Surgical Review of the Male Bovine Animal

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A surgical review of the male bovine animal requires review of the normal anatomy of the bull. The body of the penis is made up of the dense fibroelastic tunica albuginea and trabeculae that surround the cavernous spaces of the corpus cavernosum penis (CCP). The penis is surrounded by elastic tissue which allows the penis to move from the fully retracted to fully extended positions.[1] The elastic tissue is covered with glabrous skin. The glans penis and distal part of the penis are not surrounded by elastic tissue and comprise the free portion of the penis. For normal function, the length of the extended penis should be twice the length of the free portion of the penis.[2] In the nonstimulated bull the penis is retracted into the sheath, a hair covered extension of the abdominal wall. Retraction of the penis is accomplished by the paired retractor penis muscles that attach to the ventrolateral surface of the penis at the distal bend of the sigmoid flexure.[3]

Erection

The anatomical relationships of the structures associated with erections are important in understanding the erection process. The CCP begins as the crura or crus penis and continues as the cavernous spaces which extend along the body or shaft of the penis. The blood supply to the corpus cavernosum penis is via the artery of the penis which is a continuation of the internal pudendal artery. On the caudoventral surface of the ischium, the artery of the penis terminates as the deep artery of the penis which serves the CCP and the dorsal artery of the penis. The dorsal artery of the penis follows the dorsal surface of the penis and periodically gives off small branches known as penetrating arteries.[3,4] The blood leaves the CCP through the deep veins of the penis which connect with the penile veins.[5]

When the bull is sexually stimulated there is reflex dilation of the arteries which allows increased blood flow in the deep artery of the penis through the crus penis and into the corpus cavernosum penis (CCP). The CCP pressure increases from the nonerect pressure of 15 to 20 mmHg to approximately 77 mmHg.[2] There is concurrent relaxation of the retractor penis muscles allowing the sigmoid flexure to unfold and the penis to protrude from the sheath. With continual sexual stimulation the ischiocavernosus (IC) muscles begin rhythmic contraction and as the bull mounts and makes his breeding thrust intense contraction of the IC muscles produces the peak CCP pressures of **14,199 mmHg** associated with erection.[3] Following breeding IC muscle contraction ceases which allows the CCP to become an open system and the pressure drops rapidly back to approximately mean arterial blood pressure. The CCP pressure decreases to the nonerect level of 15 to 20 mmHg and the retractor penis muscles contract to retract the penis into the sheath.[3,4,5]

Prepuce

The most common genital injuries in breeding bulls are abrasions, contusions, or lacerations of the prepuce. The seriousness of these injuries depends upon the depth and extent of damage to the preputial skin and underlying elastic tissue. These injuries most commonly occur during coitus. Fortunately, most superficial injuries resolve with sexual rest. However, more extensive injuries involving the elastic tissue may require prolonged medical or surgical therapy in order to restore the bull to breeding soundness.[6,7]

Retropreputial abscess

Retropreputial abscess is a serious sequel to preputial laceration, especially in *Bos taurus* bulls. Following the initial preputial injury, the penis and prepuce are withdrawn into the preputial cavity and the contaminated wound becomes infected with subsequent abscess formation within the elastic tissue surrounding the penis. The circumscribed swelling of the abscess frequently prevents penile extension. Diagnosis is based upon physical exam findings of the circumscribed swelling evident through the sheath. The swelling must be differentiated from hematoma of the penis. Usually, retropreputial abscess occurs distal to the sigmoid flexure and frequently the swelling is not symmetrical around the shaft of the penis. Therapy consists of sys-

temic antibiotic therapy for 5 to 14 days combined with local hydrotherapy and absolute sexual rest. Fine needle aspiration of the swelling through the skin of the sheath is definitely contraindicated as subsequent adhesions will develop between the peripenile elastic tissue and the skin preventing penile extension. In rare cases the abscess may be drained through the original wound into the preputial cavity.[8]

Preputial prolapse

Preputial prolapse is a common sequel to preputial injury in *Bos indicus* bulls. Bulls of these breeds frequently have excessive preputial skin and pendulous sheaths which predispose them to breeding injury laceration.[2] Following tearing of the preputial skin edema quickly develops in the peripenile elastic tissue causing eversion or prolapse of the prepuce. Case management consists of cleansing the damaged, exposed preputial skin, application of an emollient, antibacterial ointment, and support of the edematous tissues. Systemic antibiotics not routinely used and anti-inflammatory drugs and diuretics are of little of no benefit and could interfere with tissue healing.[1,8]

The lacerations typically occur in a longitudinal direction on the ventral aspect of the prepuce. However, following retraction of the penis into the preputial cavity the laceration appears as a transverse wound. If the wound does not deeply involve elastic tissue, the bull may be able to resume breeding when granulation and epithelization occurs. The bull should have at least 60 days sexual rest before resumption of breeding.[6]

Deep lacerations with extensive elastic tissue damage frequently develop excessive fibrosis which prevents free extension and retraction of the penis. These bulls must undergo surgical scar revision in order to resume breeding soundness. With the bull restrained with heavy sedation and regional analgesia or general anesthesia a resection and anastomosis of the prepuce is performed. This surgical procedure removes the damaged skin and elastic tissue of the prepuce as well as excessive preputial skin such that following surgery the prepuce is no more than twice the length of the free portion of the penis. Sutures are removed 10-14 days postoperatively and the bull should have at least 60 days sexual rest.[1,6-8]

