

Morphological Characteristic of Placenta in Sudanese Subjects

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Abstract:

The placenta is the most important and the only organ between mother and fetus, serving multiple functions endocrinal, respiratory, metabolic and main useful functions. Normal development of a placenta is the one of the important requirements for a healthy pregnancy, regulating fetal growth and fetal health. The objectives of this study were to compare the placental weight with the infant's weight, to measure the placental diameter and to count the number of cotyledons in each placenta. The study was carried out among 240 infants, 102 females and 138 males, delivered at Omdurman new (Alsaudi) and Alshaikh Mohammed Ali Fadol hospitals of obstetrics and gynecology. All infants were looked healthy and their weight ranged from (1.85 - 4.18 kg) with mean of 3.02. The weight of placenta ranged between (0.35 - 0.77 kg) with mean of 0.535 kg. Placental weight in males ranged between (0.35 - 0.75 kg) with mean of 0.537 kg, while the female placental weight ranged between (0.4 - 0.77 kg) with mean of 0.531 kg. The placental diameter ranged between (15 - 23 cm) with mean 18.64 cm. The diameter in males ranged between (16 - 23 cm) with mean 18.52 cm. In female was ranged from (15 - 23 cm) with mean of 18.81 cm. The mean of cotyledons number was 19 with std. Deviation 1.362 and ranged from 16 to 22. The mean of number in males was 19.17 and ranged from (16 - 22) and in females the mean was 18.88 and ranged from (16 - 22). According to Pearson, Kendall's Taub and Spearman's correlations found that there is a significant relationship between infant weight and placental weight.

Keywords: placenta – cotyledon - placental weight - placental diameter - umbilical cord

Introduction:

Early in gestation, the developing embryo is small and its nutritional and waste disposal needs are minor. At this point, the embryo absorbs nutrients from the mother's endometrial secretions and expels its waste into the uterus. As time passes, the needs of the embryo increase. As it progresses from embryonic stage to fetal stage, more nutrients are required and a much more sophisticated means of nutritional and waste disposal satisfying needs must be established⁽¹⁾.

This is accomplished only after the embryo develops a vascular system and can establish an effective and efficient interface (ie, the placenta) between the mother's vascular system and its own. In addition to nourishing the fetus and providing means for disposing of its wastes, the placenta secretes a number of hormones, including the steroid hormones, estrogen and progesterone⁽²⁾. It also secretes protein hormones and is the source of human chorionic gonadotrophin (hCG). A luteinizing hormone (LH), hCG is secreted by the syncytiotrophoblast of the placenta in early pregnancy⁽²⁾. It maintains the function of the corpus luteum and stimulates progesterone production in the placenta. Because hCG is found in the blood and urine of pregnant women, it is the basis for most common tests used to diagnose pregnancy⁽²⁾.

The placenta secretes the hormone relaxin, as well, which is thought to relax the joints of the pelvis and assist in dilating the cervix during birth⁽³⁾.

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The placenta is the most important and the only organ between mother and fetus, serving multiple functions. It acts as an endocrine organ producing several types of hormones e.g. human placental lactogen, human chorionic gonadotrophin ⁽²⁾. It allows the exchange of oxygen and CO₂, whereby transfer of oxygen takes place from maternal blood to the fetus, and carbon dioxide goes out from fetus to mother⁽⁴⁾. It allows the transfer of carbohydrates, proteins, amino acids, polypeptides, lipids, vitamins, water, electrolytes and pharmacological agents from the mother to the fetus⁽⁴⁾.

A placenta has a maternal surface (basal plate) and a fetal surface (chorionic plate). The basal plate and chorionic plate meets at the placental margin and form the smooth fetal membranes ⁽⁵⁾. The space between chorionic and basal plate is filled with the intervillous lakes of maternal blood ⁽⁶⁾. The placenta develops from the same sperm and egg cells that form the fetus, and functions as a fetomaternal organ with two components, the fetal part (Chorion frondosum), and the maternal part (Decidua basalis)⁽⁵⁾.

