



## Review on Gross Testicular and Scrotal Abnormalities in Bulls

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### Abstract

Fertility of both bulls and cows is vital for good reproductive performance of the herd especially; the fertility or reproductive capacity of bull is a critical factor in determining the reproductive performance of the herd because, a single bull can breed 30 up to 60 cows. Fertility of bulls can be affected by different factors. Gross testicular and scrotal abnormalities are among those factors. The common gross abnormality of testis and scrotum includes orchitis epididymitis, cryptorchidism, testicular hypoplasia, testicular degeneration, scrotal wound and testicular hematoma and their occurrence is reported by different authors from different countries. Orchitis is common in bulls and culling is recommended for brucellar infection. Epididymitis occurs more frequently than orchitis and more frequently in the bull than in other domestic animals. Cryptorchidism is infrequently observed in bulls than in sheep and goats. Testicular hypoplasia is suspected only at puberty or later because of reduced fertility or sterility. Testicular degeneration is often secondary to some other form of testicular disease. Sperm production and/or fertility will be reduced in most cases of testicular diseases. But it may not be reduced in cases of diseases involving only one testicle. Bulls with abnormalities of testes should not be used for breeding purpose, because most of these defects are heritable, especially cryptorchidism and testicular hypoplasia.

**Keywords:** Bull; Testicular; Scrotal abnormalities; Heritability; Infertility

**Abbreviation:** AI-Artificial Insemination; CSA-Central Statistical Analysis; IBR-Infectious Bovine Rhinotracheitis; BSE- Breeding Soundness Evaluation; CO-Cryptorchidism; ORC-Orchitis; EP-Epididymitis; THP-Testicular Hypoplasia; TD-Testicular Degeneration; SW-Scrotal Wound; SH-Scrotal Hematoma

### Introduction

Reproduction in livestock, whether by natural mating or by artificial insemination, is a pivotal prerequisite for production. The predominant livestock reproductive management system throughout the world remains natural breeding, where a number of factors can influence herd or flock fertility [1]. Some of these factors are male

related; some are female and others managerial and/or environmental. But in the most cases, the herd infertility is considered as only female related factor exclusively [2].

Good fertility of both bulls and cows is imperative for adequate reproductive performance. Bulls are used either to serve cows naturally or as donors of semen for use in Artificial Insemination (AI). In the case of natural service, a single bull may be expected to serve a herd of up to 60 or more cows. On other hand, the use of a bull for AI may mean that a large number of doses of semen can be prepared from each ejaculate and inseminated too many cows during her estrus cycle. Therefore, the fertility or reproductive capacity of individual bull is a critical factor in determining the reproductive performance of cows. Unfortunately, the fertility of bulls used for natural service is rarely investigated and this can lead to substantial and expensive delay in the discovery of fertility problems.

Failure of many bulls to breed consistently and efficiently has been reported to be associated with the reproduction of poor quality semen due to gross or microscopic pathological conditions of testes and accessory glands [3]. Gross testicular and scrotal pathology classified as congenital causes such as testicular hypoplasia and cryptorchidism and acquired such as testicular degeneration, epididymitis, orchitis, scrotal wound and testicular hematoma.

The possible causes of these acquired testicular abnormalities are infectious agents, nutrition, stress, thermal influence and older age [4]. All of the abnormalities either congenital or acquired have negative effect on productivity and fertility of the bull by disturbing spermatogenesis or sperm maturation, leading to abnormal semen characteristics or preventing the passage of spermatozoa from testes to urethra [5]. Abnormalities, such as cryptorchidism, unilateral testicular hypoplasia, orchitis, scrotal hernia, and scrotal hematomas can cause abnormal scrotal shape and bulls with such abnormalities can be classified as unsatisfactory for breeding [6,7].

Bulls which are older than seven years have 0.3 to 0.5% reductions in fertility due to lower sperm production owing to higher incidence of lesions such as testicular fibrosis and tubular calcification that develops testicular degeneration.

