Section: Anatomy

Original Research Article

MORPHOMETRIC AND HISTOLOGICAL CHANGES IN SECOND AND THIRD TRIMESTER PLACENTAS FROM UP WEST

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ABSTRACT

Background: The placenta is a major organ of nutrition and homeostasis. The quality and quantity of maternal blood delivered to the intervillous space of the fetal placenta determine the development of the fetus. It is is the most accurate record of the infant's prenatal experiences.

Materials and Methods: 30 placentas were collected from the labour room and operation theatre, Department of Obstetrics and Gynaecology, JNMCH, AMU, Aligarh. Divided into two groups of 10 Second Trimester (14 to 26 Weeks) and 20 Third Trimester placentas (27 to 37 Weeks). The samples were fixed in 10% formal-saline solution. From each placenta, whole-thickness tissue blocks were processed for paraffin embedding method and 5-micron thick sections were stained with Hematoxylin-eosin, Weigert & Vangieson stains and processed for light microscopic observation

Results: Third-trimester placentas demonstrated a significant increase in placental weight, decidual area, thickness, and umbilical cord diameter compared to second-trimester placentas ($P<0.01$). Histological examination revealed a marked increase in syncytial knots, vasculosyncytial membranes, and fibrinoid necrosis, along with a significant reduction in cytotrophoblastic cells in third-trimester placentas ($P<0.01$).

Conclusion: The study demonstrates distinct gross and histomorphometric changes in the placenta with advancing gestation. These alterations reflect progressive villous maturation and enhanced maternal fetal exchange, emphasizing the dynamic role of the placenta in supporting fetal growth and development.

Keywords: Cytotrophoblastic cells, decidual area, morphometry, second trimester placenta, syncytial knot, third trimester placenta, umbilical cord, vasculosyncytial membrane.

INTRODUCTION

The placenta is a vital organ on which the intra-uterine existence of the fetus is dependent.[1] It is the union between the foetal and maternal tissues for physiologic exchange. As a major organ of nutrition and homeostasis, the placenta is essential for fetal well-being, growth and development. In this age of advanced obstetric care, the placenta has an immense role to play and is a subject of increasing interest.[2] The placenta is the most accurate record of the infant's prenatal experiences.[3] Several studies have shown structural alteration in the placenta throughout the normal pregnancy. In order to understand the role of the placenta during foetal growth, one should know placental changes in relation to gestation. Enders et al observed the presence of syncytiotrophoblasts and cytotrophoblasts in the villus and the absence of basement membrane of the capillaries in early human placentas.[4] Microvilli on the syncytium were also noted in such fetuses.[5] Demir et al reported that the cells differentiating at day 21 post conception were macrophage-like and simultaneously mesenchymal cells were transformed into haemangioblastic cell cords, which were the forerunners of capillary endothelium and hematopoietic cells.[6] The core of the villus showed large mesenchymal cells with cytoplasmic processes.

Capillaries were scarce at 6-8 weeks of gestation, but with advancing age of foetus, more capillaries were visible at 16 weeks of gestation along with nucleated RBC. Forms of cell death were probably associated with syncytiotrophoblastic stress.[7] The present study is an attempt to compare the Morphometric and Histological changes in Second Trimester and Third Trimester human placentas.

MATERIALS AND METHODS

Thirty placentas were collected from the labour room and from the Gynaecology operation theatre, Department of Obstetrics and Gynaecology, JNMCH, AMU, Aligarh. These placentas were divided into two groups of 10 Second Trimester (14 to 26 Weeks) and 20 Third Trimester (27 to 37 Weeks) human placentas.

acentas of each group were kept in separate containers filled with 10% formalin-saline solution. From each placenta, whole-thickness tissue blocks were taken and processed for paraffin sectioning. 5-micron thick sections were stained with Hematoxylin-eosin and Weigert & Van Gieson stains. The slides were observed under a light microscope.

