Journal of the American Association for Laboratory Animal Science
Vol 47, No 4
July 2008
Pages 61–63

Preputial Obstruction and Urine-induced Cellulitis Due to Nonnutritive Suckling in a Male White-tailed Deer (*Odocoileus virginianus*) Fawn

Timothy A Snider* **and Mason V Reichard**

A 73-d-old white-tailed deer (*Odocoileus virginianus*) fawn was diagnosed at necropsy with a ventral abdominal cellulitis secondary to urine after preputial swelling, urethral obstruction and hemorrhage, and focal urethral rupture. During the acute antemortem disease phase, the urinary obstruction tentatively was attributed to potential urethral uroliths, but after euthanasia, extensive gross and microscopic examinations of the urogenital tract revealed no uroliths. This fawn had been copenned with another male fawn, both of which exhibited nonnutritive suckling of the penmate's genitalia before and after periodic milk replacer feedings. We attribute this uncommon presentation of urine-induced cellulitis to urethritis and urethral rupture secondary to repeated, nursing-induced, physical trauma to the prepuce. We examine the husbandry implications of this disease with regard to management of deer fawns in a laboratory setting.

White-tailed deer (*Odocoileus virginianus*) increasingly are used for hypothesis-driven research, especially in the area of infectious diseases, for which wildlife reservoirs of important pathogens are commanding increased attention. Indeed, numerous articles covering diverse tickborne diseases,[3,6] chronic wasting disease,[9] and mycobacterial disease[5] in white-tailed deer have appeared in the peer-reviewed literature in the past 10 y.

The white-tailed deer is not considered a typical laboratory animal, but the confined husbandry as required by some of the cited studies indicates that the species require unique conditions and considerations while in a laboratory setting. Although one seminal work[2] on captive husbandry of wild mammals provides a basic introduction to captive cervids in zoologic collections, little information is available on the unique husbandry requirements of white-tailed deer in the laboratory animal setting. Further, although the cited book provides essential information[2] on fawn-rearing that unifies many anecdotal techniques, to our knowledge, only one other peer-reviewed publication[4] provides detailed information on rearing fawns in artificial conditions such as a research environment. In this report, we describe a case of distal preputial swelling resulting in obstruction and subsequent urethral rupture in a young, male, white-tailed deer fawn. The pathogenesis of the lesions and disease appear to be an unanticipated consequence of rearing fawns in confinement with other fawns.

Case Report

Nine white-tailed deer fawns were purchased at 2 to 3 d of age from a licensed breeder in June 2006 and transferred to the Oklahoma State University Office of Laboratory Animal Care. The deer fawns were used in an experimental trial studying *Anaplasma phagocytophilum*, and the experiments were approved by the Oklahoma State University Institutional Animal Care and Use Committee. The fawns were housed individually or in pairs in 1.5 m × 0.9 m × 1.2 m enclosures made of steel hog panels in tick-free isolation facilities at the Oklahoma State University Center for Veterinary Health Sciences. Enclosures were constructed on a concrete floor, and pine shavings (SunCoast Bedding, Tallahassee, FL) were provided for bedding. The fawns were housed in climate-controlled indoor facilities, and covered shelters within pens were not provided. Fawns were bottle-fed a commercial lamb milk replacer (Super Lamb, Merrick, Middleton, WI) prepared according to manufacturer's directions.

Milk replacer was initially fed at a schedule of 29.6 ml (1 fluid ounce) every 6 h for a total of 4 feedings daily. The amount of prepared milk replacer was increased by an additional 29.6 ml when individual fawns consumed the contents of all bottles at all 4 daily feedings for 3 consecutive days or as deemed necessary depending on the nutritional requirements of each deer. Fresh water was provided ad libitum, and sweet feed and alfalfa hay were introduced free choice when fawns were 2 wk old. For the first 3 wk, fawns were stimulated to defecate by rubbing of the perineum with a paper towel moistened with warm water.

Fawns were weaned from bottle feeding when they were consuming 413.9 to 473.0 ml (14 to 16 ounces) of prepared milk replacer at every feeding and when they were consuming grain and hay well (approximately 8 to 10 wk). For weaning, the volume of milk replacer was kept the same but the frequencies of feedings were decreased. Feedings were decreased from 4 times to 3 times daily for 1 wk, then for 2 feedings daily for a week, and then once daily for a week.

Fawns were given complete physical examinations periodically and were monitored twice daily for signs of illness (rough hair coat, decreased activity, decreased appetite, nasal discharge, sneezing, coughing, and so forth). Periodic blood samples

Received: 30 Nov 2007. Revision requested: 13 Jan 2008. Accepted: 24 March 2008.
Department of Pathobiology, Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, OK
**Corresponding author. Email: tim.snider@okstate.edu*

collected through sterile jugular venipuncture were submitted (Antech Diagnostics, Irvine, CA) for complete blood cell counts and fibrinogen values.

