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Original Article

Effect of birth order on placental morphology and its ratio to birth weight.

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ABSTRACT

Placenta is an important organ of pregnancy and is solely responsible for intrauterine welfare of fetus. It is being studied since times immemorial and presents a wide range of variations and its variability is associated with many factors such as maternal height, weight, nutrition during pregnancy, socio-economic status, gestational age, parity (birth order), environment, blood pressure, diabetes, anemia, birth weight, infant gender etc. Although normal standards have been established it should be known that parity being an important physiological change in women's life does affect placental morphology and very less studies have been done on placenta with regards to parity. Thus, the objective of the present study is to know the effect of birth order on placenta and establish certain norms on placental morphometric in primi's and Multi's keeping other factors constant and co-relate same with fetal birth weight. Placental morphometric most commonly studied are diameter, radius, surface area, circumference, central thickness, weight and volume. In the present study also, all the mentioned parameters have been noted except for volume and in addition shape was considered. Study was done on 100 placenta (50- primi and 50- multi) and results show all mentioned placental parameters are higher in Multiparous women except for central thickness but within normal standards. Birth weight and its ratio to placental weight is also higher in multiparous women, thus to conclude parity increases placental parameters favoring better fetal growth and improved fetal weight and this could be attributed to either sensitization of mother to paternal antigens or a more favorable condition of uterus due to vascular remodeling through previous pregnancies.

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1. Introduction

Placenta enjoys much attention as an organ of union between mother and fetus in utero and is the only source of life for fetus during that period. As the fetus grows, owing to the needs of fetus many changes happen in placental morphometric and function. Thus, placenta provides a near accurate record of intrauterine journey of fetus. Every placenta before discarding should be examined, investigations of placenta especially Human's is pressing needs of developmental biology in general and Human Embryology in particular.

At term the expelled placenta is flattened discoidal mass with an average volume of 500ml, weight 470gms, thickness 23mm, diameter 185mm and surface area 30,000sqmts. It presents two surfaces, maternal showing cotyledons and fetal presenting the umbilical cord attachment [1]. It weighs about 1/6th of fetal weight (1:6) and this ratio is fairly constant [2]. It develops from chorion frondosum (fetal part) and decidua basalis (maternal Part), thus it is a materno-fetal organ^[1].

2. Materials and Methods

Present study was conducted in the Department of Anatomy, M.R. Medical College, Gulbarga (North Karnataka, South India) for the duration of one year from Feb-2010 to Jan-2011. Total of 100 placenta (50- primi and 50- multi) were collected from labor room and OT of Sangameshwara Hospital attached to M. R Medical college. Placenta collected were washed and preserved in 10%

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formalin solution and carried in plastic covers containing 10% formalin to the study area. Mothers and their Neonates for the study were identified by Mother's name and IP number (written on plastic covers) and later on clinical data was collected. Maternal factors noted were IP number, name, age, socio-economic status, education, religion, place, height, weight, blood pressure, diabetes, hemoglobin, obstetric score, gestational age and mode of delivery. Study included maternal age group from 18- 35years with average height, weight and gestational age ranging from 37 to 42weeks. Study excluded hypertensive, diabetic, anemic, twin, preterm and other abnormal pregnancies. Fetal factors recorded were birth weight, gender and Apgar score at 1 and 5 minutes. Placentas were washed once again thoroughly at the study area and blot dried. Condition of membranes and cord were examined. In all cases, membranes were trimmed and cord cut to 2cms length from site of insertion. Maternal imprint was taken on graph sheet. Maximum diameter noted, radius obtained, surface area and circumference calculated using the formula. Central thickness was noted using teasing needle and placental weight measured using weighing machine. Cord attachment and cotyledons were also noted. Placental weight and fetal weight ratio also noted.

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean \pm SD and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student's 't' test & Fisher Exact test has been used to find significance of the study parameters between two groups. Significance is noted on 'P' value associated with 't' test. (P value: 0.05<P<0.10-Suggestive significance [+], P value: 0.01<P<0.05-Moderately significant [*] and P value: P<0.01- Strongly significant [**]).

