Incomplete Pete

A Case Report of Bilateral Cryptorchidism in Equids

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Introduction

Cryptorchidism is the most common developmental abnormality in male horses and is defined as incomplete testicular descent of one or both testicles into the scrotum. The stated prevalence of cryptorchidism in equids is between 2-8 %.[8] Right and left-sided testicular retention develop with comparable regularity, with only 10-15 % of cryptorchid stallions bilaterally afflicted.[8] However, in an ongoing study at the Mississippi State University College of Veterinary Medicine, three out of twenty cryptorchid stallions surgically castrated have been affected on both sides. Cryptorchid stallions are also known as "rigs, ridglings, originals, or if the testis is in the inguinal canal, high flankers."[3] Certain equine breeds are at an increased risk of developing cryptorchidism, including "Percherons, American Saddlebreds, and American Quarter Horses." Thoroughbreds, on the other hand, have a decreased chance of testicular retention.[8]

Most cryptorchid testicles entrapped within the abdomen remain close to the vaginal ring and are reachable through standard surgical approaches.[8] Nevertheless, cryptorchidectomy is a delicate surgical procedure with the risk of significant complications including postoperative swelling, eventration, hemorrhage, funiculitis, peritonitis, hydrocele formation, poor visibility of the operative site, penile damage, and continued stallion-like behavior.[10,11] These complications are necessary to remark upon because malpractice litigation is most commonly claimed against equine practitioners in North America due to complications during or following equine castration.[11] Surgical techniques for a cryptorchidectomy, other than traditional celiotomy, include laparoscopic procedures in both standing and recumbent horses. Through the utilization of laparoscopic cryptorchidectomy, the surgeon can minimize the incidence and risk of

significant surgical complications.[10] This case outlines an unusual diagnosis of bilateral cryptorchidism and the effectiveness of cryptorchidectomy via laparoscopic surgery.

History and Presentation

Pete, a two-year-old, intact male Quarter Horse, presented to the Mississippi State University College of Veterinary Medicine Equine Medicine and Surgery service on June 21, 2018, for surgical treatment of cryptorchidism. Pete was rescued as a "gelding" at approximately one year of age, and he underwent no castration attempts while in the care of his new owners. During his training and general daily activities, Pete's owners quickly observed him exhibiting signs of stallion-like behavior. Typical stallion-like behaviors may include visual searching with aggression, exhibiting flehmen behavior, increased phonation, circling, chin resting, erection and penile protrusion, mounting, and high levels of excitement.[12] Seeking a cause of Pete's undesired change in behavior, the owners had him examined by their primary care veterinarian.

Pete's initial physical exam by his primary veterinarian was within normal limits. However, the veterinarian remarked that he could not palpate testicles within Pete's scrotum. Additionally, the veterinarian neither visualized nor palpated any indication of prior surgical castration. The basal level of testosterone in Pete's blood was measured; and following intravenous administration of human chorionic gonadotropin, Pete's testosterone levels significantly increased at one, two, and twenty-four hours post-administration indicating a positive response. Due to the reasonable likelihood of existing testicular tissue, Pete was referred to the Mississippi State University College of Veterinary Medicine for the surgical extraction of the retained testicle or testicles.

Upon presentation to the Mississippi State University College of Veterinary Medicine Equine Medicine and Surgery service, Pete was bright, alert, and responsive. He weighed 955 pounds (433.2 kilograms) and had a five out of nine body condition score, indicating his weight was healthy when compared to his body frame. His vitals were within normal limits with a temperature of 100.3 °F, pulse of thirty-six beats per minute, and respiratory rate of sixteen breaths per minute. Pete appeared adequately hydrated with pink and moist mucous membranes and a capillary refill time of fewer than two seconds. Cardiothoracic auscultation was within normal limits with an appropriate respiratory rate and excursions, clear lung sounds, and a regular heart rate and rhythm with no murmurs. Gastrointestinal motility was normal in all four quadrants, and digital pulses were present in all four limbs. Neither testicle was palpable within the scrotum.

Diagnostic Approach/Considerations

Several diagnostic approaches were considered to confirm a diagnosis of cryptorchidism in this case. For horses with presumed cryptorchidism, the usual diagnostic approach is uncomplicated if the patient has not exchanged owners and is accompanied by accurate medical records.[5] In this case, Pete was a rescued animal with no previous medical records and no obvious external testicles at the time of purchase, which added complexity to his diagnosis. Often, horses with cryptorchidism are obtained as geldings which then begin to display stallion-like behaviors when introduced to mares. Upon initiation of these behaviors, presumed cryptorchid animals should be fully examined by a veterinarian to identify whether the animal is a pure gelding or a cryptorchid.[5] Additionally, in the majority of cases in which a testis has been excised, one can often visualize a “castration scar.”[4] When palpating for retained inguinal testicles, the administration of sedation may be necessary to adequately evaluate the external

inguinal region or genitalia of younger or more anxious colts.[11] Pete received two full physical exams without sedation which revealed no castration scar or palpable testicles within his scrotum or external inguinal ring, and the lack of tangible testes in the scrotum by one month of age is circumstantial proof of cryptorchidism.[3] Rectal palpation may be conducted to discover the anatomical location of the retained testicles; however, rectal palpation commonly offers little information on the nature of retained testicles and introduces unnecessary risk, which is why rectal palpation was omitted from Pete's diagnostics.[5,11] Alongside palpation, ultrasonographic visualization of the external inguinal region or the abdominal cavity may be beneficial when locating retained testicles.[5]

