Study on Blood Vessels of Terminal Villi of Normal Term Placenta

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ABSTRACT

Introduction and Aim: Terminal villi form the functional units of the placenta. The terminal villi consist of a layer of cytotrophoblast and syncytiotrophoblast with a core of mesoderm with blood vessels. These villi form the placental barrier and transfer nutrients from mother to fetus and waste products from fetus to mother. Successful pregnancy depends upon the formation of blood vessels in the placenta to supply the increasing demand for nutrition for developing the embryo. Inadequate vessel formation can result in impaired placental growth, malfunction, hypoxia, and fetal malnutrition that may result in fetal death. This study has been taken up to study the normal vasculature of the terminal villi of term placenta.

Materials and Methods: One hundred and fourteen normal placentae of 37-41 weeks of gestational age were collected and stained with Hematoxylin and Eosin.

Results: The mean of blood vessels/terminal villi was 6.88 with a standard deviation of 1.39. The number of vessels/terminal villi was reduced from 37 - 41 weeks of gestation.

Conclusion: In this study, we tried to study the normal vasculature of terminal villi by the histological method, which explains about normal physiology of blood circulation in the placenta.

Key Words: Terminal villi, term placenta, blood vessels.

INTRODUCTION

Successful pregnancy depends on the implantation and formation of fetal and maternal blood vessels to supply the increasing demand for nutrition for developing the embryo. Organized angiogenesis is required for optimal nutrient transfer between mother and fetus. Inadequate vessel formation or maintenance in the placenta results in impaired placental growth, malfunction, hypoxia, and fetal malnutrition that may result in fetal death (1).

Development of vessels within the villi undergoes three stages; vasculogenesis, branching angiogenesis and nonbranching angiogenesis. Vasculogenesis includes the formation of blood vessels in the villi, which is initiated by the expression of angiogenic growth factors. In branching angiogenesis existing vessels will sprout and branch, and increase the number of vessels. In nonbranching angiogenesis, exiting villi are converted into terminal villi. Terminal villi form the functional units of the placenta (2). The terminal villi consist of a layer of cytotrophoblast and syncytiotrophoblast with a core of mesoderm with blood vessels. These villi form the placental barrier and transfer nutrients from mother to fetus and waste products from fetus to mother. It also acts as a barrier for pathogens and the maternal immune system (3). The cells of these villi serve as an endocrine organ and synthesize a plethora of hormones, growth factors, and other bioactive products which maintain pregnancy (4). The placenta is a mirror of prenatal

fetal development and examining the placenta after delivery will give a history of prenatal fetal and maternal health (5). The histological examinations of the placenta are frequently used to study the prenatal history of events and in identifying the cause of death of fetus and complications for clinicians and parents (6).

This study has been aimed to see the number of blood vessels/terminal villi in the placenta of 37 - 41 weeks of gestation. This will give an idea about the normal vascular structure of the terminal villi.

MATERIALS AND METHODS

One hundred and fourteen normal placentae were collected immediately after delivery with the consent of the participant. A section of the placenta was taken from the center, fixed in 10% neutral buffered formalin and processed for Hematoxylin & Eosin (H & E) staining. Stained slides were observed under 40X for counting vessels. Randomly 10 villi were selected from the different regions of tissue, and an average of 10 villi vessels was taken for the count and tabulated.

RESULTS

We studied 114 normal placentae, in H & E staining we observed that mean of blood vessels/terminal villi (Figure No. 1) was 6.88 with standard deviation 1.39 and the number of vessels in terminal villi of 37-41 weeks gestation period is shown in Table No. 1. We also observed that the number of vessels/terminal villi was reduced from 37 weeks to 41 (Graph No. 1).

