Unilateral epididymo-orchitis with coagulative and liquefactive necrosis of the spermatic cord, epididymis, and testis of a Friesian stallion caused by *Salmonella spp*. serotype Hartford

Sabrina Hall, Page Mauk, Jim Schumacher, Jessica Klabnik-Bradford, Tulio Prado
Department of Large Animal Clinical Sciences, University of Tennessee, Knoxville, TN

Abstract

A 5-year-old Friesian stallion was presented for evaluation due to increasing discomfort, scrotal edema and right testicular enlargement, first observed 8 days prior to presentation. Hyperechoic areas (consistent with necrosis) within the right testis, anechoic fluid between the visceral and parietal tunics and scrotal edema were observed during transcutaneous ultrasonographic examination. Absence of blood flow to the distal 3 cm of the spermatic cord was detected by Doppler ultrasonography. Testicular necrosis caused by spermatic torsion was suspected and the right testis and distal aspect of the spermatic cord were excised under general anesthesia. During surgery, it was apparent that the right testis and distal portion of the spermatic cord were necrotic, but there was no evidence of torsion of spermatic cord. Histopathology findings included severe diffuse necro-suppurative orchitis, epididymitis and cellulitis, with intralesional bacterial rods. On bacterial culture, there were > 500 colonies of *Salmonella spp*. serotype Hartford.

Keywords: Stallion, necrosis, epididymitis, testis, *Salmonella*

Background

A swollen right testis and lack of blood flow within the distal portion of spermatic cord was present in a stallion. Spermatic cord torsion leading to necrosis was suspected. Based on intraoperative inspection and subsequent histopathology, epididymo-orchitis and not torsion of the spermatic cord caused necrosis. Epididymo-orchitis with coagulative and liquefactive necrosis of the spermatic cord, epididymis, and testis due to *Salmonella spp*. have been reported in humans and rams, but apparently not in stallions. This report describes epididymo-orchitis of a stallion caused by a *Salmonella spp*.

Case Presentation

A 5-year-old Friesian stallion was presented with anorexia, fever, and enlargement of the right testis. The owner, a veterinarian and equine practitioner, had detected an enlarged, firm testis 8 days prior to presentation. Two days later, the horse became anorexic and febrile (40.4°C) and was treated for 6 days with sulfadiazine/trimethoprim (22 mg/kg, PO, q12h) and phenylbutazone (2.2 mg/kg, PO, q24h). Six months before, the stallion had a fever of unknown origin for ~ 1 week, accompanied by elevations in white blood cell count and serum fibrinogen concentrations and was positive for equine herpesvirus 2 (EHV-2). The stallion was otherwise healthy and regularly used for breeding.

Upon presentation, the stallion was bright, alert, and responsive. Temperature was 38.5°C and pulse and respiratory rate were within normal limits. No signs of lameness or gait stiffness were present. The scrotum was edematous, right testis was moderately enlarged, warmer than the left testis and abnormally firm, but the stallion did not exhibit signs of discomfort when this testis was palpated. The diameter of the right testis (7.1 cm), as measured with ultrasonography, was moderately larger than that of the left (size of left testis not recorded). Ultrasonographically, the parenchyma of the right testis appeared hyperechoic, indicative of necrosis and there was excessive anechoic fluid between the visceral and parietal tunics. Doppler ultrasonographic examination revealed a lack of blood flow in vessels in the distal aspect of right spermatic cord. Testicular necrosis caused by spermatic cord torsion was suspected.

Differential Diagnosis

Although the most likely cause of testicular necrosis was a sequela to torsion of the spermatic cord, other differential diagnoses considered included traumatically induced epididymo-orchitis, inguinal herniation, testicular neoplasia, and hydrocele.[1,2] Causes of scrotal enlargement, other than torsion of the spermatic cord and epididymo-orchitis, were eliminated during ultrasonographic examination of the

scrotum and its contents. Surgical removal of the right testis and distal portion of its spermatic cord was recommended, as necrosis was suspected.

Treatment

Stallion was treated with sulfadiazine/trimethoprim (22 mg/kg, PO) and flunixin meglumine (1.1 mg/kg, IV) and sedated with xylazine HCl (1.1 mg/kg, IV). Anesthesia was induced with ketamine HCl (2 mg/kg, IV) and midazolam (0.05 mg/kg, IV), and maintained with a combination of isoflurane, ketamine, and xylazine. A balanced electrolyte solution (5 ml/kg/hour, Plasma-Lyte, Baxter Healthcare Ltd., Deerfield, IL) was given during surgery.

