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Original research article

The study of morphology of placenta with umbilical cord

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Abstract

Introduction: The human placenta is Chorio-allantoic and Haemochorial in nature. It is a flattened discoid mass of 500ml volume, 500gms weight, with an average diameter of 185mm, average thickness of 23mm in the centre diminishing towards periphery. It is usually circular or oval in shape [1]. The umbilical cord is attached centrally or eccentrically. Three umbilical vessels (2 umbilical arteries and 1 umblical vein) are normally present in each umbilical cord, distributed in placenta through two regular patterns-disperse and magisterial types. The Hyrtl's anastomosis is a connection between the two umbilical arteries in most human placentas.

Material and Methods: Total 110 fresh full term post-partum placentas were collected after normal delivery and caesarian section irrespective of age, gravida and complications during pregnancy. These fresh placentas were thoroughly washed under tap water and immediately dropped into 10% formalin and was kept properly for fixation. The placentas were then removed after fixation and noted for its shape, place of insertion of umbilical cord to the placenta, number of vessels in the umbilical cord, distribution of vessels in the placenta and presence of hyrtl's anastomosis between umbilical arteries before distribution in the placenta.

Results: The shapes of the placenta were found to be circular (55.45%), oval (18.18%), irregular (10.9%), triangular (7.27%), Discoid (4.54%), bilobed (2.72%), succenturiate (0.9%), the various types of insertion of cord to the placenta includes Eccentric (50%), Marginal (30.91%), Central (16.36%), Battledore or velamentous (1.82%). In 0.91% it is inserted into the membranes. In 99.09% placentas 3 umblical vessels are present but in 0.91% there is only one umblical artery and one umblical vein. Hyrtl's anastomosis between umblical arteries is present in 94.54% cases and completely absent in 1.82% cases. Anastomosis between the branches of arteries is seen in 1.82% cases, Hyrtl's anastomosis is seen between the artery and one of its branches in 0.91%cases. And in 0.91% cases this is not applicable as there is only one artery. The vascular pattern of distribution includes Disperse (30.91%), Magisterial (31.82%), Mixed (37.27%).

Conclusion: The most common shape of placenta is circular followed by oval. The umblical cord is inserted eccentrically into the placenta in half of the cases, followed by marginal as second most common type of insertion. Normally two umblical arteries and one umblical vein is seen remnant in the umblical cord by term gestation. Two umblical arteries branch separately in the placenta with a small connection is seen as communicating channel, fenestration or fusion called hyrtl's anastomosis between two arteries in 98% of cases,. The branching pattern of umblical arteries is mixed mostly followed by nearly equally disperse and magisterial types.

Keywords: Placenta Shape, Umbilical Cord Central, Eccentric, Marginal attachments, Disperse and Magistrate Branching , Hyrtl's anastomosis.

Introduction

Placenta forms an organ for the exchange of material between fetal and maternal bloodstreams without mixing or physical contact with two bloodstreams [2]. The examination of the placenta soon after the delivery is very crucial as it provides mirror images of fetal development. It forms the morphological record of anatomical condition, intrauterine events and intrapartum events of gestation. In the case of fetal death, the examination of the placenta is mandatory, and examination of the placenta yields valuable information for the management of mother and foetus. The first-hand information regarding the placenta is useful for obstetricians, which protects them from medicolegal problems in maternal and fetal events. Ultrasonographic examination of the placenta is an important part of the obstetrical evaluation of pregnancy. The antenatal evaluation of the placenta has become essential in all pregnant patients as fetal problems and neonatal outcome depend upon the placenta's growth and abnormalities.