Both Subfertility and infertility of bulls has a great economic effect on livestock production [8]. For instance, the use of subfertility bulls for breeding purpose delays conception, prolongs the calving season, reduces calf weaning weights, and increases the number of females culled, thereby resulting in economic losses and threatening sustainability of a livestock operation. Furthermore, infertile bulls can have adverse effects of animal welfare, due to repeated breeding and delayed calving. So gross testicular disorders of bulls have a great devastating effect on the economy of the country especially in developing countries including Ethiopia because most of peoples are dependent on pastoral and agro pastoral practices and this practice is mostly extensive farming system [9].

The objectives of this paper were:

- To give general overview on gross testicular and scrotal abnormalities in bulls.

## Literature Review

### Common gross testicular and scrotal abnormalities in bulls

**Orchitis:** Orchitis is inflammation of the testicle and it may be accompanied by periorchitis and epididymitis [10]. The pendulous scrotum of the bull, ram, and buck predisposes these animals to scrotal damage more frequently than in animals with the scrotum more closely attached to the body.

Trauma and infection are the common causes of orchitis in bull. Systemic infections may develop hematogenously, through retrograde migration from the ductus deferens and epididymis, or directly through wounds of the scrotal skin. A variety of organism have been isolated from purulent exudate including *brucella abortus*, *mycobacterium tuberculosis*, *arcanobacterium pyogenes*, *histophilus* (haemophilus) *sumni*, *bovine herpesvirus 1*, *Chlamydia* species and *mycoplasma* species [11]. In bulls, localization of virulent strain of *brucella abortus* or live vaccine strain 19 of the organism can causes severe orchitis [12].

Orchitis in the bulls is commonly unilateral, affected animals may first detected by stiff gait or reluctance to mate and affected organs are swollen, often several times normal size but painful and hot [13]. The swollen scrotum of affected bulls doughy and may become filled with a fibrino purulent exudate. Ejaculates may contain leucocytes and any sperm will have reduced motility and increased morphological abnormalities [14]. Inflammation of the testicles causes a pressure necrosis of the spermatogenic cells for the heavy tunic around the testicles. Pressure atrophy of the spermatogenic cells and fibrosis of the entire testicle follows [15]. Decreased sperm counts and decreased motility often are demonstrated in cases of acute orchitis of nonspecific etiology, and this pathology also is consistently associated with high rates of infertility [16,17].

Treatments of orchitis in acute case involve systemic anti-inflammatory drugs, antibiotics, and cool water hosing. Hemicastration can be used to remove chronically infected testicles, but this also renders the bull subfertile. Prolonged therapy with high levels of antibiotics, hydrotherapy, and nonsteroidal anti-inflammatory drugs to alleviate pain is indicated. Corticosteroids may be indicated when there is evidence of antiserum antibodies reaction is produced. However, antibiotics must be able to control any infection in the presence of this drug. Unilateral orchiectomy may be indicated in order to save unaffected testicle if the condition is unilateral. Bilateral orchiectomy may be indicated if both testicles are involved and the condition becomes severe or irreversible [18]. But culling is recommended for *brucella* infection [19]. *Brucella* orchitis should be kept in mind for the etiology of orchitis resistant to standard therapeutic approach especially in turkey where Brucellosis is endemic in some regions.

**Prevalence of orchitis:** The prevalence of orchitis in bull reported in Ethiopia ranging from 4.4% up to 7 [20]. And also 1.32% in Algeria 3% of its occurrence is reported in Australia.

**Epididymitis:** Is inflammation of the epididymis occurs more frequently than orchitis and more frequently in the bull than in other domestic animals. Numerous bacteria, viruses, and fungi may cause orchitis or epididymitis but *Corynebacterium pyogenes*, *Chlamydia* sp. and *Brucella abortus* are the most frequent causative agents. Noninfectious causes of pathogenic changes in scrotal contents are less common in the bull and usually include trauma or neoplasia. It

may be caused by spermatic granulomas resulting from duct anomalies during development, trauma and infection.

