03 Overview of Prenatal Development

- Prenatal development
- Preimplantation period
- Embryonic period
- Fetal period
Prenatal development

- Begins with the start of pregnancy and continues until the birth
- Preimplantation period, Embryonic period, Fetal period
- Developmental disturbances $\rightarrow$ congenital malformation, birth defect

<table>
<thead>
<tr>
<th>Table 3-2</th>
<th>Known Teratogens Involved in Congenital Malformations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drugs</strong></td>
<td>Ethanol, tetracycline, phenytoin(dilantin), lithium, ethotrexate, aminopterin, diethylstilbestrol, warfarin, thalidomide, isotretinoin(retinoic acid), androgens, progesterone</td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
<td>Methylmercury, polychlorinated biphenyls</td>
</tr>
<tr>
<td><strong>Infections</strong></td>
<td>Rubella virus, herpes simplex virus, human immunodeficiency virus, syphilis spirochete</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
<td>High level of ionizing type*</td>
</tr>
</tbody>
</table>
## Table 3-1: Periods of Prenatal Development

<table>
<thead>
<tr>
<th>Structure(s) present</th>
<th>PREIMPLANTATION PERIOD</th>
<th>EMBRYONIC PERIOD</th>
<th>FETAL PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zygote</td>
<td>Fertilization and implantation</td>
<td>Blastocyst to disc to embryo</td>
<td>Embryo to fetus</td>
</tr>
<tr>
<td>Blastocyst</td>
<td></td>
<td>Disc to embryo</td>
<td></td>
</tr>
</tbody>
</table>

### Description of period

- **Fertilization and implantation**
- **Induction, proliferation, differentiation, morphogenesis, and maturation to form structures**
- **Maturation of existing structures**
Preimplantation period

- The first week after conception, Fertilization ~ implantation
- Zygote $\rightarrow$ Blastocyst
- Implantation
- Blastocyst = trophoblast layer + embryoblast layer

**Developmental disturbances during preimplantation period**
- Down syndrome
- Ectopic pregnancy
From ovulation to implantation

Day 1: Fallopian tube, Zygote, Ovulated secondary oocyte

Day 0: Ovary, Endometrium

Day 2: 2 cells, 4 cells

Day 3: Morula

Day 4: Inner cell mass, Blastocyst implants Day 7

Uterus, Embryo

Embryonic time:
- E0.5: 2-cell
- E1.5: 4-cell
- E2.5: 8-cell
- E3.0: 8-cell compacted morula
- E3.25: 16-32 cell
- E3.5: 32-64 cell
- E4.5: >100 cell
1. Egg retrieval (day 0)
2. In vitro fertilization
3. Mature egg
4. Fertilized egg
5. 2-cell Embryo transfer (day 2)
6. 4-cell
7. 8 cell
8. Morula
9. Blastocyst transfer (day 5)
Embryonic period

- 2~8 weeks

- Developmental processes
  - Induction
  - Proliferation
  - Differentiation
  - Morphogenesis
  - Maturation

- Implanted blastocyst → fetus
<table>
<thead>
<tr>
<th>PROCESS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction</td>
<td>Action of one group of cells on another that leads to the establishment of</td>
</tr>
<tr>
<td></td>
<td>the developmental pathway in the responding tissue</td>
</tr>
<tr>
<td>Proliferation</td>
<td>Controlled cellular growth and accumulation of byproducts</td>
</tr>
<tr>
<td>Differentiation</td>
<td>Change in identical embryonic cells to become distinct structurally and</td>
</tr>
<tr>
<td></td>
<td>functionally</td>
</tr>
<tr>
<td>Morphogenesis</td>
<td>Development of specific tissue structure or differing form due to embryonic</td>
</tr>
<tr>
<td></td>
<td>cell migration and inductive interactions</td>
</tr>
<tr>
<td>Maturation</td>
<td>Attainment of adult function and size due to proliferation, differentiation,</td>
</tr>
<tr>
<td></td>
<td>and morphogenesis</td>
</tr>
</tbody>
</table>
Embryonic period

Second week

- Embryonic cell layer
- Bilaminar embryonic disc
- Epiblast layer
- Hypoblast layer
- Amniotic cavity
- Yolk sac
- Placenta
Embryonic period

Third week

- Primitive streak
- Mesenchyme
- Mesoderm
- Trilaminar embryonic disc
- Ectoderm
- Endoderm
- Cephalic end
- Oropharyngeal membrane
- Caudal end
- Cloacal membrane
- Central nervous system, CNS
- Neuroectoderm
- Neural plate
- Neural groove
- Neural fold
- Neural tube
- Neural crest cells
- Somites
FIGURE 3-7 Bilaminar embryonic disc with primitive streak resulting in bilateral symmetry.
## Table 3-4 Development of Embryonic Cell Layers

<table>
<thead>
<tr>
<th></th>
<th>ECTODERM</th>
<th>MESODERM</th>
<th>ENDODERM</th>
<th>NEURAL CREST CELLS*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Epiblast layer</td>
<td>Migrating cells from epiblast layer</td>
<td>Hypoblast layer</td>
<td>Migrating neuroectoderm</td>
</tr>
<tr>
<td><strong>Morphology of the structure</strong></td>
<td>Columnar</td>
<td>Varies</td>
<td>cuboidal</td>
<td>varies</td>
</tr>
<tr>
<td><strong>Future systemic tissues</strong></td>
<td>Epidermis; sensory epithelium of the eyes, ears, nose, nervous system, and neural crest cells; mammary and cutaneous glands</td>
<td>Dermis, muscle, bone, lymphatics, blood cells and bone marrow, cartilage, reproductive and excretory organs</td>
<td>Respiratory and digestive system linings, liver and pancreatic cells</td>
<td>Components of nervous system pigment cells, connective tissue proper, cartilage, bone, and certain dental tissues</td>
</tr>
</tbody>
</table>
Embryonic period

Fourth week

- Embryonic folding
- foregut, midgut, hindgut

**Developmental disturbances during the embryonic period**
- Infective Teratogens: rubella virus, syphilis spirochete
- Teratogenic Drug: fetal alcohol syndrome
- Environmental Teratogen: high level of radiation
- Nutritional and environmental factors: spina bifida
Fetal period

- Ninth week (third month) ~ ninth month
- Embryo → fetus
- Maturation
- Physiological process of maturation of the tissue and organs

**Developmental disturbances during the fetal period**
- Amniocentesis
- Amniotic fluid is sampled during the fourteenth to sixteenth weeks after the last missed menstrual period