Theriogenology Question of the Month

The American College of Theriogenologists sponsors this feature. Readers of the *JAVMA* are invited to submit contributions. Contributions should provide a learning exercise about theriogenology. A specific question should be posed for the readers. The author's answer to the question and a brief discussion should be presented. Possible topics include commonly seen problems in domestic or exotic animals. Herd problems in dairy and beef cattle, sheep, goats, horses, and exotic hoofstock, problems in kennels or catteries, or flock problems in domestic and exotic fowl also are appropriate. Please contact Dr. Craig A. Smith, Associate Editor (800/248-2862, ext 6764, or FAX 847/925-9329), for further details.

History

A 10-year-old Quarter Horse stallion was examined in mid-May at our veterinary medical facility to determine the cause of brown-tinged discolored semen. The previous year, the stallion was located in Canada and reportedly ejaculated discolored semen during the breeding season; endoscopic examination of the urethra at that time failed to reveal abnormalities. *Escherichia coli* was isolated from a semen sample, and the isolate was susceptible in vitro to amikacin, gentamicin, and enrofloxacin. However, discoloration of the semen disappeared without treatment, and the stallion successfully completed that breeding season. The stallion was moved to Texas, and thick brownish-discolored semen was obtained during 2 semen collections prior to admission to our facility.

Results of physical examination was unremarkable. A Missouri-model artificial vagina with a clear plastic bag attached for the semen receptacle was prepared and used for collection of a semen sample. An ovariectomized mount mare was used to facilitate semen collection, and successive fractions of semen were observed as they entered the bag during the ejaculatory process. Discolored semen appeared toward the end of the ejaculate, suggesting that the source was the accessory sex glands. A second ejaculate, which was similar in character to the first ejaculate, was collected by use of an open-ended artificial vagina that allowed separation of the fractions into sterile cups for microbial culture and cytologic analyses.

Prior to washing of the penis, swab specimens were procured for bacteriologic culture from the preputial sheath, penis, fossa glandis and urethral diverticulum, and urethra. The penis and fossa glandis then were washed with a surgical scrub, rinsed with tap water, and dried before ejaculates were collected. Swab specimens also were obtained from the urethra prior to and immediately after ejaculation of the entire first ejaculate, from the raw semen of the entire first ejaculate, from the sperm-rich portion of the fractionated second ejaculate, and from the sperm-poor portion of the fractionated second ejaculate. Mixed nonpathogenic bacteria were cultured from the preputial sheath, penis, fossa glandis, and urethra prior to washing; however, we did not culture substantial bacterial growth from the urethra after washing but prior to ejaculation or from the sperm-rich portion of the fractionated second ejaculate. Heavy growth of *Acinetobacter calcoaceticus* was cultured from the entire first ejaculate, sperm-poor portion of the fractionated second ejaculate (ie, latter fractions of the ejaculate), and urethra immediately after ejaculation. In vitro susceptibility testing revealed the isolate was susceptible to enrofloxacin (**minimum inhibitory concentration [MIC]** < 0.25 µg/ml) and amikacin (MIC < 8 µg/ml) but resistant to gentamicin and trimethoprim-sulfamethoxazole.

Transurethral endoscopic examination was performed (100-cm flexible videoendoscope), and the urethra, urinary bladder, ureters, urine within the bladder, and urine expelled from the ureters appeared normal. The end of the endoscope was positioned near the openings of the accessory sex gland ducts while pressure was applied per rectum to each prostatic lobe and bulbourethral gland in succession; fluid expelled was transparent without discoloration. The endoscope was passed into the right and then left seminal vesicles; abnormalities were not observed in the right seminal vesicle, but erosive seminal vesiculitis with adherent purulent material was evident in the fundus of the left seminal vesicle. Purulent material was aspirated through a cannula passed through the biopsy channel of the videoendoscope, and culture yielded heavy growth of *A calcoaceticus* with the same antimicrobial susceptibility pattern as that obtained for the previous isolate of that organism.

The lumen of each seminal vesicle was rinsed with sterile lactated Ringer's solution. We then infused 0.5 g of amikacin buffered with 10 ml of 8.4% $NaHCO_3$ diluted in 20 ml of sterile water into the lumen of each seminal vesicle.

Question

What options can be used to treat this stallion? Please turn the page.

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Answer

Surgical removal of the affected seminal vesicle, medical treatment by systemic administration of an appropriate antimicrobial, or lavage and infusion of the affected seminal vesicle with an appropriate antimicrobial preparation.

Outcome

Enrofloxacin was selected for systemic administration because of the in vitro antimicrobial susceptibility patterns and the likelihood for enrofloxacin to penetrate into accessory sex glands. An initial loading dose of enrofloxacin was administered (5 mg/kg [2.3 mg/lb], IV, q 12 h for 24 hours), which was followed by a selected dose of enrofloxacin (5 mg/kg, IV, q 24 h) for 4 days. On days 0 (day of administration of loading dose), 1, 2, 5, 6, 7, 8, 9, 10, 11, and 15, semen was collected into an artificial vagina in an effort to empty the seminal vesicles, as well as to provide ejaculates for bacteriologic culture and to provide seminal plasma for assay of enrofloxacin concentrations. Seminal plasma was harvested from ejaculates on days 0 (prior to administering enrofloxacin), 1, 2, 5, 7, 8, and 15, and enrofloxacin concentrations were assayed as described elsewhere.[1] Serum was harvested from blood samples collected from a jugular vein at 30-minute intervals (beginning immediately prior to that day's treatment) for 5 hours on days 0, 5, and 15 of treatment; serum was used for assay of enrofloxacin concentrations. Enrofloxacin appeared to enter accessory sex glands (ie, it was detected in filtered seminal plasma at concentrations of 4,822, 1,415, and 2,239 ng/ml on days 1, 2, and 5 of treatment, respectively, compared with a nonsubstantial concentration in filtered seminal plasma obtained prior to the first treatment) in concentrations approximately equal to maximum serum concentrations achieved 30 minutes after drug administration (peak serum concentrations of 2,419 and 3,499 ng/ml on days 1 and 5 of treatment, respectively).

