormal position where the placenta attaches inside the uterus but is near or over the cervical opening after 28 weeks of gestation, and the baby's placenta partially or totally covers the mother's cervix, resulting in a low-lying placenta [1]. Placenta previa is one of the causes of vaginal bleeding in late pregnancy as well as postpartum bleeding, and is a serious complication in late pregnancy [2, 3]. The epidemiological results show that the incidence of placenta previa is about 0.24-1.57% in China and 0.3-0.9% in other parts of the world [4]. With the promotion of abortion, cesarean section and other procedures in clinical practice, the incidence of placenta previa has been increasing year by year [5, 6]. Clinical practice indicates that placenta previa not only leads to a significant increase in bleeding during pregnancy, but also increases the risk of preterm delivery, asphyxia and death of the fetus, thus early diagnosis and intervention are of positive significance for the implementation of eugenic policy in China [7, 8].

Cervical length (CL) and placenta thickness (PT) are the most commonly used clinical indicators for placenta previa assessment. A retrospective analysis of 103 women found that CL could better predict pregnancy outcomes by vaginal ultrasound, with a sensitivity of 76.9%, a specificity of 86.8%, and an accuracy of 81.1%, which is of positive clinical value [9]. A multicenter retrospective study found that the incidence of preterm delivery, prenatal hemorrhage and cesarean delivery rate was significantly higher in women with thickened placental margins than that in women without thickened placental margins, and the researchers

suggested that thickened placental margins could be a risk factor for preterm delivery in pregnant women with placenta previa [10].

This study analyzed the clinical value of prenatal assessment of CL and PT in pregnancy outcome and prognosis of pregnant women with placenta previa by setting up different subgroups, thus to provide reference for improving clinical outcome of pregnant women and newborns, and reducing the incidence of adverse pregnancy events.

Materials and methods

General information

Eighty pregnant women with placenta previa who received treatment in our hospital from January 2016 to January 2020 were selected as the study subjects. The CL and PT were evaluated before delivery. The women were divided into CL ≤ 30 mm (n=32) and CL > 30 mm (n=48) groups, and PT ≥ 10 mm (n=34) and PT < 10 mm (n=46) groups.

Inclusion criteria: (1) pregnant women who were diagnosed with placenta previa by imaging [11]; (2) medical records were complete; (3) single live birth. This study had been approved by hospital ethics committee. All the enrolled subjects signed the informed consent forms.

Exclusion criteria: (1) patients with comorbid psychiatric disorders; (2) multiple births; (3) history of cervical surgery; (4) comorbid cervical lesions; (5) comorbid coagulopathy; (6) fetal malformations; (7) comorbid severe organ failure; (8) comorbid congenital heart disease; and (9) comorbid underlying diseases such as gestational hypertension.

Intervention methods

The CL and PT were measured in the subjects using Volusun 730 color Doppler ultrasound diagnostic machine (General Electric), with the probe frequency set at 3.5-5.0 MHz. The CL was determined as follows: the pregnant women were in a horizontal or lateral lying position, and after the bladder was properly inflated, the doctor made longitudinal and transverse scans over pubic symphysis to record the distance between the internal and external os of the cervix. The PT was measured as follows: the probe was moved to the junction of decidua and the chorion at the lower margin of the placenta, and the maximum vertical thickness of the placental tissue was recorded within ±10 mm of the junction. The above indices were measured 3 times consecutively and the average value was taken as the final result to minimize the measurement error.

Outcome measurement

The pregnancy outcomes were compared between the two groups, including maternal bleeding rate, blood transfusion rate and bleeding emergency cesarean section rate, emergency cesarean section rate, premature delivery rate, and postpartum hemorrhage rate. Meanwhile, the outcomes of perinatal infants in different groups were recorded, including birth weight, 5 min Apgar score, and neonatal asphyxia rate. The ROC curve of CL and PT versus premature delivery was drawn to calculate the area under the curve (AUC). The sensitivity, specificity and accuracy of CL and PT for premature delivery in women with placenta previa were calculated respectively.