Stallion was positioned in dorsal recumbency, with scrotum and inguinal regions prepared for aseptic surgery. A 10 cm, longitudinal, elliptical skin incision was made through the edematous scrotum over the right testis and extended through thickened scrotal fascia to the parietal tunic. Right testis and a large portion of its spermatic cord, each encased within the parietal tunic, were separated from surrounding fascia (Figure 1). Spermatic cord was ligated with 2 encircling sutures of 1-0 polydioxanone suture (PDS^{TM}, Ethicon, Somerville, NJ) close to the superficial inguinal ring and far proximal to a line of demarcation between healthy and necrotic tissue, and the spermatic cord was transected distal to the ligatures with an emasculator. Incision in the scrotal fascia was closed with 2-0 PDS (PDS^{TM}, Ethicon) placed in a simple-continuous pattern and scrotal skin sutured using 2-0 barbed sutures composed of glycolide, diaxanone, and trimethylene carbonate (V-Loc 90, Medtronics, Louisville, KY) placed intradermally, using a simple-continuous pattern. Testis and its parietal tunic were submitted for histolopathology and bacteriology.

One day after surgery, the stallion's temperature was 38.1^{o}C and it had a normal appetite. Owner was instructed to walk the stallion in hand at least twice daily, allow the horse to resume regular exercise at 3 weeks after surgery and continue to administer trimethoprim-sulfa (22 mg/kg, PO, q12h) for 7 days. Owner was also instructed to have stallion's semen evaluated at ~ 30 and 60 days after surgery.

Outcome

Excised testis and the distal 3 cm of the spermatic cord were necrotic and adhered to a 6 - 7 mm thick parietal tunic (Figure 2). Torsion of the spermatic cord was not apparent. There were large, glossy colonies of bacteria on Columbia blood agar and > 500 lactose-negative bacterial colonies observed on MacConkey agar. No bacteria grew on CNA agar or on anaerobic cultures. Infection of the testis and epididymis was determined to be caused by a *Salmonella spp.,* based on bacterial cultures (Figure 3).

Extensive necrosis and hemorrhage were apparent on histopathology. Bacterial rods colonized the seminiferous tubules, which were separated and expanded by neutrophils (Figures 4 - 6). Based on the findings, the diagnosis was a diffuse and necrosuppurative, bacterial orchitis and epididymitis.

Despite the isolation of *Salmonella spp.* serotype Hartford from the stallion's semen 30 days after surgery, the owner inseminated 4 mares with the stallion's semen collected 60 days after surgery. The uterus of these mares was lavaged once, 8 hours after breeding with 1 liter of isotonic saline solution containing 1 gram cefazolin (Cefazolin, West-Ward Pharmaceutical Corp., Eatontown, NJ). All mares became pregnant, but one aborted at 60 days of pregnancy; the owner attributed the abortion to a low serum progesterone concentration. Fifty colonies of *Salmonella spp*. serotype Hartford were cultured from stallion's semen 4 months after surgery; however, no *Salmonella spp.* were cultured from stallion's semen 5 months after surgery. The stallion bred 10 mares within 5 years after surgery and all 10 foaled.

Discussion

Epididymo-orchitis is commonly reported in humans, most often as a complication of enteric salmonellosis.[3-5] *Salmonella enteritidis* caused orchitis in a 10 week old boy who developed swelling of right testis, thought initially to be caused by torsion of the ipsilateral spermatic cord.[3] In one report, *Salmonella enteritidis* was cultured from the urine and blood of a patient with epididymo-orchitis who also suffered from systemic lupus erythematosus.[4] In the same report, another patient suffering from diabetes Type II developed a testicular abscess from which *Salmonella enteritidis* was cultured. Adult

human patients have developed suppurative epididymo-orchitis after gastroenteritis, with immunocompromised adults potentially at highest risk.[5]

Epididymo-orchitis caused by Salmonella in a ram was reported.[6] The testis of this ram was infected with *Salmonella enterica subspecies diarizonae* serovar 61:k:1.5, which has been associated with gastroenteritis and abortion in sheep.[6] This ram was subfertile and had decreased semen motility and scrotal enlargement due to thickening of the right epididymis and testis, which was painful on palpation. Gross and histolopathological abnormalities of the testis and epididymis were similar to those of the testis and epididymis of the stallion herein. To our knowledge, this is the first report of a pure growth of *Salmonella spp.* isolation from necrotizing epididymo-orchitis in a stallion. Infection of the epididymis of mature rams, resulting in orchitis, is nearly always caused by *Brucella ovis*, whereas the most common bacterial species causing epididymo-orchitis in immature rams are *Actinobacillus seminis* and *Histophilus ovis*.[7]

