Correlations of morphological (macroscopic and microscopic) parameters of placenta with maternal age and parity

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Abstract

Background: Placenta is a chief cause of maternal and perinatal mortality and significant factor in fetal growth retardation. It undergoes different variations in weight, volume, structure, shape and function continuously throughout the gestation tosupport the prenatal life. Cautious examination of placenta can give information which can be useful in the management of complications in mother and the newborn.

Objective: The present work has been attempted towards determination of the morphological (macroscopic and microscopic) parameters of human full-term placentae and their relation with different parity and age group of mothers.

Patients and Methods: A whole of 40 placentae were recently collected.They were divided into four groups (10 women each); primigravida age<35 years, primigravida age>35 years, multigravida<35 years; multigravida > 35years.Neonataland placental weights,placental thickness and number of cotyledons were measured.Tissue for histological examination wasobtained to study the parameters of microscopic morphometry (number of apoptotic cells, number of terminal villi, number of syncytial knots, number of fetal capillaries and thickness of trophoblastic basement membrane).

Results: Placental and neonatal weights were within normal range. They were augmented with maternal age and parity. Number of cotyledons was higher than those reported by other authors in other populations but it was still within normal range and it was significantly decreased in multigravida> 35.Placental thickness was within normal range and it was significantly decreased in multigravida> 35**.** All microscopic parameters were increased with maternal age and parity..

Conclusion: There were correlations between microscopic and macroscopic parameters. Thelength of stem villi were less in multigravida> 35 since placental thickness was decreased in this group. All microscopic parameters were increased with maternal age and parity.These variations may have some important bearing on the placental inadequacy in higher age group and parity of mother.

Key words: placental weight, number of cotyledons and apoptotic cells.

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Introduction

Placenta is a chief cause of maternal andperinatal mortality and a significant factor infetal growth retardation [1]. Survival and growth offetus is essentially dependent on formation,full development and functions of the placenta.

It is a copy which reflects the intrauterinestatus of the fetus. It shows the most correct record of the prenatal experience of an infant. It undergoes different changes in weight, volume, structure, shape and functional ways throughout the gestation to support the prenatal life [2].

The examination of the placenta in utero as well as postpartum provides valuable information about the state of the fetal health[3]. Watchful examination of placenta can give evidence which can be suitable in the management of complications in mother and the newborn. A great majority of death-in-utero in this country may be due to placental insufficiency. This problem may have some correlation between parity, maternal age and weight of placenta.

The present work has been attempted towards determination of the morphological (macroscopical and microscopical) parameters of human full-term placentae and their relation with different parity and age group of mothers

Materials and Methods

A whole number of 40 freshly delivered placentae were collected from the Al-batool hospital for women and children in Diyala. The placentae were collected soon after their expulsion, from normal deliveries. They were divided into four groups (10 women each); primigravida age<35 years, primigravida age>35 years, multigravida<35 years; multigravida > 35 years. The collected placentae were washed under running tap water and the membranes were thoroughly examined and trimmed. The umbilical cord was cut, leaving a length of 5cms from its placental site of insertion.

The specimens were then transported to the Department of Anatomy in formalin (10%) filled plastic containers. All the specimens were tagged with number discs before the commencement of thestudy, for the purpose of identity.

In all the collected placentae, the following parameters werestudied: weight, shape, placental thicknessand the number of cotyledons.

From each placenta, tissue pieces measuring 0.25×0.25 cm were taken 2cm from the attachment of umbilical cord [4]. After 24 hours fixation in 10% formalin (Fluka AG. Chemicals, Buchs), the fixed tissues were processed for routine paraffin-wax embedding. From each paraffin tissue block, 2 sets of sections were prepared. The 1st set was used for routine heamatoxylin-eosin stain; the 2nd set for the Periodic Acid Schiff's' reaction (PAS) [5]. In our study microscopic morphometric included the following parameters : number of apoptotic cells, number of terminal villi , number of syncytial knots ,number of fetal capillaries and thickness of trophoblastic basement membrane (microns) using 40X objective and 10X ocular at 6 random fields per sections.