Statistical analysis

SPSS 22.0 software was used for statistical analysis, and the normal distribution test was carried out on the collected data. If the data conformed to the normal distribution, the count data were expressed as [n (%)] and compared by *Chi*-square test or the exact probability method. The measurement data were expressed as mean ± standard deviation and examined by t-test, and the ROC curve was plotted to calculate the diagnostic performance. The difference was statistically significant when $P < 0.05$ [12].

Results

Baseline data of the enrolled subjects

There were 80 cases of placenta previa, with an average age of 30.19±2.11 years, an average number of pregnancies of 1.89±0.54, and an average number of deliveries of 0.98±0.23. There were 18 cases of miscarriage (22.50%), 10 cases with history of uterine manipulation (induced abortion, curettage, *etc.*) (12.50%), and 15 cases of cesarean section (18.75%), with an average detected gestational age of 27.28±2.19 weeks. There were 23 cases of complete placenta previa, 30 cases of partial

Table 1. Comparison of differences in baseline data ($\bar{x}$ ± sd)/[n (%)]

Clinical information		> 30 mm group (n=48)	≤ 30 mm group (n=32)	t/X^2	*P*
Average age (years)		29.98±2.33	30.19±2.43	0.388	0.699
Average weight (kg)		73.29±3.43	73.34±3.51	0.063	0.95
Average number of pregnancies		1.91±0.43	1.88±0.35	0.329	0.743
Average number of births		0.99±0.32	0.98±0.29	0.142	0.887
Type of placenta previa	Complete	14	9	0.012	0.993
	Marginal	18	12		
	Partial	16	11		

Table 2. Comparison of differences in maternal clinical data between groups with different PT ($\bar{x}$ ± sd)/[n (%)]

Clinical information		< 10 mm group (n=46)	≥ 10 mm group (n=34)	t/X^2	*P*
Average age (years)		29.89±2.41	30.02±2.29	0.244	0.808
Average weight (kg)		73.41±3.09	73.37±3.21	0.056	0.955
Average number of pregnancies		1.89±0.37	1.88±0.41	0.114	0.91
Average number of births		0.98±0.29	0.98±0.26	0.0	1.0
Type of placenta previa	Complete	13	10	0.051	0.974
	Marginal	17	13		
	Partial	16	11		

Table 3. Comparison of differences in pregnancy outcomes between groups with different CL [n (%)]

Group	n	Prenatal hemorrhage rate	Blood transfusion rate	Rate of emergency caesarean section due to bleeding	Preterm delivery rate	Postpartum hemorrhage rate
> 30 mm	48	14 (29.17)	1 (2.08)	11 (22.92)	7 (14.58)	7 (14.58)
≤ 30 mm	32	25 (78.13)	5 (15.63)	16 (50.00)	15 (46.88)	14 (43.75)
X^2	-	18.42	5.075	6.299	10.042	8.437
P	-	< 0.001	0.024	0.012	0.002	0.004

placenta previa, and 27 cases of marginal placenta previa (**Tables 1**, **2**).

Comparison of pregnancy outcome in different groups

Compared to women with CL > 30 mm, women with CL ≤ 30 mm had significantly higher rates of prenatal bleeding, blood transfusion, emergency cesarean delivery, preterm delivery and postpartum bleeding ($P < 0.05$) (**Table 3**). The rates of above adverse events in women with PT ≥ 10 mm were significantly higher than those in women with PT < 10 mm (**Table 4**).

Comparison of the differences in prognosis

Compared with perinatal infants in the group with CL ≤ 30 mm, perinatal infants in the group with CL > 30 mm had lower birth weight and 5 min Apgar score and higher incidence of neonatal asphyxia ($P < 0.05$) (**Figure 1A**). Compared with perinatal infants in the group with PT < 10 mm, perinatal infants in the group with PT ≥ 10 mm had lower birth weight and 5 min Apgar score and higher incidence of neonatal asphyxia ($P < 0.05$) (**Figure 1B**).

