A Study Evaluating Correlation between Umbilical Cord Attachment on Placenta in Normotensive and Hypertensive Pregnant Females and its Effects on Fetus

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Abstract

Introduction: Well nourished newborn is a reflection of adequate placental function.The umbilical cord that connects fetus and placenta can attach itself to placenta at different placenta.The incidence of central, eccentric, marginal and velamentous cord insertion is 18%,73%, 7% and 1-2%, respectively. This insertion type significantly influences fetal growth and pregnancy outcomes.

Methodology: This study was conducted in Department of Anatomy of SBKS MIRC, Vadodara. This was a comparative study between normotensive and hypertensive group in which 500 subjects, in each group were included. Insertion of umbilical cord on placentawas determined and fetal growth and outcome with type of insertion were correlated.

Results: The two groups were comparable in terms of demographics.Higher proportion of those in hypertensive group had marginal insertion of umbilical cord (23.40%) as compared to 2.90% in normotensive group. Mean systolic (150.10±7.51mmHg) as well as diastolic blood pressure (91.23±4.00mmHg) was higher in those with marginal insertion of placenta. Mean fetal birth weight and APGAR score at birth and 5 minute and proportion of fetus reaching full term, live births were low in those in those in the hypertensive group especially in those with marginal insertion of placenta.

Conclusion: Thus it can be concluded that abnormal attachment of umbilical cord on placenta has significant impact on fetal growth and influences the outcomes of pregnancy directly and indirectly.

Key word: *- Placenta, Umbilical cord, Cotyledon, Hypertension, Hypotension, Fetus.*

Introduction

Adequate placental function results in well nourished newborn. Umbilical cord connects fetus and placenta and delivers oxygen and nutrients, throughout pregnancy, to the developing fetus. Thus, development of the umbilical cord determines and influences fetus growth. The site ofcord insertion can becentral, eccentric, marginal(Battledore) or velamentous (into fetal membranes) each occurring with an incidence 18%, 73%, 7% and 1-2%,respectively. [1] The attachment is considered marginal when cord attaches itself to placenta within 20mm from the placental edge. The insertion is called velamentous when umbilical cord inserts in to the chorio-amniotic membranes instead of placental mass. [2]

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Two differenttheories can explain this variation in attachment:i) "placental migration theory or trophotropism", which states that, to achieve better perfusion,placentamigrates towards the richly vascularised areaas the gestation advances. ii) "blastocyst polaritytheory", which specifies that malpositioning of blastocyst during implantation results in abnormal cord insertion. [3]

Various literatures have debated the significance of abnormal insertion of umbilical cord. It has been reported that marginal insertion is associated with increased frequency in abortions, malformed foetuses. It is also correlated with neonatal asphyxia and premature labour. Velamentous cord insertion results in lack theprotection of Wharton's jelly to the vessels and this makes the vessels prone torupture and/or compression and can thereby cut off umbilical blood flow, acutely, which increases risk of perinatal death. [4]

Poor obstetric outcomes are observed in those with abnormal cord insertion. There have been reports of rise in fetal malformations, birth of neonates that are low weight, preterm induction of labor, intrauterine growth restriction, vasa previa, low APGAR scores and intra partum complications. ShanklinDR et al, reported that in newborn weighing less than 2.5 kg, velamentousor marginal umbilical cord insertion was common. [5] Rath et alobserved that hypertensive mothers' commonly have marginal insertion of cord. [6]

We conducted this study to evaluate types of umbilical cordinsertions on placenta in normotensiveand hypertensive pregnant females and correlate this finding with fetal outcomes.

Methodology

This study was conducted in Department of Anatomyof SBKS MIRC, Vadodara. This was a comparative study between normotensive and hypertensive group in which 500 subjects, in each group, were included.It took five years for the study to get completed and the period of study was fromJan'12 to Dec'17. Fetal parameters were recorded. Morphology and Morphometric of placenta was evaluated. Insertion site of umbilicalcord was noted. We calculated minimum distance betweenplacentalmargin andinsertion site of umbilical cord usinga measuring scale and the same was labelled as'd'. Themean radius,denoted as 'r', was calculated from the surface. Insertion percentage wascalculated using the formula:(d/r) x 100. High insertionpercentage suggests central insertionon the other hand low insertion percentage was suggestive of marginal insertion. The insertion was categorised as central (76-100%), eccentric-lateral (51-75%),eccentric-medial (26-50%) and marginal (0-25%). The collected data was entered into MS Excel and was analysed. Mean+SDand frequencies were calculated wherever appropriate. The level of significancewas estimated using unpaired 't' test.

Results

A total of 1000 cases, 500 hypertensives and 500 normotensive pregnant females were enrolled. In the hypertensive group, 25% (n=125), 50% (n=250) and 25 % (n=125) had gestational hypertension, pre-eclampsia and eclampsia, respectively.

Patients enrolled were in 20 - 35 years age range.

