Core Curriculum in Perinatal Pathology

Chapter 2

Early development of the embryo

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Early development
Prefertilization events
   Sexual reproduction
   Chromosomes
      The X chromosome
      The Y chromosome
   Meiosis
      Meiosis I
      Meiosis II
   Oogenesis – formation of the female gamete
   Spermatogenesis – formation of the male gamete
Fertilization
   Phases of fertilization
      Passage of sperm through corona radiata
      Penetration of zona pellucida
      Fusion of plasma membranes of the oocyte and sperm
      Completion of the 2nd meiotic division
      Formation of the male pronucleus
Cleavage
Formation of the blastocyst
Objectives

The purpose of this chapter is to review the early stages of human development.

1) Formation and maturation of the male and female gametes
2) The basic terminology of chromosomes and cell division
3) Fertilization
4) First week of embryonic development:
   a. Cleavage
   b. Formation of the morula
   c. Formation of the blastocyst

Early development

Human development begins at fertilization but several important events happen before union of the oocyte and sperm occurs (HANDEL, ET AL., 1997).

Oocytes are produced by the ovary (oogenesis) and expelled from it during ovulation (Fig. 2-1; Table 2.1) (SCOTT, ET AL., 1990; BUKOVSKY, ET AL., 2005). The fimbriae of the fallopian tube transport the oocyte into the ampulla where it may be fertilized. Sperms are produced in the testes (spermatogenesis) and are stored in the epididymis (Fig. 2-2; Table 2.2) (VEECK, ET AL., 2000; WYLIE, ET AL., 2000; GASSEI, ET AL., 2007; BONILLA, ET AL., 2008).

Ejaculation of semen during sexual intercourse results in the deposit of millions of sperms in the vagina around the external uterine os. Several hundred sperms pass through the uterus and enter the fallopian tubes. Many of them surround the secondary oocyte if it is present.
**Figure 2-1.** Human ovary showing various stages of ovum maturation.
1) Primary (Primordial) follicle. 2) Double layered follicle. 3) Follicle with beginning of antrum formation. 4) Follicle approaching to maturity. 5) Mature follicle. 6) Discharged ovum. 7) Mature corpus luteum. 8) Regressing corpus luteum. 9) Corpus albicans.
FIGURE 2-2. Spermatogenesis showing the associated chromosomal changes.
(n: the amount of DNA, c: Ploidy or the number of chromosomes)
TABLE 2-1. **Oogenesis.**

<table>
<thead>
<tr>
<th>AGE</th>
<th>FOLLICULAR HISTOLOGY</th>
<th>MEIOTIC EVENTS IN OVUM</th>
<th>CHROMOSOMAL COMPLEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FETAL PERIOD</strong></td>
<td>No follicle</td>
<td>Oogonium</td>
<td>44 + XX</td>
</tr>
<tr>
<td><strong>BEFORE OR AT BIRTH</strong></td>
<td>Primordial follicle</td>
<td>Primary oocyte – meiosis in progress</td>
<td>44 + XX</td>
</tr>
<tr>
<td><strong>AFTER BIRTH</strong></td>
<td>Primary follicle</td>
<td>Primary oocyte – Arrested in diplotene stage of 1st meiotic division</td>
<td>44 + XX</td>
</tr>
<tr>
<td><strong>AFTER PUBERTY</strong></td>
<td>Secondary follicle</td>
<td>Primary oocyte</td>
<td>44 + XX</td>
</tr>
<tr>
<td></td>
<td>Tertiary follicle</td>
<td>1st meiotic division completed, beginning of 2nd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ovulated ovum</td>
<td>Secondary oocyte and polar body I</td>
<td>22 + X</td>
</tr>
<tr>
<td></td>
<td>Fertilized ovum</td>
<td>Ovulation</td>
<td></td>
</tr>
</tbody>
</table>

END OF CHAPTER SAMPLE