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Original Article

# Developmental study on ovary of human foetuses

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ABSTRACT

*Introduction:* The primary gonadal blastema within the genital ridge is formed by two types of somatic cells; cells segregated from the mesonephros and cells of the proliferating coelomic epithelium. The main objectives of the study are to observe the sequential changes of the germ cells and other somatic cells at different gestational ages of the foetal ovary and to look for any variations in its histogenesis.
*Method:* 52 numbers of human foetuses of different gestational ages were dissected and ovaries were removed. To study the cytoarchitecture, the specimens were fixed in neutral buffered formalin and were subjected to standard histological processing and routine haematoxylin and eosin staining as well as masson's trichrome stain.
*Results:* Maximum numbers of clusters of oogonium were found at 20th week of gestation, thereafter it gradually decreased in number till 40th week. Primordial follicles are formed as early as 14th week and it gradually increased as the age advanced. Primary follicle appeared at 24th week. Both antral and growing follicles were encountered from 38th week onwards. Interstitial cells were seen from 14th week, reaching peak at 22nd–24th week and very few of them were still seen at 40th week. Surface of the ovary is lined by simple cuboidal epithelium right from 14th week. Invaginating surface epithelial cells were also seen till 25th week.
*Discussion:* The detailed knowledge of the development of ovary may be helpful to the clinicians, particularly obstretrician and endocrinologist.


## 1. Introduction

Genital system and urinary system both developed from common mesodermal ridge along the posterior wall of the abdominal cavity, and initially, the excretory duct of both the system enter a common cavity, the cloaca. Gametes are derived from primordial germ cells that are formed in epiblast during the second week of gestation and that move to the wall of yolk sac. During the fourth week of gestation, these cells begins to migrate from the yolk sac towards the developing gonads, where they arrived by the end of fifth week of gestation.[1] The primary gonadal blastema within the genital ridge is formed by two types of somatic cells; cells segregated from the mesonephros and cells of the proliferating coelomic epithelium.[2] Upon arrival at the genital ridge, the PGCs, now called oogonia, intermingle with the somatic cells that will support their subsequent development. These pregranulosa cells arise from epithelial cells that invaginate into the genital ridge.[3] The primordial germ cells pass to the female gonad in the late somite stages. At 5 weeks of ovulational age the gonadal ridge was recognized as a small bulged on the dorsal coelomic wall, lateral to the aorta and medial to the mesonephric duct.[4] Up to the seventh week the ambisexual gonad possesses no sexually differentiating features.[5]

Fingerlike epithelial cord- the gonadal cord soon grows into the underlying mesenchyme. The indifferent gonad now consists of an external cortex and an internal medulla. In embryos with an XX sex chromosome complex, the cortex differentiates further and the medulla regresses. Gonadal cords do not become prominent, but they extend into the medulla and form a rudimentary rete ovarii. This structure and the gonadal cords normally degenerate. Secondary cortical cords extend from the surface epithelium of the developing ovary into the underlying mesenchyme during the early fetal period. As the cortical cords increases in size, primordial germ cells are incorporated in them.[6] These cells undergo mitotic division, by the end of the 3rd month, they are arrange in cluster surrounded by a layer of flat epithelial cells.[1] Maximum mitotic activity in the oogonia occur on 11th–16th weeks of gestation.[7] By 5th month, the total number of germ cells in the ovary reaches

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maximum, estimated at 7th million. Then apoptosis of the cells begins and many oogonia and primary oocytes degenerate and become atretic. By 7thmonth majority of the oogonia have become degenerated except for a few near the surface. All the surviving primary oocytes have entered prophase of meiosis I, and most of them are individually surrounded by a layer of flat follicular epithelial cells and becomes primordial follicle.[1] 1,000,000 primary oocytes remain at birth, 40,000 by puberty, and only 400 are ovulated during reproductive life.[5] Absence of SRY established the development of female.[1] WT1 can activate the Dax-1 promoter and *Dax*-1is required for ovary development.[3]

## 2. Materials and methods

The materials studied consisted of 52 numbers of normal human female fetuses of different gestational ages starting from 14th week to 40 week, products of terminated pregnancy under MTP Act of India, 1971 and stillbirths. These fetuses were collected from Obstetrics and Gynecology, RIMS Hospital, Imphal with permission of concerned authorities & parents, and the study was consented by ethical committee. Only those fetuses which were free from any gross anatomical abnormality were selected for the present study. The age of the fetuses was calculated from the obstetrical history, crown rump length (CRL) and gross features. The fetuses were preserved in 10% formalin for 10 days and then dissected. To study the cytoarchitecture, the specimens were fixed in neutral buffered formalin and were subjected to standard histological processing and routine haematoxylin and eosin (H&E) staining as well as Masson Trichrome stains. Slides were examined under trinocular research microscope at different magnification and photographs were taken. The finding of the present study was compared and discussed with the findings of the available literatures.