While the lesions of the epididymis occurs in most domestic species, most commonly observed in ram. The lesions may be unilateral or bilateral and causing the blockage of the duct system and edema and also degeneration of the testes are concerned. It interferes with sperm transport and storage. The tail of the epididymis is more frequently involved. Proximal involvement, especially the efferent duct may results in the failure of fluid absorption in the epididymis and back pressure on the testis resulting in the rapid damage to the testicles. The affected portions of the epididymis usually feel firm and enlarged. Spermatic granuloma can results from rupture of the epididymal tubules and the escape of the spermatozoa into the surrounding tissues. In severe case, epididymitis increases the scrotal temperature.

There can be variable reduction in sperm cell concentration and WBC may be present in the ejaculate. And also there is decreased sperm cell motility and an increased number of abnormal cells. Immobilization or head to head agglutination of the sperm cell occurs due to antiserum antibody reaction produced by the breakdown of the blood test is barrier.

Prolonged therapy with high levels of antibiotics, hydrotherapy, and non-steroidal anti-inflammatory drugs to alleviate pain is indicated. Corticosteroids may be indicated when there is evidence of antiserum antibodies reaction is produced. However, antibiotics must be able to control any infection in the presence of this drug. Unilateral orchiectomy may be indicated in order to save unaffected testicle if the condition is unilateral. Bilateral orchiectomy may be indicated if both testicles are involved and the condition becomes severe or irreversible. But culling is recommended for *brucella* infection. *Brucella* epididymitis should be kept in mind for the etiology of epididymitis resistant to standard therapeutic approach especially in our country where Brucellosis is endemic in some regions.

**Prevalence of epididymitis:** As reported by different authors, 2 to 3.4% prevalence of epididymitis recorded in Ethiopia respectively. And 3% prevalence reported in Australia.

**Cryptorchidism:** Reproductive disorders have serious consequences on livestock production. Cryptorchidism is one of such disorders. Cryptorchidism is failure of one or both testes to descend into the scrotal sac in cattle, sheep, and goats. It may be either unilateral or bilateral but, unilateral is most common. The testis is already lodged in the scrotum by the time of birth in cattle, sheep and goats; however, in dogs, cats, pigs and horses, descent is completed after birth. The normal position of descended testis is within the scrotum but in case of cryptorchidism, it may be located in the abdominal, inguinal or subcutaneous area giving the description abdominal testis, inguinal testis and subcutaneous testis respectively.

The disease is heritable and usually detected at birth or shortly after birth. It was thought to be caused by inbreeding and managed by culling, but genetic, epigenetic and environmental factors have been incriminated in its occurrence. Based on recent evidence therefore, cryptorchidism is viewed as a multifactorial disease rather than a single disease, since it provides early evidence on other phenotypic defects such as tumors and defects in spermatogenesis.

## Discussion

Among domestic animals, bucks, ram, boar, stallion, dog and bulls are affected. Cryptorchidism is relatively rare in cattle, but it is frequently seen in sheep and goats.

**Testes are found in one of four general locations:** abdominal cavity, inguinal canal subcutaneous, or scrotal. The distinction between inguinal and subcutaneous locations is important.

Non-scrotal testes are found in one of three general locations (abdominal, inguinal, or s.c.), so it is logical that three phases are involved in the process of testis descent. These are:

- Abdominal testis translocation, specifically retention near the neck of the developing bladder as the abdominal cavity enlarges followed by slight testis relocation to the future internal inguinal ring.
- Transinguinal migration of a testis, moving a cauda epididymidis and testis through the abdominal wall.
- Inguinoscrotal migration of a testis, from a subcutaneous location outside the inguinal canal to correct final position in the bottom of the scrotum. Most authors have combined movement of a testis through the abdominal wall and final migration to the scrotum as 'inguinoscrotal testis descent'.