Penis

Surgical conditions of the bull penis include rupture of the tunica albuginea or "ruptured penis, fractured penis, or hematoma of the penis". This injury occurs during the ejaculatory lunge when sudden angulation of the erect penis causes an abrupt increase in intracorporeal pressure with subsequent rupture of the tunica albuginea of the penis.[1] Experimental studies have shown that the average rupture pressure of the bull penis is 75,000 mmHg pressure. The rupture predictably occurs as a transverse tear on the dorsum of the sigmoid flexure of the penis opposite the initial attachment of the paired retractor penis muscles.[4,9] Clinical signs are an acute swelling in the sheath immediately cranial to the scrotum. Skin bruising may be noticeable in light colored bulls and preputial prolapse is frequently present. This preputial prolapse has a characteristic edematous bluish appearance.

Approximately 50% of affected bulls reportedly return to breeding soundness following a minimum of 60 days sexual rest. However, 75 - 80% of bulls undergoing surgical repair of the tunica albuginea return to breeding soundness.[7] The surgical technique involves restraining the bull in right lateral recumbency with heavy sedation or general anesthesia. An incision is made cranial to the scrotum and parallel to the teats. The clotted blood of the hematoma is encountered immediately beneath the skin in the elastic tissue surrounding the penis. Following evacuation of the clot the penis is exteriorized, remaining elastic tissue is incised and the rent in the dorsum of the tunica albuginea is located by careful dissection. The frayed edges of the rent are judiciously trimmed and the edges apposed with #1 coated polygalactia acid suture. The elastic tissues are apposed with #2/0 chromic gut and the subcutaneous tissues and skin closed in routine fashion. Sutures are removed and the bull should have minimum of 60 days forced sexual rest followed by veterinary examination prior to resuming breeding.[1,8,10]

Shunts

In the normal penis there are no venous outlets along the body or shaft of the penis. Occasionally there will be or develop vascular connections between the CCP and the venous structures exterior to the CCP.[11] When this occurs the bull cannot obtain full erection because the CCP is not a closed system. As the blood is pumped from the crura by contraction of the IC muscles, it will flow through the vascular connections to exterior veins. The CCP pressure necessary for full erection cannot be obtained and the bull is unable to breed. The vascular connections can develop during the healing process after penile rupture has occurred. It is possible to return these bulls to service by surgical removal of the vascular connection and allowing the lesion to heal by first intention so that the CCP is a closed system during the erection process.[1,8]

Spiral deviations

Penile deviations are occasionally encountered in breeding bulls. These deviations occur as 3 types, spi-

ral, ventral, or "S" shaped.[1,12] Surgical repair has been most successful with the spiral deviations. The typical bull presented for spiral deviation of the penis is 2 or 3 years of age and has completed one successful breeding season. During the next breeding season cows are noticed to return to heat and upon close observation the owner notices the bull does not make intromission due to the corkscrew appearance of the penis. The veterinarian is cautioned that spiral deviation is frequently observed in bulls collected by electroejaculation. It has also been reported that a large percentage of bulls undergo spiral deviation of the penis when collected with a transparent artificial vagina. Therefore, spiral deviation as a cause of infertility should only be diagnosed by test breeding when the spiral consistently prevents intromission.

Surgical correction is performed with the bull under heavy sedation or general anesthesia restrained in right lateral recumbency. A strip of the deep fascia lata is harvested from the bull's left thigh for use as a graft under the apical ligament. Some surgeons prefer synthetic mesh material for the graft. A longitudinal incision is made on the dorsum of the penis from the glans to several centimeters into the prepuce and deepened through the elastic tissue to expose the apical ligament. The apical ligament is incised longitudinally to expose the tunica albuginea of the penis. The cleaned fascia lata graft is sutured to the dorsum of the tunica albuginea with interrupted #3/0 polygalactia acid sutures and the apical ligament is reapposed over the graft. The elastic and subcutaneous tissue is closed with #3/0 chromic gut and the skin is closed with an appositional pattern. Sutures are removed in 10 - 14 days and the bull should have a minimum of 60 days forced sexual rest.[1,8]

Persistent Frenulum

Failure of separation of the penis and prepuce at puberty results in the formation of a persistent frenulum. The condition is usually noticed when the bull is presented for breeding soundness or first enters the breeding herd. The frenulum is easily diagnosed as a firm band of tissue joining the prepuce to the glans penis.[14] The condition is easily corrected with the bull restrained in a chute by local infiltration of the limits of the frenulum, ligation of each end of the frenulum, and excision of the tissue. The bull should be breeding sound with 30 days sexual rest. The owner should be cautioned that persistent frenulum is considered heritable and recommend that all male calves sired by the bull should be castrated.[1,2]

Warts

Fibropapilloma of the penis is occasionally encountered in young bulls as a result of papilloma virus infection of the skin of the penis.[15,16] Typically the warts occur as single pedunculated growths near the glans penis. With the bull restrained in a chute or table catheterize the urethra with a #10 male dog catheter to ensure that the urethra is not injured during surgical removal of the growth. Debulk the lesion with a #10 surgical blade to identify the stalk of the lesion. Carefully remove the stalk, achieve hemostasis and suture the skin of the penis to cover the defect created by wart removal. The author prefers **#1 chromic gut suture** and the bull should have a minimum **of 2 weeks forced sexual rest**, depending upon the size of the defect following wart removal.

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