

Effects of marginal umbilical cord insertion on the prognosis of fetus

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Summary

Objective: To investigate the effect of marginal placental insertion of the umbilical cord on the prognosis of a fetus. **Material and Methods:** Retrospective analysis was performed to compare the differences in fetal weight (FW), placental weight (PW), fetal/placental weight ratio (FPR) and complications between 295 cases with marginal insertion of umbilical cord, and 297 cases with normal umbilical cord insertion. The cases studied, with marginal insertion of umbilical cord, were admitted between 2013-2017 to the Second Western China Hospital of Sichuan University. The cases were divided into “upper”, “lower” and “other”, according to the site of umbilical cord insertion into the placenta. **Results:** The FW was lower, while the incident of low-birth weight infants was higher in the marginal umbilical cord insertion group than in the normal umbilical cord insertion group. In the subgroup of lower marginal insertions, the PW and FW were lower and the FPR was higher than in the subgroup of upper marginal insertion sites. **Conclusion:** The fetus with lower marginal umbilical cord insertion should be attended closely, with frequent monitoring of the developmental indices in order to screen abnormal growth of the fetus.

Key words: Marginal umbilical cord insertion; Fetal weight; Placental weight; Fetal/placental weight ratio; Complications.

Introduction

The umbilical cord is a link between a fetus and its mother for purposes of gas exchange, nutrient supply and removal of metabolic wastes; it is, therefore, an important factor affecting the development of the fetus. Umbilical cord insertion includes central, eccentric, marginal and velamentous umbilical cord insertions. Marginal insertion refers to an abnormality in which the umbilical cord enters the placenta too close to its margin, that is, within 2 cm of the edge. The morbidity is 6.3% of singleton births [1]. The velamentous insertions means the umbilical cord inserts into the fetal membranes (choriambnionic membranes), then travels within the membranes to the placenta (between the amnion and the chorion).

Recently, the morbidity of abnormal insertion of umbilical cords has increased due to damage to the endometrium related to increased numbers of abortions, *in vitro* fertilization and embryo transfer, diagnostic curettage and Caesarean section. For the fetus with an abnormal insertion of the umbilical cord, the dilatation of the mother’s cervix, and the descension and presentation during labor and delivery may further compress the umbilical vasculature and threaten the life of the fetus.

Although previous research has indicated that a marginal umbilical cord insertion has less effect on the mother and fetus than a velamentous umbilical cord insertion, there is a dearth of more specific investigation into the effects of umbilical cord insertion sites on fetal weight, labor method and complications. This study begins to address these gaps

in the literature on effects of umbilical cord insertion sites. The present study is a retrospective analysis of data from 295 cases with marginal umbilical cord insertion and data from 297 cases with normal umbilical cord insertion, in order to compare fetal weight (FW), placental weight (PW), fetus-placenta ratio ratio (FPR) and occurrence of complications between the two groups.

Materials and Methods

The study with marginal umbilical cord insertion included 295 pregnant women who were admitted and gave birth in the Obstetrics Department of the hospital during 2013-2017(MI group). The normal group included 297 pregnant women with normal umbilical cord insertion (NI group). All pregnant women in the study were singleton, free of complications such as diabetes, hypertension or anemia. The last menstrual period and gestational age were confirmed. All pregnant women had detailed labor and delivery records. All the infants were in the same room with the mother except for those with low birth weight or premature delivery and they stayed in Neonatal Intensive Care Unit (NICU) one-two weeks until discharge.

Prenatal ultrasound examinations were performed at gestational age of 23⁺⁰-25⁺⁶ weeks. Ultrasonography was performed by five sonographers qualified for prenatal diagnosis, and their measurements were consistent with internal comparisons. When marginal umbilical cord insertion was found, another doctor was asked to review them, and the final report was issued by two sonographers. All women

Table 1. — General information in MI group and NI groups

	NI group	MI group	<i>p</i> score
Case	297	295	> 0.05
Maternal age	31.13 ± 4.2	31.13 ± 3.9	> 0.05
Gravidity	2.18 ± 1.3	1.99 ± 1.42	> 0.05
Parity	0.42 ± 0.53	0.27 ± 0.47	< 0.05
Gestational weeks	39 + 4 ± 1.08	39 + 2 ± 0.78	> 0.05
Conception way(nature)	280 (94.28%)	279 (94.58%)	> 0.05

Table 2. — FW, PW, FPR in MI group and NI groups

	case	FW	PW	FPR
NI group	297	3346.8 ± 387.49	599.19 ± 90.55	5.66 ± 0.76
MI group	295	3244.7 ± 365.48	590 ± 85.62	5.57 ± 0.78
<i>p</i> score		< 0.05	> 0.05	> 0.05

were examined systemically in the Ultrasound department of the hospital with 2-5 MHz probe. The insertion site of umbilical cord into placenta and the distance from the insertion site to the edge of placenta were carefully searched for and recorded. The insertion site was recorded as the upper group or the lower group. Those who did not exactly determine the location exactly were assigned to other group.

The data were analyzed with software SPSS22.0. Measurement data were expressed as mean ± SD and analyzed with *t*-test and counting data were analyzed with *Chi-square* test. The significant level was set as $p < 0.05$.

Results

Age, gravidity, and gestation week were not significantly different between the MI and NI groups. The parity in NI group was significantly ($p < 0.05$) higher than that of the MI group. The method of conception in both groups was similar, as natural fertilization accounted for more than 94%. The general information is listed in Table 1.