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Material and Methods

The study was done in 110 specimens collected from Government general hospital (GMC), Mancherial Telangana in collaboration with Department of Obstetrics and Gynaecology in the year 2022 to 2023. The specimens were collected immediately after normal deliveries or caessarian sections from all full term subjects irrespective of age, gravida and type of delivery. These placentas were immediately transferred to 10% Formalin solution with added 2.5% glycerol, Thymol and phenol crystals to prevent fungation and for proper fixation with appropriate measures. Then these fixed placentas are removed, washed thoroughly, the scrapings of the remnant membranes are removed after careful observation of each placenta and examined for five parameters which include their shape [1] and type of cord insertion [2]. The umblical cord and placenta were dissected to examine the number of vessels present inside the cord [3], the presence of hyrtl's anastomosis between the umblical arteries [4] and the pattern of distribution of blood vessels in to the placenta [5]. Photographs of all the different types, patterns and variations are taken.

Results and Discussion

1. Shape of Placenta

The present study on placental shapes is more informative as it shows various new different shapes including bilobed, irregular and succenturiate in addition to circular, oval and triangular, as abnormal shapes of placenta may cause utero-placental or feto-placental vascular pathologies.

Table 1: Result of Various shapes of the placenta in comparison with previous studies

S. No.	Shape of placenta	No. of cases	Percentage	Sarojamma *et al*. (1986) [3]	Gunapriya *et al*. (2001) [4]	Muthuprasad *et al*. (2018) [5]
1	Circular	61	55.45%	57%	93%	63%
2	Oval	20	18.18%	36%	7%	34.25%
3	Irregular	12	10.90%	-	-	-
4	Triangular	8	7.27%	7%	-	2.75%
5	Discoid	4	4.55%	-	-	-
6	Bilobed	3	2.72%	-	-	-
7	Succenturiate	1	0.90%	-	-	-
	Total	110	100%	100%	100%	100%

Succenturiate lobe is one or, more small accessory placental lobe, size of a cotyledon which develops in the membranes at a distant from the periphery of the main placental disc usually having vascular connections of fetal origin which runs through the membranes connecting main placenta to the succenturiate lobe. Its overall incidence is approximately 3 per 1000 pregnancies. Most of the succenturiate lobe have vasa praevia. Succenturiate lobes of placenta are associated with retained placenta and hence postpartum infection and hemorrhage. Snigdha kumara *et al*. [6] reported a case of pregnancy with an incidental finding of succenturiate lobe of placenta in a 35-year pregnant woman.

Bilobed placenta is a placental morphological variation with an estimated incidence of 4% of all pregnancies. It is associated with an increased risk of cord insertion anomalies and vasa previa [7]. Reddy *et al*. [8]. Conducted a cross-sectional study in 975 cases (all pregnancies of > 32 weeks of gestation, between April 2012-June 2013) to evaluate the prevalence and pattern of placental and umbilical cord abnormalities. A total of 262 different abnormalities (26.87%) occurred, and 82 (8.41%) were placental; in particular, 11 cases of bilobed placenta were identified (3.76% among total abnormalities) and only in one case did the cord have a velamentous insertion.

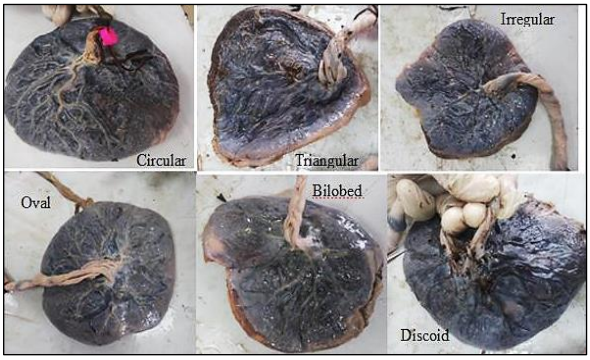

Fig 1: Various shapes of placenta

2. Attachment of umblical cord:

- **Central:** Normally the umbilical cord attaches to the center of the placenta.
- **Eccentric:** It refers to the lateral insertion of the umbilical cord at a distance more than 2cm away from the placental margin.
- **Marginal:** The cord is said to be attached marginally when it is at a distance of less than 2 cm from

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the placental margin.