Because of the possibility of cryptorchidism in bulls being an inherited trait, cryptorchid bulls should not be used for breeding purposes. Cryptorchidism may still occur sporadically within a herd, but refraining from breeding cryptorchid males is one of the more reliable ways of decreasing the incidence overall. Cummins and Glover, reported that unilateral cryptorchidism causes infertility (temporal loss of procreation ability) while bilateral cryptorchidism causes sterility (permanent loss of procreation ability). Consequently, unilaterally cryptorchid bulls are not recommended for breeding due to perceived tendency of the condition to be heritable *via* an autosomal recessive mechanism affected stud bulls should be culled.

**Prevalence of cryptorchidism:** Cryptorchidism is rarely observed in bulls than in sheep and goats. Unilateral cryptorchidism is more common than bilateral cryptorchidism. The prevalence of cryptorchidism is reported 1.7% in North America, 1.74% in Nigeria and 0.3% to 3.1% in Ethiopia. Furthermore, lower than 0.05% prevalence reviewed in Canada. These variations might be because of dissimilarity of environmental conditions of the study areas.

**Testicular hypoplasia:** Testicular hypoplasia is a gross diagnostic term used for the presence of developmental disorder in which one or both testicles fail to reach normal size at sexual maturity and become smaller sized testes about 1/4 to 2/3 of the normal on one or both sides. The small size and flabby consistency of these testicles is caused by poor development of sperm-producing tissue. As a result, Ejaculate will show either no sperm or a low number of sperm with numerous abnormal forms. It may be unilateral or bilateral and totally or partially hypoplastic. Unilateral is more common than bilateral. In case of bilaterally affected animal, it leads to total infertility. Normal fertility is maintained in unilaterally affected animals. And also the right testis is more affected than left testis.

Testicular hypoplasia is suspected only at puberty or later because of reduced fertility or sterility. It can result from a variety of factors impacting on the number, function and fate of male germ cells in domestic animals. The gonadal hypoplasia is a congenital, mostly hereditary condition. Primary causes of testicular hypoplasia are aneuploidy; a recessive autosomal gene with partial penetrance and other chromosomal abnormalities.

High incidence of testicular hypoplasia detected during breeding soundness examination performed before the breeding season, on a commercial farm. It is, therefore, very important to perform such examination to determine cattle reproductive efficiency in a short and long period, since this evaluation can establish the fate of the bulls and the genetics of the cattle. For a given hereditary nature of testicular hypoplasia, it is recommended that the hypoplastic bulls and the suspected of being so, be removed from the farm or immediately castrated. Finally, it is better to investigate the origin of these animals to avoid that new animals from this bloodline are acquired by the farmer.

**Prevalence of testicular hypoplasia:** The occurrence of testicular hypoplasia had no significant association with the location and age of the bulls. Its prevalence is 12.96% and 11.8% in Ethiopia, 0.66% in Algeria, 3.45% in Brahman bulls, 3.21% in brown Swiss breeds, 1.4% in Santa Gertrudis bulls and 3.1% in Brahman bulls were reported.

**Testicular degeneration:** Degeneration is deterioration of a tissue or an organ in which its function is diminished or its structure is impaired. Testicular degeneration is an acquired disease that can result in either permanent or temporarily sterility. Unlike testicular hypoplasia, the testicles were normal in size before they became small in case of testicular degeneration. In most cases, the testis may maintain its normal size during the early stages of degeneration, because the process of degeneration is usually a long process.

Testicular degeneration can be unilateral or bilateral. It can involve a whole testis or a part of a testis, or it may only affect a few random seminiferous tubules. The seminiferous epithelium of the testis is highly susceptible to damage, with a wide variety of agents causing reversible or irreversible degeneration. A common cause of reversible testicular degeneration is high fever because, fever raises both body and scrotal temperatures and also effective sperm production requires that the scrotal temperature be at least 2-3 degrees below the core body temperature.

