

Mini Review

A Brief Overview to the Beginning of the Human Embryologic Development

Koroglu P* and Alkan F

Department of Histology and Embryology, Halic University, Faculty of Medicine, Istanbul, Turkey

*Corresponding author: Köroğlu P, Department of Histology and Embryology, Halic University, Faculty of Medicine, Istanbul, Turkey

Received: April 10, 2018; Accepted: April 19, 2018;

Published: April 26, 2018

Abstract

Human development begins with fertilization. Fertilization means that the male gametocyte sperm and the female gametocyte cell oocyte combine to bring the zygote. Male and female embryologic development is called gametogenesis: Oogenesis and spermatogenesis can be examined in two sub-sections. Gametes that are formed from the epiblast layer during the second week of development and then settle in the wall of the vitellus sac. At about the fourth week, they begin migrating to the developing gonads on the back wall of the embryo. The main goal of this review to summarize the gametogenesis period by showing special embryologic models. A large number of studies examined the gametogenesis period although it is not still completely understood. This review summarizes the literature concerning the gametogenesis period and introduction to embryology. We discuss the latest findings in this field; suggesting that gametogenesis period may have a potential role in the management of fertility process.

Keywords: Gametogenesis; Spermatogenesis; Oogenesis; Blastomer; Infertility.

Gametogenesis

Human development begins when a male gamete or sperm unites with a female gamete or ovum to form a single cell called a zygote. Gametogenesis process involving the chromosomes and cytoplasm of the gametes, prepares these cells for fertilization. During gametogenesis, the chromosome number is reduced by half and the shape of the cells is altered. Gametes develop in the gonads (sex cells). In males, its name is spermatogenesis, formation of sperm. In females, its name is oogenesis, formation of oogenesis. The process of gametes formation that occurs in the gonads (ovary or testis). It is defined as a process by which diploid or haploid cells undergo cell division and differentiation to form mature haploid gametes. Spermatogenesis and oogenesis are both forms of gametogenesis, in which a diploid gamete cell produces haploid sperm and egg cells [1].

Primordial germ cells are the progenitor cells that give rise to the gametes. Primordial germ cells migrating from the vitellus sac to the reproductive organ developmental zone are distributed among the cells in the region (Figure 1,2). After a while, changes start in the male testes. The differentiation in primordial germ cells, which started in the third month of uterine life in female, but it, starts in puberty in male. A newborn males, sex cord's shape are like a column. In this case, all of the primordial germ cells are seated on the basal membrane of the sex cord and are mixed with the modified cell that Sertoli cells (Sustentacular). Along with the formation of the lumen, the primordial germ cells turn into spermatogoniums. At the meiosis cleavage stages they enter into a tight relationship with the Sertoli cell. Sertoli cells, the structural cells of the reproductive epithelium of the sex cord, perform vital tasks such as supplementing, feeding, hormone secretion, mitosis and regeneration. Sertoli cells are nurse cells [2-5] (Figure 3,4).

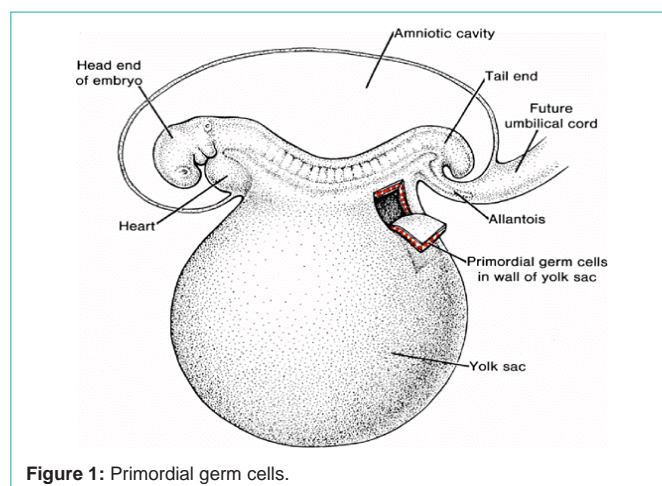


Figure 1: Primordial germ cells.