RESULTS

3.1 Comparison of gross features of the second-trimester and third-trimester placenta

As illustrated in [Table 1], the placental weight of second-trimester and third-trimester placentas were 352.77 58.43% and 513.16 38.04% respectively, whereas the mean percentage of the decidual area (in cm2) were found to increase from 240.10 44.503% in the second-trimester placenta to 295.768 47.11% in the third trimester placenta. The thickness (in cm) of the second-trimester placenta was observed as 1.612 0.031% while the same in the third trimester placenta was an increased value, i.e. 2.19 0.38%. Besides, the cord diameter (mm) in both cases increases from 9.0376 1.591% to 10.70 0.333%. With the help of Student's T-test, the P value of all the variables was calculated to be <0.01.

Table 1: Gross parameters in the second and third trimesters placenta.

Gross Features	Second Trimester	Third Trimester	Significant P<0.01
Placental weight(gm)	352.77±58.43	513.16±38.04	Significant
Decidual area (cm2)	240.10±44.503	295.768±47.11	Significant
Thickness(cm)	1.612±.031	2.19±0.38	Significant
Umbilical Cord- diameter(mm)	9.0376±1.591	10.70±0.333	Significant

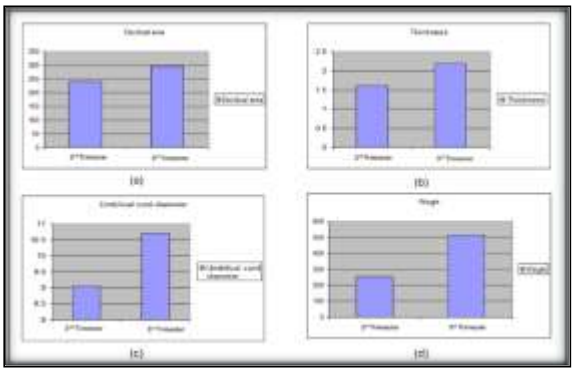

Figure 1: Shows a Comparison of gross placental parameters between the second and third trimesters.; (a) Decidual area shows an increase in the third trimester. (b) Placental thickness is greater in third-trimester specimens. (c) Umbilical cord diameter increases with advancing gestation. (d) Placental weight is significantly higher in the third trimester.

3.2 Comparison of histological features of second and third trimester placenta

As depicted in Table 2, the mean syncytial knot count in placentas of the second trimester and Third trimester groups were 11.8 ± 4.16% and 25.83 ±2.58% respectively. The mean percentage of Cytotrophoblastic cells were decreased from 14.16 ± 2.62 % in the second trimester to 1.61 ± 1.69 % in term group.

The vasculosyncytial membrane second trimester was observed as 1.0 ± 1.22 % while there was an increase in vasculosyncytial membrane of 22.5±5.14 % in the third trimester placenta. An average of 1.66 ± 1.50 % fibrinoid necrosis was observed in placentas of the second-trimester group, whereas 4 ± 1.4 % fibrinoid necrosis was observed in placentas of the third-trimester group (Fig. 4). With the help of Student's t-test, the P-values for all variables were calculated as < 0.01.

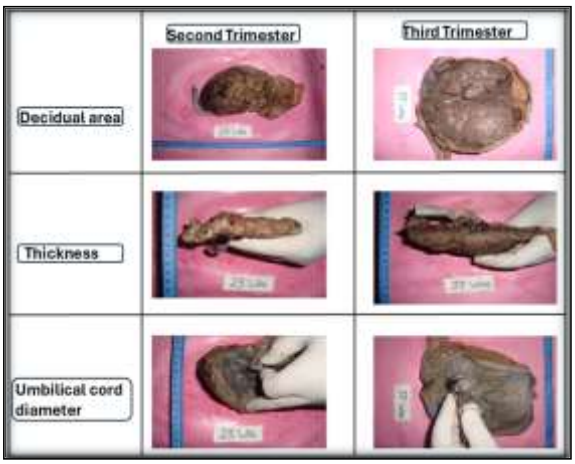

Figure 2: Gross comparison of placental parameters between the second and third trimesters.; (a) Decidual area shows smaller and less developed in the second trimester (23 weeks) compared to the more expanded decidual surface in the third trimester (37 weeks). (b) Placental thickness increases visibly from the second to the third trimester. (c) The umbilical cord is slimmer in the second trimester and appears broader and more mature in the third trimester.

