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Spermaogenesis

Spermaogenesis is the process by which spermatids become matured spermatozoa.

Changes taking place during spermeogenesis:

i. Condensation of nuclear material

ii. Formation of acrosome, mitochondrial spiral filament and tail structures

iii. Removal of extraneous (extra volume of nonessential) cytoplasm.

Spermination

Spermination is the process by which the matured sperms are released from Sertoli cells into the lumen of seminiferous tubules.

FACTORS AFFECTING SPERMATOGENESIS

Spermatogenesis is influenced by:

1. Sertoli cells

2. Hormones

3. Other factors.

1. Role of Sertoli Cell in Spermatogenesis .Sertoli cells influence spermatogenesis by:

i. Supporting and nourishing the germ cells

ii. Providing hormonal substances necessary for

spermatogenesis

iii. Secreting androgen-binding protein (ABP), which is essential for testosterone activity, particularly on spermatogenesis

iv. Releasing sperms into the lumen of seminiferous tubules (spermination).

2. Role of Hormones in Spermatogenesis

Spermatogenesis is influenced by many hormones, which act either directly or indirectly: gives the hormones essential for each stage of spermatogenesis.

Hormones necessary for spermatogenesis are:

i. Follicle-stimulating hormone (FSH)

ii. Testosterone

iii. Estrogen

iv. Luteinizing hormone (LH)

v. Growth hormone (GH)

vi. Inhibin

vii. Activin.

i. Follicule-stimulating hormone

Follicule-stimulating hormone is responsible for the initiation of spermatogenesis. It binds with Sertoli cells and spermatogonia and induces the proliferation of spermatogonia. It also stimulates the formation of estrogen and androgen-binding protein from Sertoli cells .

ii. Testosterone

Testosterone is responsible for the sequence of remaining stages in spermatogenesis. It is also responsible for the maintenance of spermatogenesis. Testosterone activity is largely influenced by androgen-binding protein.

iii. Estrogen

Estrogen is formed from testosterone in Sertoli cells. It is necessary for spermeogenesis.

iv. Luteinizing Hormone

In males, this hormone is called interstitial cell stimulating hormone. It is essential for the secretion of testosterone from Leydig cells.

v. Growth Hormone

Growth hormone is essential for the general metabolic processes in testis. It is also necessary for the proliferation of spermatogonia. In pituitary dwarfs, the spermatogenesis is severely affected.

vi. Inhibin

Inhibin is a peptide hormone and serves as a transforming growth factor. It is secreted by Sertoli cells. In females, it is secreted by granulosa cells of ovarian follicles. Its secretion is stimulated by FSH.Inhibin plays an important role in the regulation of spermatogenesis by inhibiting FSH secretion through feedback mechanism. FSH secreted from anterior pituitary induces spermatogenesis by stimulating Sertoli cells. It also stimulates the secretion of inhibin from Sertoli cells. So, when the rate of spermatogenesis increases, there is a simultaneous increase in inhibin secretion also. Inhibin in turn, acts on

anterior pituitary and inhibits the secretion of FSH, leading to decrease in the pace of spermatogenesis.

Hormones necessary for spermatogenesis & Stage of spermatogenesis Hormones necessary

Stage of proliferation- Follicle-stimulating hormone ,Growth hormone

Stage of growth- Testosterone ,Growth hormone

Stage of maturation -Testosterone,Growth hormone

Stage of transformation -Testosterone ,Estrogen

It is believed that inhibin also inhibits FSH secretion indirectly by inhibiting GnRH secretion from hypothalamus.

vii. Activin

Activin is also a peptide hormone secreted in gonads along with inhibin. The exact location of its secretion in testis is not known. It is suggested that activin is secreted by Sertoli cells and Leydig cells. Activin has opposite actions of inhibin. It increases the secretion of FSH and accelerates spermatogenesis.

3. Role of Other Factors in Spermatogenesis

i. Increase in body temperature

Increase in body temperature prevents spermatogenesis. Normally, the temperature in scrotum is about 2°C less than the body temperature. This low temperature is essential for spermatogenesis. When the temperature increases, the spermatogenesis stops. It is very common in cryptorchidism (undescended testes). In cryptorchidism, the testes are in the abdomen, where the temperature is

always higher than that of scrotum. High temperature in the abdomen causes degeneration of seminiferous tubules and stoppage of spermatogenesis.

ii. Diseases

Infectious diseases such as mumps cause degeneration of seminiferous tubules and stoppage of spermatogenesis.

