Study of Correlation of Neonatal Outcomes with Gross Abnormalities of Placenta and Umbilical Cord

Nair BT[1], Raju U[2]

Abstract

Introduction: Perinatal outcome of new-borns is greatly influenced by abnormalities of placenta and umbilical cord. In most of the deliveries, whether home or institutional, the placenta and umbilical cords are discarded without examination. Due to paucity of information on abnormalities of placenta and cord, there is hardly any correlation with foetal outcomes. The aim was to study the correlation between the foetal outcome and the different types of abnormalities of placenta and umbilical cord. **Materials and Methods:** A prospective, cross-sectional, descriptive, randomised study was conducted from January 2016 to December 2016 in a tertiary care hospital in North India. The study was carried out on 1000 term singleton new-borns. The placenta and umbilical cords were obtained from both normal and caesarean section deliveries. A proforma was used to gather data from the patients and new-borns. Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc, Chicago, IL, IBM version) along with Microsoft Excel (2010 version). **Results:** One thousand placentae and umbilical cords were examined of which high placental weight/birth weight ratio, gross anomalies of placenta (infarctions, calcifications and retro placental haematoma), marginal (battledore and velamentous) umbilical cord insertions, long umbilical cords and single umbilical artery were associated with negative foetal outcomes. **Conclusions:** There was a high incidence of adverse foetal outcome with placental and umbilical cord abnormalities. Education of our health personnel dealing with deliveries on the importance of proper examination of the placenta and umbilical cords should be emphasised and instituted upon.

Key words: Placental Abnormalities, Umbilical Cord Anomalies, Foetal Outcome.

Introduction

The human placenta presents a paradox as despite being the most easily available structures for examination yet it is one of the least studied and known. The placenta and umbilical cord are the only vital organs of prenatal life which can be examined easily without endangering the mother or the baby. Fox and Langley described the placenta as the mirror of the prenatal period. But they further described

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it as a mirror which has not been sufficiently polished[1].

Gross anomalies in placenta and cord have some prognostic value as far as mortality and morbidity during neonatal period is concerned. Macroscopic examination of placenta and cord can be done very easily and the abnormalities associated with them can forewarn and yield a great quantum of information regarding the neonates. Despite this, there has been very meagre reports in Indian literature on association of placental and umbilical cord abnormalities and neonatal outcomes. The study is being undertaken to find out the correlation between placental weight, cord length, anomalies of placenta and cord with neonatal events and weight of the new-borns.

Placenta with the umbilical cord is the main channel of nutrition and has an important relation to the intra uterine development of the foetus. Defects or disease of the placenta or cord, if of sufficient degree may seriously affect the health and even the life of the foetus. It is very difficult to test the functional capacity of the placenta. Hence, anatomic studies involving gross morphology of the cord and placenta are undertaken to determine the normal relationship with the new-born which is of considerable importance. The objectives of this study were to study the correlation between different types of abnormalities of placenta and umbilical cord and the foetal outcome.

Materials and Methods

This was a prospective, cross-sectional, descriptive, hospital based, randomised study was conducted from January 2016 to December 2016 in a tertiary care hospital in North India. The study was carried out on 1000 term (between 37 and 42 weeks of gestation) new-borns and their placenta and umbilical cord. These were obtained from both normal and caesarean section deliveries. The placenta and umbilical cord were observed for any abnormalities in the structure, shape, cord insertion and number of vessels in the cord.

The *inclusion criteria* for the study were singleton deliveries of gestational age 37 to 42 weeks, born by vaginal or caesarean sections. The cases excluded were multiple pregnancies, previously diagnosed intrauterine foetal deaths, preterm deliveries < 37weeks or pregnancies of > 42weeks gestation and patients who had manual removal of placentae.