3. Results

All maternal parameters recorded were statistically similar in both study groups except for Age (primi belonged to lower age group than multi), Hindus were more in the study, BMI was significantly high in multi and incidence of LSCS when compared to normal delivery was more in primi than multi. Placental

parameters recorded showed: % of circular placenta is slightly higher in multi (94%) than primi (90%), however statistically not significant (graph 1). Other parameter such as diameter, radius, surface area and circumference are higher in multi (18.86cms, 9.43cms, 283.97sqcms and 59.22cms) than primi (18.09cms, 9.04cms, 261.33sqcms and 56.79cms), Statistically [+] (graph 2a, 2b, 2c & 2d respectively). Central Thickness is almost similar in both groups. Average placental weight (graph 3) is more in multi (511.00gms) than primi (447.30gms), statistically [**]. Average number of cotyledons (graph 4) are more in multi (15.24) than primi (12.60), statistically [**]. Cord attachment (graph 5): Central cord attachment is more in multi (68%) than primi (40%) statistically [**], Peripheral cord attachment more in primi (30%) than multi (8%) statistically [**], Paracentral cord attachment is more in primi (30%) than multi (24%), statistically not significant. Average Birth weight (graph 6) is more in multi (2.95kgs) than primi (2.48kgs), statistically [**] and Average Placental weight: Birth weight is more in multi (1: 5.82) than primi (1: 5.60). Table 1 depicts the comparison of various placental variables mentioned in both study groups of present work with percentage distribution, mean \pm SD and P- value.

At term the expelled placenta is flattened discoidal mass with an average volume of 500ml, weight 470gms, thickness 23mm, diameter 185mm and surface area 30,000sqmts. It presents two surfaces, maternal showing cotyledons and fetal presenting the umbilical cord attachment [1]. It weighs about 1/6th of fetal weight (1:6) and this ratio is fairly constant [2]. It develops from chorion frondosum (fetal part) and decidua basalis (maternal Part), thus it is a materno-fetal organ^[1].

Table: 1:Percentage distribution, Mean+/- SD and P- value of Placental variables in primi and multi.

Variables	Percentage distribution		Mean +/- SD		P- value
	Primi (50)	Multi (50)	Primi (50)	Multi (50)	
Shape-circular oval	45 (90%) 05 (10%)	47 (94%) 03 (06%)	- -	- -	0.461
Diameter- <15 (cms) 15-20 >20	04 (08%) 39 (78%) 07 (14%)	02 (04%) 36 (72%) 12 (24%)	18.09+/-2.06	18.86+/-1.87	0.053+
Radius -<10 (cms) >10	43 (86%) 07 (14%)	38 (76%) 12 (24%)	09.04+/-1.03	09.43+/-0.93	0.053+
Surface Area (cms ²) 100- 200 200- 300 300- 400 >400	07 (14%) 33 (66%) 09 (18%) 01 (02%)	02 (04%) 31 (62%) 16 (32%) 01 (02%)	261.33+/- 62.02	283.97+/-58.65	0.064+
Circumference (cms) 40- 50 51- 60 61- 70 >70	07 (14%) 28 (56%) 14 (28%) 00 (00%)	02 (04%) 30 (60%) 17 (34%) 01 (02%)	56.79+/- 6.49	59.22+/- 5.87	0.053+
Central thickness (cms) 1.0- 2.0 2.0- 3.0 >3.0	20 (40%) 30 (60%) 00 (00%)	12 (24%) 36 (72%) 02 (04%)	2.21+/- 0.31	2.21+/- 0.33	0.951
Placental weight (gms) 300- 400 400- 500 >500	16 (32%) 22 (44%) 12 (24%)	03 (06%) 24 (48%) 23 (46%)	447.30+/- 65.90	511.00+/- 69.49	<0.001**
No of cotyledons 01-10 11- 20 > 20	07 (14%) 43 (86%) 00 (00%)	08 (16%) 40 (80%) 02 (04%)	12.60+/- 2.46	15.24+/- 3.63	<0.001**
Cord insertion Central Peripheral Paracentral	20 (40%) 15 (30%) 15 (30%)	34 (68%) 04 (08%) 12 (24%)	- - -	- - -	0.005** 0.005** 0.499
Birth weight (kgs) 2.00- 2.49 2.50- 3.00 3.00- 3.50	27 (54%) 23 (46%) 00 (00%)	04 (08%) 28 (56%) 18 (36%)	2.47+/- 0.29	2.95+/- 0.36	<0.001**
Placental: fetal weight ratio <5.0 >5.0	10 (20%) 40 (80%)	08 (16%) 42 (84%)	5.60+/- 0.69	5.82+/- 0.78	0.141+