- **Velamentous:** It refers to insertion of the umbilical cord into the chorion laevea at a point away from the placental edge, and the vessels pass to the placenta across the surface of the membranes between the amnion and the chorion.
- **Furcate:** This type of umbilical cord insertion refers to the separation of umbilical cord vessels prior to their attachment into the placenta.

There are several potential risks associated with marginal cord insertion like anaemia. It can impact fetal development, can restrict or reduce the blood flow and circulation to the fetus during pregnancy leading to intrauterine growth restriction (IUGR) and other developmental abnormalities in the fetus. It may increase the chances of spontaneous abortion in the 1st or 2nd trimester, in premature birth and excessive bleeding during vaginal childbirth.

Vasa previa (a rare and potentially dangerous condition) is a complication that is most likely related to velamentous cord insertion, but marginal cord insertion can also make vasa previa more likely. The velamentous vessels can easily rupture during labour, leading to significant bleeding and other complications [11].

Table 2: Results and comparison of various types of insertion of cord to the placenta

S. No.	Type of insertion	Present study	Sarojamma *et al.* (1986) [3]	Shanklin *et al.* [9]	Gunapriya *et al.* (2001) [4]	Eastman-Hellman *et al.* [10]	Muthuprasad *et al.* (2018) [5]
1	Eccentric	50%	53%	89	86	73	60
2	Marginal	30.91%	2	1.9	9	14	12
3	Central	16.36%	40	11	5	18	25.3
4	Battledore	1.82%	4	0.77	-	1.25	2.7
5	Into membranes	0.91%	-	-	-	-	-

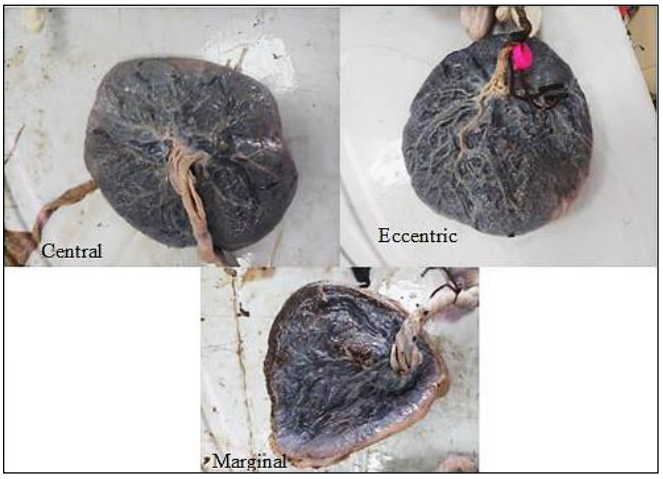

Fig 2: Showing central, eccentric and marginal insertions of placenta

The present study shows that cord insertion can also be seen into the membranes instead of placenta.

3. Number of blood vessels in the cord

Number of umblical arteries is important as it allows the umbilical arteries to carry deoxygenated and nutrient-depleted fetal blood from the fetus to the villous core fetal vessels and by measuring the amount of forward blood flow through the umbilical artery during both fetal systole and diastole, an overall measure of fetal health can be obtained.

Single umblical artery (SUA) is associated strongly with gastrointestinal atresia or stenosis, suggesting common developmental mechanisms. The increased risk of recurrence of single umblical artery suggests that genetic and/or persisting environmental factors influence the risk. We found that SUA had equally strong associations with trisomies 13 and 18. SUA was associated with an increased risk of congenital heart defects up to 7-8 times. There was an association with microcephaly, congenital hydrocephalus and other congenital malformations of the brain and spinal cord. Diaphragmatic hernia, limb reductions and cleft lip or palate had a weaker association with SUA.

Table 3: Showing no. of vessels in placenta

S. No.	Type of insertion	No. of cases	Percentage
1	3 vessels	109	99.09%
2	2 vessels	1	0.91%

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Fig 3: Showing single umbilical artery

In the present study, one case has been reported with the presence of single umblical artery out of 110 cases (0.91%). M. Mukherji *et al*. (1969) [12] has observed single umblical artery in 4.8% cases in his study: single umbilical artery reported by Benirscheke and Bourne *et al*. (1960) [13] is 0.1 per cent; little *et al*. is (1961) [14] as 4.7 per cent; Wentworth *et al*. (1965) [15] is 0.8 per cent.