Testosterone

Testosterone secretion starts at 7th week of fetal life by fetal genital ridge. Fetal testes begin to secrete testosterone at about 2nd to 4th month of fetal life. In fetal life, testosterone secretion from testes is stimulated by human chorionic gonadotropins, secreted by placenta. But in childhood, practically no testosterone is secreted approximately until 10 to 12 years of age. Afterwards, the testosterone secretion starts and it increases rapidly at the onset of puberty and lasts through most of the remaining part of life. The secretion starts decreasing after 40 years and becomes almost zero by the age of 90 years.

FUNCTIONS OF TESTOSTERONE

In general, testosterone is responsible for the distinguishing characters of masculine body. It also plays an important role in fetal life.

Functions of Testosterone in Fetal Life

Testosterone performs three functions in fetus:

1. Sex differentiation in fetus

2. Development of accessory sex organs

3. Descent of the testes.

- Sex differentiation in fetus

Sex chromosomes are responsible for the determination of sex of the fetus whereas testosterone is responsible for the sex differentiation of fetus.

Fetus has two genital ducts:

i. Müllerian duct, which gives rise to female accessory sex organs such as vagina, uterus and fallopian tube

ii. Wolffian duct, which gives rise to male accessory sex organs such as epididymis, vas deferens and seminal vesicles.

If testosterone is secreted from the genital ridge of the fetus at about 7th week of intrauterine life, the müllerian duct system disappears and male sexorgans develop from Wolffian duct.

In addition to testosterone, müllerian regression factor (MRF) secreted by Sertoli cells is also responsible for regression of müllerian duct.In the absence of testosterone, Wolffian duct regresses and female sex organs develop from müllerian duct.

2. Development of accessory sex organs and external genitalia

Testosterone is also essential for the growth of the external genitalia, viz. penis and scrotum and other accessory sex organs, namely genital ducts, seminal vesicles and prostate.

3. Descent of testes

Descent of testes is the process by which testes enter scrotum from abdominal cavity. Initially, testes are developed in the abdominal cavity and are later pushed down into the scrotum through inguinal canal, just

before birth. The process by which testes enter the scrotum is called the descent of testes. Testosterone is necessary for descent of testes.

Cryptorchidism

Cryptorchidism is a congenital disorder characterized by the failure of one or both the testes to descent from abdomen into scrotum. In such case, the testes are called undescended testes. Males with untreated testes are prone for testicular cancer.

Treatment

Administration of testosterone or gonadotropic hormones (which stimulate Leydig cells) causes descent of testes, provided the inguinal canal is large enough to allow the passage of testes. Surgery is required if the inguinal canal is narrow.

Functions of Testosterone in Adult Life

Testosterone has two important functions in adult:

1. Effect on sex organs

Testosterone increases the size of penis, scrotum and the testes after puberty. All these organs are enlarged at least 8 folds between the onset of puberty and the age of 20 years, under the influence of testosterone. Testosterone is also necessary for spermatogenesis.

2. Effect on secondary sexual characters

Secondary sexual characters are the physical and behavioral characteristics that distinguish the male from female. These characters appear at the time of puberty in humans. Testosterone is responsible for the development of secondary sexual characters in males.

Secondary sexual characters in males:

i. Effect on muscular growth

One of the most important male sexual characters is the development of musculature after puberty. Muscle mass increases by about 50%, due to the anabolic effect of testosterone on proteins. Testosterone accelerates the transport of amino acids into the muscle cells, synthesis of proteins and storage of proteins. Testosterone also decreases the breakdown of proteins.

ii. Effect on bone grow

After puberty, testosterone increases the thickness of bones by increasing the bone matrix and deposition of calcium. It is because of the protein anabolic activity of testosterone. Deposition of calcium is secondary to the increase in bone matrix.In addition to increase in the size and strength of bones, testosterone also causes early fusion of epiphyses of long bones with shaft. So, if testes are removed before puberty, the fusion of epiphyses is

delayed and the height of the person increases.

iii. Effect on shoulder and pelvic bones

Testosterone causes broadening of shoulders and it has a specific effect on pelvic,which results in:

a. Lengthening of pelvis

b. Funnel-like shape of pelvis.

c. Narrowing of pelvic outlet.