[+] suggestive significance, [*] moderately significant, [**] highly significant

Table: 2 Comparison of variables from the present study with available literatures

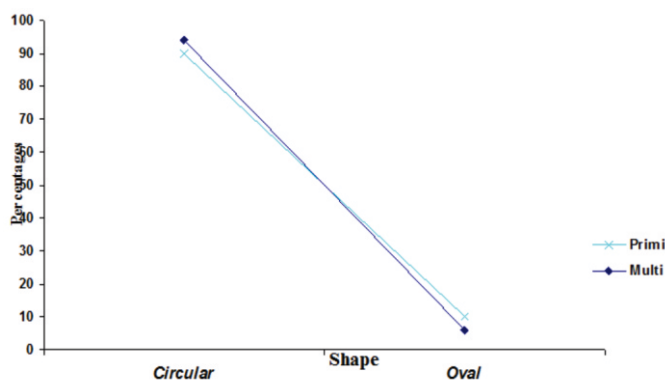
Variables	Present Study N=100		Salafia et al N=24,061		Mckneown& Record N=4931		Guna priya et al N=101	Chung et al N=340	Rath G et al N=74	ManopJantha naphan N=238
	Primi (50)	Multi (50)	Primi 9515	Multi 14546	Primi (2117)	Multi (2814)				
Shape: circular oval/ not round	45 05	47 (92) 03 (08)	9211 23,920(23,131) 304 626(930)		-		94 07	-	-	-
Diameter(cms)	18.09	18.86	19.0	19.1-19.5	-	-	-	-	-	-
Radius(cms)	09.04	09.43	-	-	-	-	-	-	-	-
Surface area(cms ²)	261.33	283.97	-	- (247.7)	-	-	-	276	-	-
Circumference(cms)	56.79	59.22	-	-	-	-	-	-	-	-
Central thickness(cms)	2.21	2.21	2.2	2.09-2.33	-	-	2.1	-	-	-
Placental weight(gms)	447.30	511.0	427.9	439.6-459.5	613.6	636.3(38wks) 636.3 677.2(40wks) 663.6 686.3(42wks)	528.55	-	-	519
No of cotyledons	12.60	15.24	-	-			18	-	-	-
Cord insertion Central: Peripheral: Paracentral:	20(40%) 34(68%) 15(30%) 04(08%) 15(30%) 12(24%)		-	-					18(24%) 36(49%) 20(27%)	-
Birth weight(kgs)	2.47	2.95	3.15	3.21-3.33	3.14	3.25(38wks) 3.37 3.49(40wks) 3.49 3.52(42wks)		-	-	-
Placental weight: fetal weight ratio	5.60	5.82	-	-				-	-	5.85(17.08%)

4. Discussion

Placenta during ancient days was known as "AFTERBIRTH" and knowledge of this Afterbirth goes far back into human history and reference is found in many age old literatures including the old Testament of Bible, where in Placenta is designated as 'EXTERNAL SOUL' being tied up in the 'Bundle Of Life' the Umbilical Cord[3]. Many folklores, traditional belief's and superstitions associated with Placenta, Umbilical Cord and Fetal Membranes have persisted even today.