4. Braching patterns of vessels seen in placenta

Vascular pattern of placental blood vessel is described as three types disperse (dichotomous), magisterial (monopoidal) and mixed. The umbilical vessels undergo successive divisions and rapidly diminished in calibre which can be seen in the disperse pattern where as in magisterial pattern umbilical vessels gives side branches and calibre of the vessel is almost equal up to the periphery. In mixed pattern the umbilical vessels show a combination of both in which the umbilical vessel shows successive divisions along with side branches.

Table 4: Showing various patterns of branching in placenta

S. No.	Branching pattern	No. of cases	Percentage
1.	Disperse	34	30.91%
2.	Magistral	35	31.82%
3.	Mixed	41	37.27%

Fig 4: Disperse and magisterial types of vascular branchin

Table 5: Comparison of various branching patterns of vessels

S. No	Study	Disperse	Magisterial	Mixed
1.	Kishore16(1967)	61.8%	38.2%	-
2.	Sudha17(2009)	40%	14%	44%
3.	Dinesh18(2021)	64%	14%	22%
4.	Priyanka19(2021)	9.3%	44%	46%
5.	Present study(2023)	34%	31.82%	37.2%

Hyrtl's anastomosis

Hyrtl's anastomosis, an intra-arterial shunt, is present in approximately 96% of umbilical cords between the umbilical arteries, is usually 1.5 to 2 cm long and positioned within 3 cm of the placental cord insertion. The presence of Hyrtl's anastomosis plays a protective role when the placental territories supplied by the umbilical arteries are different in size. It equalizes pressures between the 2 umbilical arteries before entering the placenta and functions as a safety valve in the event of placental compression or umbilical artery (UA) blockage [1]. The anastomosis was represented by a *vessel, a fenestration or coalescence* of the umbilical arteries [2].

Table 6: Showing the presence of Hyrtl's anastomosis

Sl. No.	Hyrtl's anastomosis	Present study (2024)	Ulla Ullberg *et al.*	Seema valsalan E

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		No. of cases	Percent age	(2001) Angiography	*et al*. (2018)
1.	Present between main arteries	104	94.54%	47.76%	60.36%
2.	Artery to branch anastomosis	1	0.91%	40.30%	36.93%
3.	Branch to branch anastomosis	2	1.82%	1.49%	
4.	Double anastomosis	0	0	1.49%	0.9%
5.	Not applicable (one artery only)	1	0.91%	2.98%	0
6.	Completely Absent	1	0.91%	5.97%	1.8%
7.	Total	110	100%	100%	100%

Earlier studies have suggested that the abnormalities in Hyrtl's anastomosis may be associated with the development of PIH and other adverse pregnancy outcomes.

Ulla ullberg *et al*. [20] studied about hyrtl's anastomosis in 67cases by using Doppler angiography and reported that he found single hyrtl's anastomosis in 60 cases, double in 1 case and absent in 4 cases. He reported only one umblical artery in single case.

Seema valsalan *et al*. [21] has reported in a placental specimen study done in 111cases that hyrtl's anastomosis, which include transverse, oblique, fenestration and fusion types, was seen in 109 cases and absent in 2 cases. Out of 109 cases, 1 case showed double anastomosis, anastomosis is seen between arteries in 67cases and between artery and branches or between branches in 41 cases.

In the present study in 110 cases, 104 showed hyrtl's anastomosis between main arteries and absent in one case. One case showed only one artery. In the remaining 3 cases branches are involved in anastomosis. The present study did not show any double anastomosis.

Fig 5: Hyrtl's anastomosis

Fig 6: Fusion of umbilical arteries before branching

Fig 7: Anastomosis between branches of umbilical artery

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