Thus, pelvis in males is different from that of females, which is broad and round or oval in shape.

iv. Effect on skin

Testosterone increases the thickness of skin and ruggedness of subcutaneous tissue. These changes in skin are due to the deposition of proteins in skin. It also increases the quantity of melanin pigment, which is responsible for the deepening of the skin color.Testosterone enhances the secretory activity of sebaceous glands. So, at the time of puberty, when the body is exposed to sudden increase in testosterone secretion, the excess secretion of sebum leads to development of acne on the face. After few years, the skin gets adapted to testosterone secretion and the acne disappears.

v. Effect on hair distribution

Testosterone causes male type of hair distribution on the body, i.e. hair growth over the pubis, along linea alba up to umbilicus, on face, chest and other parts of the body such as back and limbs. In males, the pubic .hair has the

base of the triangle downwards where as in females it is upwards. Testosterone decreases the hair growth on the head and may cause baldness, if there is genetic background.

vi. Effect on voice

At the time of adolescence, the boys have a cracking voice. It is because of the testosterone effect, which causes:

a. Hypertrophy of laryngeal muscles

b. Enlargement of larynx and lengthening

c. Thickening of vocal cords.

Later, the cracking voice changes gradually into a typical adult male voice with a bossing sound.

vii. Effect on basal metabolic rate

At the time of puberty and earlier part of adult life, the testosterone increases the basal metabolic rate to about 5% to 10% by its anabolic effects on protein metabolism.

viii. Effect on electrolyte and water balance

Testosterone increases the sodium reabsorption from

renal tubules, along with water reabsorption. It leads to increase in ECF volume.

ix. Effect on blood

Testosterone has got erythropoietic action. So, after puberty, testosterone causes mild increase in RBC count. It also increases the blood volume by increasing the water retention and ECF volume.

MODE OF ACTION OF TESTOSTERONE

Testosterone combines with receptor proteins. The testosterone-receptor complex migrates to nucleus, binds with a nuclear protein and induces the DNA-RNA transcription process. In 30 minutes, the RNA polymer is activated and the concentration of RNA increases. The quantity of DNA also increases.So, the testosterone primarily stimulates the protein synthesis in the target cells, which are responsible for the development of secondary sexual characters. Testosterone is converted into dihydrotestosterone (DHT) in the target cells of some accessory sex organs such as epididymis and penis. DHT combines with receptor proteins and the DHT-receptor complex induces the DNA-RNA transcription process. DHT receptor complex is more stable than testosterone receptor complex. In brain, testosterone is converted into estrogen (estradiol).

REGULATION OF TESTOSTERONE SECRETION

In Fetus

During fetal life, the testosterone secretion from testes is stimulated by human chorionic gonadotropin, which has the properties similar to those of luteinizing hormone. Human chorionic gonadotropin stimulates the development of Leydig cells in the fetal testes and promotes testosterone secretion.

In Adults

Luteinizing hormone (LH) or interstitial cell stimulating hormone (ICSH) stimulates the Leydig cells and the quantity of testosterone secreted is directly proportional to the amount of LH available.Secretion of LH from anterior pituitary gland is stimulated by luteinizing

hormone releasing hormone (LHRH) from hypothalamus.

Feedback Control

Testosterone regulates its own secretion by negative feedback mechanism. It acts on hypothalamus and inhibits the secretion of LHRH. When LHRH secretion is inhibited, LH is not released from anterior pituitary, resulting in stoppage of testosterone secretion from testes. On the other hand, when testosterone production is low, lack of inhibition of hypothalamus leads to secre tion of testosterone through LHRH and LH.

ANABOLIC STEROIDS

Anabolic steroids are the synthetic forms of testosterone, which are used to increase the growth of muscles and bones. Like androgens, these steroids also increase the growth of muscles and bones by accelerating protein synthesis (anabolic effect). These drugs are also called anabolic-androgenic steroids (AAS).

