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MEDICINE AND SURGERY

200 LEVEL

EMBRYOLOGY

1. OVULATION

This is the release of an oocyte from the ovarian follicle. Ovulation is triggered by a surge of LH production, ovulation usually follows the LH peak by 12 to 24 hours. Under influence of FSH and LH, around mid-cycle or 14 days, the follicle grows rapidly producing a bulge or cystic swelling on the ovarian surface, and a small oval avascular spot, the stigma, is seen on the swelling. Before ovulation, the oocyte and some cells of the cumulus oophorus detach from the inside of the distended follicle. At ovulation, there is a "surge" of LH release, the stigma balloons out, forming a surface vesicle, then it ruptures, expelling the oocyte with follicular fluid. The oocyte is covered by the zona pellucida and one or more layers of follicular cells which radially arrange themselves as the corona radiata. Signs of ovulation include mittelschmerz or intermenstrual pain and basal body temperature rise (slightly). Although the time; between ovulation and succeeding menstrual bleeding is constant, the time between ovulation and the preceding menstruation is highly variable and depends on how long the follicle needs to mature; one cycle of maturation may need more time than another.

2. DIFFERENCES BETWEEN MEOSIS 1 AND MEOSIS 2

MEOSIS 1	MEOSIS 2
Starts as diploid; ends as haploid	Starts as haploid; ends as haploid
Reductive division	Equational division
Homologous chromosome pairs separate	Sister chromatids separate
Crossing over happens	Crossing over does not happen
Complicated division process	Simple division process
Long duration	Short duration
Preceded by S-phase and G-phase	Preceded only by G-phase
Sister chromatids in prophase have convergent arms	Sister chromatids in prophase have divergent arms
Equatorial plane is centered	Equatorial plane is rotated 90°
Prophase split into 5 sub-phases	Prophase does not have sub-phases
Ends with 2 daughter cells	Ends with 4 daughter cells

3. STAGES INVOLVED IN FERTILIZATION
    I. Passage of sperm through the corona radiata: Sperms must be capacitated to pass through the corona radiata.
    II. Penetration of the zona pellucida: For fertilisation to occur, a spermatozoon needs to cross the zona pellucida (ZP), which is a glycoprotein layer surrounding the

oocyte. Crossing the ZP requires an acrosome reaction (AR) where enzymes released from the spermatozoon head locally digest and soften the ZP so that the spermatozoon can penetrate deeper. Here, a biomechanical sperm-oocyte interaction model that considers the AR using the finite element method was formulated. This modelling is used to determine which of the following factors directly contribute to the crossing of the ZP: local ZP softening by AR, sperm head shape, ZP hardening elsewhere than in the AR site, ZP thickness and sperm hyperactivation (more flagellar beating). It has been found that an AR softening the ZP to over one-tenth of its basal stiffness is important for successful sperm penetration, and that 'sharper' heads have a biomechanical advantage in penetrating deeper.

III. Fusion of plasma membrane of the sperm and oocyte: The plasma membrane of the sperm is left behind while the head and tail enter into the cytoplasm of the oocyte.

IV. Completion of the 2nd meiotic division and formation of female pronucleus: 2nd meiotic division is completed to produce the mature oocyte and 2nd polar body. The nucleus of the mature oocyte is called the female pronucleus.

V. Formation of male pronucleus: Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form male pronucleus and the tail degenerates. The oocyte containing 2 haploid pronuclei is called an ootid.

VI. The 2 pronuclei fuse into a single diploid aggregation of chromosomes, the ootid becomes a zygote.

4. DIFFERENCES BETWEEN MONOZYGOTIC TWINS AND DIZYGOTIC TWINS

MONOZYGOTIC TWINS	DIZYGOTIC TWINS
Formed from a single zygote	Formed from 2 zygotes
Incidence is less common	Incidence is more common
Genetically identical	Genetically unidentical
Twins are of the same sex	Twins may be of the same sex or different sexes
They look alike	They do not look alike
Mostly diamniotic, monochorionic, with single placenta	Mostly diamniotic, dichorionic, with two placentas
Formed by fertilization of one oocyte by one sperm	Formed by fertilization of two oocytes by two sperms
Conjoined twins ae monozygotic	Conjoined twins are not dizygotic