GROSS MORPHOLOGICAL AND HISTOLOGICAL STUDY ON NORMAL HUMAN PLACENTA

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Summary

Placenta is a vital organ for maintaining pregnancy and promoting normal foetal development. It is sometimes described as the mirror of the perinatal period. Still one of the common methods of investigation of the factors endangering the foetus and newborn during the perinatal period is the examination of placenta. The present study was conducted to make a gross morphological and histological evaluation of placenta in Bangladeshi population. This cross-sectional study was carried out in the Department of Anatomy, Chittagong Medical College Hospital over a period of 1 year from July 2011 to June 2012. The placentae from mature children delivered through caesarean section between 37 to 40th weeks of gestation with no complications having a birth weight of more than 2.5 kg were the study population. A total of 100 such placentae were consecutively selected from the study population. The morphological study of placenta included placental volume, weight, number of cotyledons, shape, diameter, thickness, mode of insertion of umbilical cord and histological study was volume (%) of villous area of the placenta. The mean age of the mothers whose placentae were studied was 25.3 ± 3.8 years (Range: 18 – 36). The mean birth weight of the neonates was 3.0 ± 0.3 kg. Majority (96%) of the placenta was rounded in shape. The mean weight and volume of the placenta was 538.5±38.7 g and 451±41.03 ml respectively, while the mean diameter was 16.8 + 0.99 cm. The mean thickness was 17.53 ± 3.66 mm. Over 70% of the cords were inserted at the peripheral part of the placenta. The mean number of cotyledons was 18 and the volume of villous area was 51.1%. Majority of the placentae in Bangladeshi population is round with the eccentric insertion of umbilical cord. The other features like weight, diameter and thickness, the number of cotyledons and volume of villous area are almost comparable with those of a typical one.

Key words: Morphology; Histology, Placenta; Pregnancy.

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Introduction

The placenta is a fetal organ providing the interchange blood between mother and fetus. This organ functions as transport and secreting organ even during its development and thus all developmental changes need to be in accordance with its function. The full-term human placenta is a circular discoidal organ with a diameter of about 22 cm, a central thickness of 2.5 cm, and an average weight of 470 gm. However, there is considerable variation from placenta to placenta, which strongly depends on the mode of delivery. Especially when planning a morphometric analysis of the placenta, factors such as when and where the umbilical cord has been clamped are crucial, for loss of maternal and/or fetal blood clearly affects the dimensions of the placenta [1]. The present study was conducted to find the morphological and histological appearances of human placenta in the context of Bangladeshi population.

Materials and methods

A cross sectional study was carried out in the Department of Anatomy, Chittagong Medical College Hospital over a period of 1 year from July 2011 to June 2012.

A total of 100 consecutive placentas were selected from the study population.

The placenta from mother who delivered a baby with a birth weight of more than 2.5 kg after a fully uncomplicated term pregnancy were the study population.
Convenience sampling was done.

Inclusion Criteria

The placenta was collected from 100 Bangladeshi women who gave birth to a single live baby through caesarean section between 37th to 40th weeks of gestation.

Exclusion Criteria

Mothers with diabetes, hypertension, positive VDRL or HBsAg test, pre-eclamptia and eclamptia or mothers having twin baby and a baby with visible congenital anomalies were excluded from the study. The necessary information regarding these exclusion criteria were obtained from the hospital records.

The statistical analyses were performed using computer software SPSS (Statistical Package for Social Sciences) and the test statistics used to analyse the data were descriptive statistics.

Results

Age distribution of the mothers whose placentae were included for study shows that more than three-quarters (77%) of the mothers were 20 – 30 years old, 9% were < 20 years and 14% were 30 or > 30 years old. The mean age was 25.3(Range: 18 – 36) years. Of the 100 subjects, 36% were primipara and 64% were multipara. The mean birth weight of the neonates was 3.0 ± 0.3 kg. Eighty percent of the neonates were female and the rest are male giving a female to male ratio of 4:1. Majority (83%) of the neonates had APGAR score 8 at birth. (Table I).Majority of placentae was round in shape (96%) and mode of insertion of umbilical cord was eccentric (72%) (Table II). The no of cotyledons ranges from 12 to 20. In more than 70% cases the number of cotyledons vary from 16-18. The mean weight of the placenta was 538.5 ± 38.7 g. The mean volume of the placenta was 451.2 ± 41.03. In 70% placenta the weight was within (500 – 600) gm, while 84% of the placental volume was 400 – 500 ml. The mean diameter of the placenta was 16.8 ± 0.99 cm, while the mean thickness of the placenta was 17.53 ± 3.66 mm. (Table II).The mean volume of villous area of placenta was 51.18 ± 2.30% (Table III).