Besides secreting hormones, the placenta protects the fetus from immune attack by the mother and induces increased maternal blood flow to the placenta ⁽⁶⁾. Near the time of delivery, the placenta produces hormones that mature the fetal organs in preparation for life outside of the uterus. The placenta supports essential fetal respiratory functions before lung development, carrying oxygen and nutrients from the maternal blood across the membrane into the fetal circulation by diffusion and allowing carbon dioxide to pass in the opposite direction⁽⁷⁾. The placenta provides the fetus with water, inorganic salts, carbohydrates, fats, proteins and vitamins and carries fetal waste into the mother's circulatory system to be secreted via her urinary system⁽⁸⁾. The placenta also protects the fetus by prohibiting some harmful microorganisms from entering fetal circulation. A portion of the placental membrane called the placental barrier provides this protection ⁽⁹⁾. Storage is another function of the placenta, the placenta stores carbohydrates, calcium, iron and proteins for release into fetal circulation ⁽¹⁰⁾. Two portions make up the placenta: fetal and maternal. The fetal circulation enters the placenta via the two umbilical arteries that are embedded within the umbilical cord. Once the fetal arteries enter the placenta, they branch into units called cotyledons, which are structures similar to inverted trees ⁽¹¹⁾. The tiniest branches of the fetal circulation are made up of capillary loops embedded within the chorionic villi. The fetal circulation continues to branch until it reaches capillaries of the villi ⁽¹¹⁾. Once nutrients have been absorbed and waste products released, the fetal blood collects in the umbilical vein, where it returns to the fetus. The maternal portion of the placenta receives blood by way of the spiral arteries of the uterus. When the spiral arteries make contact with the placenta, they end in open channels that pour maternal blood into the intervillous space. The intervillous blood is returned to the maternal circulation through drain-like uterine veins. As much as 35% of the maternal blood will course through the intervillous space to support the fetus until the time of delivery. ⁽⁵⁾

The fetal and maternal portions of the placenta connect via the umbilical cord. This sustaining connection between the fetus and the placenta is formed rudimentarily by the fifth week of gestation ⁽¹²⁾.

The fetal heart pumps fetal blood through the umbilical arteries into the placenta, where tiny branches are bathed in maternal blood. These vessels are drained by the tributaries of the umbilical vein, which take the blood back into the cord to the fetus for return to the heart. As a result, used blood is pumped through arteries to the mother and refreshed blood is returned to the fetal circulation by veins. After birth, this job is performed by the lungs. Shortly after birth the cord is clamped and cut and the remnant shrivels and separates from the infant's navel 1 to 3 weeks following birth. ⁽¹³⁾

Patients and Methods:

Study design: Descriptive prospective study in which samples was collected throughout the study.

Study Area: Study was carried out in Omdurman new (Alsaudi) and Alshaikh

Mohammed Ali Fadol hospitals of obstetrics and gynecology, which are located in Khartoum state, Omdurman city, which is located west to the Khartoum city the capital of Sudan.

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Study population: Included all singleton newborn infants delivered at the time of the study with their placenta in Omdurman new (Alsaudi) and Alshaikh Mohammed Ali Fadol hospitals of obstetrics gynecology. Those subjects suffering from obstetric abnormalities, i.e., abruptio placenta, intra uterine growth retardation (IUGR), twins, congestive cardiac failure, jaundice, hypertension, diabetes and pre-eclampsia were excluded from this study. It was done during the period between October and November 2010.

Sample size: A total of 240 infants (both sexes) with their umbilical cords according to the following equation formula:

$$n = n = \frac{t^2 \times p(1 - p)}{m^2} \text{ required sample size.}$$

t = confidence level at 95 % (standard value of 1.96).

p = estimated prevalence of umbilical cord measurement in target area.

m = margin of error at 5 % (standard value of 0.05).

Sample collection: Placentae were collected immediately after delivery. The weight of the newborn infants was estimated by sensitive balance. At the same time the placenta was prepared to evaluate their morphological parameters including weight, diameter, length and number of cotyledons.

Technique: Accurately the weight of the infants was measured by sensitive balance. Morphological parameters were measured as follows:

(A) Placental weight was measured by sensitive balance.

(B) Placental diameter was measured by plastic meter.

(C) Number of cotyledons was counted by inspection.

Data analysis: Data was analyzed by statistical package for social science (SPSS). Data are displayed by tables and histogram.

Results:

The study was carried out among 246 infants, 108 females and 138 males, all infants looked healthy and their weight ranged from 2 to 4.18 kg with mean 3.01 and stander deviation (Std.) 0.426, table (1) and figure (1).