All eligible pregnant women (including those with pregnancy induced hypertension (PIH), getational diabetes mellitus (GDM), Rh negative pregnancy, anaemia or oligohydramnios) were informed about the study using a proforma (English/ Hindi) and were appropriately counselled. Patients who could not understand English or Hindi had their questionnaires interpreted to them via trained interpreters in the local language they could understand. All eligible women who gave informed written consent were included for this study.

Ethical clearance was obtained from the Institutional Ethics Committee. Permission as well as cooperation was obtained from the nursing staff as well as the residents on duty in the labour room as well as in the Operation Theatre of the hospital. Immediately after delivery, the umbilical cord was clamped about 5cm from its attachment to the abdomen of the neonate and the neonate was handed over to the paediatric resident who did the Apgar scoring at 1 and 5 min.

The placentas were collected and washed under running tap water to wash off adherent blood clots from the maternal surface of the placenta. The placentas were trimmed off all membranes and the umbilical cord was severed at the insertion site on the placental surface. The placentas were then accurately weighed. The placental weights (PW) were taken three times on a calibrated digital weighing machine to the nearest gram and then the average of these was noted. The weighing was done as early as possible within half hour after delivery. After removal from the placenta, the length of the umbilical cord was measured using a measuring tape. The length of the cut end attached to the foetus was also added to the umbilical cord length detached from the placenta.

Macroscopic examination of the placenta and umbilical cord were done soon after delivery. Apart from the gross analysis, presence or absence of placental calcification, infarctions and retro placental clots were noted. In the case of umbilical cord, besides length of cord up to its insertion on the foetal surface of placenta, number of umbilical vessels and other abnormalities like true or false knots were noted.

Umbilical cords (UC) were put under four categories on the basis of their insertion with the placenta namely central, paracentral, battledore and velamentous insertion. Central insertion was defined as UC insertion near the centre of the placenta (i.e., less than 3 cm from the centre). Paracentral UC was defined as insertion of the UC more than 3 cm from the centre and also more than 2 cm from the nearest margin. Battledore UC insertion was defined within 2 cm of the placenta's edge. Velamentous insertion was defined as UC insertion directly into the membranes[2].

Infant Anthropometry: A proforma containing details of the neonate such as gestational age at birth (in

weeks), gender and anthropometry (weight, length and head circumference) was filled. The following parameters of the placentas were noted with the corresponding neonates like weight, type of cord insertion, length of UC. All measurements were done within 24 hours after delivery by standard techniques.

Birth weight of naked neonate in the supine position was obtained soon after birth by digital scale with 10 gm subdivision. Body length was measured with a non-elastic standard tape to the nearest centimetre when the infant lies in a quiet position. A total of three consecutive measurements were taken for each variable and then the mean of these values were recorded. The placental and cord abnormalities were analysed and correlated with neonatal clinical correlations.

PW/BW ratio was calculated and multiplied by 100. The neonates were divided into three groups (low, normal, high) PW/BW ratios. The data so collected was analysed and different tests of significance in statistics were applied to know the variation of PW/BW ratio in different maternal medical conditions and also its significance. Cut off values of low PW/BW ratio, normal PW/BW ratio and high PW/BW ratio were empirically taken on percentile basis. PW/BW ratio below the tenth percentile were categorised as low PW/BW ratio group, those with a PW/BW ratio above the 90th percentile were labelled as high PW/BW ratio group. The rest of the placentas between 10^{th} and 90^{th} centiles were labelled as normal PW/BW ratio group.

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc, Chicago, IL, IBM version) along with Microsoft Excel (2010 version). Pearson's correlations was done using SPSS and Tests of Significant difference was done using Microsoft Excel. Statistical significance was defined as $p< 0.05$.

Results

Demographic variables, neonatal and maternal features of the present study are shown inTable1. The birth weight and placental weight at different gestational ages were compared and also the placental weight/birth weight (PW/BW) ratio was compared to gestational age. Both the birth weights and placental weights increased with increasing gestational age but the correlation was not significant. PW/BW ratio also increased with increasing gestational age. However, there was again no significant correlation statistically (Table 2).