Table I : Distribution of neonates by their characteristics at birth (n = 100)

Characteristics of neonate	Frequency	Percentage	Mean ± SD
Birth weight (kg)	---	---	3.0 ± 0.3
Sex			
Male	20	80.0	---
Female	80	20.0	---
APGAR score			
7	17	17.0	---
8	83	83.0	---

Table II : Gross morphological features of the studied placentae (n = 100)

Morphologic characteristics	Frequency	Percentage (%)	Mean ± SD
Shape			
Round	96	94.0	--
Oval	04	4.0	--
Mode of insertion of umbilical cord			
Central	28	28.0	--
Eccentric	72	72.0	--
Weight (gm)			
450 - 500 gm	30	30.0	--
500 - 550 gm	51	51.0	538.50 ± 38.73
550 - 600 gm	19	19.0	--
Diameter (cm)	---	---	16.8 ± 0.99
Thickness (mm)	---	---	17.5 ± 3.7
Volume (ml)			
≤ 400 ml	09	9.0	--
400 - 500 ml	84	84.0	451.20 ± 41.03
> 500 ml	07	7.0	--
No. of Cotyledon			
≤ 15	02	2.0	--
16 - 18	71	71.0	17.65 ± 1.03
≥ 18	27	27.0	--

Table III : Distribution of placentas by their microscopic findings (n = 100)

	Mean	SD	Median	Range
Volume (%) of Villous Area	51.18	2.30 5	1.30	46.2 - 58.0

Discussion

The placenta is a vital organ for intra-uterine existence of the foetus. The quality and quantity of maternal blood delivered to the intervillous spaces of the placenta determine the development of foetus. Several studies have shown structural alteration in the placenta throughout pregnancy. In order to understand the role of the placenta in foetal growth, one has to know placental changes in relation to gestation which could well be studied by its morphology and histology.

Morphologic appearance

Previous data given in literature mostly supports the view that shape of placenta is predominantly oval [2]. Sharply contrasting with this finding the present study demonstrates that majority (96%) of the placenta was round in shape. However, our finding is quite consistent with the findings of recent studies which showed that shape of persistent area of chorionic villi determines the shape of the placenta and usually it is a ciruclar area giving discoid shape to the placenta [3,4]. Chabeset al concluded that the shape of the placenta is more prone to be circular in highlanders with greater number of cotyledons and increased proportion of fetal capillaries and trophoblast over stroma [5].

We observed that over 70% of the cord had 'Eccentric insertion' and the rest had 'Central insertion'. Placental weight has been taken as an indicator of placental function. The insertion of the umbilical cord to the placenta remains central at mid-gestation and it becomes more eccentric as gestation proceeds [3]. In the present study, the mean placental weight was found to be 538.0 gm which bears consistency with the present study. Sadler described that weight of the placenta ranges from 500–600 gm [6]. Goswami and colleagues observed that the weight of the placenta ranged from 450 – 650 gm [7]. Borton demonstrated that weight of the placenta ranged from 400 – 600 gm [8]. Placental weight varies considerably depending on the technique of preparation of the placenta and timing of collection [9]. The low mean placental weight could be due to diminished amount of villous tissue and stroma and more voluminous Intervillous Septae (IVS). Previous data have produced contradictory results regarding placental weight.

Chabes and associates and Reshetnikovaet al found lower placental weights at High Altitude (HA) while Kruger and Stella reported higher weights [9,10,11]. A number of factors may contribute to these discrepancies which among others may include mode of delivery, collection, handling and processing techniques as well as volume of blood remaining in placenta at the time of delivery or after separation of cord. However, one confounder i.e. the mode of delivery was controlled in our study as all subjects were delivered by caesarean section. Reduction in placental weight has been found in women who smoked during antenatal period [12]. There is also consistent relationship between lighter placenta and intrauterine growth retardation [13].