In enclosures with 2 fawns, nonnutritive suckling of the external genitalia of the penmate occurred occasionally, especially before and after milk feedings. In a few instances, fawns also were seen attempting to nurse on the genitalia of fawns in adjacent pens. Pairs of fawns were arranged to minimize or prevent nursing behavior. Affected male fawns exhibited intermittent redness and swelling of the distal urethra, but abnormal urination behavior was not seen in any fawn until the present case.

At 73 d of age, 1 male fawn (deer 63) developed severe depression and anorexia accompanied by intermittent bruxism and low-grade fever. The fawn was managed conservatively with isolation accompanied by hand feeding and nursing care. The course of illness was 36 h, and only in the last 8 h was diffuse swelling of the ventral abdominal skin noted. Retrospective queries of caretakers and investigators established that urination was absent for at least the last 12 h.

A tentative diagnosis of urethral rupture secondary to urolithiasis was made, and blood urea nitrogen was checked (Azostix, Bayer, Elkhart, IN), revealing a level greater than 80 mg/dl (the spot tested was extremely darker than the spot indicating the upper limit of detection [50 to 80 mg/dl] for this semiquantitative test). Hematologic analyses revealed leukocytosis with marked neutrophilia and monocytosis; fibrinogen was elevated also (Table 1). Because hematologic values of cervids can vary according to sex, age, time of year, geographic location, nutritional status, and method of restraint used to obtain the sample,[7] hematologic data are shown in comparison to 2, uninfected control deer used in the *A. phagocytophilum* study that were of comparable age, sex, nutritional status and that had been housed identically. Because of future elimination from the *A. phagocytophilum* study if management was pursued, euthanasia was elected and performed with intravenous barbiturates.

On necropsy examination, significant gross lesions were limited to the urogenital tract and associated ventral abdominal soft tissues. The distal prepuce was markedly swollen and moderately hyperemic and occluded passage of urine. Caudal ventral abdominal skin and subcutaneous tissues were markedly thickened, with subcutaneous regions of up to 3 cm thick and composed of extremely watery, pale tissue that had a strong urine odor (Figure 1). This skin and subcutaneous change extended 9 cm cranial to the prepuce and 6 cm caudal to the prepuce (Figure 2). The distal penile urethra exhibited marked mucosal hemorrhage (Figure 3), and the proximal penile urethra and distal trigone showed moderate congestion. A focal urethral rupture, accompanied by minimal hemorrhage, was located just proximal to the focus of distal urethral hemorrhage. The urinary bladder was distended with urine, and ureters were minimally dilated. Kidneys bulged slightly on section. Extensive examination for uroliths was undertaken, and none were found.

For microscopic examination, tissues were immersion-fixed in 10% buffered neutral formalin for 48 h, processed routinely through graded alcohols and xylene, embedded in paraffin, sectioned at 4 µm, stained with hematoxylin and eosin, and coverslipped. Significant microscopic lesions were limited to the urogenital tract, where penile urethral hemorrhage was confirmed, and the regional skin, where severe necrotizing cellulitis, intravascular thrombi, and interstitial edema with infiltrating neutrophils were noted.

Table 1. Select hematologic and fibrinogen values of white-tailed deer fawns in the present study.

	Control deer 1	Control deer 2	Deer presented
White blood cells (10^3/µl)	1.81	2.40	6.06
Neutrophils (10^3/µl)	0.003	0.835	3.730
Monocytes (10^3/µl)	0.185	0.273	0.932
Fibrinogen (mg/dl)	318	296	588

Figure 1. Cross-section of ventral abdominal skin caudal to the prepuce shows severe thickening of the subcutaneous tissues by slightly opaque, amber, watery edema fluid.

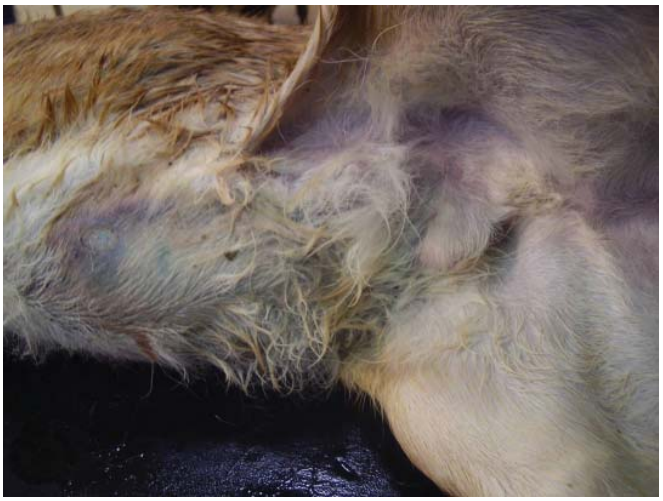

Figure 2. Extensive subcutaneous bruising and swelling is seen cranial and caudal to the prepuce.