There were 333 NICU admissions in the high PW/BW ratio group, 25 admissions in normal PW/BW ratio group and 16 admissions in low PW/BW ratio group (Table 3). Out of these NICU admissions, all the 100 admissions of high PW/BW had Apgar score <7. None of the babies admitted in NICU of normal or low PW/BW ratio were due to Apgar score <7.

Correlations of PW/BW ratios with various maternal conditions were studied. High PW/BW ratio was found in cases with maternal hypertension and foetal IUGR and this was found to be significant statistically (Table 4). However no correlation was found of PW/BW ratios with maternal diabetes mellitus, Rh negative pregnancy, anaemia or oligohydramnios. There was a statistically significant relationship of gross anomalies of placentas with foetal outcome in Table 5 (Chi square = 20.49, p= 0.0023).

Statistically significant correlation was also found between the cord length and the length of the baby at birth as in Table 6 (r=0.880, p<0.002). Table 7 shows the complications associated with each of the three categories of the umbilical cord length. All cord complications were associated with long cords as compared to cords with normal length and the difference was statistically significant (p<0.001). Nuchal coiling of umbilical cord was seen in 20.4 % (204 cases).There was one case with cord length 102 cm where baby had four nuchal coiling and was severely asphyxiated at birth.

There were two arteries and one vein in 997 umbilical cords examined. However three umbilical cords had single umbilical artery. Out of these babies, one of them had a hypolplastic left heart syndrome and the second one had single kidney. The third case of umbilical cord with single umbilical artery was a normal baby.

Birth asphyxia was more commonly seen with long and short cords as compared to cords of normal length (Table 8). There was also a positive correlation between umbilical cord length and the length of the baby (r = 0.880, p=0.002) as in Table 9.

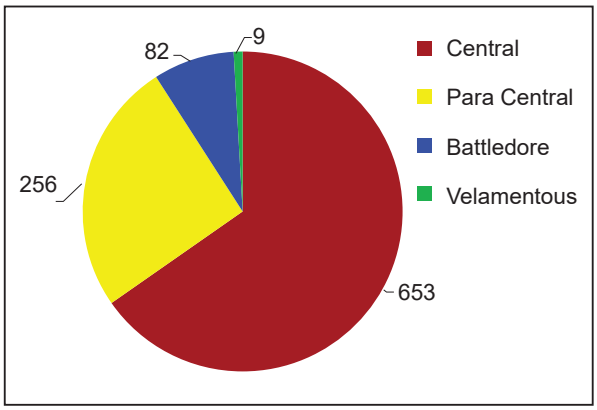

Fig 1: Types of placenta

Table 1: Characteristics of Mothers and Foetal Outcome

Characteristics	Number	Percentage
Booked/unbooked pregnancy		
Booked	898	89.8
Unbooked	102	10.2
Parity		
>2	388	38.8
2	456	45.6
>2	156	15.6
Age group		
18-24	350	35.0
25-29	488	48.8
0-34	104	10.4
>35	58	5.8
Gestational age		
37	98	9.8
38	124	12.4
39	368	36.8
40	186	18.6
41	118	11.8
42	106	10.6
Mode of Delivery		
Vaginal	692	69.2
LSCS	308	30.8
Foetal Outcome		
Alive	864	86.4
Asphyxiated	131	13.1
Dead	10	1.0

Table 2: Neonatal birth weight (grams), placental weight (grams) and placental-birth weight ratio in relation to gestational age at birth

Gestational age (weeks)	N(%)	Birth weight Mean(SD)	Placental Weight Mean(SD)	Placental Weight Birth weight Ratio Mean(SD)
37	98 (9.8)	2834 (472)	436 (82)	15.4 (3.1)
38	124 (12.4)	3182 (272)	522 (80)	16.4 (3.1)
39	368 (36.8)	3192 (452)	561 (81)	17.6 (2.4)
40	186 (18.6)	3386 (434)	635 (74)	18.7 (2.2)
41	118 (11.8)	3472 (428)	690 (73)	19.8 (2.2)
42	106 (10.6)	3496(520)	72056	20.5 (2.1)

