Human Development

Gametogenesis

egg and sperm are formed by meiosis

Fertilization

few sperm cells actually make it to the egg

fresh sperm cannot fertilize egg

must undergo capacitation; takes ~10 hours

when sperm contacts eggs membrane, acrosome

secretes enzymes that digest hole so head of sperm can enter egg

egg prevents more than 1 sperm from penetration:

egg generates a fertilization membrane that pushes other sperm away

upon fertilization, egg completes meiosis II

then chromosomes of egg and sperm mix to produce a zygote

46 chromosomes

mitosis begins

Stages of Human Development

Human gestation last an average of 266 days (38 weeks)

since date of conception isn’t usually known time is measured from 1st day of last menstrual period

birth is predicted to occur 40 weeks (280 days) past then

Duration of Pregnancy

is divided in 3 month intervals called trimesters

1st trimester

fertilization 1st month of fetal life

stress, drugs and nutritional deficiencies are most threatening during this time
2\textsuperscript{nd} trimester
weeks 13 – 24
organs complete most of their development
infants born near end of this period have some chance of survival

3\textsuperscript{rd} trimester
week 25 to birth

Developmental Landmarks

1. Preembryonic Stages
2. Embryonic Stages
3. Fetal Stages

1. Preembryonic Stages

Cleavage
mitotic divisions occur in 1\textsuperscript{st} 3 days after fertilization

1\textsuperscript{st} cleavage occurs in about 30 hrs after fertilization

each cell \(\equiv\) blastomere
\(=\) all cells are identical

Morula
by \(\sim\)72 hrs, reaches uterus, is a morula
\(=\) solid ball of about 16 or more cells

no larger than original zygote

morula lies free in uterus for \(\sim\)4-5 days and continues to divide into \(\sim\)100 cell blastocyst

Blastocyst

blastocyst is hollow \(\equiv\) internal cavity = blastocoel

wall = trophoblast \(\equiv\) will help form placenta

thickened clump of cells = inner cell mass
will become embryo and membranes

Implantation
~6 days after fertilization, blastocyst begins to implant in **endometrium**

implantation takes ~ 1 week

~1 in 300 pregnancies blastocyst implants somewhere other than in the uterus
most cases are tubal pregnancies
‡ if not detected can rupture and kill the mother

**Primitive Streak**

while implantation occurs:

inner cell mass separates into 2 cell layers
  - epiblast
  - hypoblast

a groove forms along surface = **primitive streak**

cells migrate into this streak and form a 3\(^{rd}\) cell layer between the 1\(^{st}\) 2

at this point the embryo consists of three **primary germ layers:**
  - ectoderm
  - mesoderm
  - endoderm

once the 3 germ layers are formed = **embryo**

2. **Embryonic Stages**

once blastodisc is fully implanted in the uterine lining it is called an **embryo**

begins about day 16

**organogenesis** one of main processes; eg:

**neurulation**: ‡ formation of neural tube

**pharyngeal pouches**: ‡ give rise to middle ear, tonsils, thymus, some other glands

**somites**: ‡ vertebrae, ribs, spinal nerves and trunk muscles

**Embryonic Membranes**
amnion
yolk sac
allantois
chorion

Placenta

functions of placenta:
  fetal nutrition
  excretion
  respiration
  endocrine
  immunity

3. Fetal Stages

at end of 8 weeks, organism is ~ 3 cm long, all organs are in place
  = fetus

main changes that occur now are rapid growth

50% of growth occurs in last 10 weeks

Disorders related to Development

Miscarriage

most miscarriages are early spontaneous abortions
  ✽ easily mistaken for a late or heavy menstrual period

estimates:
  25-30% of blastocysts fail to implant
  42% of implanted blastocysts die by the end of the 2nd week

16% of those that make it through 2 weeks are
  seriously abnormal and abort within the next week

61% of early spontaneous abortions were due to
  chromosomal abnormalities

Birth Defects

study of birth defects = teratology

by 2 yrs ✽ 6% of children are diagnosed with congenital abnormalities
by age 5 : 8%

causes of birth defects:
   1. genetic anomalies
   2. teratogens
   3. unknown causes

1. genetic anomalies

   33% of all cases of birth defects are due to genetic anomalies

2. teratogens

   defects caused by: viruses and other infectious diseases, radiation, drugs, chemicals,

   greatest vulnerability is between weeks 3 and 8
   ✦ different organs have different critical periods

       eg. limbs: exposure between 24 – 36 days
       eg. brain: exposure between 3-16 weeks

3. unknown causes

   in 50-60% of these cases the cause is unknown