Discussion

This report describes a case of severe preputial swelling and subsequent urethral rupture resulting in a urine-induced, regional cellulitis in a young fawn. Because urolithiasis and other obstructive processes (that is, neoplasia) were ruled out as a potential cause, we concluded that the preputial swelling accompanied by adjacent urethral hemorrhage and rupture was due to physical trauma from nonnutritive suckling by the penmate.

Urolithiasis accompanied by a "possibly ruptured bladder" in a cervid fawn was reported previously.[1] Although a similar diagnosis initially was favored in the case reported here,

Figure 3. Distal penile urethra exhibits mucosal hyperemia and hemorrhage as well as mild thickening of the wall.

evidence of urolith or urinary crystal formation were not detected. Therefore, this pathogenesis was ruled out, and the abnormal nursing behavior was considered to be the principal cause.

Nonnutritive suckling was seen in other fawns during the course of this and other studies and is best documented in calves.[8] Nonnutritive suckling in calves occurs in the face of provision of adequate nutrition,[8] and in these deer fawns occurred despite provision of milk and caloric needs that exceeded standards recently published.[4] Although the behavioral aspects of this condition are beyond the scope of the present report, a comparison of nonnutritive suckling in teat-fed calves and bucket-fed calves showed that nutritive and nonnutritive teat suckling affected cardiac rate and reduced nonnutritive suckling of penmates or their environment.[8] Although direct extrapolation across species is difficult, suckling may fulfill an instinctive behavioral need and promote physiologic well-being. Because suckling of pen mates is commonly and anecdotally reported to occur in groups of captive fawns, this behavior should be considered a potential cause of physical trauma and either accommodated or prevented, as possible. In the case of these research deer, some fawns were penned together because of pragmatic considerations related to space availability and, most importantly, because the suckling of pen mates had never previously been associated with any injury or illness.

This case indicates that nonnutritive suckling in fawn penmates is a potential risk factor for physical trauma to external genitalia that could result in urethral occlusion, urine flow blockage, and subsequent urethral rupture. Because this lesion and disease could interrupt laboratory trials using fawns, efforts should be made to pen them individually, avoiding or preventing nonnutritive cross-suckling. If this is not possible, providing a dry teat after meals, as was done in the calf study, may be helpful.[8]

References

1. **Anderson AE.** 1962. A possible case of urinary calculi in a mule deer fawn. J Mammal **43:**268–269.
2. **Crandall LS.** 1964. Family cervidae. In: Management of wild mammals in captivity. Chicago: University of Chicago Press. p 555–606.
3. **Dugan VG**, **Yabsley MJ**, **Tate CM**, **Mead DG**, **Munderloh UG**, **Herron MJ**, **Stallknecht DE**, **Little SE**, **Davidson WR.** 2006. Evaluation of white-tailed deer (*Odocoileus virginianus*) as natural sentinels for *Anaplasma phagocytophilum.* Vector Borne Zoonotic Dis **6:**192–207.
4. **Kendall LV, Kennett MJ, Fish RE.** 1998. Short-term care of white-tailed deer fawns (*Odocoileus virginianus*) in a conventional laboratory animal facility. Contemp Top Lab Anim Sci **37:**96–100.
5. **O'Brien DJ**, **Schmitt SM**, **Fitzgerald SD**, **Berry DE**, **Hickling GJ.** 2006. Managing the wildlife reservoir of *Mycobacterium bovis*: the Michigan, USA, experience. Vet Microbiol **112:**313–323.
6. **Paddock CD, Childs JE.** 2003. *Ehrlichia chaffeensis*: a prototypical emerging pathogen. Clin Microbiol Rev **16:**37–64.
7. **Seal US, Verme LJ, Ozoga JJ.** 1981. Physiologic values. In*:* Diseases and parasites of white-tailed deer. Tallahassee: Tall Timbers Research Station. p 17–34.
8. **Veissier I**, **de Passillé AM**, **Després G**, **Rushen J**, **Charpentier I**, **Ramirez de la Fe AR**, **Pradel P.** 2002. Does nutritive and nonnutritive sucking reduce other oral behaviors and stimulate rest in calves? J Anim Sci **80:**2574–2587.
9. **Williams ES, Miller MW, Kreeger TJ**, **Kahn RH, Thorne ET.** 2002. Chronic wasting disease of deer and elk: a review with recommendation for management. J Wildl Manage **66:**551–563.