Table 3: Comparison of NICU admissions and APGAR scores of high, normal and low Placental Weight – Birth Weight ratio groups

Parameter	PW/BW ratios				
	High (%) (n=333)	Normal (%) (n=333)	OR	95% CI	p-Value
NICU admission	100 (30)	25 (7.5)	4.98	1.48-19.88	<0.01
APGAR score<7	100 (30)	0	-	-	<0.0001
	Low (%) (n=333)	Normal (%) (n=333)			
NICU admission	16 (4.8)	25 (7.5)	0.64	0.12 – 4.14	>0.05
APGAR score<7	0	0	-	-	

Table 4: Correlation of PW/BW ratios with medical conditions of mother and baby

Medical disorder	PW/BW ratio			Chi-square	p Value
	Low	Normal	High		
Anemia	0	4	14	3.60	>0.05
DM	4	13	11	1.12	>0.05
Rh negative	4	5	4	0.11	>0.05
Oligohydraminos	14	6	23	2.96	>0.05
IUGR	2	2	56	25.24	<0.0001
HTN	6	32	110	28.92	<0.0001

Table 5: Foetal outcome in various gross anomalies of placenta

Foetal Outcome	Normal (N/%)	Infarction (N/%)	Calcification (N/%)	Retro-placental Hematoma (N/%)
Total	506 (50.6)	254 (25.4)	208 (20.8)	32 (3.2)
Normal	463 (46.3)	192 (19.2)	172 (17.2)	32 (3.2)
Asphyxia only	43 (4.3)	54 (5.4)	34 (3.4)	0
Death	0	8 (0.8)	2(0.2)	0

Table 6: Distribution of cases in groups according to length of umbilical cord

Length of Cord	No. of cases	Percentage (%)	Mean umbilical cord length in cm
Short	61	6.1	37.06 ± 6.34
Normal	890	89.0	63.44 ± 11.93
Long	49	4.9	100.86 ± 6.51
Total	**1000**	**100**	

Table 7: Correlation of umbilical cord length with cord complications

Umbilical cord length		Cord complication					
		No. of cases N (%)	Nuchal cords (n = 204) (%)	True knot (n = 15) (%)	Cord prolapse (n = 8) (%)	Cord hematoma (n = 1) (%)	Total (n = 228)
Short cord	<35 cm	61(6.1)	1 (1.6)	0	0	0	1
Normal	35-80 cm	890(89)	166 (18.6)	10 (1.1)	5 (0.56)	1 (0.1)	182
Long* cord	>80 cm	49(4.9)	37 (75.5)	5 (10.2)	3 (6.1)	0	35

Cord complications increases with increase in cord length * p<0.001

Table 8: Correlation of umbilical cord length and changes in foetal heart rate (FHR)

Length of Cord	No. of cases	Percentage (%)	Mean umbilical cord length in cm	Foetal Heart Rate FHR)			p-value
				Tachycardia	Normal	Bradycardia	<0.001
Long	49	4.9	102.84 ± 5.54	10 (20.4 %)	14 (28.6 %)	25 (51.02 %)	
Normal	890	89	65.52 ± 10.84	17 (1.9 %)	743 (83.48 %)	130 (14.6 %)	
Short	61	6.1	35.04 ± 5.24	16 (26.2 %)	28 (45.9 %)	17 (27.9 %)	P<0.001

Table 9: Correlation between Umbilical Cord Length and length of neonate

		Umbilical Cord Length	Length of neonate(cm)
	Pearson Correlation	1	0.880*
	Sig. (2 tailed)		0.002
	N	1000	1000
Length (cm)	Pearson correlation	0.880*	1
	Sig. (2 tailed)	0.002	
	N	1000	1000

Discussion

Placenta plays a vital role in normal foetal development. Variations in placental or umbilical morphometry leads to neonatal morbidity and mortality.