Spermatogenesis

Spermatogenesis is a complex period that relies on coordinated cell proliferation and apoptosis [6]. Spermatogenesis is a temporal event during which a relatively undifferentiated diploid cell called spermatogonium slowly evolves into a highly specialized haploid cell called spermatozoon. The main aim of spermatogenesis is to produce a genetically unique male gamete that can fertilize an ovum and produce offspring [7]. Spermatogenesis can be divided into three stages.

- Spermatogonial stage - mitotic clonal expansion
- Meiotic stage -production of the haploid gamete
- Spermatogenesis stage -morphological changes of spermatids into spermatozoa.

Process by which spermatogonia differentiate into mature

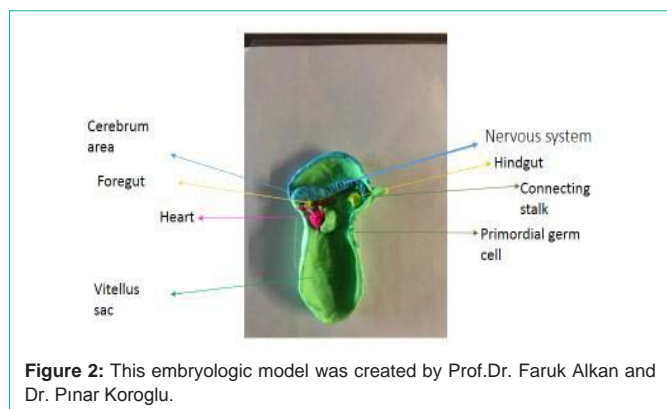


Figure 2: This embryonic model was created by Prof.Dr. Faruk Alkan and Dr. Pinar Koroglu.

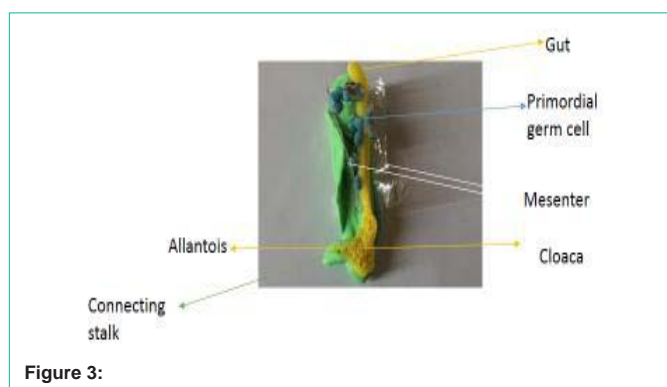


Figure 3:

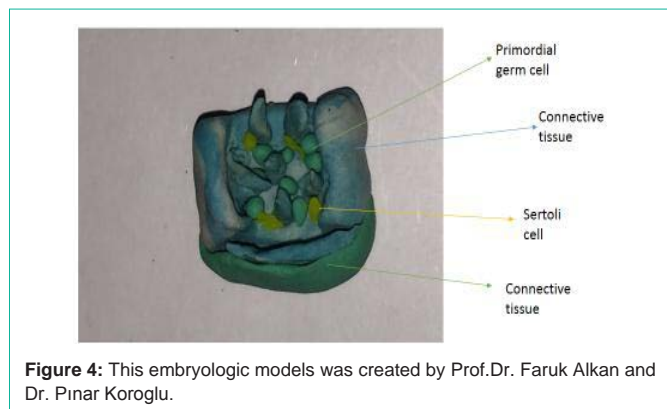


Figure 4: This embryonic models was created by Prof.Dr. Faruk Alkan and Dr. Pinar Koroglu.

spermatozoa. Begins at puberty.

Spermatozoa are formed in the wall of seminiferous tubules of the testes. The process of transformation of a circular spermatid to a spermatozoon is called spermiogenesis.