Predictive value of CL and PT for preterm in women with placenta previa

The predicted AUC for CL was 0.9444 (95% CI: 0.8626-1.000) ($P < 0.001$) and 0.9316 (95% CI: 0.8412-1.000) ($P < 0.001$), respectively (**Figure 2**). The sensitivity, specificity, and accuracy of CL, PT, and CL+PT for the prediction of preterm in women with placenta previa were calculated separately, and it was found that

Table 4. Comparison of differences in maternal pregnancy outcomes between groups with different PT [n (%)]

Group	n	Prenatal hemorrhage rate	Blood transfusion rate	Rate of emergency caesarean section due to bleeding	Preterm delivery rate	Postpartum hemorrhage rate
< 10 mm	46	14 (30.43)	1 (2.17)	10 (21.74)	6 (13.04)	7 (15.22)
≥ 10 mm	34	25 (73.53)	5 (14.71)	17 (50.00)	16 (47.06)	14 (41.18)
X^2	-	14.532	4.426	6.983	11.346	6.805
P	-	< 0.001	0.035	0.008	0.001	0.009

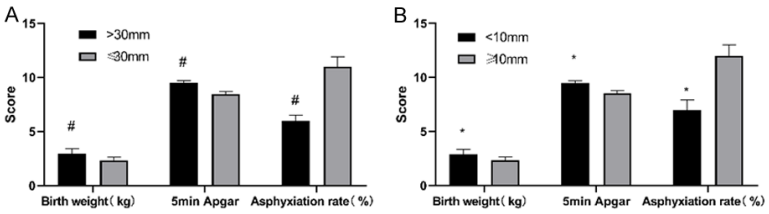

Figure 1. Comparison of the differential prognosis of perinatal infants in different groups. CL groups (A); PT groups (B). # indicated that compared with CL > 30 mm group, the difference of the same index between groups was statistically significant; * indicated that compared with PT < 10 mm group, the difference of the same index between groups was statistically significant.

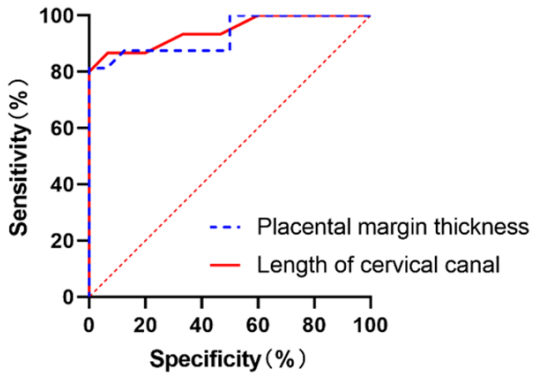

Figure 2. The predictive value of CL and PT for preterm delivery in placenta previa. The predicted AUC of CL was 0.9444, with a 95% CI of 0.8626-1.000, *P* < 0.001, and the predicted AUC of PT was 0.9316, with a 95% CI of 0.8412-1.000, *P* < 0.001.

Table 5. Analysis of the predictive value of different testing modalities for preterm delivery in placenta previa (%)

Detection method	Sensitivity	Specificity	Accuracy
CL	76.51	87.29	83.29
PT	83.21	86.19	84.19
Combined testing	92.19	98.17	96.11

there was no significant difference between CL alone and PT alone in terms of sensitivity, specificity, and accuracy, whereas the sensitivity, specificity, and accuracy of combined testing were significantly higher (**Table 5**).

Discussion

Placenta previa is the placenta that appears low in the early pregnancy [13]. It is not until 28 or 30 weeks that ultrasound can determine that the placenta is too close to the cervix [14]. Clinically, placenta previa is divided into complete, marginal, and partial types based on the distance between the lower edge of the placenta and the cervical opening. Women with placenta previa should be followed up closely. Therefore, the placenta and the implant may be peeled off in the third trimester of pregnancy. If the peeling range is large or the peeling is repeated, the mother is prone to vaginal bleeding or even shock due to massive bleeding, leading to the death of the pregnant mother or fetal death in the uterus [15-17]. The etiology of placenta previa is not clear. Previous studies have pointed out that multiple pregnancies, multiple abortions, multiple curettage operations, drug, smoking, *etc*. may be related to the occurrence of the disease. There are currently no targeted clinical prevention methods. Therefore, early diagnosis and appropriate treatment are important ways to improve the clinical outcomes in pregnant women with placenta previa and perinatal infants [18-20].

