OOCYTE

Egg, Egg Cell, Ovocyte

A female germ cell involved in reproduction.

♀ Reproductive cells  ♂ Female

About Oocyte

Function

An oocyte is a female germ cell involved in reproduction. In other words, it is an immature ovum, or egg cell. It is one of the largest cells in the body (approx. 110µm in diameter) and develops in the ovarian follicle, a specialized unit of the ovary, during the process of oogenesis/folliculogenesis in the cortex.

Because the fate of an oocyte is to become fertilized and ultimately grow into a fully functioning organism, it must be ready to regulate multiple cellular and developmental processes. The oocyte, a large and complex cell, must be supplied with numerous molecules that will direct the growth of the embryo and control cellular activities. As the oocyte is a product of female gametogenesis, the maternal contribution to the oocyte and consequently the newly fertilized egg is enormous. There are many types of molecules that are maternally supplied to the oocyte, which will direct various activities within the growing zygote.

Structure

- **Cytoplasm** - oocytes are rich in cytoplasm, which contains many types of molecules to nourish the cell early in development.
- **Nucleus** - during the primary oocyte stage of oogenesis, the nucleus is called a germinal vesicle.
- **Mitochondria** - the oocyte receives mitochondria from maternal cells, which will go on to control embryonic metabolism and apoptotic events. The partitioning of mitochondria is carried out by a system of microtubules that will localize mitochondria throughout the oocyte.
- **Nucleolus** - a structure found within the nucleus, is the location where rRNA is transcribed and assembled into ribosomes. While the nucleolus is dense and inactive in a mature oocyte, it is required for proper development of the embryo.
- **Ribosomes** - maternal cells also synthesize and contribute a store of ribosomes that are required for the translation of proteins before the zygotic genome is activated.

Development

The process of oogenesis starts in the fetal ovaries with the development of oogonia from primordial germ cells (PGCs).

Oogonia are formed during fetal development, and divide via mitosis, much like spermatogonia in the testis. In other words, primary oocytes reach their maximum development at 20 weeks of gestational age, when approximately seven million primary oocytes have been created; however, at birth, this number has already been reduced to approximately 1-2 million. The process of oogenesis/folliculogenesis is highly regulated by hormones and other substances.

Oocytes are commonly divided into:

- **Primary oocytes (GV + MI)** - dictyate in prophase I for up to 50 years. The oocyte maturation inhibitor (OMI) is an inhibitory factor created by follicular cells during a primary oocyte maturation. It is believed to be the reason why the oocyte remains for so long in the immature dictyate state of meiosis. During the fist dictyate in prophase I (pro-MI) the nucleus takes a special form of a germinal vesicle (GV) (Pic. 1). The breakdown of the
germinal vesicle (GVBD, equivalent to nuclear envelope breakdown in somatic cells) indicates a resumption of meiosis and the extrusion of the first polar body (1 PB) indicates completion of the first meiotic division in human MI oocytes (Pic. 2). Then, the oocytes immediately enter the second meiotic division.

- Secondary oocytes (MI) - halted in metaphase II until fertilization (Pic. 3). Meiosis of a secondary oocyte is completed only if a sperm succeeds in penetrating its barriers. Meiosis II then resumes, producing one haploid ovum that, at the instant of fertilization by a (haploid) sperm, becomes the first diploid cell of the new offspring (a zygote) (Pic. 4) Thus, the ovum can be thought of as a brief, transitional, haploid stage between the diploid oocyte and diploid zygote.

News and future perspectives

It has become a current social trend for women to delay childbearing. However, the quality of oocytes from older females is compromised and the pregnancy rate of older women is lower. With the increased rate of delayed childbearing, it is becoming more and more crucial to understand the mechanisms underlying the compromised quality of oocytes from older women, including mitochondrial dysfunctions, aneuploidy and epigenetic changes (Pic. 5). Establishing proper epigenetic modifications during oogenesis and early embryo development is an important aspect in reproduction. The reprogramming process may be influenced by external and internal factors that result in improper epigenetic changes in germ cells. Furthermore, germ cell epigenetic changes might be inherited by the next generations. Studies suggest that age-related effects, including epigenetic changes, on oocytes might be prevented by diets, medicine or other methods. However, until now we still cannot effectively prevent the age-related deleterious effects on oocytes.

Find more about related issues

Diagnoses

Anorexia Nervosa
An eating disorder characterized by the maintenance of a body weight below average, fear of gaining weight, and a distorted body image. Learn more at: www.fertilitypedia.org/therapy/diag/anorexia-nervosa

Polycystic ovary syndrome
A condition in which a woman has an imbalance of female sex hormones. This may lead to changes in the menstrual cycle, cysts in the ovaries, trouble g. Learn more at: www.fertilitypedia.org/therapy/diag/polycystic-ovary-syndrome

Anovulation
Failure of the ovaries to release an oocyte over a period of time generally exceeding 3 months. Learn more at: www.fertilitypedia.org/therapy/diag/anovulation

Menstrual cycle disorders
An abnormal condition in a woman's menstrual cycle. Learn more at: www.fertilitypedia.org/therapy/diag/menstrual-cycle-disorders

