GAMETOGENESIS IN MAMMALS

Q. Are primordial germ cells and spermatogonia the same cells? Q.What are the PGCs?

i)Primordial germ cells are highly specialised cells that are precursors of gametes, which, following meiosis, develop as haploid sperm and eggs that generate a new organism upon fertilisation. They transmit genetic and epigenetic information between generations and ensure the survival of a species.

ii)The precursor of spermatogonia or oogonia is a **primordial germ cell** that differentiated from germinal epithelial tissue. Both are diploid cells that divide mitotically while the primary spermatocyte or oocyte are the ones that divide meiotically and become haploid cells.

Q.What is DAZL protein?

i)The DAZ (Deleted in AZoospermia) gene family encodes potential RNA binding proteins that are expressed in prenatal and postnatal germ cells of males and females.

ii)The protein encoded by this gene is localized to the nucleus and cytoplasm of fetal germ cells and to the cytoplasm of developing oocytes.

iii)In the testis, this protein is localized to the nucleus of spermatogonia but relocates to the cytoplasm during meiosis where it persists in spermatids and spermatozoa.

iv)**Transposition** and **amplification** of this autosomal gene during *primate evolution gave rise* to the DAZ gene cluster on the Y chromosome. Mutations in this gene have been linked to severe spermatogenic failure and infertility in males.

In mice and pigs deficient in DAZL, PGCs migrate to the gonad but do not undertake germ cell determination, and may instead produce germ cell tumors.

Q. What role do germ cells play in gametogenesis?

i)The PGCs that migrate to the gonads and the first process that has to happen is that the germ cells become **competent** to respond to the gonad's signals.

ii)This "licensing" of sexual choice is permitted by **DAZL protein**, which appears to regulate mRNA translation (Gill et al. 2011). If DAZL protein is not made, the PGCs migrate to the gonad but do not develop either male or female phenotypes, **instead remaining as PGCs.**

The signals from the gonad create profound differences between spermatogenesis and oogenesis in mammals.

Q.State sexual dimorphism in mammalian meiosis.

Oogenesis	Spermatogenesis
Meiosis initiated once in a finite population of cells	Meiosis initiated continuously in a mitotically dividing stem cell population
One gamete produced per meiosis	4 gametes produced per meiosis
Completion of meiosis delayed for months or years	Meiosis completed in days or weeks
Meiosis at first meiotic prophase and reinitiated in a smaller population of cells	Meiosis and differentiation proceed continuously without cell cycle arrest
Differentiation of gametes occurs while diploid, in 1st meiotic prophase	Differentiation of gametes occur while haploid, after meiosis ends
All chromosomes exhibit equivalent transcription and recombination during meiotic prophase	Sex chromosome excluded from recombination and transcription during first meiotic prophase

Q.What is the role of retinoic acid in early embryogenesis?

Retinoic acid (RA) is a morphogen derived from retinol (vitamin A) that plays important roles in cell growth, differentiation, and organogenesis. The production of RA from retinol requires two consecutive enzymatic reactions catalyzed by different sets of dehydrogenases. The retinol is first oxidized into retinal, which is then oxidized into RA. The RA interacts with retinoic acid receptor (RAR) and retinoic acid X receptor (RXR) which then regulate the target gene expression during early embryonic development.

Q.What is the role of Wnt4? Female germ cells are essential for organogenesis of the ovary; without them, ovarian follicles do not form and functional and structural characteristics of the ovary are lost. Wnt4 or β-catenin was inactivated in the fetal ovary, female germ cells underwent degeneration.