Therapeutic Uses of Anabolic Steroids

1. Growth stimulation
2. Bone marrow stimulation
3. Hormone replacement therapy
4. Induction of puberty in males.

Abuse of Anabolic Steroids

Anabolic steroids are commonly used by athletes to improve their performances during competitions, particularly in professional sports. Organizations of many sports have banned the use of anabolic steroids by their

athletes.

SEMEN

Semen is a white or grey fluid that contains sperms. It is the collection of fluids from testes, seminal vesicles, prostate gland and bulbourethral glands. Semen is discharged during sexual act and the process of discharge of semen is called ejaculation.Testes contribute sperms. Prostate secretion gives milky appearance to the semen. Secretions from seminal vesicles and bulbourethral glands provide mucoid consistency to semen.

NATURE OF SEMEN

At the time of ejaculation, human semen is liquid in nature. Immediately, it coagulates and after some time it becomes liquid once again (secondary liquefaction).Fibrinogen secreted from the seminal vesicle is converted into a weak coagulum by the clotting enzymes secreted from prostate gland. Coagulum is liquefied after about 30 minutes, as it is lysed by fibrinolysin produced in prostate gland.When semen is ejaculated, the sperms are non motile due to the viscosity of coagulum. When the coagulum dissolves, the sperms become motile.

PROPERTIES OF SEMEN

1. Specific gravity : 1.028
2. Volume : 2 mL to 6 mL per ejaculation
3. Reaction : It is alkaline with a pH of 7.5.

Alkalinity is due to the prostate fluid.

COMPOSITION OF SEMEN

Semen contains 10% sperms and 90% of fluid part, which

is called seminal plasma. Seminal plasma contains the products from seminal vesicle and prostate gland . It also has small amount of secretions from the mucus glands, particularly the bulbourethral glands.

SEMEN ANALYSIS

Analysis of semen evaluates the qualities of semen, which is useful to investigate the infertility.

Parameters of semen analysis:

1. Volume
2. Reaction and pH
3. Liquefaction
4. Sperm count
5. Morphology of sperm
6. Motility of sperms
7. Pus cells and RBCs
8. Fructose level.

QUALITIES OF SEMEN REQUIRED FOR FERTILITY

Minimum required qualities of semen for fertility are:

1. Volume of semen per ejaculation must be at least 2 mL
2. Sperm count must be at least 20 million/mL
3. Number of sperms in each ejaculation must be atleast 40 million

4. 75% of sperms per ejaculation must be alive

5. 50% of sperms must be motile

6. 30% of sperms must have normal shape and structure

7. Sperms with head defect must be less than 35%

8. Sperms with midpiece defect must be less than 20%

9. Sperms with tail defect must be less than 20%.

MALE ORGASM

The male orgasm is a complex system involving multiple hormones, organs, and nerve pathways.

The hormone testosterone, produced in the testicles, plays a central role by enhancing the sexual desire (libido) that leads to arousal, erection, and ultimately orgasm. By contrast, low testosterone not only decreases a man's energy and mood, it makes him less responsive to sexual stimuli, both physical and mental.

With that being said, a man often only requires physical stimulation to achieve arousal, while women typically need physical and mental stimulation to achieve the same.

Men differ from women in that their orgasms—the climax of the sexual response—come on faster and are shorter than women's. By and large, the male orgasm will last for five to 10 seconds. Women will last 10 to 15 seconds on average, although some have reported orgasms that last as long as a minute (a virtual impossibility for men).

The male ejaculate, semen , is comprised of sperm cells

and seminal fluid, the latter of which contains phosphorylcholine (an enzyme that aids in fertility) and fructose (which provides fuel for sperm). The average volume of semen expelled by a healthy man is around a teaspoon.

4 Phases of the Male Orgasm

The route to ejaculation in men is actually delineated by four distinct phases, of which orgasm is the third. While the duration and intensity of these phases can vary, the experience will proceed in a strictly specific way.

The model was first outlined by William Masters and Virginia Johnson in their 1966 book, Human Sexual Response .

Arousal

Arousal is the stage in which physical, sensory, and emotional cues prompt the brain to release a neurotransmitter known as acetylcholine. This, in turn, triggers the release of nitric oxide into the arteries of the penis, causing them to expand and rapidly fill with blood. The resulting erection is generally accompanied by changes in respiration, increased overall muscle tension, and the retraction of the scrotal sac.