Placental weight: The weight of placenta ranged between 250 to 770 gm with mean 528.05 gm and Std. 110.916. There was deference in mean weight between males and females, the former was the heavier. Placental weight in males ranged between 350 to 750 gm with mean 537.39 gm and Std. 104.730., while the female placental weight ranged between 250 to 770 gm with mean 516.11 gm and Std. 117.766, table (2) and figure (2). The maximum placental weight heavier in female than male that came from the infant weight which was heavier in that case of male infant.

Placental diameter: The placental diameter ranged between 12 to 23 cm with mean 18.48 cm and Std. 2.094. The diameter in males ranged between 16 to 23 cm with mean 18.52 cm and Std. 1.880, in female ranged between 12 to 23 cm with mean 18.43 cm and Std. Deviation 2.348, table (3) and figure (3).

Cotyledons number: The mean of cotyledons number was 18.88 with Std. 1.731 and ranged from 12 to 22. The mean of number in males was 19.17 with std. 1.278 and ranged from 16 to 22 and in females the mean was 18.50 with 2.125 std. deviation and ranged from 12 to 22, table (4).

Discussion:

This research studied the overall shape of the placenta without taking into account any diseases or ailments to the mother and the fetus developed, the study was only concerned with the external form of the placenta. Most previous studies focused on studying the changes which occur to the placenta that result from external factors, but this research was interested only in studying the overall shape of the placenta in healthy Sudanese.

Weight and sex: In this study the weight of babies at birth was 2.90 ± 0.4 , 3.09 ± 0.4 (mean \pm standard deviation) in female and male babies respectively. It was found that the male weight was greater than female weight.

Table 1: Weight vs. Sex

	Mean	Std. Deviation	Minimum	Maximum
Female	2.90 Kg	0.404	2	4
Males	3.09 Kg	0.424	2	4.18

Table 2: Weight of Placental vs. Sex

	Mean	Std. Deviation	Minimum	Maximum
female	516.11 Kg	117.766	250	770
male	537.39 Kg	104.730	350	750

Table 3: Placental diameter

	Mean	Std. Deviation	Minimum	Maximum
female	18.43	2.348	12	23
male	18.52	1.880	16	23

Table 4: Number of Cotyledons

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	Mean	Std. Deviation	Minimum	Maximum
female	18.50	2.125	12	22
male	19.17	1.278	16	22

Placental Dimensions: The weight of placenta ranged between 250 to 770 gm with mean 528.05 gm and Std.110.916. There was difference in mean weight between males and females, the former was the heavier. Placental weight in males ranged between 350 to 750 gm with mean 537.39 gm and Std. 104.730., while the female placental weight ranged between 250 to 770 gm with mean 516.11 gm and Std. 104.730, table (2) and figure (2). The maximum weight was heavier in female than male that came from the infant weight which was heavier in that case of male infant, while Jaya et al reported that the average weight of placenta of full term normal babies was 502.4 g (SD43.3) and studied the relationship between placental weight and birth weight and reported that the average weight of placenta of full term normal babies was 502.4 g (SD 43.3)⁽¹⁴⁾. The placental weight increased with the increase in birth weight and gestational age⁽¹⁵⁾. Park said that the average weight of the 378 placentae was 616gm and for normal cases it was 621gm⁽¹⁶⁾.

Ashfaq et al reported that the mean weight of full term normal placenta was 530±10 and the mean diameter of full term placenta was 14, 26⁽¹⁷⁾. Majumdar et al found that the mean birth weight babies were 2, 8±0, 32 kg the mean weight of the placenta was 485, 85±47,31gm and the mean of cotyledons number of placenta was 17±2⁽¹⁸⁾. Frisancho et al said that the mean weight of placenta was 551gm and the mean of new born infant's weight was 3111.3 kg⁽¹⁹⁾.

The mean and standard deviation of neonates' weights at birth and placental weights were 3214.28 ± 529 and 529.72 ± 113 g, respectively was reported by Asgharnia⁽²⁰⁾. This study found that the diameters of placenta were symmetrical more in male than female, in male babies 18.5 ± 1.9 cm and female babies 18.4 ± 2.3cm.

Cotyledons number: In the present study it was found that the cotyledons number was approximately equal in both sex of babies (18.5 ± 2.2, 19.2 ± 1.3) in female and male respectively. The results of the study reveal a normal placental weight at term and also showed that placental weight increases are associated with increased birth weight in normal pregnancy. This study agrees with other studies reported by Manop et al⁽²¹⁾.