It was seen that significantly higher proportion of patients in hypertensive group had marginal insertion of placenta as shown in table 1.

Table 1: Site of Insertion of Placenta in different groups

Site of Insertion of Placenta	Normotensive		Hypertensive group								p-value
			GH		PE		Eclampsia		Total		
	N	%	N	%	N	%	N	%	N	%	
Central	215	21.50%	16	1.60%	30	3.00%	20	2.00%	66	6.60%	<0.001
EM	123	12.30%	21	2.10%	62	6.20%	22	2.20%	105	10.50%	0.212
EL	133	13.30%	30	3.00%	34	3.40%	31	3.10%	95	9.50%	0.241
Marginal	29	2.90%	58	5.80%	124	12.40%	52	5.20%	234	23.40%	<0.001

EM - Eccentric Medial; EL - Eccentric Lateral

The mean systolic blood pressure was higher in those in Marginal insertion of placenta as compared to other groups as shown in table 2.

Table 2: Site of Insertion of Placenta and Mean blood pressure

Mean BP (mmHg)	Normotensive (Mean±SD)		Hypertensive group(Mean±SD)								p-value
			GH		PE		Eclampsia		Total		
	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	
Central	123.09±4.11	82.23±4.07	148.13±5.72	90.25±3.80	148.83±8.16	91.40±3.73	148.20±8.12	91.20±3.97	148.39±7.33	90.95±3.83	<0.001
EM	122.87±4.24	82.37±4.34	148.67±6.86	90.69±3.53	150.19±7.32	92.00±4.15	149.55±7.58	90.56±3.83	149.47±7.25	90.42±3.84	<0.001
EL	123.29±4.10	82.51±3.82	152.43±6.71	91.87±2.98	148.21±6.79	91.76±4.24	148.94±8.44	90.74±3.88	149.86±7.32	91.12±3.70	<0.001
Marginal	122.83±3.98	81.66±3.83	151.07±7.06	91.33±2.83	150.34±7.40	92.45±4.89	148.88±8.08	91.91±4.27	150.10±7.51	91.23±4.00	<0.001

EM - Eccentric Medial; EL - Eccentric Lateral

The mean birth weight of the neonates was low in those born in marginal attachment of placenta as shown in table 3.

Table 3: Site of insertion and Mean fetal body weight

Mean Birth Weight (Kg) (Mean±SD)	Normotensive	Hypertensive group				p-value
		GH	PE	Eclampsia	Total	
Central	2.90±0.53	2.21±1.08	2.47±0.55	2.39±0.89	2.36±0.84	0.0132
EM	2.87±1.03	2.17±0.90	2.41±0.35	2.22±0.58	2.26±0.61	0.0231
EL	2.81±1.00	2.06±0.90	2.35±0.55	2.00±0.99	2.14±0.82	0.0412
Marginal	2.43±0.68	2.04±0.98	2.31±0.41	1.91±0.72	2.09±0.70	<0.001

EM - Eccentric Medial; EL - Eccentric Lateral

In both the groups, a significantly higher proportion of neonates in those with marginal attachment had weight less than 2.5kg as shown in table 4.

Table 4: Correlation between insertion of placenta and neonate weight

	Normotensive				Hypertensive group			
Neonate weight	**<2.5 kg**		**>=2.5kg**		**<2.5 kg**		**>=2.5kg**	
Central	6	1.20%	209	41.80%	32	6.40%	34	6.80%
Eccentric Medial	1	0.20%	122	24.40%	36	7.20%	69	13.80%
Eccentric Lateral	3	0.60%	130	26.00%	50	10.00%	45	9.00%
Marginal	17	3.40%	12	2.40%	136	27.20%	98	19.60%

The APGAR score at birth and at 5 minutes was low in those with marginal attachment of placenta as compared to those with central attachment of placenta as shown in table 5.

Table 5: Site of insertion and APGAR score at birth

APGAR score at birth(Mean±SD)	**Normotensive Group**	**Hypertensive group**			
		GH	**PE**	**Eclampsia**	**Total**
Central	8.1±1.03	6.26±2.4	6.41±2.79	6.95±1.47	6.54±2.22
Eccentric Medial	7.88±1.4	6±2.35	6.27±1.99	6.79±2.4	6.35±2.25
Eccentric Lateral	7.59±1.19	5.9±2.84	5.3±2.74	6.29±1.93	5.83±2.50
Marginal	7.55±1.49	5.53±2.51	5.03±1.61	6.1±2.49	5.55±2.20
APGAR score at 5 minutes (Mean±SD)	**Normotensive Group**	Hypertensive group			
		GH	PE	Eclampsia	**Total**
Central	9.55±0.72	8.24±3.22	8.79±1.71	8.32±3.61	8.45±2.85
Eccentric Medial	9.36±1.41	7.69±3.14	8.42±3	8.12±2.49	8.08±2.88
Eccentric Lateral	9.22±1.16	7.52±3.79	8.03±2.29	6.9±3.52	7.48±3.20
Marginal	9.12±1.53	7.2±3.33	7.63±3.05	6.58±1.99	7.14±2.79

Preterm deliveries, IUDs and NICU admissions were common in those with marginal attachment of placenta as shown in table 6 in both the groups.

