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1. Spermatogenesis is the process of the gradual transformation of germ cells into spermatozoa. It occurs mainly within the seminiferous tubules of the testes and can be divided into three phases, each of which is associated with different germ cell types:

Proliferative phase: spermatogonia → spermatocytes

Meiotic phase: spermatocytes → spermatids

Differentiation phase (also known as spermiogenesis): spermatids → spermatozoa

Unlike the female production of gametes which occurs entirely before birth, with gamete maturation occurring in a pulsatile fashion after puberty, males produce gametes continuously from puberty onwards for the rest of their reproductive lives and the release of the gametes is constant.

The seminiferous tubules are the site of spermatogenesis. The two main cell types within the tubules involved in spermatogenesis are the germ cells, which will develop into sperm, and somatic cells known as Sertoli cells, which nuture the germ cells throughout the development process.

As the germ cells progress through their stages of development they move slowly from the basement membrane of the tubules through the tight junctions between the Sertoli cells into the tubular lumen.

For humans, the entire process of spermatogenesis is variously estimated as taking 74 days (according to tritium-labelled biopsies) and approximately 120 days (according to DNA clock measurements). Including the transport on ductal system, it takes 3 months. Testes produce 200 to 300 million spermatozoa daily.However, only about half or 100 million of these become viable sperm

Stages of spermatogenesis

Proliferation phase

Stem or A spermatogonia located in the basal region of the tubular epithelium undergo mitosis. The progeny of these divisions maintain their own numbers as well as giving rise to several interconnected B spermatogonia (the number of these arising from a single A spermatogonia is species dependent). B spermatogonia divide to give rise to primary (1o) spermatocytes. All descendants of a B spermatogonium remain connected by cytoplasmic bridges, forming a syncytium - like cell clone which undergoes synchronous development.

Meiotic phase

Each 1o spermatocyte divides to give rise to two short-lived secondary (2o) spermatocytes, which in turn give rise to two spermatids each. The spermatids contain a haploid number of chromosomes (half the number of a somatic cell). 1o spermatocytes are the largest cells in the spermatogenic series and are located approximately midway within the seminiferous epithelium.

The process of meiosis occurs over a long period, with prophase of the first meiotic division taking up to three weeks

Differentiation phase

This phase is also known as spermiogenesis.

Spermatids undergo transformation into spermatozoa. Many changes occur within the cells, the three major ones being:

i) formation of the acrosome, which covers the cranial part of the head. The acrosome will contain hydrolytic enzymes to allow fusion of sperm and egg for fertilisation.

ii) condensation of nuclear chromatin in the head to form a dark-staining structure

iii) growth of the tail opposite the acrosome, and loss of excess cytoplasmic material which is shed as a residual body. The body is phagoctosed by the Sertoli cells.

The morphological changes occurring during this process can be seen if sections of different seminiferous tubules are examined.

Hormonal Control of spermatogenesis

Spermatogenesis is controlled by a complex feedback mechanism involving the hypothalamus, anterior pituitary and testes. Gonadotrophic releasing hormone (GnRH) is released by the hypothalamus in a pulsatile manner and travels through portal vessels to the anterior pituitary, where it acts of the gonadotrophic cells. These cells respond to the stimulation by producing either follicle stimulating hormone (FSH) or luteinising hormone (LH) depending on the pattern of GnRH secretion.

LH and FSH travel in the bloodstream to the testes, where LH acts on the Leydig cells to stimulate them to convert steroids to testosterone and other androgens, which in turn contribute to the stimulation of Sertoli cells.

FSH acts on the receptors of Sertoli cells and, in combination with testosterone, stimulates many functions, including synthesis and secretion of oestrogen, inhibin and many other products, meiosis, spermatocyte maturation and Leydig cell function.

Inhibin, testosterone and oestrogen feedback negatively on the anterior pituitary and hypothalamus to suppress secretion of gonadotrophic hormones

5. Male infertility is any health issue in a man that lowers the chances of his female partner getting pregnant.

About 13 out of 100 couples can't get pregnant with unprotected sex. There are many causes for infertility in men and women. In over a third of infertility cases, the problem is with the man. This is most often due to problems with his sperm production or with sperm delivery.

What Happens Under Normal Conditions?

The man's body makes tiny cells called sperm. During sex, ejaculation normally delivers the sperm into the woman's body.

