History

A 3-year-old 817-kg (1,797-lb) Angus bull was evaluated at the J.T. Vaughan Large Animal Teaching Hospital at Auburn University because of an inability to copulate. According to the owners, the bull had successfully sired calves the previous breeding season but had not been observed successfully breeding females during the current season. The owners indicated that the bull displayed acceptable libido and would mount cows normally, but he failed to extend the penis or to achieve intromission. There was no history of previous injury or penile trauma.

The bull had no evidence of muscle atrophy. No genital abnormalities were identified during physical examination, which included manual extension and examination of the penis. A breeding soundness examination performed in accordance with the standards of the Society for Theriogenology revealed that quality of semen obtained with electroejaculation was adequate, but the bull was unable to achieve and maintain an erection during electroejaculation. The penis partially engorged, which was followed by a loss of tumescence during electroejaculation. The findings and clinical history suggested impotence attributable to failure to achieve or maintain adequate pressure in the corpus cavernosum penis (CCP).

Question

What diagnostic testing can be used to aid in identifying the bull’s condition? Please turn the page.
Answer

A test breeding is useful to confirm erection failure, but it will not identify the cause of the erection failure. Inability to achieve and maintain penile erection in the absence of gross abnormalities of the penis can be evaluated by use of cavernosography, which may be supplemented by ultrasonographic examination of the accessible portions of the penis.

Results

Food was withheld from the bull for 24 hours. The bull was then tranquilized by administration of acepromazine (0.04 mg/kg [0.018 mg/lb], IV). The sedated bull was positioned in right lateral recumbency, and a towel clamp was placed under the apical ligament on the dorsum of the penis approximately 5 cm from the tip of the penis to assist with manual extension and stabilization of the penis; clinicians were careful to avoid placing the forceps in cavernosal tissue. A suture was placed through the skin of the sheath and between the retractor penis muscles and penis to aid in pulling the penis away from the body wall to facilitate radiography. A 16-gauge, 3.8-cm needle was inserted at a 45° angle on the dorsum of the penis adjacent to the towel clamp; the needle penetrated through the skin and tunica albuginea into the CCP. An IV extension set was attached to the needle, and sterile saline (0.9% NaCl) solution was injected to test the position of the needle (if the needle is in the CCP, there will be minimal resistance to injection of the saline solution). A radiographic plate was positioned; 20 mL of water-soluble, iodinated radiographic contrast material was injected into the CCP; and radiographs were obtained. Images of the penis from the glans to the sigmoid flexure (which required 3 or 4 radiographic plates) were acquired within 60 seconds after injection (Figure 1). These images were compared with cavernosograms of a clinically normal bull (Figure 2) and a bull with a penile hematoma that resulted from rupture of the tunica albuginea at the sigmoid flexure (eg, so-called broken or fractured penis; Figure 3).

Examination of the radiographic images of the bull described here revealed multiple vascular shunts (Figure 4). For this type of vascular pattern, the most likely cause of the clinical signs was congenital cavernosal shunts.

Figure 2—Right lateral radiographic view of the penis of a clinically normal bull obtained after injection of contrast material. Cranial is to the left. There is uniform filling of the CCP with no extracorporal vasculature. Notice the ventral vascular canals (arrows).

Figure 3—Right lateral radiographic view of the penis of a bull with an acquired vascular shunt secondary to rupture of the tunical albuginea at the sigmoid flexure (so-called broken or fractured penis). The image was obtained approximately 30 seconds after injection of contrast medium into the CCP. Cranial is to the left. There is a single large shunt vessel (arrow) with several smaller vessels on the dorsal aspect of the distal bend of the sigmoid flexure.

Figure 4—Same right lateral radiographic view of the distal portion of the penis of the bull as in Figure 1. Notice the multiple vascular shunts (arrows). This pattern, combined with the history and physical examination findings, would be consistent with congenital vascular shunts.
Ultrasonographic examination of the penis was performed to enable clinicians to assess structural changes not apparent during clinical or radiographic evaluation (Figure 5). A reference image of the normal architecture was used for comparison (Figure 6).

Discussion

Erectile dysfunction in bulls is often associated with the inability to fill the cavernous penis with blood. This can be a result of occlusion of the longitudinal vascular canals of the cavernous penis or, more commonly, vascular shunts between the CCP and extracorporeal vasculature. Normally, there are no vascular communications extending from the dorsal and ventral vascular canals or cavernous spaces through the tunica albuginea to the extracorporeal circulation (Figure 2).1–6 Such communications prevent the CCP from being a closed system and thus do not allow the increased pressure required to achieve a complete erection.