Golgi phase

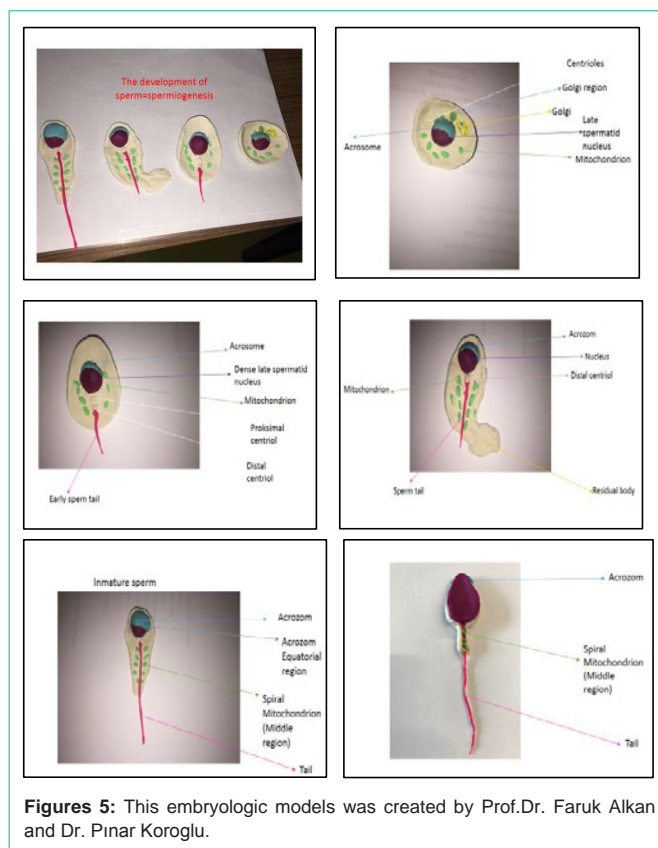
Cap phase

Acrosomal phase

Maturation phase (Figure 5).

Oogenesis

Oogenesis occurs in the ovaries and in the oviducts. It starts before birth. In humans, oogenesis begins approximately 3 weeks after fertilization. Primordial germ cells arise from the yolk sac and



Figures 5: This embryonic models was created by Prof.Dr. Faruk Alkan and Dr. Pinar Koroglu.

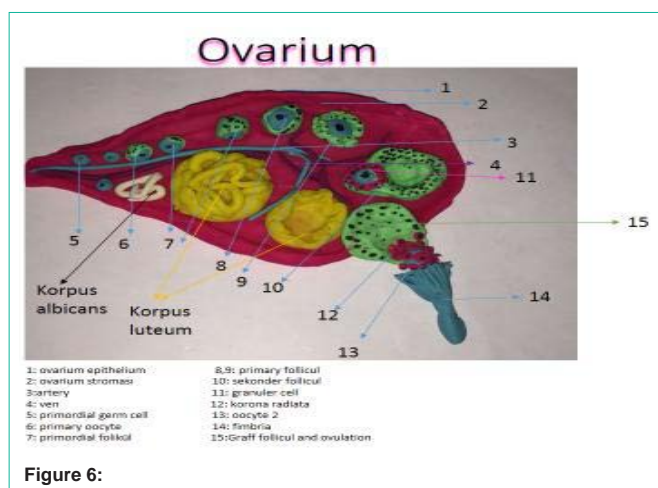


Figure 6:

migrate via amoeboid movements, through the hind gut; to the genital ridge. Primordial germ cells undergo rapid mitotic division during this migration. Upon arrival, the primordial germ cells give rise to oogonia or germ stem cells that continue to proliferate to further expand the germ cell pool. The number of oogonia increases from 600,000 by the eighth week of gestation to over 10 times that number by 20 weeks. At around 7 week's gestation, these cells from the primitive medullary cords and the sex cords, respectively. Follicle formation begins at around week 16-18 of fetal life. Oogonia are enveloped by somatic epithelial cells derived from genital ridge mesenchymal cells, forming primordial follicles. The oogonia then cease mitotic activity and enter meiosis (Figure 6) [8].

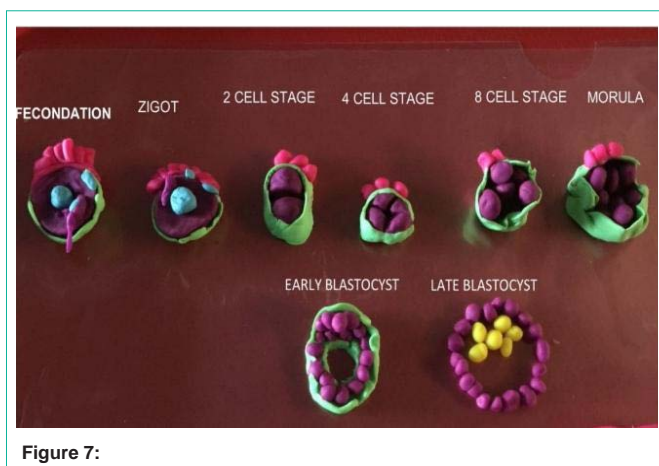


Figure 7:

Pre-implantation embryo development involves oocyte maturation, fertilization, cleavage division, cell proliferation and differentiation, and finally generation of the blastocyst [9].