Plateau

Plateau is the phase immediately preceding orgasm in which the voluntary thrusts of the body, specifically the pelvis, suddenly become involuntary, increasing both in intensity and speed. It is at this stage that the heart rate increases to between 150 and 175 beats per minute, accompanied by a marked rise in blood pressure and body

temperature.

Traces of seminal fluid ("pre-cum") may leak from the urethra. The release of pre-ejaculatory fluid is more than just incidental; it alters the pH of the urethra so that the sperm has a better chance of survival.

All told, the plateau phase lasts between 30 seconds and two minutes.

Orgasm

The orgasm phase is divided into two parts. The first, known as emission, is the stage where ejaculation is inevitable. This is immediately followed by the second stage, ejaculation, in which strong contractions of the penile muscle, anus, and perineal muscles help propel the semen from the body.

During orgasm, the reward center of the brain (specifically the cerebellum, amygdala, nucleus accumbens, and ventral tegmental area) is flooded with neurochemicals, inciting the intense emotional response associated with an orgasm.

At the same time, the lateral orbitofrontal cortex located behind the left eye shuts down entirely. This is the part of the brain that plays a central role in judgment and self-control. The effect explains why people often describe an orgasm as a state where "nothing else matters."

Resolution and Refraction

Resolution is the phase following orgasm where the penis starts to lose its erection. This is often accompanied by feelings of extreme relaxation or even drowsiness.

Refraction, also known as the refractory period, is the stage following climax when a man is unable to achieve another erection even with stimulation. In younger men, the refractory period may be as short as 15 minutes. In older men, it may last as long as an entire day.

Male Multiple Orgasms

"Multiorgasmic" is a term used to describe the ability to have more than one orgasm within the span of minutes or seconds. The orgasm may not involve actual ejaculate but must include the physiological and emotional components of ejaculation.

According to research from the

Department of Urologic Sciences at the University of British Columbia in Canada, only around 10 percent of men in their 20s and less than 7 percent of men under 30 are considered multiorgasmic.

The multiorgasmic state can be classified in one of two ways:

Beyond age, there are several factors commonly noted in multiorgasmic men. These include the use of psychoactive drugs, having multiple partners, having novel sex partners, and the use of sex toys to enhance tactile stimulation.

What this suggests is that the ability to achieve multiple orgasms is the result of a heightened state of arousal rather than any unique hormonal or physiological response.

Male Orgasm Disorders

Orgasm disorders differ from ejaculation disorders in that the latter refers to the actual emission of semen. Common ejaculation disorders include premature ejaculation ,

retrograde ejaculation (in which semen is redirected to the bladder), and anejaculation (inability to ejaculate).

Retrograde ejaculation should not be confused with dry orgasm, a condition in which very little semen is expelled during climax. Also known as orgasmic anejaculation, dry orgasm commonly occurs after bladder or prostate surgery, or as the result of low testosterone, sperm duct blockage, high blood pressure, or an enlarged prostate.

By contrast, anorgasmia is a condition in which a man or woman is unable to achieve orgasm. Anorgasmia may be caused by psychological problems, such as stress, trauma, and performance anxiety, or physical ones, such as diabetes, hypertension, and hypogonadism (low testosterone). Prostate surgery (prostatectomy) is also a common cause, as are certain medications such as selective serotonin reuptake inhibitors (SSRIs) used to treat depression.

The treatment of anorgasmia depends on the underlying cause and may include psychotherapy, a change of medications, testosterone replacement therapy, or the use of Dostinex (cabergoline), a dopamine promoter that can alter the hormonal response in men with anorgasmia.

Unfortunately, erectile dysfunction drugs like Viagra (sildenafil) and Cialis (tadalafil) cannot treat orgasm problems, as their only function is to increase blood flow

to the penis. They do not enhance libido and typically fail to work in the absence of sexual stimulation.

On the other hand, some men are able to enhance both an erection and orgasm with digital prostate massage . This is a technique in which a finger is inserted into the rectum prior to and/or during sex to manually stimulate the prostate gland. Located on the front wall of the rectum, the walnut-sized gland is considered by some to be the male G-spot.

MALE INFERTILITY.