Statistical analysis

The data collected were analyzed using the computer facility with the available software statistical packages of SPSS 17 (Statistical Packages for Social Science, version 17.0). Results were presented in simple measure of mean ± S.D (standard Deviation). The significance of difference among quantitative variables of groups was assessed using one –way analysis of variance (ANOVA)[6].

Different men, and PSA test was performed which gave negative results.

Result

In all groups, the placenta is disk like, and round to oval. On the maternal surface, an incomplete system of "grooves" subdivides this surface into 34-38 lobes or cotyledons. The number of cotyledons was non-significantly decreased in multigravida> 35 years. The weight of the placentae ranged

from 510-593 gm. It was noted that the weight of placenta being increased with maternal age and parity. It was significantly increased in primigravida>35 and multigravida >35. Regarding the weight of the baby , its lowest value was reported by primigravida<35 (3191gm.) while its highest value was reported by multigravida >35(3425gm) as shown in tables 1 and 2.

Table (1): Shows Mean ± standard deviation of macroscopic.

Parameter	Primigravida <35	Primigravida >35	Multigravida <35	Multigravida >35
Number of cotyledons	38 4.5	38.8 4.7	38.6 4.7	34.8 6.0
Weight of Placenta/gm.	510 52.1	581.6 44.4	518.3 8 9.0	593.3 5 5.7
Thickness of placenta/cm	2.5 0.3	2.7 0.4	2.8 0.6	2.1 0.6
Weight of Baby/gm.	3191.6 162.5	3250 141.4	3241.6 257.7	3425.0 117.2

Table (2): Shows Multiple comparison(ANOVA)of macroscopic parameters

		Primigravida <35	Primigravida >35	multigravida<35	multigravida >35
Weight of placenta	Primi<35		0.925	0.991	0.912
	Primi>35	0.925		0.933	0.988
	Multi<35	0.991	0.933		0.921
	Multi>35	0.912	0.988	0.921	
Number of cotyledon	Primi<35		0.759	0.806	0.247
	Primi>35	0.759		0.951	0.145
	Multi<35	0.806	0.951		0.162
	Multi>35	0.247	0.145	0.162	
Thickness of placenta	Primi<35		0.363	0.276	0.185
	Primi>35	0.363		0.855	0.029*
	Multi<35	0.276	0.855		0.019*
	Multi>35	0.185	0.029*	0.019*	
	Multi>35	0.720	0.005*	0.062	
Weight of baby	Primi<35		0.762	0.796	0.231
	Primi>35	0.762		0.966	0.367
	Multi<35	0.796	0.966		0.345
	Multi>35	0.231	0.367	0.345	

*The mean difference is significant at the 0.05 level.

The number of villi was ranged from 10.5 (primigravida<35) to 12.2 (multigravida >35) . The Number of Apoptotic Cells was ranged from 11.4 (primigravida<35) to 12.8 (multigravida >35) .

The number of apoptotic cells was significantly decreased in primigravida<35 when compared with multigravida <35 and multigravida >35.The syncytial knots were ranged from 12.4 (primigravida<35) to12.9 (multigravida <35) as shown in tables 3 and 4.

Table (3): Shows Mean± Standard deviation of microscopic parameter

Parameter	Primigravida ‹35	primigravida › 35	Multigravida ‹ 35	Multigravida › 35
Number of villi	10.5 1.15	11.2 0.9	11.9 1.1	12.2 1.0
Number Apoptotic cells	11.4 0.7	11.7 0.6	12.7 0.7	12.8 0.7
Number of Syncytial knots	12.4 0.8	12.8 0.6	12.9 0.6	12.8 0.7
Thickness of basement membrane/µm	0.8 8.5E-02	1.0 4.5E-02	1.0 4.6E-02	1.0 4.17E-02
Number of fetal capillaries	8.3 0.7	9.5 0.3	9.9 0.7	10.3 0.6

The thickness of basement membrane was ranged from 0.84µm (primigravida<35) to 1.07µm (multigravida >35).The number of fetal capillaries was increased with maternal age and parity. It was ranged from 8.3 (primigravida<35) to 10.3 (multigravida >35). The number of fetal capillaries was significantly decreased in primigravida<35 when compared with other groups as shown in (Tables 3 and 4).