After 5 days of treatment, the dosage of enrofloxacin was increased in an attempt to further increase seminal plasma concentrations of the drug. The higher dose of enrofloxacin (10 mg/kg [4.5 mg/lb], IV, q 24 h) was administered for an additional 10 days. Semen collected after enrofloxacin treatment on days 7, 8, and 15 and blood samples collected at 30-minute intervals beginning immediately prior to drug administration on day 15 were assayed for enrofloxacin. Enrofloxacin concentrations in seminal plasma were 7,890, 8,515, and 4,486 ng/ml on days 7, 8, and 15, respectively. Peak enrofloxacin concentration in serum was 4,480 ng/ml on day 15.

During the course of treatment, gross discoloration of semen disappeared, and the number of neutrophils and bacteria in smears of ejaculates greatly decreased. Centrifugation of semen samples and cytologic examination of the resulting pellets revealed a few remaining neutrophils and bacteria. Swab specimens of semen samples collected 1 week after initiation of treatment and on the last day of treatment did not yield substantial growth after bacterial culture for 48 hours. After several months of sexual rest, several samples of semen were collected from the stallion, and brownish discoloration of the semen was evident in each collection. The owner declined additional examination and treatment of the stallion.

Discussion

One option for treatment included seminal vesiculectomy. Surgical removal of an affected seminal vesicle has been performed in stallions.[2,3] However, because this procedure can result in adverse effects, such as postsurgical ejaculatory dysfunction,[3] the owners declined the surgery.

Systemic administration of an appropriate antimicrobial for a prolonged period was a second option. Systemic administration of antimicrobials may not be successful because of failure of the antimicrobial to penetrate into infected tissues.[4,a] Antimicrobials that are bases with good lipid solubility and a high pKa are believed to be desirable for systemic treatment of infections of the reproductive tract.[4] Fluoroquinolones have been advocated for treatment of animals with infections of the accessory sex glands (eg, dogs with prostatitis) because of their lipid solubility, low protein-binding capacity, and low degree of extracellular ionization.[5] Enrofloxacin is not labeled for use in horses.

A third option was to lavage the seminal vesicles prior to localized infusion of the vesicles with an antimicrobial. This procedure has been used in horses in which the antimicrobial chosen on the basis of in vitro susceptibility testing did not have desirable characteristics for systemic administration to treat reproductive tract infections. This procedure may have the added advantages of removing purulent material prior to instilling high local concentrations of an antimicrobial. To ensure adequate concentrations of antimicrobials in seminal vesicles, repeated endoscopically guided cannulation of duct openings followed by lavage and instillation of antimicrobials has been advocated.[3]

An alternative to treating the stallion was to treat semen collected from the stallion and use it for artificial insemination. Semen from the stallion could be collected, filtered, and mixed with extender containing amikacin. Optimally, the semen would remain in the amikacin-containing extender at ambient temperature for at least 30 minutes to control bacterial growth. Swab specimens of semen obtained from this stallion and prepared in this manner did not yield substantial growth when cultured. In another report,[4] use of this procedure restored pregnancy rates to normal when mares were bred artificially with semen from a stallion with seminal vesiculitis and ampullitis caused by *Pseudomonas aeruginosa*.

The stallion reported here was of interest because we had not seen erosive seminal vesiculitis or infection of the reproductive tract in a stallion caused by *A calcoaceticus*. Whether the erosions visible in the fundus of the affected seminal vesicle contributed to treatment failure is unknown. Of more interest was the finding that systemic administration of enrofloxacin apparently resulted in penetration of the accessory sex glands, resulting in high concentrations of the drug in the seminal plasma. Whether oral administration of the drug would have resulted in high concentrations in seminal plasma is unknown, but IV administration of

enrofloxacin (7.5 mg/kg [3.4 mg/lb], IV) can increase serum concentrations of the drug 10-fold, compared with serum concentrations after oral administration (7.5 mg/kg, PO) of the IV preparation.[6]

Although adverse effects were not detected in the stallion reported here, IV administration of enrofloxacin resulted in lameness and cellulitis around the tarsal plantar ligament, mild superficial digital flexor tendinitis, or tarsal sheath effusion without accompanying lameness in 3 of 16 adult horses treated with 15 or 25 mg of enrofloxacin/kg (6.8 or 11.4 mg/lb) every 24 hours for 21 days.[7] Those investigators cautioned that rapid IV administration of enrofloxacin at that dosage (15 or 25 mg/kg) may induce transient neurologic signs that could be avoided by slower injection and dilution of the drug.

[a]Strezemienski PJ, Benson CE, Blanchard TL, et al. Failure of gentamicin sulfate to enter stallion accessory fluids (abstr), in *Proceedings*. 5th Int Conf Equine Infect Dis, 1987.

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