Male fertility largely depends on the quality of sperm production, which is affected by a large number of genes that directly affect spermatogenesis or act indirectly via regulating the HPG axis. Expression of these genes may be altered because of OS and DNA damage associated with lifestyle and bioenvironmental factors associated with male infertility.During spermatogenesis, one of the most critical events in primary spermatocytes is the synapsis of homologous chromosomes and recombination. These two steps require a repertoire of genes/proteins to be expressed in a precise order to achieve recombination. The prerequisite for recombination is the creation of single-strand nicks or doublestrand breaks and its repair as such or as a recombined molecule. Reversal of DNA damage by yoga and meditation help repair these breaks and increase the quality of sperm produced through spermatogenesis.

Symptoms

The main sign of male infertility is the inability to conceive a child. There may be no other obvious signs or symptoms. In some cases, however, an underlying problem such as an inherited disorder, a hormonal imbalance, dilated veins around the testicle or a condition that blocks the passage of sperm causes signs and symptoms.

Although most men with male infertility do not notice symptoms other than the inability to conceive a child, signs and symptoms associated with male infertility include:

Problems with sexual function — for example, difficulty with ejaculation or small volumes of fluid ejaculated, reduced sexual desire, or difficulty maintaining an erection (erectile dysfunction)

Pain, swelling or a lump in the testicle area

Recurrent respiratory infections

Inability to smell

Abnormal breast growth (gynecomastia)

Decreased facial or body hair or other signs of a chromosomal or hormonal abnormality

A lower than normal sperm count (fewer than 15 million sperm per milliliter of semen or a total sperm count of less than 39 million per ejaculate)

When to see a doctor

See a doctor if you have been unable to conceive a child after a year of regular, unprotected intercourse or sooner if you have any of the following:

Erection or ejaculation problems, low sex drive, or other problems with sexual function

Pain, discomfort, a lump or swelling in the testicle area

A history of testicle, prostate or sexual problems

A groin, testicle, penis or scrotum surgery

Causes

Male fertility is a complex process. To get your partner pregnant, the following must occur:

You must produce healthy sperm. Initially, this involves the growth and formation of the male reproductive organs during puberty. At least one of your testicles must be functioning correctly, and your body must produce testosterone and other hormones to trigger and maintain sperm production.

Sperm have to be carried into the semen. Once sperm are produced in the testicles, delicate tubes transport them until they mix with semen and are ejaculated out of the penis.

There needs to be enough sperm in the semen. If the number of sperm in your semen (sperm count) is low, it decreases the odds that one of your sperm will fertilize your partner's egg. A low sperm count is fewer than 15 million sperm per milliliter of semen or fewer than 39 million per ejaculate.

Sperm must be functional and able to move. If the

movement (motility) or function of your sperm is abnormal, the sperm may not be able to reach or penetrate your partner's egg.

Medical causes

Problems with male fertility can be caused by a number of health issues and medical treatments. Some of these include:

Varicocele. A varicocele is a swelling of the veins that drain the testicle. It's the most common reversible cause of male infertility. Although the exact reason that varicoceles cause infertility is unknown, it may be related to abnormal testicular temperature regulation. Varicoceles result in reduced quality of the sperm.

Treating the varicocele can improve sperm numbers and function, and may potentially improve outcomes when using assisted reproductive techniques such as in vitro fertilization.

Infection. Some infections can interfere with sperm production or sperm health or can cause scarring that blocks the passage of sperm. These include inflammation of the epididymis (epididymitis) or testicles (orchitis) and some sexually transmitted infections, including gonorrhea or HIV. Although some infections can result in permanent testicular damage, most often sperm can still be retrieved.

Ejaculation issues. Retrograde ejaculation occurs when

semen enters the bladder during orgasm instead of emerging out the tip of the penis. Various health conditions can cause retrograde ejaculation, including diabetes, spinal injuries, medications, and surgery of the bladder, prostate or urethra.

Some men with spinal cord injuries or certain diseases can't ejaculate semen, even though they still produce sperm. Often in these cases sperm can still be retrieved for use in assisted reproductive techniques.

Antibodies that attack sperm. Anti-sperm antibodies are immune system cells that mistakenly identify sperm as harmful invaders and attempt to eliminate them.

Tumors. Cancers and nonmalignant tumors can affect the male reproductive organs directly, through the glands that release hormones related to reproduction, such as the pituitary gland, or through unknown causes. In some cases, surgery, radiation or chemotherapy to treat tumors can affect male fertility.