Table (4): Show multiple comparison (ANOVA) of microscopic parameters

		Primigravida ‹35	primigravida › 35	Multigravida ‹ 35	Multigravida › 35
Number of villi	Primi<35		0.360	0.046*	0.016*
	Primi>35	0.360		0.261	0.119
	Multi<35	0.046*	0.261		0.653
	Multi>35	0.016*	0.119	0.653	
Number of apoptotic cells	Primi<35		0.551	0.029*	0.015*
	Primi>35	0.551		0.104	0.059
	Multi<35	0.029*	0.104		0.780
	Multi>35	0.015*	0.059	0.780	
Number of syncytial knots	Primi<35		0.442	0.342	0.406
	Primi>35	0.442		0.855	0.950
	Multi<35	0.342	0.855		0.904
	Multi>35	0.406	0.950	0.904	
Thickness of basement membrane	Primi<35		0.051	0.982	0.978
	Primi>35	0.051		0.054	0.055
	Multi<35	0.982	0.054		0.996
	Multi>35	0.978	0.055	0.996	
Number of fetal capillary	Primi<35		0.11*	0.001*	0.000*
	Primi>35	0.011*		0.442	0.115
	Multi<35	0.001*	0.442		0.409
	Multi>35	0.000*	0.115	0.409	

*The mean difference is significant at the 0.05 level

Table (5): Shows correlation between macro and microscopic parameter of placenta.

Parameter	Number Cotyledon	Thickness Of placenta	Weight of placenta	Weight of baby	Number of villi	Number of apoptottic cell	Number of syncytial knot	Thicknessof basement	Number of fetal capillary
Cotyledons	1.00	0.611**	0.432**	0.143	-0.575**	-0.134	-0.501**	0.184	-0.174
Thickness of placenta	0.611**	1.000	0.126	-0.177	-0.382	-0.156	0.148	-0.107	-0.138
Weight of placenta	-0.432****	0.126	1.000	0.252	-0.253	0.059	-0.563**	0.004	0.358
Weight of the baby	-0.432****	-0.177	0.252	1000	0.120	0.601**	0.101	-0.032	0.552**
Number of villi	-0.575****	-.0382	0.253	0.120	1.000	1.180	0.504**	-0.043	0.315
Number of apoptotic cells	-0.13	-0.16	0.059	0.601	0.180	1.000	0.233	0.00	0.449**
Number of syncytial knots	-0.501	-0.148	-0.563**	0.101	0.504**	0.233	1.00	-0.162	-0.178
Thickness of basement Membrane.	0.184	-0.107	0.004	-0.032	-0.043	-0.001	-0.162	1.000	-0.050
Number of fetal capillary	-0.174	-0.138	0.358	0.552**	0.315	0.449**	-0.178	-0.050	1.000

Discussion

Round or oval placentas are the predominant human placental form, but many other shapes exist (bilobedplacenta, placenta membranacea, succenturiate placenta, fenestrated placenta, ring (zonary) placenta [7]. Anomalies may develop from abnormal fetal genes expressed by the placenta, an abnormal maternal environment, or an abnormal fetal-maternal interaction [8]. As all the subjects were apparently healthy and there was no evidence of maternal malnutrition. The hemoglobin level was about 10gm/dl in all subjects included in this study. This may be the reason of normal shape. Only in severe malnutrition, abnormal shape has been reported by previous workers [9,10].

An incomplete system of grooves subdivided the basal surface of the placenta into 10 to 40 slightly elevated areas called maternal cotyledons (lobes or lobules). According to Kaufman [11], each lobe is occupied by one or several villous trees. The number of cotyledons in placentas of Turkish mother was 16 [12], in placentas of mothers from Bangladesh was 15 [13]. And in placentas from Indian mothers was 17 [14]. The number of cotyledons in our groups ranged from 34-38 which was higher than those in the above reports and it was non significantly decreased in multigravida > 35 years. This may be attributable to a variety of factors such as variations in ethnic grouping and may be some other factors [15].