Fallopian tube blockage
An obstruction prevents the egg or sperm from traveling down the tube, thus making fertilization impossible. Learn more at: www.fertilitypedia.org/therapy/diag/fallopian-tube-blockage

Endometriosis
A state in which pieces of the tissue alike to the lining of the uterus (endometrium) grow in other parts of the body. Learn more at: www.fertilitypedia.org/therapy/diag/endometriosis
Turner syndrome
Turner syndrome is a genetic disorder in which a female is partly or completely missing one X chromosome that results in ovarian dysgenesis. Learn more at: www.fertilitypedia.org/therapy/diap/tturner-syndrome

Kallmann syndrome
A genetic condition where the primary symptom is a failure to start puberty or a failure to fully complete puberty. Learn more at: www.fertilitypedia.org/therapy/diap/kallmann-syndrome

Hematosalpinx
Hematosalpinx is a medical condition involving bleeding into the fallopian tube. Learn more at: www.fertilitypedia.org/therapy/diap/hematosalpinx

Uterine malformations
A type of female genital malformation resulting from an abnormal development of the Müllerian duct(s) during embryogenesis. Learn more at: www.fertilitypedia.org/therapy/diap/uterine-malformations

Premature ovarian failure
The loss of function of the ovaries before age 40. Learn more at: www.fertilitypedia.org/therapy/diap/premature-ovarian-failure

Hypogonadism
A medical term which describes a diminished functional activity of the gonads – the testes and ovaries. Learn more at: www.fertilitypedia.org/therapy/diap/hypogonadism

Menopause
The time in most women’s lives when menstrual periods stop permanently, and the woman is no longer able to have children. Learn more at: www.fertilitypedia.org/therapy/diap/menopause

Hydrosalpinx
A hydrosalpinx is an abnormal pouch containing liquid in a fallopian tube. Learn more at: www.fertilitypedia.org/therapy/diap/hydrosalpinx

Pyosalpinx
A distally blocked Fallopian tube filled with pus. Learn more at: www.fertilitypedia.org/therapy/diap/pyosalpinx-do-rf

Pelvic Inflammatory Disease
Infection of the upper part of the female reproductive system and a common complication of some sexually transmitted diseases. Learn more at: www.fertilitypedia.org/therapy/diap/pelvic-inflammatory-disease-do-rf

Amenorrhoea
The absence of a menstrual period in women of reproductive age. Learn more at: www.fertilitypedia.org/therapy/diap/amenorrhoea

Uterine fibroids
The most common benign smooth muscle tumors of the uterus encountered in women of reproductive age. Learn more at: www.fertilitypedia.org/therapy/diap/uterine-fibroids

Ovarian cancer
A type of cancer in which abnormal cells begin to grow in one or both of a woman’s ovaries. Learn more at: www.fertilitypedia.org/therapy/diap/ovarian-cancer
Oligomenorrhea
Light or infrequent menstrual flow at intervals of 39 days to 6 months or 5–7 cycles in a year.
Learn more at: www.fertilitypedia.org/therapy/diag/oligomenorrhea

Tubal ligation
A permanent form of female sterilization, in which the fallopian tubes are severed and sealed or "pinched shut", in order to prevent fertilization.
Learn more at: www.fertilitypedia.org/therapy/diag/tubal-ligation

Ovariectomy
Surgical removal of one or both ovaries.
Learn more at: www.fertilitypedia.org/therapy/diag/ovariectomy

Poor ovarian reserve
A condition of low fertility characterized by low numbers of remaining oocytes in the ovaries or possibly impaired oocyte development or recruitment.
Learn more at: www.fertilitypedia.org/therapy/diag/poor-ovarian-reserve

Hyperprolactinemia
The presence of abnormally high levels of prolactin in the blood.
Learn more at: www.fertilitypedia.org/therapy/diag/hyperprolactinemia

Luteinised unruptured follicle syndrome
The luteinisation of ovulatory follicle without a release of an oocyte.
Learn more at: www.fertilitypedia.org/therapy/diag/luteinised-unruptured-follicle-syndrome

Tubal phimosis
The type of blockage that affects the part of the fallopian tube end towards the ovary.
Learn more at: www.fertilitypedia.org/therapy/diag/tubal-phimosis

Sertoli cell-only syndrome
The absence of any developmental stage of sperm cell in the testes.
Learn more at: www.fertilitypedia.org/therapy/diag/sertoli-cell-only-syndrome

Hysterectomy
A surgery performed to remove a woman's uterus.
Learn more at: www.fertilitypedia.org/therapy/diag/hysterectomy

Organ
Ovary
The ovum-producing organs of the internal female reproductive system.
Learn more at: www.fertilitypedia.org/edu/organisms/ovary

Reproductive functions
Fertilization
The fusion of an ovum with a sperm to initiate the development of a new individual organism.
Learn more at: www.fertilitypedia.org/edu/reproductive-functions/fertilization
Selected factors of older women's inducing epigenetic changes in aged oocytes.

Sources

“Anatomy and Physiology of the Female Reproductive System” —sourced from OpenStax College licensed under CC BY 4.0 Download for free at http://cnx.org/content/col11496/latest/

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