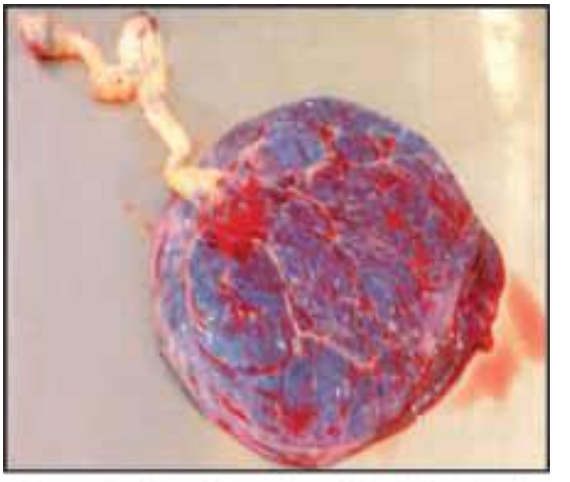

Fig 1 : Peripheral Insertion of Umbilical Cord

Fig 2 : Central Insertion of Umbilical Cord

In the present study the mean volume of the placentae was 451 ml. Murthy and associates demonstrated that the volume of normal placenta was 402 ml [14]. Begum found that the mean volume of placenta was 444 ml [15]. According to Gray a full term placenta contains 15-30 cotyledons [16]. Several investigators observed that the number of cotyledons ranged from 15-20 [3,6]. Quite consistent with these findings, our study found the number of cotyledons to be 16-18 in more than 70% cases. In the present study, the mean diameter of placenta was 16.8 cm. Several investigators reported diameter of the placenta to range from 6 cm at 3rd month to 18 cm at full-term. According to Gray the diameter of full term placenta may range from 15-20 cm which is further strengthened by Begum and colleagues'study which reported that the mean diameter of placenta was 15.6 cm [15,16]. The thickness of normal placenta at term varies from 10-40 mm and it is thickest at its centre (The original embryonic pole) and it rapidly thins out towards its periphery where it continues as the chorion leave [16]. Begum observed that the mean thickens of placenta was 2.1 cm [15]. Sadler reported that the mean thickens of full-term placenta ranged from 1.5-3.0 cm which is consistent with the findings of present study (Mean thickness was 1.75 cm) [6].

The difference in placental index at Low Altitude (LA) and High Altitude (HA) was found to be insignificant. Reshetnikovaet al stated that both placenta and foetus are lighter in weight at HA, so that the index, which is the ratio of the two, remained the same [10]. Under normal conditions there is a close relationship between fetal weight and placental weight. Udaina and Jain showed a linear relationship between fetus and placenta, i.e, both fetal and placental weight decrease in pregnancy induced hypertension [17].

Kruger and Stella reported higher placental index at high altitudes [11]. According to them heavier placenta could result from denser distribution of some histological structure within the placenta and this probably was a compensatory mechanism for better oxygenation of the fetus at HA. The possible explanation for the discrepancy found in placental index in different studies could be the difference in altitude level.

As the current study was conducted at low altitude (sea level as the study was conducted in Chittagong), which might have contributed to reduced size of the placenta. Enlargement of the organ with a resultant increase in placental index may be restricted to the most extreme conditions of hypoxia. Mayhew et al also showed that there is reduction in size of placenta at higher altitudes [18]. Kruger & Stella also observed the fact [11].

Microscopic findings of placenta

Placental tissues from different parts of the placenta may differ in their histometric characteristics. Therefore, some specific sites were chosen for taking tissues for histological examinations. The site opposite the cord attachment was considered as a central region and the peripheral region was chosen relatively distant from the central region. Again, tissues were taken only from the intermediate part of the cotyledon half way between the maternal and foetal surfaces of the placenta for avoiding the structural difference in tissues from parabasal and sub chorionic areas. Teasdale demonstrated that the former areas had significantly more peripheral villi and villous space for necessary exchange between the mother and the foetus [19]. The point counting technique was used to estimate the volume proportions of the placental components. This method along with commonly used plenimetric method was preferred as it is simpler and is claimed to be no less accurate than the plenimetric method [15]. Many of the authors like to follow both to avail the benefits of the two methods. The microscopic study was done on the tissues stained by Haematoxylin and Eosin. This stain makes a sharp demarcation between fibres and cell nuclei (The two showing up as blue and pink respectively). Thus the stroma could be distinguished easily from the cytotrophoblast and the syncytiotrophoblast. Biswas,et al found the volume of villous area in normal placenta to be 47% [20]. Begum found the mean of volume of villous area to be 54.6%. The present study showed that the mean volume percentage of villous area was 51.1% which fairly compares with Begum and Biswas studies [15,20].

From the findings of the study, it can be concluded that majority of the placenta in Bangladeshi population is round with eccentric

insertion of umbilical cord. The other features like weight, diameter, thickness, the number of cotyledons and volume of villous area are almost comparable with those of a typical one. As the present study was conducted on a small sample, a large-scale, multicentre study is recommended to validate the findings of the present study.

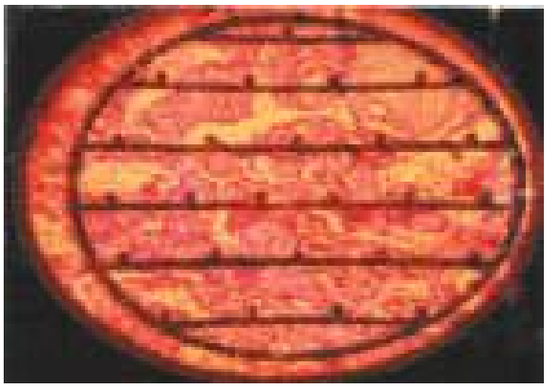

Fig 3 : Placenta under integrating eye piece to measure the villous area (40 objective <H&E stain)

Conclusion

From the findings of the study, it can be concluded that majority of the placenta is round with eccentric insertion of umbilical cord. The other features like weight, diameter, thickness, the number of cotyledons and vojume % of villous area are almost similar with those of standard one. As the present study was conducted on a small sample, a large-scale, multicentre study is recommended to validate the findings of the present study.

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Disclosure

All the authors declared no competing interest.

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