Fertilization, development, and birth
Lecture #11
Biology 307
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Outline

- Fertilization
- Development before Birth
  - Fetal Circulation
- Embryonic Development
- Fetal Development
- Birth
- Development after Birth
- Aging

Fertilization

- Steps of fertilization.
  - Several sperm penetrate corona radiata.
  - Several sperm attempt to penetrate zona pellucida.
  - One sperm enters egg and nuclei fuse, producing a zygote.
  - Egg’s plasma membrane and zona pellucida change to prevent polyspermy.
Fertilization

Occurrence of Pregnancy

- When a zygote begins dividing, it is termed an **embryo**.
  - Developing embryo travels down oviduct and eventually implants in endometrium.
    - Presence of human gonadotropin hormone in the blood confirms pregnancy.
    - If implantation does not occur, a woman never knows fertilization took place.
Human Development before Implantation

Development before Birth

- Processes of development.
  - Cleavage - Cell division without growth.
  - Morphogenesis - Shaping of embryo.
  - Differentiation - Cells take on specific structure and function.
  - Growth - Increase in size of cells.
Development before Birth

- Stages of development.
  - Morula - Solid mass of cells resulting from cleavage.
  - Blastocyst - Ball of cells formed from morula.
    - Embryonic disk - Inner mass of cells of blastocyst.
  - Gastrula - Embryo composed of three tissues.
    - Ectoderm, mesoderm, endoderm.
Development before Birth

- Stages of development.
  - Neurula - Nervous system develops from ectoderm located just above the notochord.
    - Involves induction as one tissue influences the development of another tissue.

Primitive Streak and Neurula
Extraembryonic Membranes

- Membranes that extend out beyond the embryo.
  - Amnion - Provides fluid environment for developing embryo and fetus.
  - Yolk sac - First site of red blood cell formation.
  - Allantois - Contributes to cardiovascular system.
Fetal Circulation

- The **umbilical cord** stretches between the placenta and the fetus and contains the umbilical arteries and veins.
  - Exchange of gases and nutrients between maternal and fetal blood takes place in the umbilical arteries.
  - Umbilical vein carries blood and oxygen away from the placenta to the fetus.
Embryonic Development

- **Embryonic development** occurs from the second week to the eighth week.
- **Fetal development** occurs from the third month through the ninth month.

Embryonic Development

- Immediately after fertilization, the embryo divides and develops into a blastocyst.
  - Bounded by a layer of cells that becomes the chorion.
- Implantation completed by the end of the second week.
- Embryo is a gastrula by the end of the third week.
- Placenta is forming by end of fourth week.
Embryonic Development

- By the end of the second month, all organs have appeared and the placenta is fully functioning.
  - Embryonic development complete.
Five-Week-Old Embryo

Fetal Development

- At the beginning of the third month, head growth begins to slow and the body increases in length.
- Ossification centers appear in bones.
- Sex can be determined sometime in the third month.
Three-to-Four Month-Old Fetus

Fifth through Seventh Months

- Mother begins to feel fetal movement.
- Wrinkled skin covered by fine hair, **lanugo**, is covered by a greasy substance **vernix caseosa**.
- Lungs lack surfactant.
Six-Month-Old-Fetus

Eighth and Ninth Months

- Fetus usually rotates so head is pointed down toward cervix.
- Fetus is now about 530 mm in length and weighs about 3,400 g.
- Full-term babies have the best chance of survival.
Development of Male and Female Sex Organs

- Sex of an individual is determined at the moment of fertilization.
  - Gonads arise from indifferent tissue that can develop into ovaries or testes, depending on the action of hormones.
    - In the absence of a Y chromosome and in the presence of two X chromosomes, ovaries develop instead of testes.

Birth

- True labor is marked by uterine contractions that occur regularly every 15-20 minutes and last for 40 seconds or more.
  - Positive feedback control.
- Parturition.
  - Stage 1.
    - Mucous plug may be expelled from cervical canal.
    - Cervix dilates completely.
Birth

- Stage 2.
  - Baby’s head descends into the vagina.
  - Baby is delivered.
- Stage 3.
  - Placenta delivered.

Stages of Parturition

a. 9-month-old fetus
b. First stage of birth: cervix dilates

c. Second stage of birth: baby emerges
d. Third stage of birth: expelling afterbirth
Female Breast and Lactation

- Female breast contains 15-20 lobules, each with a milk duct beginning at the nipple and ending in alveoli.
  - In pregnancy, breasts enlarge as ducts and alveoli increase in number and size.
    - Milk usually not produced during pregnancy.
      - Prolactin suppressed due to increase in estrogen and progesterone.
      - Suckling stimulates release of oxytocin.

Female Breast Anatomy
Development after Birth

- Aging encompasses progressive changes that contribute to an increased risk of infirmity, disease, and death.
  - Theories.
    - Genetic in Origin.
    - Whole-Body Process.
    - Extrinsic Factors.

Effect of Age on Body Systems

- Skin.
  - Skin becomes less elastic due to changes in elastic fibers.
- Processing and transporting.
  - Heart shrinks due to a reduction in cardiac muscle.
  - Blood pressure gradually increases.
  - Liver not as efficient in metabolizing drugs.
  - Blood supply to kidneys reduced.
Effect of Age on Body Systems

- **Integration and coordination.**
  - Few neural cells of the cerebral cortex are lost during the aging process.
  - Reaction time slows.
  - Loss of skeletal muscle mass not uncommon.

- **Reproductive system.**
  - Females undergo menopause.
  - Male androgen levels fall between ages 50-90, but sperm produced until death.

Review

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