The present report indicates the importance of considering Salmonella infection as a cause of an enlarged testis, particularly if the affected patient is immunocompromised. Six months prior to presentation, this stallion had developed an infection caused by EHV-2. There are apparently no reports associating infection caused by EHV-2 with bacterial orchitis of horses; however, EHV-2 causes immunosuppression and increases susceptibility to infection by other viral or bacterial agents.[8] Co-incidentally, foals immunized against EHV-2 were more resistant to pneumonia caused by *Rhodococcus equi* than non-immunized controls.[9]

Learning points:

- Coagulative and liquefactive epididymo-orchitis caused by *Salmonella spp*. is reported in a stallion, apparently for the first time.
- Epididymo-orchitis caused by *Salmonella spp.* may not reduce a stallion's fertility, if infection is resolved.
- Salmonella infection should be considered as a possible cause of testicular enlargement in stallions.
- Infection with EHV-2 may be a predisposing factor in development of epididymo-orchitis caused by Salmonella.

References

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Figure 1. Right testis and distal 3 cm of the spermatic cord excised using closed-technique orchiectomy.

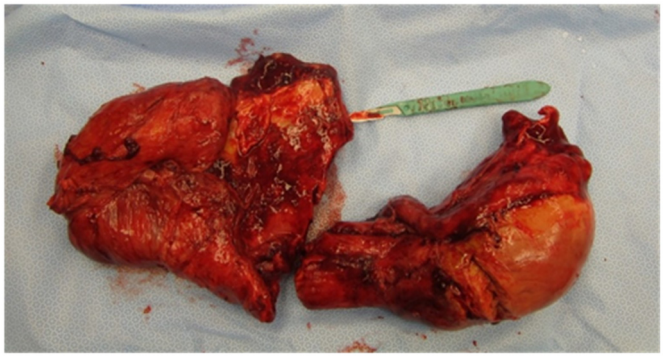

Figure 2. Fibrotic, edematous, and partially necrotic testis.

Figure 3. Greater than 500 colonies of Salmonella were present on a MacConkey agar plate.

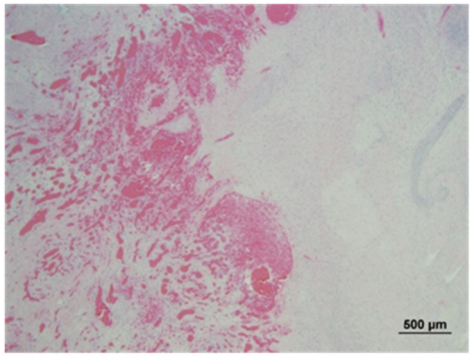

Figure 4. Extensive necrotic lesions bordered by hemorrhage.

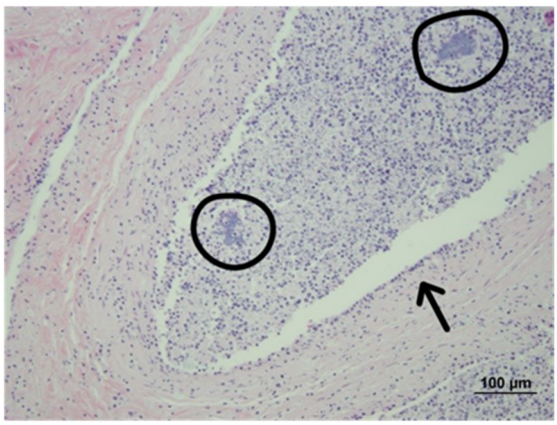

Figure 5. Epididymis with necrosis and scattered bacterial colonies filling the lumen; note bacterial colony (circle) and necrosis (arrow).

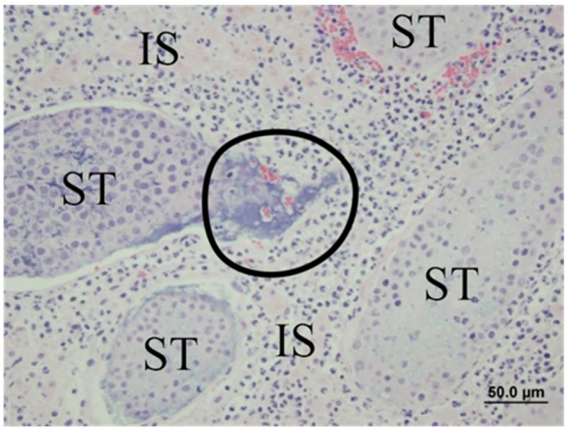

Figure 6. Seminiferous tubules of the affected testis with separation and expansion of interstitial tissue due to infiltration of neutrophils; note bacterial colony in a seminiferous tubule (circle); ST, seminiferous tubule; IS, interstitial space.