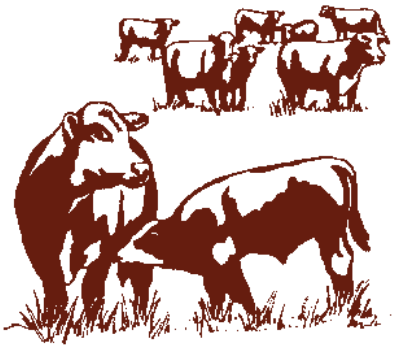

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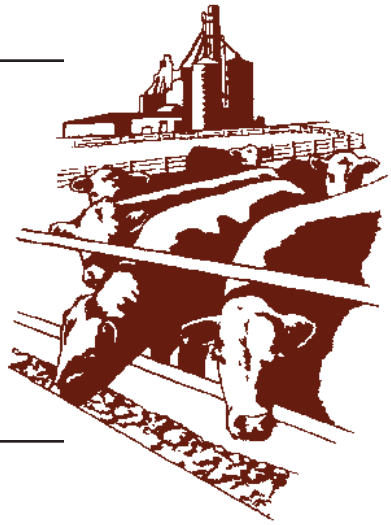

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Reproductive Tract Anatomy and Physiology of the Bull

E. J. Turman, Animal Science Department Oklahoma State University
T. D. Rich, Animal Science Department Oklahoma State University

The reproductive tract of the bull consists of the testicles and secondary sex organs, which transport the spermatozoa from the testicle and eventually deposits them in the female reproductive tract. These organs are the epididymis, vas deferens and penis, plus three accessory sex glands, the seminal vesicles, prostate and Cowper's gland. This basic anatomy is illustrated in figure 1 as a greatly simplified diagrammatic sketch.

The testicle has two very vital functions: (1) producing the spermatozoa; and (2) producing the specific male hormone, testosterone. The testicles are located outside of the body cavity in the scrotum. This is essential for normal sperm formation since this occurs only at a temperature several degrees below normal body temperature. However, very cold temperatures could damage the testicle. The scrotum, therefore, must help protect the testicle against both of these extremes of temperature. This is done by means of a temperature sensitive layer of muscle (cremaster muscle) located in the walls of the scrotum, which relaxes when hot, and contracts when cold. Relaxation increases the relative length of the scrotum thus moving the testicles away from body heat. In cold weather, the reverse happens—the scrotum shortens and the testicles are held close to the warm body.

Occasionally, one or both testicles fail to descend into the scrotum during embryological development, and are retained in the body cavity. Such male are referred to as cryptorchids. Since body heat can destroy sperm producing ability, no sperm are produced by the retained testicle. The testicle in the scrotum will function normally and usually produces enough sperm so that the male will be of near normal fertility. However, since this condition appears to have a hereditary basis, such males should not be used for breeding. If both testicles are retained, the male will be sterile.

Usually, hormone production is near normal in the cryptorchid testicle and the male develops and behaves like a normal male. If the retained testicle is not removed at time of castration, the male will develop the secondary sex characters of an uncastrated male. This operation is not as simple, nor as safe, as removing testicles that are in the scrotum. Thus, it is recommended to select against this trait by culling cryptorchid males.

In addition to cryptorchidism, there are other circumstances which may cause sterility by raising the temperature of the testicle. Examples of such conditions are: excessive fat deposits in the scrotum; several days of very high fever; and exposing the males for extended periods to very high environmental temperatures. Usually, if a male was producing sperm prior to exposure to such conditions, and the period of exposure is not too prolonged, the resulting sterility is only temporary (6 to 10 weeks) and, if the conditions are corrected, normal fertility will eventually return.

The testicle contains many long tiny, coiled tubules, the seminiferous tubules, within which the sperm are formed and mature. Scattered throughout the loose connective tissue which surrounds the seminiferous tubules are many highly specialized cells, the interstitial cells of Leydig which produce the male hormone.