This study analyzed the clinical value of prenatal assessment of CL and PT in pregnancy outcome and prognosis of pregnant women with placenta previa, and the results showed that the rates of antepartum hemorrhage, blood transfusion, emergency cesarean section with hemorrhage, preterm delivery and postpartum

hemorrhage in women with CL ≤ 30 mm were significantly higher than those in women with CL > 30 mm, suggesting that shorter CL caused adverse pregnancy outcomes. A retrospective analysis of 90 parturients showed that assessment of CL by vaginal ultrasound could better predict the outcomes in cesarean delivery with a diagnostic sensitivity of 78.89%, a specificity of 89.18%, an accuracy of 81.29%, a positive predictive value of 88.98% and a negative predictive value of 73.78% [21]. We believe that placenta previa tends to pull the cervix during late pregnancy, leading to shortening of CL, which makes some placenta previa unable to stretch and eventually induces placental abruption, which may be the main cause of preterm delivery and prenatal bleeding [22, 23]. The effect of CL on perinatal prognosis was further analyzed, and the results showed that the birth weight and 5 min Apgar score were significantly lower and the incidence of neonatal asphyxia was significantly higher in the group with CL ≤ 30 mm. Some scholars have pointed out that the shortened CL means that the placenta previa of the lower uterus and the internal cervix opening cannot be attached smoothly, which increases the risk of peeling [24]. Thus CL may be potential index for assessment of the maternal and infant outcome. It was found in the above-mentioned research that CL at 34 weeks of gestation was positively correlated with the gestational week of the termination of pregnancy. We speculated that preterm delivery is associated with poor perinatal outcomes, and it has been established above that the shortened CL increases the rate of preterm delivery in placenta previa, thus the incidence of poor perinatal outcomes tends to be higher.

The study also showed that compared with PT < 10 mm group, PT ≥ 10 mm group had higher incidence of adverse events. Compared with perinatal infants in the group with PT < 10 mm, the birth weight and 5 min Apgar score of PT ≥ 10 mm group were significantly lower, and the incidence of neonatal asphyxia was significantly higher. Some scholars have found that the PT is one of the risk factors for prenatal hemorrhage, and they observed 71 women with placenta previa at 28-38 weeks of gestation and found that the placental edge thickened women had higher incidence of prenatal hemorrhage while the average incidence of bleeding increased from 1.61±0.61 to 3.71±1.41 [25]. We believe that the thickening of the placenta may be related to the rich blood flow at the edge of the placenta and the sub-placental decidua. The thicker edge of the placenta indicates its fast growth rate. The thickened placenta is more likely to cause friction with fetal presentation. Therefore, it will significantly increase the rate of prenatal hemorrhage, and placental thickening will also have an impact on the clinical outcome of perinatal infants [26, 27]. The results showed that the predicted AUC of CL was 0.9444, with a 95% CI of 0.8626-1.000, and the predicted AUC of PT was 0.9316, with a 95% CI of 0.8412-1.000, suggesting that these indicators had good predictive values for adverse pregnancy outcomes.

In conclusion, the prenatal assessment of CL and PT has practical clinical significance for women with placenta previa, which is helpful for the assessment of adverse pregnancy outcomes and perinatal outcomes, and is worthy of clinical application. The innovation of this study lies in the data analysis to explore the predictive value of CL and PT on the pregnancy outcomes of placenta previa women. The data are relatively detailed and reliable, which provide a theoretical reference for clinical intervention in women with placenta previa. The limitation of this study is that it involved a small number of cases in our hospital, and individual and geographical differences may cause bias in the results, which will be corrected in the next step.

Disclosure of conflict of interest

None.

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