Table 6: Correlation of fetal outcomes with site of attachment of placenta

	Normotensive				Hypertensive group			
Term at birth	**Full term**		**Pre-term**		**Full term**		**Pre-term**	
	N	%	N	%	N	%	N	%
Central	182	18.20%	33	3.30%	43	4.30%	23	2.30%
Eccentric Medial	113	11.30%	10	1.00%	73	7.30%	32	3.20%
Eccentric Lateral	117	11.70%	16	1.60%	51	5.10%	44	4.40%
Marginal	24	2.40%	5	0.50%	158	15.80%	76	7.60%
Birth status	Live Birth		IUD		Live Birth		IUD	
	N	%	N	%	N	%	N	%
Central	211	21.10%	4	0.40%	56	5.60%	10	1.00%
Eccentric Medial	122	12.20%	1	0.10%	97	9.70%	8	0.80%
Eccentric Lateral	131	13.10%	2	0.20%	78	7.80%	17	1.70%
Marginal	29	2.90%	0	0.00%	219	21.90%	15	1.50%
ICU admission	Required		Not-required		Required		Not-required	
	N	%	N	%	N	%	N	%
Central	5	0.50%	206	20.60%	22	2.20%	34	3.40%
Eccentric Medial	4	0.40%	118	11.80%	28	2.80%	69	6.90%
Eccentric Lateral	4	0.40%	127	12.70%	33	3.30%	45	4.50%
Marginal	1	0.10%	28	2.80%	74	7.40%	145	14.50%

Discussion

Various studies have implicated role of marginal insertion of umbilical cord in the placenta with induction of hypertension.[7, 8] In the present study it was seen that marginal attachment of placenta was common in those in hypertensive group. However, 'eccentric' insertion of the umbilical cord was reported in both normotensive and hypertensive groups by certain authors. [3, 9].The difference may be due to the fact that these authors enrolled pre-eclamptic females in hypertensive group where our study enrolled those with gestational hypertension and eclampsia as well. And as confirmed in the findings of Udainia A. et al with the increase inthe severity of PIH, the umbilical cord insertion on placenta shifts marginally and may even become velamentous. [9] Additionally, we observed that in those with marginal insertion of placenta the blood pressure was on higher side as compared to other type of insertions in both the groups. There are two different theories, one that

suggest that hypertension lead to marginal attachment and other that marginal attachment of placenta induces hypertension.Cai LYet al and Jain A et al have reported that hypertension is induced by abnormal insertion of placenta. [3, 9]

Authors like Udaina A et al, Jain A et al have reported low birth weight in those with marginal attachment. [3, 9] In the present study also it was observed that fetal weight was low in those with hypertensive group as compared to normotensive group and was lowest in those with marginal attachment of placenta. Thus our finding is consistent with literature that abnormalcord insertion is correlated with intrauterinegrowth restriction (IUGR), this may be because abnormal insertion of umbilical cord may impact the nutrient and oxygen transfer across placenta. [3, 10] The reason for abnormal nutrient transfer may be that the in such circumstances of abnormal attachment, density of vessels inplacentae is low asagainst when the insertion is normal; also an increased vascular resistance may be encountered on account of long fetal stem vessels. [3]

We observed low mean APGAR scores at birth and at 5 minutes in those in the hypertensive group, especially in those with marginal attachment of placenta. Similar to our study Heinonen S et al observed low APGAR score at 1 minute and 5 minutes after birth in those with abnormal placental attachment as compared to those with normal attachment of placenta. [12]

Brody S, et al., observed that battledore placenta may sometimes be responsible for the premature initiation of labour. This may be because of interference with fetal circulation which causes fetal embarrassment and upset the balance of opposing forces existing betweenthe uterus, placenta, and fetus for the maintenance of pregnancy and thus induceslabor prematurely. [11] In the present study, it was observed that preterm deliveries occurred commonly in the hypertensive group and that more frequently in those with marginal insertion of placenta. In the study by Heinonen S et al, prematurity was observed in 13.9% of the cases with abnormal placental attachment as compared to 6.1% of the cases in those with normal placental attachment. [12] Similar to our study the authors, Heinonen S et al, also observed higher fetal mortality and increased ICU requirement in those with abnormal placental attachment.

Conclusion

Thus it can be concluded that abnormal attachment of umbilical cord on placenta has significant impact on fetal growth and influences the outcomes of pregnancy directly and indirectly.

Ethical Clearance- Taken from Sumandeep Vidyapeeth University committee

Source of Funding- Self

Conflict of Interest - Nil

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