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PREVALENCE OF RENAL UROLITHIASIS IN A LARGE, CAPTIVE WHITE-TAILED DEER HERD

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Abstract: Prevalence of renal urolithiasis in a large, captive white-tailed deer (*Odocoileus virginianus*) herd was examined over a two-year period of time. In 1973, 1.3% of 225 deer examined had calculi in the renal pelvis and 4.4% had kidney lesions, either independent or in combination with the calculi. In 1974, prevalence increased and 5.9% of 354 deer had calculi and 6.5% had kidney lesions. Calculi and lesions affected all sex and age-classes. Involvement was both unilateral and bilateral with 23.8% having stones in both kidneys and 30.4% having lesions in both kidneys. Lesions and calculi occurred together in 42.8% of cases. Etiology is unknown, but possible relationships are discussed.

INTRODUCTION

Renal urolithiasis has been reported from a wide range of species, both with and without associated clinical signs and consequences. Ruminants in particular are susceptible to calculi formation and the prevalence may be very high under certain conditions or in certain locations.[4] Calculi in ruminants are thought to be associated frequently with nutritional problems, but renal injury is also an important etiological factor.[3,4]

This paper reports on a relatively high prevalence of renal urolithiasis and lesions in a white-tailed deer (*Odocoileus virginianus*) herd observed over two seasons. The herd inhabits 2,064 ha in southwestern Pennsylvania surrounded by a 2.4 m high woven wire fence. Vegetation within the preserve is mainly oak-hickory forest (93%) with the remainder narrow stands of hemlock bordering drainages, and open fields seeded to perennial grasses and some legumes. Because of severe overutilization of natural forage, ruminants in the preserve are provided a supplemental ration of concentrate (Table 1) on a year-around basis plus alfalfa hay in the winter. Supplement is essentially available *ad libitum* and from October 1972 through August 1974 the supplement comprised over 59% by volume and 80% by weight of the annual deer diet.[2]

We are uncertain of the etiology of the observed urolithiasis and the relationship, if any, to the kidney lesions also observed. However, the prevalence likely is related to the supplemental feeding program.

RESULTS

Prevalence

Animals shot for herd control in the Fall of 1973 and 1974 were brought to a central processing station. All organs and tissues were carefully examined for gross lesions. In 1973, 25 deer were examined and 10 (4.4%) had gross kidney lesions resembling either infarcts or chronic pyelonephritis. One of these deer, plus two others, also had calculi in the renal pelvis (1.3%). No obstructions were noted and the ureters and bladders were free of calculi and lesions.

During the 1974 season, 354 deer were similarly examined. Prevalence significantly increased and 23 (6.5%) had gross kidney lesions and 21 (5.9%) had calculi in the renal pelvis. In addition, 6 deer (1.7%) had marked dilation of the renal pelvis without the presence of other gross lesions or calculi.

Both kidney lesions and calculi affected all sex and age-classes without any apparent significant differences. Involvement was both unilateral and bilateral, with 30.4% having lesions in both kidneys and 23.8% having stones in both kidneys. Both lesions and calculi were present in 42.8% of the deer.

TABLE 1. Supplemental ration used at Rachelwood Wildlife Research Preserve, New Florence, Pennsylvania.

1,200 lbs.	whole corn
800 lbs.	whole oats
10 lbs.	dicalcium phosphate
25 lbs.	trace mineral salt
100 lbs.	cane molasses
1 lb.	vitamin trace mineral premix
2,106 lbs.	mix

Guaranteed Analysis of Trace Mineral Salt

Salt (NaCl)	not more than 98.0
Salt (NaCl)	not less than 95.0
Zinc (Zn)	not less than 0.350%
Manganese (Mn)	not less than 0.280%
Iron (Fe)	not less than 0.175%
Copper (Cu)	not less than 0.035%
Iodine (I)	not less than 0.007%
Cobalt (Co)	not less than 0.007%