There are many possible causes of testicular degeneration which are recorded in the literature. Environmental temperature, scrotal insulation, systemic pyrexia (but only if prolonged and high), local inflammation including orchitis and frostbite can cause testicular degeneration. In addition to, Infectious agents like Infectious Bovine Rhinotracheitis (IBR) and enteric virus. Age related (senile degeneration), environmental related (radiation, heavy metals). Dietary related (zinc and vitamin A deficiency) are among its causes. Many causes of testicular degeneration do not manifest themselves in infertility immediately, as there is interval of 4-8 weeks between the time at which the susceptible stage of spermatogenesis (particularly primary spermatocyte) is affected and the time at which affected sperms are finally ejaculated.

The bull's testicles are one of the most important anatomical organs to examine when it comes to breeding. The ability and fertility of the bull can always be keeping a close eye on livestock production investment. Diligent observation and subsequent testing can eliminate potential disasters in breeding program when a bull degenerates. Good management practices are strictly implemented to control and prevent its occurrence. Removing of testicular degenerated bulls from the herd is recommended.

**Prevalence of testicular degeneration:** The prevalence of testicular degeneration did not significantly vary with location, age and body condition of the bulls. However, contradicting finding has been reported where it was significantly varying with age. The disparity

between the current and previous studies could be due to variations in climatic condition of the study areas, farming systems and breed of the studied animals. Reports about testicular degeneration indicate 7.6% and 8.1% in Ethiopia; and 0.62% in Canada prevalence recorded.

**Scrotal wound:** A wound may be described in many ways; by its etiology, anatomical location, by whether it is acute or chronic, by the method of closure, by its presenting symptoms or indeed by the appearance of the predominant tissue types in the wound bed. All definitions serve a critical purpose in the assessment and appropriate management of the wound through to symptom resolution or, if viable, healing. A wound by true definition is a breakdown in the protective function of the skin; the loss of continuity of epithelium, with or without loss of underlying connective tissue (*i.e.* muscle, bone, nerves) following injury to the skin or underlying tissues/organs caused by surgery, a blow, a cut, chemicals, heat/cold, friction/shear force, pressure or as a result of disease.

The location of the scrotum makes it susceptible to injury. Blunt forces (for example, crushing blow) cause most injuries. However, occasionally gunshot or stab wounds penetrate the scrotum and testes. The injuries may also occur when a hard mate trod on the testis of the recumbent bull or when the scrotum is kicked. Rarely, the scrotum can develop severe and rapidly progressive infections such as gangren. Severe parasitic infestation of the scrotum can causes scrotal wound.

Severe scrotal dermatitis resulting for example from chorioptic mange or rarely mycotic infection may induce testicular degeneration. A common consequence of severe scrotal trauma is rupture of tunica vaginalis of the testis. This typically results in profuse hemorrhage and formation of a hematocele. The scrotum is immediately swollen and painful. Marked swelling of the scrotum by fluid accumulating secondary to generalized ascites has been described affecting a number of bulls in separate herds. In some herd, neither precise cause nor pathogenesis of the hydrocele were ascertained, but infections with *Ostertagia spp* and the tick borne protozoan *Eperythrozoon spp* were identified in bulls in separate herds and may have been causally involved. Depending on the severity of the damage, the bull's semen viability may be affected with a higher number of abnormal sperm. Bulls can recover from these injuries, but permanent damage is possible.

No prospect of recovery of the ruptured testis exists. However, preserving the function of the surviving testis is important. Controlling and preventing ectoparasitic infestation and avoiding injurious to scrotum is very important including good husbandry management.

**Prevalence of scrotal wound:** As discussed above, the bull's scrotum highly prone to injuries because of its pendulous scrotum, the prevalence of 5.3% and 4.7% were reported in Ethiopia and also 4.3% in Canada.