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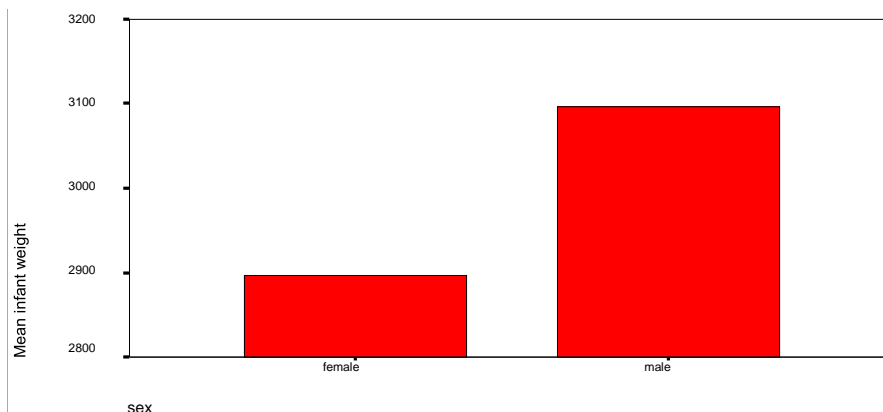


Figure 1: Weight vs Sex.

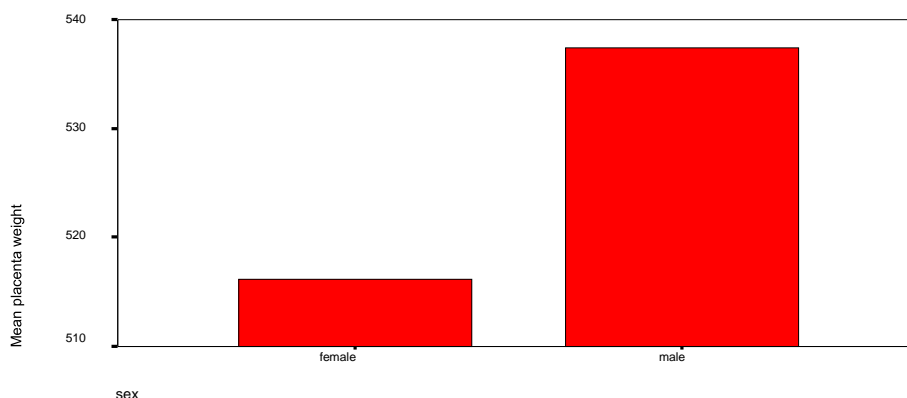


Figure 2: Weight of Placental.

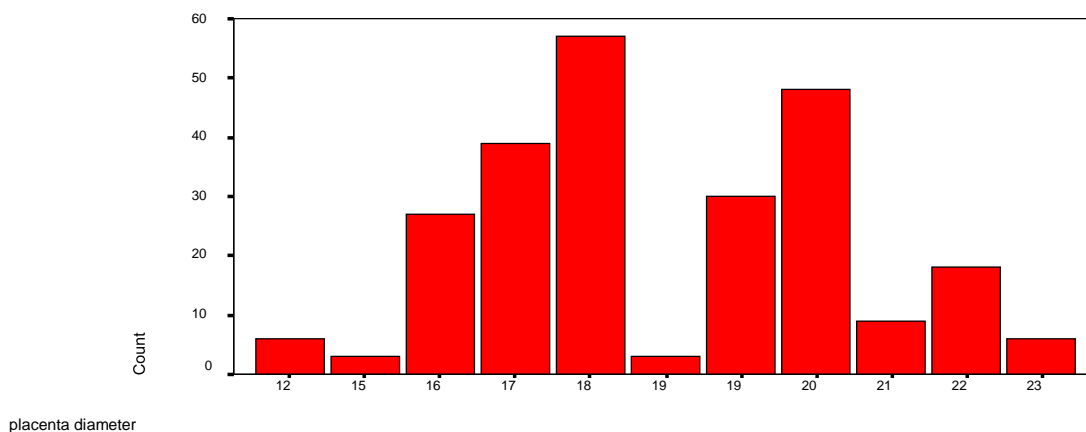


Figure 3: Placental diameter.

Conclusion:

This research found that the birth weight of males was larger than females in Sudanese newborns and related to the weight of placenta, but cotyledons number was equal in both sexes of children. This clearly shows the morphometric of the placenta is very important because it can determine the extent of the health of the newborn. It is crucial to link the microscopic characteristics of the placenta in future studies.

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