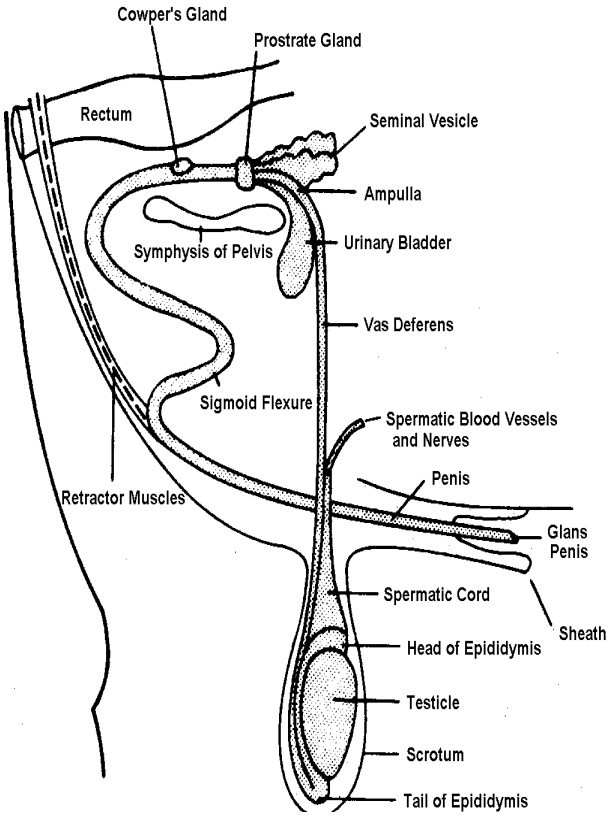

Figure 1. Diagramatic Drawing of the Reproductive Tract of the Bull.

There are many hundreds of individual seminiferous tubules in the testicle. However, they unite with one another until, eventually, some dozen tubules pass out of the testicle into the head of the epididymis.

The epididymis is a compact, flat, elongated structure closely attached to one side of the testicle. In it the dozen or so vasa efferentia from the testicle are combined into a single tubule some 130 to 160 feet in length, but which is packed into the relatively short epididymis. Eventually, this tubule emerges from the tail of the epididymis as a single straight tubule (the vas deferens) and passes, as part of the spermatic cord, through the inguinal ring into the body cavity.

It requires 45 to 50 days for sperm to be formed in the seminiferous tubules and move through the epididymis where they mature for ejaculation. About one week of this time is spent in the epididymis, a period of time that appears to be necessary for the sperm cells to mature into fertile sperm. The sperm in the epididymis are much more resistant to damage from heat than are the sperm that have already been formed and are stored in the epididymis. This may result in a slight delay between the time a male is exposed to some unfavorable condition and the time his fertility is reduced. However, this period of reduced fertility may last for the 45 to 50 days required for producing a new sperm cell. This may explain why a male may settle females for a week or so after recovering from a high fever and then go through a infertile period of several weeks.

Since the epididymis is a single tube which serves as an outlet for all the sperm produced in the testicle, any blockage of this tube is a serious matter. Sometimes, there is a temporary blockage due to swelling following an injury or infection (epididymitis). However, occasionally this swelling or infection results in the formation of scar tissue in the tubule, permanently blocking it and preventing the passage of sperm.

The spermatic cord includes, in addition to the vas deferens, the blood vessels and nerves supplying the testicle and the supporting muscles and connective tissue. Males may be sterilized by an operation called vasectomy in which the vas deferens are cut so sperm cannot pass to the outside of the body. If only the vas deferens are cut, the testicle continues to function normally producing both sperm and male hormone. However, if the blood vessels of the spermatic cord are cut or blocked, shutting off the blood supply, the testicle will stop functioning and waste away.

One of the weak spots of the male anatomy is the inguinal ring, the opening through which the spermatic cord passes into the body cavity. If it enlarges, usually as a result of an injury, a loop of the intestine can pass into the scrotum, resulting in a scrotal hernia. Since predisposition to injury at this point appears to have a hereditary basis, males with scrotal hernias should not be used for breeding even though they may be of normal fertility.

The two vas deferens eventually unite into a single tube (the urethra), the channel passing through the penis. The urethra serves as the common passage way for the excretory products of the two male tracts—semen of the reproductive tract and urine of the urinary tract.

Two of the accessory glands are found in the general region where the vas deferens unite to become the urethra. These glands produce the secretions that make up most of the liquid portion of the semen of the bull. In addition, the secretions activate the sperm to become motile.

The largest of these, and the one producing the largest fraction of the seminal fluid, is the seminal vesicles. They consist of two lobes about 4 to 5 inches long each connected to the urethra by a duct. The other accessory gland in this region is the prostrate gland, located at the neck of the urinary bladder where it empties into the urethra. The prostate is poorly developed in the bull and does not produce a very large volume of secretion.