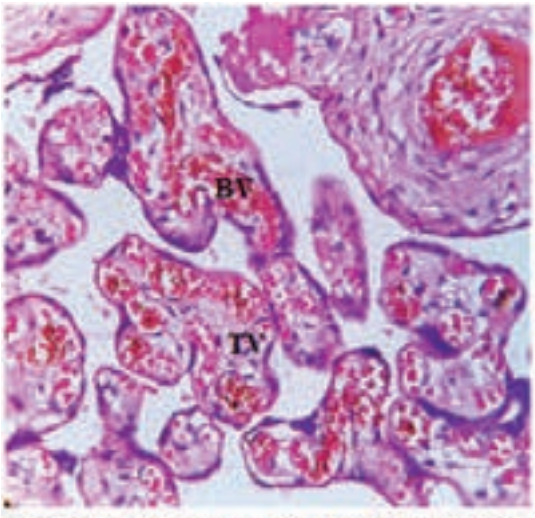
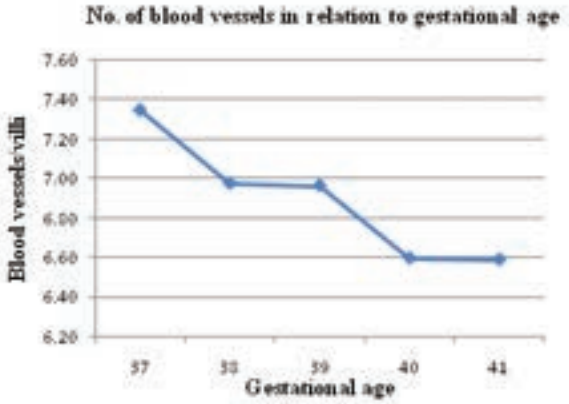


Fig. No.1: Terminal villi (TV) with blood vessels (BV)

Table 1: Mean number of blood vessels / terminal villi in 37 – 41 weeks of gestation period.

Gestational age (GA) in weeks	Number of cases (n)	Mean	SD
37	12	7.35	1.08
38	30	6.98	1.54
39	30	6.96	1.18
40	34	6.60	1.35
41	8	6.71	2.03
Total	**114**	**6.88**	**1.39**

Graph 1: Number of blood vessels / terminal villi in relation to gestational age



DISCUSSION

Terminal villi are produced by the mature intermediate villi by out-bulging of coiled capillaries. The terminal villi development is influenced by the longitudinal growth of mature intermediate villi and its capillaries. The number of terminal villi is produced by the more capillary growth, which exceeds the longitudinal growth of the mature intermediate villi. The capillary growth is influenced by hypoxia. The terminal villi contain only capillaries and sinusoids. The capillary loops of terminal villi arise from the intermediate villi and are connected to the neighboring terminal villi. Thus blood leaving from the terminal villi crosses 3-5 terminal villi. They are arranged parallel to each other. The average vessel diameter of the terminal villi is 12.3 µm, and the length is 3,000-5000 µm (7). There are many angiogenic growth factors identified in the placenta, which influence the formation of terminal villi i.e., non-branching angiogenesis. Among these

VEGF is said to be the potent angiogenic growth factor in the placenta. In branching angiogenesis Vascular Endothelial Growth Factor (VEGF), fms like thyrosine kinase receptor-1 (flt-1), Kinase Domain Receptor (KDR) are increased, and in non-branching angiogenesis, Placental Growth Receptor (PlGF) and flt-1 are increased, while VEGF is decreased (2,8).

In this study, we observed that the mean number of blood vessels/terminal villi of 37-41 weeks of gestational age placenta was 6.88 ± 1.39. The number of the vessel was reduced from 37 to 41 weeks of gestation. In one of the studies on terminal villi of the normal and gestational diabetic placenta, it was observed that the density of blood vessels/unit area was 10.70 ± 4.66 (mm^3) in normal and in diabetic it was 21.76 ± 8.52 (mm^3) / unit area. The increased number of blood capillaries is due to hyperplasia of terminal villi and low oxygen content (9). In normal, the core of terminal villi consists of 1-6 capillaries/ terminal villi (3). In one of the histomorphometric study of terminal villi of normal and pre-eclamptic placentae, it was observed that the vascular density in normal was 25.63 ± 8.88 mm^3 and 22.04 ±8.72 mm^3 per unit area in pre-eclamptic terminal villi (10). Studying normal vasculature will help to understand the placental physiology and pathology.

CONCLUSION

Vessels of the terminal villi are essential areas of gaseous exchange between fetus and mother for the growth of the fetus. In this study, we tried to study the normal vasculature of terminal villi by the histological method, which explains about normal physiology of blood circulation in the placenta.

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