In the present study, mean placental weight was 580gm whereas other studies[3] have shown lower average placental weight of 508g. This could possibly be due to a difference in the socioeconomic status, quality of antenatal care, nutritional and racial differences. Many studies showed a great influence of gestational age on birth weight and placental weight of new borns[4,5]. Kinare et al. also stated that the capacity of foetal weight growth was determined by placental growth[5]. In another study, Molteni found that the mean placental weight was related to gestational age also[4]. Our study also showed a positive correlation between birth weight and placental weight with gestational weight (Table 2). However this correlation was not statistically significant.

The PW/BW ratio was found to show most significant correlation with maternal diseases like hypertension and IUGR[6]. In a study by Shehata et al also, it was found that in maternal conditions as mentioned above, high PW/BW ratio itself was found to correlate with adverse neonatal outcomes. They found better neonatal outcomes with low PW/BW ratio[7]. In the present study also, similar findings were seen (Table 4). Therefore, evaluation of placental growth during pregnancy can predict risks to new-borns at birth and hence appropriate interventions can be done accordingly. Immediate perinatal outcomes of full-term neonates were closely related with the variations in PW/BW ratio. Also those cases with high PW/BW ratio had more number of admissions to NICU and also birth asphyxia. On the contrary, low PW/BW showed lesser NICU admission rates[8,9].

Calcifications, infarctions and retroplacental haematomas showed an increased incidence with increasing gestational age. These were also more in cases with Pregnancy Induced Hypertension (PIH) and eclampsia as in other studies[10,11]. These studies also showed adverse perinatal outcomes in neonates like asphyxia and neonatal deaths with gross placental malformations as shown in the present study.

The umbilical cord is the main link from the foetus to the placenta. More information regarding the neonate is obtained from the placenta and umbilical cord than even by a detailed antenatal history of the mother. There are various types of umbilical cord abnormalities. There is a wide variation in the umbilical cord length varying from no cord (achordia) to very long cords even up to 300 cm[12]. About 5% of cords are shorter than 45 cm, and another 5% are longer than 95 cm. Umbilical cord on an average measures about 55 cm[13]. In the present study, the umbilical cord length varied from 26 to 122 cm. The mean length of umbilical cord was 64.12 cm (±14.98 cm). This is similar to values obtained in previous studies[14]. Out of 1000 umbilical cords studied, 6.1% (61) were short, 89% (890) were of normal length and 4.9% (49) were long cord. The reasons for differences in cord length are unknown[15]. The abnormalities can range from vasa praevia (foetal blood vessels traverse the lower uterine segment in advance of the presenting part) to false knots[16]. Vas praevia often leads to foetal death while false knots have no clinical significance at all.

With the availability of antenatal ultrasonography, many of these placental and cord anomalies may be detected ante-natally[17]. Thus, associated morbidity and mortality of neonates can be prevented. Single umbilical artery is commonly associated with congenital anomalies even up to 20%. [18] These includes renal, gastrointestinal, cardiovascular and various multiple congenital anomaly syndromes[19,20]. Thus, various studies have found that umbilical cord is a very reliable indicator of foetal movement and foetal well being[21].

Conclusion

The present study stresses upon the importance of a detailed examination of the usually uncared and discarded placenta and cord as soon as the baby is born. Early prenatal diagnosis of placenta and umbilical cord may be of help in anticipating perinatal adverse outcomes. Besides ultrasonography, other newer equipment and strategies should also be developed to diagnose placental and cord abnormalities antenatally, so as to decrease the incidence of the perinatal morbidity and mortality in the future and help in the delivery of a healthy baby.

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