Placental weight reflects placental development and functions and is correlated with maternal age, gestational age(38-39 weeks) and parity. Sinclair [16]. Found the placental weight to increase linearly as gestation progresses. Garrow and Hawes showed that after 42 weeks, there was no accumulation of structural proteins in the placenta but that the increasing weight

resulted from pooling of fetal blood [17]. In the present study, the weight ranged from 510-593gm. and it was noted that placental weight correlated with maternal age and with parity. This result coincides with previous results [4].

Kinare *et al*. stated that the capacity of fetal weight growth is determined by placental growth [18]. Molteni *et al.* have shown the average placental weight is related to gestational age. In our groups, the birth weight ranged from 3191.6-3425 gm. being increased with maternal age and parity [19].

The human full term placenta has a central thickness of 1.5-3cm [20]. In our groups, the thickness of placenta ranged from 2.1-2.8cm. It was non-significantly decreased in multigravida > 35. Thickness of the placenta depends upon the length of the stem villi [21]. Therefore, the length of the stem villi were less in multipara> 35 than those in other groups.

Longitudinal growth of the capillaries within the mature intermediate villi exceeds that of the villi themselves so the capillaries coil and form loops that bulge from the villous surface, forming grape-like outgrowths known as terminal villi [11,22].

The result of current study demonstrated a positive correlation of terminal villi with maternal age and parity. This means that the capillary growth exceeds the growth of villi themselves .

It is well known that apoptosis includes chromatin condensation with nuclear fragmentation and cytoplasmic condensation with cell shrinkage. These morphologic changes may be part of normal physiology or may be secondary to pathologic insult [23,24,25]. Hypoxia may not be the sole inducer of placental apoptosis. Oxidative free radicals (oxidative stress) may be associated with enhanced placental apoptosis and increased turnover of the syncytiotrophoblast[26]. Thromboxane A2

was recently found to enhance apoptosis in human Trophoblast [27]. The result demonstrated a positive correlation of apoptotic cells with maternal age and parity

Syncytial knots, sprouts and bridges are a very heterogeneous group of syncytiotrophoblast specialization, all of which have remarkable accumulations of nuclei in common [28]. Their number increases in many pathologic placentas. The interpretation comprises local hyperplasia of the syncytium (20); structural expression of placental insufficiency [29]; structural expression of ischemia, hypoxia or hypertension [30] and the results of fetal mal perfusion of placental villi [31].In our study we concluded that the non-significant increase of syncytial knots with maternal age and parity could be attributed to decrease placental perfusion with increase maternal age and parity.

It is well known that molecular composition of the basement membrane changes during maturation of villous trophoblastic and endothelial basement membranes, these changes are particularly obvious in area of trophoblast proliferation and villous sprouting [32]. Due to increased incidence of apoptosis, large number of parenchymal cells (trophoblast, endothelial cells) has been observed to be eliminated and replaced by fibrous tissue [33] .This fibrous tissue was synthesized by fibroblasts of villous stroma. Fibroblasts also take part in the synthesis of subtrophoblastic basement membrane [34]. In this way, secondary to increase incidence of apoptosis, large number of parenchymal cells (trophoblast, endothelial cells) had been replaced by fibrous tissue and this played a role in

increase thickness of basement membrane with increasing maternal age and parity.

Placental angiogenesis can be subdivided regarding its mechanisms and the geometry of the resulting vascular bed [35,36,37] into branching angiogenesis (multiple sprouting of micro vessels produces a complex multiply branched capillary web)and non-branching angiogenesis(Vascular bed expands by elongation of existing capillary loops).

In study groups, the number of fetal capillaries was significantly increased with maternal age and parity . This indicated that branching angiogenesis was stimulated with increasing maternal age and parity.

In conclusion, placental and neonatal weights were within normal range. They were increased with maternal age and parity. Number of cotyledons was higher than those reported by other authors in other populations but it was still within normal range and it was significantly decreased in multigravida> 35 .Placental thickness was within normal range and it was significantly decreased in multigravida> 35. This means that length of stem villi were less in this group. All microscopic parameters were increased with maternal age and parity. This could be attributed to decreased placental perfusion.

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