## 3. Results

The collected specimens were categorized in five groups: Group I: 14th–20th week, Group II: 21st–25th week, Group III: 26th–30th week, Group IV: 31st–35th week, and group V: 36th–40th week.

### 3.1. Group I: 14th–20th week

At 14th week the ovary shows outer cortex and inner medulla. Surface of the cortex is lined by single layer of cuboidal cells (Fig. 1). Cortex shows clusters of different size of oogonia. These clusters of oogonia are surrounded by a fibroblast like cells called stromal cells. Oogonia are identified by its comparatively larger size, vesicular nucleus and foamy cytoplasm. Stromal cells are spindle in shape with an oval nucleus and arrange in cords. Scattered numbers of cells with rounded nuclei and lightly stained cytoplasm due to present of fat droplets (interstitial cells) are also observed among the stromal cells (Fig. 1). Invagination of surface epithelial cells into the interior of developing ovarian cortex also seen. Many degenerating oogonia are also observed in the cortex; they are identified by degenerative changes in their nucleus i.e. pyknotic, karyolysis, and karyorrhexis. Some primary oocytes are individually surrounded by very thin flattened epithelial cells, thus forming the primordial follicles. Some of the oocytes of primordial follicles shows degenerative changes as indicated by fragmentation of nuclei. Some dividing oogonia are also encountered at this week which is identified by two separate nuclei; however cytoplasm surrounding each nucleus is in continuity with each other. Cortex also shows scattered number of fine capillaries penetrating from the blood vessels present in the medulla in which some red blood cells can be detected. Deep to cortex there is a fibrovascular layer of connective tissue called medulla. There is no distinct boundary between cortex and medulla. It shows numerous thin walled blood vessels around which there is abundant collection of fibrous tissues (Fig. 1). Medulla is continuous with mesovarium. Collagen fibers can be demonstrated by Masson's Trichrome stained as early as 14th week. At 16th week clusters of oogonium are increased as compared to the previous week. The numbers of interstitial cells surrounding the clusters are comparatively more as compared to previous week. At 18th week many well formed primordial follicles are seen at corticomedullary junction. Numerous thin walled blood vessels and plenty of elongated cells are visible in the medulla (Fig. 2). At 20th week maximum clusters of oogonium were detected.

### 3.2. Group II: 21st–25th week

Number of clusters of oogonium is comparatively less as compare to the previous groups whereas the number of primordial follicle is increased marginally. At 24th week flattened follicular cells of some follicle started to grow and become cuboidal cells; hence forming primary follicle. Plenty of interstitial cells are still present among the stromal cells. Invaginating cells from surface epithelial cells are also still observed in some areas. Cortex and medulla is well demarcated in this group (Fig. 2).

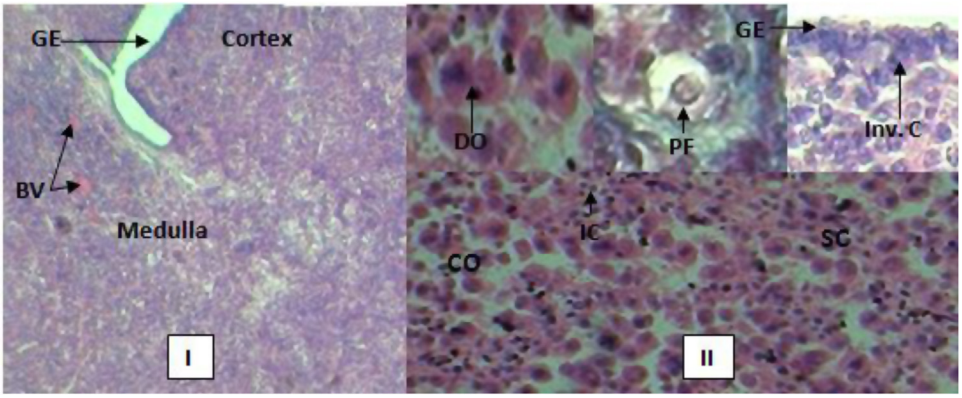


**Fig. 1.** Ovary of 14th week old foetus stained with haematoxyllin & eosin (H&E) stain. I = Low magnification showing outer cortex(C), inner medulla (M), germinal epithelium (GE) & blood vessels (BV). II = Magnified view showing dividing oogonium(DO), developing primordial follicle (PF), Invaginating cells (Inv. C) from surface epithelium, clusters of oogonium (CO), Stromal cells (SC) and interstitial cells (IC).