Undescended testicles. In some males, during fetal development one or both testicles fail to descend from the abdomen into the sac that normally contains the testicles (scrotum). Decreased fertility is more likely in men who have had this condition.

Hormone imbalances. Infertility can result from disorders of the testicles themselves or an abnormality affecting other hormonal systems including the hypothalamus, pituitary, thyroid and adrenal glands. Low testosterone

(male hypogonadism) and other hormonal problems have a number of possible underlying causes.

Defects of tubules that transport sperm. Many different tubes carry sperm. They can be blocked due to various causes, including inadvertent injury from surgery, prior infections, trauma or abnormal development, such as with cystic fibrosis or similar inherited conditions.

Blockage can occur at any level, including within the testicle, in the tubes that drain the testicle, in the epididymis, in the vas deferens, near the ejaculatory ducts or in the urethra.

Chromosome defects. Inherited disorders such as Klinefelter's syndrome — in which a male is born with two X chromosomes and one Y chromosome (instead of one X and one Y) — cause abnormal development of the male reproductive organs. Other genetic syndromes associated with infertility include cystic fibrosis, Kallmann's syndrome and Kartagener's syndrome.

Problems with sexual intercourse. These can include trouble keeping or maintaining an erection sufficient for sex (erectile dysfunction), premature ejaculation, painful intercourse, anatomical abnormalities such as having a urethral opening beneath the penis (hypospadias), or psychological or relationship problems that interfere with sex.

Celiac disease. A digestive disorder caused by sensitivity to gluten, celiac disease can cause male infertility. Fertility

may improve after adopting a gluten-free diet.

Certain medications. Testosterone replacement therapy, long-term anabolic steroid use, cancer medications (chemotherapy), certain antifungal medications, some ulcer drugs and certain other medications can impair sperm production and decrease male fertility.

Prior surgeries. Certain surgeries may prevent you from having sperm in your ejaculate, including vasectomy, inguinal hernia repairs, scrotal or testicular surgeries, prostate surgeries, and large abdominal surgeries performed for testicular and rectal cancers, among others. In most cases, surgery can be performed to either reverse these blockage or to retrieve sperm directly from the epididymis and testicles.

Environmental causes

Overexposure to certain environmental elements such as heat, toxins and chemicals can reduce sperm production or sperm function. Specific causes include:

Industrial chemicals. Extended exposure to benzenes, toluene, xylene, pesticides, herbicides, organic solvents, painting materials and lead may contribute to low sperm counts.

Heavy metal exposure. Exposure to lead or other heavy metals also may cause infertility.

Radiation or X-rays. Exposure to radiation can reduce sperm production, though it will often eventually return to normal. With high doses of radiation, sperm production

can be permanently reduced.

Overheating the testicles. Elevated temperatures impair sperm production and function. Although studies are limited and are inconclusive, frequent use of saunas or hot tubs may temporarily impair your sperm count.

Sitting for long periods, wearing tight clothing or working on a laptop computer for long stretches of time also may increase the temperature in your scrotum and may slightly reduce sperm production.

Health, lifestyle and other causes

Some other causes of male infertility include:

Drug use. Anabolic steroids taken to stimulate muscle strength and growth can cause the testicles to shrink and sperm production to decrease. Use of cocaine or marijuana may temporarily reduce the number and quality of your sperm as well.

Alcohol use. Drinking alcohol can lower testosterone levels, cause erectile dysfunction and decrease sperm production. Liver disease caused by excessive drinking also may lead to fertility problems.

Tobacco smoking. Men who smoke may have a lower sperm count than do those who don't smoke. Secondhand smoke also may affect male fertility.

Emotional stress. Stress can interfere with certain

hormones needed to produce sperm. Severe or prolonged emotional stress, including problems with fertility, can affect your sperm count.

Depression. Research shows that the likelihood of pregnancy may be lower if a male partner has severe depression. In addition, depression in men may cause sexual dysfunction due to reduced libido, erectile dysfunction, or delayed or inhibited ejaculation.

Weight. Obesity can impair fertility in several ways, including directly impacting sperm themselves as well as by causing hormone changes that reduce male fertility.