Table 2: Histological parameters in the second and third trimesters placenta.

Histological Feature (per 200 villi)	Second Trimester (Mean ± SD)	Third Trimester (Mean ± SD)	Significance
Syncytial Knots	11.8 ± 4.16	25.83 ± 2.58	Significant ($p < 0.01$)
Cytotrophoblastic Cells	14.16 ± 2.62	1.61 ± 1.69	Significant ($p < 0.01$)
Vasculosyncytial Membranes	1 ± 1.22	22.5 ± 5.14	Significant ($p < 0.01$)
Fibrinoid Necrosis	1.66 ± 1.50	4 ± 1.40	Significant ($p < 0.01$)

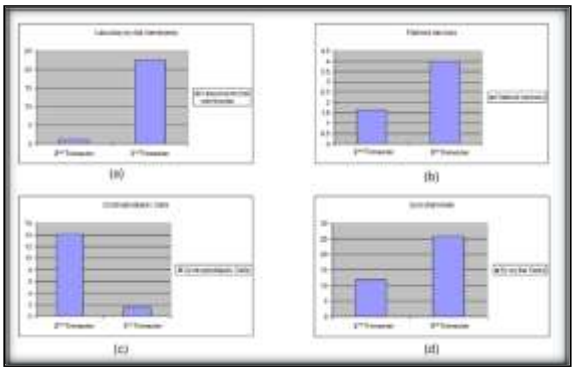

Figure 3: Shows comparative histological features of the human placenta in the second and third trimester; (a) Vasculosyncytial membranes show a marked increase in the third trimester. (b) Fibrinoid necrosis is higher in third-trimester placentas. (c) Cytotrophoblastic cells decrease with advancing gestation. (d) Syncytial knots increase significantly in the third trimester.

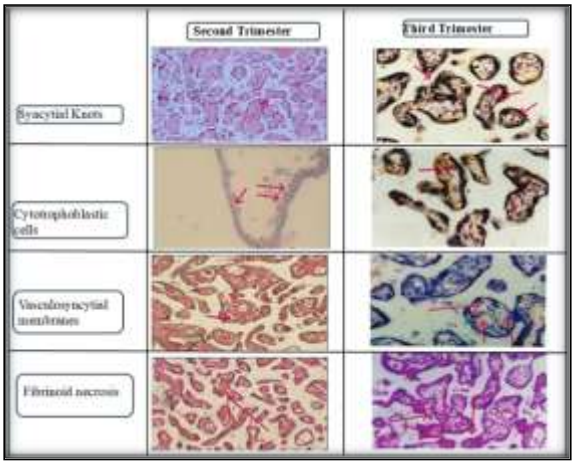

Figure 4: Histological comparison of placental villous features between the second and third trimesters: a) Syncytial knots are few and small in the second trimester, becoming more numerous and prominent in the third trimester. (b) Cytotrophoblastic cells are abundant in the second trimester but markedly reduced in the third trimester due to syncytial differentiation. (c) Vasculosyncytial membranes are less developed in the second trimester, with well-formed and more frequent membranes in the third trimester, indicating enhanced maternal-foetal exchange. (d) Fibrinoid necrosis is minimal in the second trimester, with an increased presence in the third trimester reflecting advancing villous maturation.