Vascular shunts are classified as congenital or acquired.1,2,5 Inability to achieve and maintain penile erection in the absence of gross abnormalities of the penis is consistent with a vascular shunt between the CCP and the extracorporal vasculature or obstruction of the trabecular spaces of the CCP as a result of thrombosis or fibrosis.1–5

Acquired shunts are the most common type of cavernosal shunt and are typically secondary to penile hematoma (eg, broken penis) or trauma to the penis (eg, a bite wound).1,2,4,5 Acquired cavernosal shunts can also be a complication after surgery to correct penile deviation.2,5 For a broken penis, a penile hematoma develops when there is rupture of the tunica albuginea on the dorsal aspect of the distal bend of the sigmoid flexure during copulation (Figure 3). Vascular shunts are especially likely to develop during healing of a tear in the tunica albuginea when the tear is not surgically repaired.1,2,5 Acquired shunts are typically caused by rupture of a single blood vessel or, at most, several small blood vessels at the site of injury.1,2,5 Shunts associated with hematomas are amenable to surgical repair via wedge resection and primary closure of the tunica albuginea. Vascular shunts that develop secondary to penetrating wounds are also amenable to repair.2,5 In contrast to shunts associated with a penile hematoma resulting from rupture of the tunica albuginea at the sigmoid flexure, shunts caused by penetrating wounds are typically located in the free portion of the penis.1,2,5

Congenital shunts usually are associated with multiple blood vessels connecting the CCP to the extracorporeal vasculature. The cause of congenital shunts is not known, but these shunts may be associated with a congenital weakness in the tunica albuginea of the distal portion of the penis.1,2,5 The authors are unaware of any investigations conducted to assess the role of genetics in congenital penile vascular shunts. Diagnosis of congenital shunts is based on identifying the characteristic vascular pattern seen during contrast radiography and no history of trauma, hematoma, or surgery of the penis.3–5 Interestingly, some bulls with congenital shunts can successfully perform natural breeding prior to the onset of impotence.3
Contrast radiography of the penis can be performed in bulls restrained in a standing position. However, the process is simpler and more easily performed with the bull positioned in right lateral recumbency on a tilt table. It is not always necessary to sedate or anesthetize a bull to perform this procedure, but withholding feed for 24 to 48 hours will minimize bloating associated with lateral recumbency.

Contrast medium will quickly be cleared from the CCP (within 15 minutes after injection). In the authors’ experience, the contrast medium is best visualized within the first 60 seconds after injection and is more difficult to see by 2 minutes after injection. However, repeated injections of contrast material can be performed if additional radiographs (cavernosograms) are required. Obtaining images of the entire penis may require the use of 3 or 4 radiographic plates, depending on the size of the plates.

Although ultrasonography is not routinely used in the evaluation of bovine penile vascular shunts, it was performed on this bull. The normal architecture of the bovine penis is readily apparent during ultrasonographic examination by use of a high-frequency linear probe (7 to 12 MHz; Figure 6). In the bull described here, there was marked distortion of the free portion of the penis with loss of the typically well-delineated longitudinal fibers of the tunica albuginea and blending of the peripenile tissues with that of the CCP (Figure 5). Furthermore, small vessels could be seen in this tissue, similar to the vascular pattern noted during contrast radiography.

The authors are not aware of any published information on the use of ultrasonography for evaluation of penile shunts, and histologic examination was not performed; thus, the cause of the ultrasonographic changes identified in this bull is not known. However, given the ultrasonographic appearance of the tunica albuginea, it is possible that the changes were the result of previous trauma despite a lack of obvious abnormalities during gross examination of the penis. If this possibility is correct, it would indicate that the vascular shunts in this bull were not congenital but, rather, acquired secondary to disruption of the tunica albuginea. The inciting trauma could have been a crushing injury. It is also plausible that the ultrasonographic changes to the tunica albuginea were the result of an inherent congenital weakness, as has been postulated in other reports. Additional results of ultrasonographic examination of bulls with penile shunts combined with results of histologic examination and an accurate history indicating the potential cause of a penile shunt are needed to determine the value of ultrasonography in these cases.

Outcome

The clinicians considered that the bull was not a surgical candidate because of the extensive vascular shunts. Although the authors are not aware of any genetic basis for the development of congenital penile vascular shunts, it would be questionable to recommend that affected bulls be used for breeding. However, because the bull described here had genetic value to the owner, and because it was possible, as determined on the basis of results of the ultrasonographic examination, that the vascular shunts were secondary to trauma, we recommended that the bull be transported to a custom semen collection facility for collection and freezing of semen.

Footnotes

a. Isoview 370, Bracco Diagnostics, Princeton, NJ.

References