The (Figure 7) shows that the period of first week of human development. When a secondary oocyte is conducted by a sperm, it completes the second meiotic division. As a result, a mature ovum and three polar body. The nucleus of mature ovum is female pronucleus. After the sperm enters the ovum's cytoplasm, the head of sperm separates from the tail and enlarges to become the male pronucleus. Fertilization is complete when the sperm attempted to penetrate the ovum. The first significant event in fertilization is the fusion of the membranes of the two gametes, resulting in the formation of a channel that allows the passage of material from one cell to the other. The male and female pronucleus forming a new cell called the zygote [10]. Zygote that is a diploid cell like a somatic cell.

$2n$ (diploid) zygote = n (haploid) sperm + n (haploid) ovum

After this process, the zygote undergoes cleavage (a series of mitotic division) into a small cell called blastomer. About three days after fertilization, a ball of 12 to 16 blastomeres, called a morula. A cavity soon forms in the morula, converting it into a blastocyst consisting of an inner cell mass or embryoblast which give rise to embryo. Four to five days after fertilization, the zona pellucida disappears, and the blastocyst attaches to the endometrial epithelium. By the end of the first week, the blastocyst is superficially implanted

in the endometrium [11-12].

Conclusion

Infertility is a widely spreading pandemic worldwide concern. It was shown that fertility potential of people via variable mechanisms is very important and difficult period. Preventing in fertile people is key to know this developmental duration well. Additionally, assisted reproductive techniques may be improved day by day. That's why, this development period knowledge is very crucial. To sum up with, several mechanisms have been suggested to have a role in infertility process. The aim of this mini-review is to highlight the pathological basis of a brief overview to the beginning of the human embryologic development.

References

1. Keith M, Persaud TVN, Torchia M. The developing human, 10th Edition. Clinically Oriented Embryology.
2. Wear HM, McPike MJ, Watanabe KH. From primordial germ cells to primordial follicles: A review and visual representation of early ovarian development in mice. *J Ovarian Res.* 2016; 9: 36.
3. Hill MA. UNSW Embryology. Primordial germ cell migration movie. 2017.
4. Marlow F. Primordial germ cell specification and migration. *F1000Res.* 2015; 16: 4.
5. Sakkas D, Seli E, Bizzaro D, Tarozzi N, Manicardi GC. Abnormal spermatozoa in the ejaculate: Abortive apoptosis and faulty nuclear remodelling during spermatogenesis. *Reprod Biomed Online.* 2003; 7: 428-432.
6. Spermatogenesis: An Overview.
7. Rimón-Dahari N, Yerushalmi-Heinemann L, Alyagor L, Dekel N. Ovarian Folliculogenesis. *Results Probl. Cell Differ.* 2016; 58: 167-190.
8. Zhang P, Zucchelli M, Bruce S, Hambiliki F, Stavreus-evers A, Ievkov, et al. Transcriptome profiling of human pre-implantation development. *Plos one.* 2009.
9. Budhwar S, Singh V, Verma P, Singh K. Fertilization failure and gamete health: Is there a link? *Front Biosci (Schol Ed).* 2017; 9: 395-419.
10. Bukovsky A. Ovarian Stem Cell Niche and Follicular Renewal in Mammals. *Anat Rec.* 2011; 294: 1284-1306.
11. Heeren AM, He N, de Souza AF, Goercharn-Ramlal A, Van Iperen L, Roost MS et al. On the development of extragonadal and gonadal human germ cells. *Biol Open.* 2016; 5: 185-194.
12. Seydoux G, Braun RE. Pathway to totipotency: Lessons from germ cells. *Cell.* 2006; 127: 891-904.