Guaranteed Analysis—Per Pound of Vitamins Trace Mineral Premix

Vitamin A	3,000,000 USP units
Vtiamin D3	1,000,000 IC units
Vitamin D2	1,000,000 USP units
Vitamin E	500 Int. units
Vitamin B 12 activity	2 mg
Riboflavin	200 mg
d-Pantothenic acid (as calcium d-pantothenate 218 mgs.)	200 mg
Choline chloride	46,088 mg
Niacin	4,000 mg
Thiamine	200 mg
Pyridoxine	40 mg
Folic acid	20 mg

Iron (Fe)	2.50%
Zinc (Zn)	2.50%
Manganese (Mn)	.50%
Iodine (I)	.50%
Cobalt (Co)	.50%
Magnesium (Mg)	.26%
Copper (Cu)	.20%

Description of calculi

Calculi observed ranged from single stones up to 10 mm in diameter to multiple particles with some as small as 1 mm in diameter. They were all brownish in color with rough, irregular surfaces. The calculi were all hard, but brittle and could be easily fragmented. In all but one case, they were present only in the renal pelvis. The single exception was an adult male collected in 1974 that had several fragments of calculi in the proximal ureter. Chemical analysis of calculi from two animals were both positive for calcium and oxalates. All other calculi were similar in appearance and we assumed that the chemical composition was consistent.

Description of kidney lesions

Gross lesions consisted of single or multiple areas of chronic scarring characterized by pale, depressed areas on the surface extending into the parenchyma in a wedge shape. Lesions frequently extended into the cortex, and occasionally involved the medulla, but never more than mid-way into the medullary area. They were grossly characterized as infarcts, but the possibility of chronic pyelonephritis could not be discounted. When calculi were present, the pelvis was usually, but not always, mildly to moderately dilated. Histologic examination in some cases supported the gross diagnosis of renal infarcts, but other cases were more suggestive of an ascending pyelonephritis.

DISCUSSION

While the possibility of calculi being a sequela to renal infection cannot be discounted, we do not believe that the cases observed can all be attributed to that cause. Since more than half the cases had stones present without gross lesions, the probability seems greater that the calculi produced secondary problems, either pyelonephritis or infarcts, or both.

The calculi and kidney lesions are considered to be incidental findings in otherwise healthy animals. We have no evidence that the kidney problems are a herd health or mortality factor. During 1973 and 1974, necropsies were performed on 52 deer found dead or sick from a variety of causes, but no mortality was attributed to kidney prbolems. In two cases where morbidity was attributed to trauma, focal interstitial nephritis in both kidneys with a small calculi was an incidental finding in one deer; and bilateral nephritis with a large stone in one kidney was found in the other. In the latter case, rumen protozoa were also found in pelvis vessels.

Additionally, the deer with calculi and/or kidney lesions were in excellent physical condition. While body weight data are not statistically significant, they do reflect the good condition of the deer. Males 2.5 years and older ($n=16$) with stones or lesions averaged 2.5 kg heavier than unaffected deer. Does in the same category ($n=11$) averaged 1.6 kg heavier. While only speculation is possible, the heavier average body weights of affected deer may reflect increased use of the supplemental feed compared to unaffected animals.

Nutritional factors that may singly or in combination predispose ruminants to calculi formation have been reported by many workers and have been summarized by White and Porter.[4] High ratios of concentrate to roughage certainly exist, especially in those animals consuming large quantities of supplement. Ca:P rations approaching 1:1 or lower also exist when the mineral supplement is not well distributed throughout the mixture. Oats and molasses, important ingredients in the supplement have been used in experimental calculus provoking diets.[1] The available mast, herbaceous, and browse forage items are not known to be high in calculogenic components such as oxalate, phosphate, silicate, or estrogenic substances. Insufficient water intake and the drinking of mineralized water both have been suggested and discounted as possible causes of urolithiasis. However, this herd has access to an excellent and well-distributed supply of fairly soft water, so this possibility must be discounted.

Unexplained is the sudden increase in prevalence of both calculi and kidney lesions. The presently used supplemental ration had been used since June, 1972. Renal calculi were not seen in the fall of 1972, but only 98 animals were examined and none as thoroughly as the examinations started in 1973. However, after more than a year on the diet, frequency of occurrence was still relatively low in 1973 compared to 1974. The sudden increase in prevalence in 1974 is without explanation and does cast some doubt on the ration as the main etiologic factor in the calculi formation.

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