The data for FW, PW and FPR in the two groups are listed in Table 2. The FW in NI group was higher than that in the MI group by asignificant difference ($p < 0.05$). The PW and FPR were also higher in the NI group, but there was no significant difference ($p > 0.05$). Differences were also noted between upper vs. lower insertion sites into the placenta in marginal umbilical cord insertion group (Table 3). The FW and PW were significantly (< 0.05) higher in fetuses with upper placental cord insertion than in those with lower placental insertion sites. The FPR was significantly lower (< 0.05) in upper umbilical cord insertion than in cord insertions into the lower part of placenta ($p < 0.05$).

The complications included premature rupture of membranes, postpartum hemorrhage, preterm delivery, low birth weight infants, macrosomic infants, and fetal distress (Table 4). The rate of low birth weight infants (defined as infants weighing less than 2500 g) in the MI group was significantly higher than that in NI group ($p < 0.05$), but there was no significant difference in other complications between

two groups ($p > 0.05$). There was one case of stillbirth in the MI group, due to a true knot of the umbilical cord, which was confirmed after induced labor.

Discussion

The FW is an important indicator to reflect the growth and development of fetus while the PW and FPR are closely correlated with FW; these three indices are used to evaluate the nutrition efficiency of the placenta [2]. Over-weight placenta or higher FPR may increase the malignant prognosis of the fetus, such as perinatal death, low Apgar score, low birth weight [3], and even the risk of hypertension in adulthood [4]. The reason for an overweight placenta is not clear. It is proposed that the limited growth of the fetus signals the need for more nutrition, resulting in over-growth of placenta, or that the ischemia and infarction of the placenta results in an overweight placenta [5]. It is reported that FPR can be used to effectively evaluate the placenta efficiency in twin pregnancy [6]. There are few reports, however, about the predictive or evaluative application of FPR and PW to placental efficiency or other measures of fetal well-being in cases of marginal umbilical cord insertion or in cases of different insertionsites of marginal umbilical cord insertion.

The present study indicated that the FW was significantly lower in marginal umbilical cord insertion than normal umbilical cord insertion, while PW and FPR were not significantly different. These results implied that the closer distance of cord insertion to the edge of placenta may limit the nutrition supply to fetus and FW is more sensitive to nutrition supply than PW and FPR. Looking further at upper and lower marginal insertion groups, analysis indicated that the PW, FW in the lower insertion group were all lower than that in upper insertion group. These results suggest that umbilical cord insertion into lower part of placenta exerts a larger detrimental effect on fetal development than that of umbilical cord insertion into upper part of placenta.

Lower FW and higher FPR imply poorer prognosis. One reason for this may be that lower insertion site is closer to

Table 3. — Classification comparison of different insertion positions in MI group

	case	FW	PW	FPR
Upper	179	3292.95 ± 347.31*	604.87 ± 81.89*	5.52 ± 0.79*
Lower	99	3181.46 ± 406.14*	566.17 ± 81.00*	5.67 ± 0.72*
Others	17	3178.92 ± 312.58	582.14 ± 100.98	5.58 ± 0.88

* $p < 0.05$ in Upper and Lower group.

Table 4. — Complications in MI group and NI groups

Complications	NI group		MI group	
	cases	ratio	cases	ratio
Premature rupture	78	26.26%	70	23.73%
Postpartum hemorrhage	11	3.70%	14	4.75%
Premature delivery	6	2.02%	6	2.03%
Fetal distress	1	0.34%	4	1.36%
Low birth weight	0	0	8	2.7%*
Fetal macrosomia	18	6.10%	8	2.70%
Still birth	0	0	1	0.34%

* $p < 0.05$ in Low birth weight infant (premature rupture: the membranes rupture naturally before labor; postpartum hemorrhage: the bleeding amount exceeds 500 mL within 24 hours after delivery; premature delivery: the period of labor between 28 weeks and less than 37 week; fetal distress: signs of hypoxia in utero endanger the health and life of the fetus. Low birth weight infant: a birth weight of less than 2,500 grams; fetal macrosomia: weight of a newborn equal to or greater than 4,000 grams within one hour of birth; stillbirth: the fetus dies in uterus after 20 weeks of pregnancy).

the cervical internal orifice and the descending presentation compresses the umbilical cord, affecting the nutrition absorption by the fetus. This study identifies a significant difference in parity but not in gravidity and gestational weeks between the MI and NI groups. These results are consistent with previous study [7] and suggest that marginal umbilical cord insertion is more prevalent in primipara. There was no difference in the method of conception between the two groups, suggesting that in vitro fertilization did not increase the incidence of marginal umbilical cord insertion in the present study.

The complications in both groups were similar, with no significant differences in premature rupture of membranes, postpartum hemorrhage, preterm delivery, fetal macrosomia or fetal distress. The exception to this was the rate of low birth weight infants, which was significantly higher in the MI group than that in the NI group, indicating that marginal umbilical cord insertion affects the nutritional supply to placenta-fetus. There was one case of stillbirth in MI group, which was confirmed after induced labor as true knot of umbilical cord. Premature rupture of membranes was the most common complication in both MI and NI groups respectively, with a morbidity of 26.26% and 23.73%, respectively, which is consistent with literature [8]. This suggests that there is common pathological mechanism for the functional changes of embryolemma, umbilical

cord and placenta. The effect of marginal umbilical cord insertion on placenta is smaller than that of velamentous placenta, therefore, the rate of premature rupture of membranes was not significantly increased.

In summary, the present study indicates that marginal umbilical cord insertion can affect the development of fetus. This is especially true when the insertion of the umbilical cord is in the lower, versus the upper part of the placenta, when FW, PW and FPR are more likely to be detrimentally affected. Therefore, more attention is warranted for marginal umbilical cord insertions in the lower part of placenta. Ultrasound allows early detection of this abnormality and allows obstetricians to communicate early with pregnant women to inform them of the possible prognosis and strengthen nutrition during pregnancy.

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Conflict of interest

The authors declare no conflict of interest.

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