If retained testicles remain undiscoverable by palpation or ultrasonographic examination in a suspect cryptorchid like Pete, hormonal testing is advised. Measuring estrogen levels in the animal can aid in the differentiation between cryptorchids and geldings three or more years of age, but estrogen analysis is not deemed to be of diagnostic benefit in younger horses like Pete.[5] Another potential hormone test for the diagnosis of a cryptorchid animal is the measurement of serum anti-Müllerian hormone. Inside the male fetus, anti-Müllerian hormone is a glycoprotein emitted from the fetal testis that degenerates the Müllerian duct. Cryptorchid testicles continue to secrete anti-Müllerian hormone, and measurement of these concentrations can support a diagnosis of equine cryptorchidism.[7]

Determination of testosterone levels in the blood is the most commonly employed hormone test for the diagnosis of cryptorchidism.[6] A single testosterone analysis may be adequate to identify the existence or lack of testicular tissue.[5] While geldings present with deficient blood testosterone levels generally less than 100 pg/ml, cryptorchid stallions display moderately elevated levels between 100 to 500 pg/ml. Intact studs present with high testosterone

levels equal to or greater than 500 to 1,000 pg/ml.[6] The presence of testosterone in cryptorchid animals can explain why they continue to present with libido and aggressive male behavior. If testosterone levels in a single sample are not diagnostic or are inconsistent with clinical signs, a human chorionic gonadotropin (hCG)-stimulation test may be conducted. For this test, a baseline testosterone level is obtained; then, serial testosterone measurements are recorded one to two hours following administration of the hCG. If one or more testicles are present within the patient, the hCG will stimulate the testes to produce testosterone which will increase levels in the post-administration samples of testosterone.[5] There should be no surge in testosterone levels in genuine geldings after administration of hCG.[6]

In Pete's case, an hCG-stimulation test was performed through B.E.T. labs in Lexington, Kentucky, via his referring veterinarian. Pete's baseline testosterone levels measured 5.0 pg/ml initially indicating no present testicular tissue. However, he then received an intravenous injection of hCG, and periodic blood samples were collected and sent to the laboratory for evaluation. At one hour post-injection, Pete's testosterone level read 65.2 pg/ml. At two hours post-injection, his testosterone level was 276.1 pg/ml. Finally, at twenty-four hours post-injection, his testosterone level reached 501.2 pg/ml. This significant elevation in testosterone signified the presence of viable testicular tissue reacting to the hCG administration. Without any evidence of prior castration attempts, initial speculation held that Pete was a cryptorchid stallion, but surgical exploration and extraction of the retained testicle or testicles would provide a definitive diagnosis.

Pathophysiology

To comprehend the pathophysiology of cryptorchidism, one must first consider the embryological development and events preceding typical testicular descent.[13] In male horses, at

day twenty-seven of embryonic development, routine differentiation of the gonads commences with the formation of the gonadal ridge caudal to the kidney, and sexual differentiation of the gonad into a testicle ensues by day forty. The testicles are initially suspended from the body wall “cranially by the cranial suspensory ligament and dorsally by the mesorchium. The gubernaculum extends from the caudal pole of the testes to the inguinal canal.”[8] Around day forty-five, the gubernaculum is enclosed by an “outgrowth of peritoneum” which ultimately becomes the vaginal process. At roughly four months gestation, a raised estrogen level within the mare causes the testes to hypertrophy.[13] Then, at around five months, the cranial suspensory ligament begins to atrophy.[8] Approaching eight months of pregnancy, the testicular hypertrophy proceeds until the testicles are nearly adult-sized and cannot pass into the inguinal canal. In the final month of gestation, the maternal hormonal levels shift causing the interstitial cells to “degenerate, causing up to a forty percent reduction in testicular mass." While the testicles are shrinking, the change in hormone levels causes the fully formed gubernaculum to “undergo fibrosis” and a reduction in size. Subsequent contraction is implemented on the testicle to draw it into the inguinal canal.[13] The testicles are typically settled into the scrotum within thirty days prior and ten days after parturition in the healthy colt.[5] Following birth, the vaginal ring constricts, blocking the testes from rising back into the abdomen.[8]

Although the full pathophysiology of cryptorchidism is not wholly understood, it has been considered that equine cryptorchidism is generally correlated with the gubernaculum unsuccessfully expanding the vaginal ring or inadequate gubernaculum retrogression, restricting the capacity of the testis to descend into the scrotum.[8] Furthermore, a breakdown in any part of this complicated system of “hypertrophy, atrophy, and fibrosis” may lead to cryptorchidism.[13] Additional determinants associated with irregular testicular descent include ineffectual or