DISCUSSION

Syncytial knots are focal clumps of syncytial nuclei that protrude into the intervillous space from the surface of the villi and appear in gradually increasing numbers during the later stages of pregnancy. According to Jones and Fox, syncytial knots seem to be a sequestration phenomenon, for the nuclei forming the knots show morphological features suggestive of aging.[8] An increase in the syncytial knots was reported in third Trimester compared to second Trimester grouping our study. This was in conformity with the findings of Mallik et al. In normal pregnancy the incidence of syncytial knots never exceeded 60% and was found usually to be less than 30% of the villi. Number of cytotrophoblastic cells were decreased in third Trimester compared to second Trimester placentas.[9] This finding was very much in accordance with the previous studies conducted by Schroder, Hormann and Clavero Nunez. They stated that villous cytotrophoblastic cells, which are so prominent in the early stages of gestation, progressively disappear as pregnancy advances and are absent from the mature villi.[10,11] Boyd and Hughes and Wislocki and Dempsey showed by electron microscopy that villous cytotrophoblastic cells were still present in mature placentas.[12,13] Few vasculosyncytial membranes were observed in second Trimester while there was more vasculosyncytial membrane in third Trimester placentas. Fox et al. found that 99% of term placentas from uncomplicated pregnancies have vasculo-syncytial membranes on more than 5% of their villi and hence any placenta with an incidence less than this can be considered as being deficient.[10] A lack of vasculo-syncytial membrane from terminal villi of the placenta represents failure of trophoblastic differentiation and is associated with high incidence of intra-uterine fetal hypoxia. An increase in fibrinoid necrosis was observed in placentas of third Trimester as compared to second Trimester. These finding confirmatory to study of placentas from uncomplicated term pregnancies.[8]

The placental weight of second trimester placentas was recorded as 352.77 58.43%. A statistically significant (P value < 0.01) increase in the placental weight 513.16 38.04% was observed in third trimester [Table 1]. This was in conformity with the finding of Younoszai and Haworth (1969).[14] Thompson and co-workers (1969) were of the view that placental weight varies considerably depending on the technique of preparation of the placenta.[15] Garrow (1970) suggested that normal placental weight at term is 430-650 gm. Das Gupta, Mathur and Gupta (1974) gave the range of placental weight between 250-700 gm in Indian subjects. The mean percentage of the decidual area (in cm2) were found to increase from 240.10 44.503% in second trimester placenta to 295.768 47.11% in third trimester placenta. A statistically significant (P value < 0.01)

increase in the placental weight was observed in third trimester [Table 1] However, according to Younoszai and Haworth (1969) the difference in the mean placental decidual area in the preterm and normal term placenta was found to be statistically insignificant.[14]

The thickness (in cm) in second trimester placenta was observed as 1.612 0.031% while the same in third trimester placenta was an increased value i.e., 2.19 0.38% None the less, this observation though graphically significant but is statistically insignificant. Conversely, Younoszai and Haworth (1969) highlighted that the mean placental thickness in the normal term placenta was significantly greater than in the preterm placenta ($P < 0.05$).[14] Placental thickness varied directly with the duration of gestation. There is no relation between any of the placental dimensions and gestational age in the term placenta. According to Schensker (1976) placental thickness increase continuously an average maximum value of 3.6 0.5% until 36 weeks, whereas Grannum and Hobbins (1983) reported that placental thickness increased linearly until 36 weeks of pregnancy after which there is a gradual decrease which is mediated by the degree of placental maturation. Koslowski et al (1980) and Tewari et al (1997) also reported the similar finding.

The umbilical cord diameter (mm) in second trimester and third trimester placenta increases from 9.0376 1.591% to 10.70 0.333% respectively. This was statistically significant ($P <0.01$). Too many references regarding the cord diameter were not available. Lyndon et al (1987) visualised umbilical cord in transverse sections and studied its thickness. The normal diameter of umbilical cord is 1-2 cm.

CONCLUSION

The study demonstrates significant gross and histomorphometric changes in the placenta with advancing gestation. Increased placental weight, decidual area, and umbilical cord diameter in the third trimester reflect progressive structural adaptation to meet fetal demands. Histologically, increased syncytial knots, vasculosyncytial membranes, and fibrinoid necrosis, along with reduced cytotrophoblastic cells, indicate advanced villous maturation and enhanced maternal–fetal exchange. These findings emphasize the dynamic role of the placenta in supporting normal fetal growth and provide a baseline for identifying gestational abnormalities.

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