Literatures available give an impression that Placenta is a highly variable organ and tremendous studies on it from 16th century to present day have been done. Present study was done in view to know difference of Placental parameters in 1st birth and next birth and compared with previous available literatures. Shape of Placenta:

Present study was done on 100 placentas and showed 92 (45 primi& 47 multi) to be circular and 8 (5 primi& 3 multi). Gunapriya et al, in their study on 101 placentas opined 94 to be circular and 7 oval, irrespective of parity [4] [Table 2]. However present study shows circular Placentas to be more in multi than primi though statistically not significant. Kloosterman explains: In circular Placenta, there is circular and regular regression of surrounding chorion leaving a rounded disc at chorionfrondosum and multiparous women provides more favourable condition for placental development and function by remodeling of maternal vasculature through previous pregnancies [5].

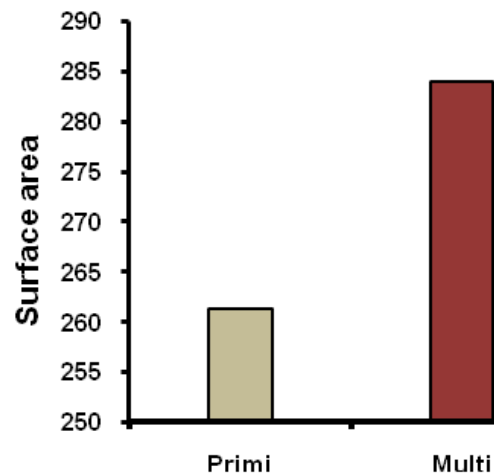
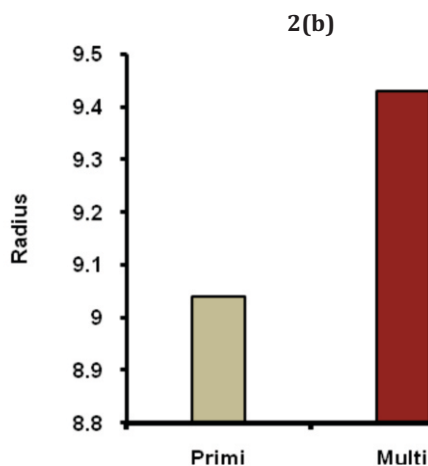
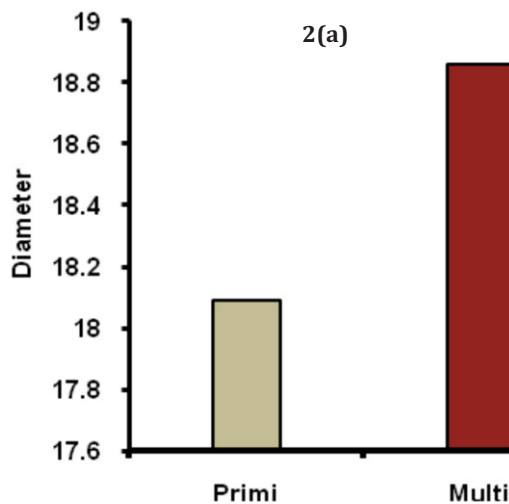
Graph 1 showing percentage of shape of placenta

Morphometric of Placenta [Table 2]:

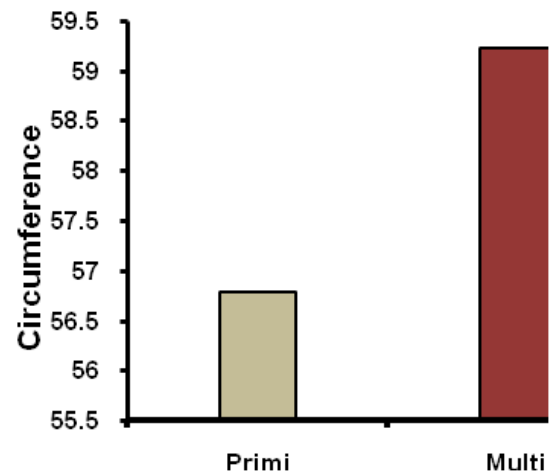
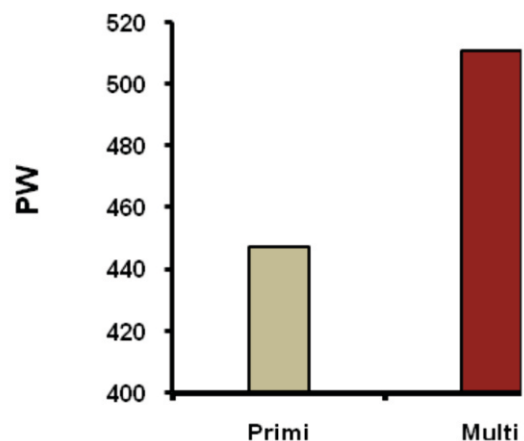
Metrics considered in the present study were maximum diameter, radius (half the diameter), surface area, circumference, central thickness and placental weight. Method of obtaining data is already mentioned in materials and methods. Percentage distribution, mean value+/- SD and p- value for significance of mentioned parameters are represented in Table-1. Salafia et al studied 24,061 placenta, 9515 belonged to primi with average diameter 19.0cms and the rest belonged to multi with different parities ranging from 19.1 to 19.5cms [6]. Radius in the study was calculated to obtain surface area and circumference. Irrespective of parities, Salafia et al mentions average surface area to be 247.7sqcms (N= 24,061)& Chung et al as 276sqcms from their study on 340 placentas [7]. From the present study we can conclude

that parameters such as diameter, radius, surface area and circumference are higher in multi than primi (graph 2a, 2b, 2c & 2d) & their p value indicates suggestive significance. All these dimensions are important because they are directly proportional to diffusion rate, providing better nutrition to embryo. Central thickness is almost same in both group and correlated with few authors, statistically not significant. One of the most contributing metric for the present study is placental weight, average PW (graph 3) in multi (511.0) is significantly higher than in primi (447.30). Salafia et al conclude average PW in primi to be 427.9gms and multi ranged from 439.6-459.5gms for different birth orders (PW in multi's is higher) [6]. Mckneown & Record observed average PW in primi to be 613.6gms and multi 636.3gms at 38 weeks, 636.3gms and 677.2gms at 40 weeks and 663.6gms and 686.3gms at 42 wks, at all gestational ages PW in multi's is higher, thus supporting the present study [8]. PW is directly proportional to BW maintaining average ratio of 1: 6, then onwards very high placenta are associated with low BW.

Graphs showing representation of Mean \pm SD of placental parametric in primi & multi



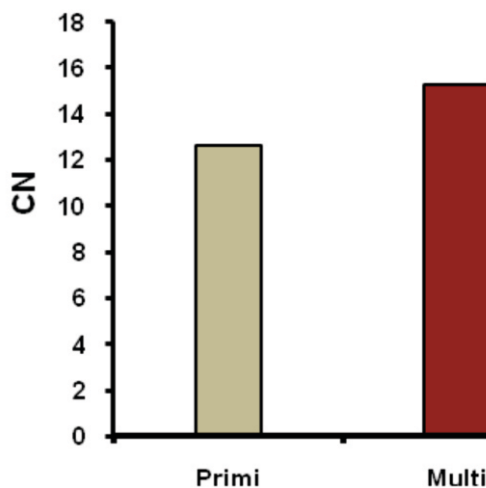
2(d)

Graph 3 showing mean \pm SD of PW

Number of cotyledons(CN):

Literatures available mention average number of cotyledons in human Placenta to be ranging from 15- 20. Present study notes average cotyledon number (graph 4) to be 12.60 in primi and 15.24 in multi showing a significant difference between both study groups. Gunapriya et al note it to be 18 [4][Table 2]. Konyali et al from their study on animal experiments (goat, doe and buck) have demonstrated that there is positive co-relation between birth weight, CN and PW, CN and PW are influenced by parity and birth type sex combination[9]. Dwyer CM et al from their study on lambs opined first parity ewes have smaller and less efficient Placenta, although CN not affected[10].