"inadequate gonadotropin stimulation, intrinsically defective testes, and mechanical impediment of descent, all of which may, in turn, have a genetic basis."[3] Examples of mechanical impediments may include “cystic rete testis, testicular tumors, and perseverance of the cranial suspensory ligament.”[8]

There is evidence of a genetic link or heritability of cryptorchidism, but this genetic link is not well documented and does not justify the total population of cryptorchid animals.[3] One possible explanation for the genetic link associated specifically with bilateral cryptorchidism is the involvement of the insulin-like factor 3 (Insl3) gene. The Insl3 gene is characteristically expressed in Leydig cells of the fetal and postnatal testis. In a study from 1999, it was demonstrated that bilateral cryptorchidism can occur with a targeted interruption of the expression of the Insl3 gene and subsequent disruption of gubernaculum development and fibrosis. This research infers that mutations in the gene encoding Insl3 could be a viable cause of cryptorchidism.[14]

Frequently, the preponderance of bilaterally retained testicles lie within the inguinal canal; however, the testicles may also be fully retained in the abdomen, as in Pete's case, subcutaneously along the prepuce, or within the femoral triangle.[4,13] It is also possible that the tail of the epididymis and any mass of spermatic cord may be in the inguinal canal while the remainder lies within the abdomen, creating a partial abdominal cryptorchid.[13] Due to the high temperature of retained testicles, cryptorchids are unable to generate spermatozoa. Therefore, a bilateral cryptorchid stallion, like Pete, is sterile. Male horses with at least one scrotal testicle are customarily fertile considering the descended testis provides enough motile spermatozoa to reproduce.[5]

Treatment and Management

The appropriate treatment of cryptorchidism is surgical castration. Inducing testicular descent through hormone therapy is not advised or effective.[13] Stallion-like behaviors should diminish following castration; and surgical castration should prevent detrimental medical conditions affiliated with retained testicles, like testicular tumors.[5] Options for surgical approaches include inguinal, parainguinal, suprapubic paramedian, and flank approaches, or laparoscopic standing or recumbent cryptorchidectomy.[11] Standing laparoscopic cryptorchidectomy has been the most commonly implemented laparoscopic technique "because it provides visualization of the entire, intra-abdominal pathway undertaken by the descendent testicle while avoiding general anesthesia." On the other hand, a standing approach may not be appropriate for refractory or young animals. In contrast, a dorsally recumbent laparoscopic cryptorchidectomy can be efficiently executed in all horses, and it "avoids patient movement, facilitating removal of bilaterally retained testis while providing good visualization of a single retained testis, and allowing easy and safe removal of the descended testis during one anesthetic period."[1]

Pete's owners elected laparoscopic surgical castration to correct Pete's presumed cryptorchidism, and Pete was enrolled in an ongoing study at the Mississippi State University College of Veterinary Medicine concerning surgical correction of equine cryptorchidism while the patient is placed in a modified Trendelenburg position. This is a position in which the table is tilted with the head down so that the patient's head is lower than their hind appendages at a 30-degree angle. This tilted recumbency produces further visualization of the lower abdomen and pelvis, particularly during robotic or laparoscopic procedures.[2]

Pete was placed under general anesthesia and positioned in dorsal recumbency on the surgical table. His surgical sites were properly prepped, including his umbilicus and bilateral inguinal rings. Pete’s hind limbs were secured to a single tree hoist bar and attached to a hoist using shackles. An incision was made on the ventral midline of Pete's abdomen at the level of the umbilicus through the skin, subcutaneous tissues, and linea alba. A sharp trocar/cannula combination was used to pierce his peritoneum, and the laparoscope was placed into the incision. The abdomen was then insufflated with carbon dioxide to a pressure of 20 mmHg. Pete's hindlimbs were raised with the hoist to a modified Trendelenburg position to displace the abdominal viscera and improve visualization of the caudal abdomen. Both of Pete's testicles were visualized on either side of the bladder, confirming a diagnosis of abdominal bilateral cryptorchidism. Two separate incisions were made cranial and axial to the left and right inguinal rings, and Semm claw grasping forceps were inserted into each incision. Each testicle was identified and grasped with the Semm claw grasping forceps, and Pete was lowered back onto the surgical table into dorsal recumbency. Each testis was extracted through its respective incision, and each testicle was clamped with two large Oschner forceps. Next, each testicle was properly ligated with transfixing sutures and transected. Both spermatic cords were examined for hemorrhage and placed back into the abdomen. The carbon dioxide was evacuated from the abdomen, and the incisions were closed.

Case Outcome

Pete recovered uneventfully from his procedure, and no complications were noted. He was discharged from the Mississippi State University College of Veterinary Medicine the following day with trimethoprim sulfa to reduce the risk of perioperative infection and flunixin meglumine to provide pain relief and reduce inflammation.[9] It was recommended that Pete be

monitored under strict stall rest for three days then released into a small paddock for ten days to allow adequate time for his surgical incisions to heal. His owners were cautioned of the fact that Pete would likely have testosterone circulating in his blood for around thirty days following his procedure and may still exhibit stallion-like behaviors during that time. Pete's owners were unable to be contacted for an update on his current condition.

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