The third accessory gland, the Cowper's glands are small, firm glands located on either side of the urethra. It is believed that one of the chief functions of their secretion is to cleanse the urethra of any residue of urine which might be harmful to spermatozoa. The clear secretion that often drips from the penis during sexual excite-

ment prior to service is largely produced by these glands.

Occasionally, one of the accessory glands may become infected, resulting in semen samples that are yellow and cloudy and which contain many pus cells. In bulls it is not uncommon for the seminal vesicles to be so affected (seminal vesiculitis).

The sigmoid flexure is an anatomical structure which provides the means by which the penis is held inside the body and sheath, except during time of service. Strong retractor muscles serve to hold the penis in the "S" shaped configuration. Occasionally, these muscles are too weak to function properly and a portion of the penis and sheath lining protrude at all times. This exposes the male to the danger of mechanical injury, particularly in rough brushy country, or on ranges where there is considerable cactus and prickly pear.

The penis is the organ of insemination. In all domestic animals it consists of two, and in man three, cylindrical bodies called the corpora cavernose penis. The spaces of the corpora cavernosa become filled with blood during sexual excitement, resulting in erection of the organ. The end of the penis is the glans penis. The glans penis is richly supplied with nerves and is the source of the sensations associated with copulation.

Semen

Semen consists of the spermatozoa and a liquid portion composed largely of the secretions of the accessory glands. The volume of semen and numbers of sperm ejaculated by different bulls varies considerably. However, most bulls will ejaculate 3 to 5cc of semen containing about 1 billion sperm per cc or 3 to 5 billion sperm per ejaculate.

Once sexual maturity is reached in farm animals, sperm production is continuous throughout the remainder of reproductive life. During periods of sexual rest old sperm in the upper part of the tract die, degenerate and are absorbed. For this reason, the first sample collected after a long period of sexual inactivity may appear to have a high percentage of dead and abnormal sperm. Therefore, semen evaluation of a bull should not be made on one collection alone.

Semen evaluation is being practiced more and more. However, it should be realized that its primary value lies in detecting males that have very definite semen deficiencies such as: either no sperm, or a very low number of sperm cells; poor motility; excessively large numbers of abnormal sperm; a large percentage of dead sperm; and the presence of large amounts of pus. Males producing semen of this sort will usually, at best, be of low fertility. However, there is a wide range of semen quality in males of normal fertility, and it is usually difficult, if not impossible, to accurately predict the level of fertility of a male that does not have grossly deficient semen.

Hormonal Regulation of the Male Reproductive System

The normal functioning of the male in reproduction is largely controlled by hormones. A hormone is a specific chemical substance produced by a specialized gland, called an endocrine gland, which passes into the body fluids (blood and lymph) and is transported to various parts of the body where it exerts some specific effect.

The testicle functions as an endocrine gland because of the production of the male hormone, testosterone, by the interstitial cells. Testosterone has several major effects:

(1). It is largely responsible for the development and maintenance of the male reproductive tract.
(2). It causes the development and maintenance of the secondary sex characters of the male. These are those characteristics associated with "masculinity," such as: growth of beard and change of voice in man; the spur and comb of the rooster; the tusks of the boar; and the crest and heavily muscled shoulders of the bull.
(3). It is a major factor in normal sex drive and behavior of the male.
(4). It increases muscular and skeletal growth.
(5). It is essential for normal sperm formation.

The testicle is, in turn, under the influence of hormones produced by other glands in the body. The primary hormones regulating the testicle are the gonadotropic hormones produced by the anterior lobe of the pituitary gland . The pituitary gland is a small gland located under the brain at the base of the skull. The pituitary hormones regulating reproduction in both the male and the female, (by stimulating the testes or ovaries) are called gonadotropic hormones.

Not only is the hormal production by the testicle regulated by hormones released by the anterior pituitary but the reverse is true. The level of testosterone in the blood regulates the secretion of the gonadotropic hormones by means of a feedback mechanism.

Either purified preparations of gonadotropic hormones described or preparations with a similar physiological action are available for use by veterinarians. They can be useful in treating some cases of reproductive failures, but only if the trouble is caused by a deficiency of that hormone.

Because of the feedback mechanism controlling hormone release, normal functioning depends on a proper balance of the hormones and too much can be just as undesirable as too little. The use of hormone therapy should not be routinely carried out, but should be done only by qualified persons, and with the expectation that they may not be of benefit.

Authors:
E. J. Turman, Animal Science Department Oklahoma State University
T. D. Rich, Animal Science Department Oklahoma State University

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