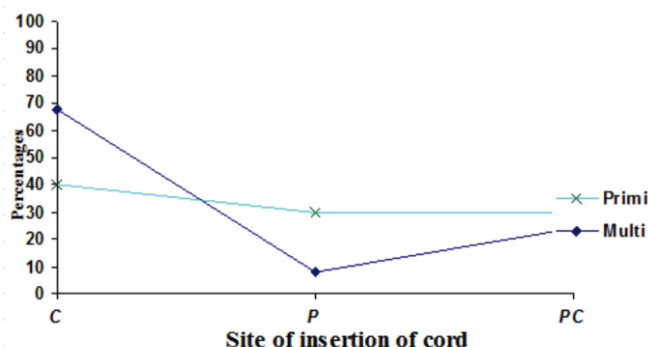
Graph 4 showing mean+/- SD of cotyledon number



Cord insertion:

Present study records of cord attachment are shown in Table 1 & graph 5, indicating central cord attachment is higher and peripheral cord attachment is least in multi. This again can be explained as better intra uterine environment due to vascular remodeling through previous pregnancies for proper placental development and function, there is a regular regression of chorionic villi leaving central cord attachment. Results of Rath G et al on cord attachment of 74 normotensives are mentioned in Table 2, he however goes further to opine on paracentral 36(49%) attachments as medial 16(22%) and lateral 20(27%)[11].

Graph 5 showing percentage of type of cord insertion

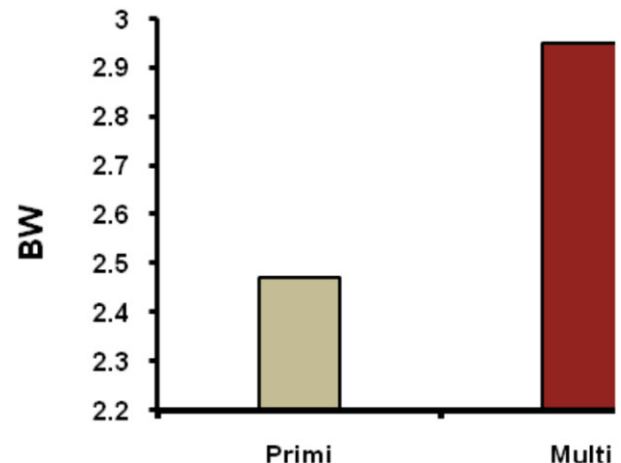


Birth weight:

Fetal factors recorded in the present study are Apgar score (statistically similar in both groups), Gender (70% female births & 30% male births in primi and 56% female births and 44% male births in multi) and Birth weight.

Birth weight was recorded to note the difference in primi and multi, results shown in Table 1, indicating that birth weight (graph 6) is significantly higher in multi than primi. Results of Salafia et al & Mckneown & Record are mentioned in Table 2 and are similar with present study (birth weight in multi is higher than primi) however average values of compared studies are more than present study may be due regional factors influencing the pregnancy.

Graph 6 showing mean+/-SD of Birth Weight



PW: BW ratio:

This ratio is fairly constant being 1:6. Results of present work shown in Table 1 and manopJanthanaphan mentions as 17.08% which is about 1:5.85[12][Table 2].

Warborton et al from their study have opined that effect of parity on BW and PW is due sensitization of mother to paternally derived antigens and there is little or no effect found when father is different in successive pregnancies[13]. However, Kloostermann tells effect of parity is due to vascular remodeling of uterus through previous pregnancies[5]. From the present work and comparison with few authors it can be said that parity increases placental parameters favouring better fetal growth.

4. Conclusion:

Placenta is the mirror image which reflects the intra-uterine status of fetus. It provides tissue record of the intra-uterine environment in the evaluation of pregnancy gone awry. Ratio of PW: BW is a common yardstick used in clinical assessment of placental function. With advent of advanced technologies such as the Gray scale ultrasound and Colour Doppler imaging, an adequate knowledge of the morphometric analysis of placenta with its clinical relevance proves to be useful in the early assessment of placental sufficiency and also the state of fetal wellbeing.

From the present study, we know that most of parameters of placenta are higher in multi providing better environment for growth of fetus. Thus, to conclude holding most maternal parameters constant, average placental parameters and dimensions tend to increase with parity, which provides better intra- uterine growth of fetus, thus birth weight increases with parity.

5. Conclusion:

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