**Scrotal hematoma:** Hematoma is an extravasation of blood outside the blood vessels, generally the result of haemorrhage due to lesion in a blood vessel. It is a pocket or localized collection of blood usually in liquid form within the tissue. This distinguishes it from an ecchymosis, which is the spread of blood under the skin in a thin layer, commonly called a bruise. It is not to be confused with haemangioma which is an abnormal buildup of blood vessels in the skin or internal organs.

Scrotal hematoma is more common in beef bulls following scrotal trauma. The scrotum is swollen and tense but relatively painless. The testicle remains normal, despite the large volume of blood in the scrotum.

Scrotal hematoma typically occurs secondary to trauma and blood vessel rupture within the spermatic cord or tunica albuginea. Prognosis for fertility after hemicastration depends on the functionality of the remaining testicle possibly affected by inflammation and impaired thermoregulation. Moreover, anti-sperm antibody formation and immune infertility could occur after blood-testis barrier disruption.

Conservative treatment of testicular trauma is indicated for mild hematoma without tear of the tunica albuginea and without decreased blood flow of the testis. A testicular rupture may occur later in the course of conservative treatment. Conservative treatment consists of analgesics, elevation of the scrotum, local cooling and bed rest.

The scrotal management is necessary for a pronounced hematoma (hematocele), for suspected testicular rupture and for a decreased testicular blood flow. Surgical treatment depends on the intraoperative findings including detorsion of the testis, removal of hematoma or nonviable tissue, suture of the tunica albuginea.

Prevalence of scrotal hematoma: In Ethiopia 2.1 % of scrotal hematoma was reported in Addis Ababa enterprise abattoir.

Prevalence of gross testicular and scrotal abnormalities of bull in different countries as reported by different journals is listed as following by tabulation (Table1).

| CO   | ORC | EP  | THP   | TD   | SW  | SH  | TOTAL | country   | Authors  |
|------|-----|-----|-------|------|-----|-----|-------|-----------|--|
| 0.3  | 7.1 | 2   | 12.96 | 7.6  | 5.3 |     | 37.04 | Ethiopia  | Eshetu <i>et al.</i> 2016                                |
| 3.1  | 4.4 | 3.4 | 11.8  | 8.1  | 4.7 | 2.1 | 30.4  | Ethiopia  | Migbaru, <i>et al.</i> 2014                              |
| 0.05 |     |     |       | 0.62 | 4.3 |     | 22.1  | Canada    | Barth and Walder, 2002 and Kastlelic, <i>et al.</i> 2001 |
|      | 3   |     | 4.4   |      |     |     |       | Australia | McGowan, <i>et al.</i> 2002                              |
| 1.74 |     |     |       |      |     |     |       | Nigeria   | Adeyeye and Wkkala (2013)                                |

**Table 1:** Incidence/prevalence of testicular and scrotal abnormalities in different countries

## Conclusion

Fertility of both bulls and cows is imperative in cattle production investment to attain adequate reproductive performance of the herd. The reproductive capacity of individual bull is a crucial factor in determining the reproductive performance of the herds, because single bull can serve a herd of up to 60 or more cows. Reproductive disorder of bulls includes congenital causes like testicular hypoplasia and cryptorchidism and acquired like testicular degeneration, epididymitis, orchitis, scrotal wound and testicular hematoma and it have serious economic impact on livestock production. To reduce the economic impact of these abnormalities on fertility and productivity of cattle production appropriate control measures should also be implemented.

Based on the above conclusion, the following recommendations are forwarded:

- Vaccinations and control of infectious diseases of reproductive system
- Performing regular breeding soundness evaluation
- Maintain a relatively young bull herd and acclimatise the bull
- Restriction of breeding seasons to allow a period of sexual rest to breeder or herd
- Unilateral cryptorchid or hypoplastic bulls should never been used for reproduction purposes, because of heritable condition of the abnormalities.

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