The male reproductive system makes, stores, and transports sperm. Chemicals in your body called hormones control this. Sperm and male sex hormone (testosterone) are made in the 2 testicles. The testicles are in the scrotum, a sac of skin below the penis. When the sperm leave the testicles, they go into a tube behind each testicle. This tube is called the epididymis.

Just before ejaculation, the sperm go from the epididymis into another set of tubes. These tubes are called the vas deferens. Each vas deferens leads from the epididymis to behind your bladder in the pelvis. There each vas deferens joins the ejaculatory duct from the seminal vesicle. When you ejaculate, the sperm mix with fluid from the prostate and seminal vesicles. This forms semen. Semen then travels through the urethra and out of the penis.

Male fertility depends on your body making normal sperm and delivering them. The sperm go into the female partner's vagina. The sperm travel through her cervix into her uterus to her fallopian tubes. There, if a sperm and egg meet, fertilization happens.

The system only works when genes, hormone levels and environmental conditions are right.

**Causes**

Making mature, healthy sperm that can travel depends on many things. Problems can stop cells from growing into sperm. Problems can keep the sperm from reaching the egg. Even the temperature of the scrotum may affect fertility. These are the main causes of male infertility:

Sperm Disorders

The most common problems are with making and growing sperm. Sperm may:

not grow fully

be oddly shaped

not move the right way

be made in very low numbers (oligospermia)

not be made at all (azoospermia)

Sperm problems can be from traits you're born with. Lifestyle choices can lower sperm numbers. Smoking, drinking alcohol, and taking certain medications can lower sperm numbers. Other causes of low sperm numbers include long-term sickness (such as kidney failure), childhood infections (such as mumps), and chromosome or hormone problems (such as low testosterone).

Damage to the reproductive system can cause low or no sperm. About 4 out of every 10 men with total lack of sperm (azoospermia) have an obstruction (blockage). A birth defect or a problem such as an infection can cause a blockage.

Varicoceles

Varicoceles are swollen veins in the scrotum. They're found in 16 out of 100 of all men. They are more common in infertile men (40 out of 100). They harm sperm growth by blocking proper blood drainage. It may be that varicoceles cause blood to flow back into your scrotum from your belly. The testicles are then too warm for making sperm. This can cause low sperm numbers.

Retrograde Ejaculation

Retrograde ejaculation is when semen goes backwards in the body. They go  into your bladder instead of out the penis. This happens when nerves and muscles in your bladder don't close during orgasm (climax). Semen may have normal sperm, but the semen cannot reach the vagina.

Retrograde ejaculation can be caused by surgery, medications or health problems of the nervous system. Signs are cloudy urine after ejaculation and less fluid or "dry" ejaculation.

Immunologic Infertility

Sometimes a man's body makes antibodies that attack his own sperm. Antibodies are most often made because of injury, surgery or infection. They keep sperm from moving and working normally. We don't know yet exactly how antibodies lower fertility. We do know they can make it hard for sperm to swim to the fallopian tube and enter an egg. This is not a common cause of male infertility.

Obstruction

Sometimes sperm can be blocked. Repeated infections, surgery (such as vasectomy), swelling or developmental defects can cause blockage. Any part of the male reproductive tract can be blocked. With a blockage, sperm from the testicles can't leave the body during ejaculation.

Hormones

Hormones made by the pituitary gland tell the testicles to make sperm. Very low hormone levels cause poor sperm growth.

Chromosomes

Sperm carry half of the DNA to the egg. Changes in the number and structure of chromosomes can affect fertility. For example, the male Y chromosome may be missing parts.

Medication

Certain medications can change sperm production, function and delivery. These medications are most often given to treat health problems like:

arthritis

depression

digestive problems

infections

high blood pressure

cancer

Diagnosis

Causes of male fertility can be hard to diagnose. The problems are most often with sperm production or delivery. Diagnosis starts with a full history and physical exam. Your health care provider may also want to do blood work and semen tests.

Treatment

Treatment depends on what's causing infertility. Many problems can be fixed with drugs or surgery. This would allow conception through normal sex. The treatments below are broken into 3 categories:

Non-surgical therapy for Male Infertility

Surgical Therapy for Male Infertility

Treatment for Unknown Causes of Male Infertility