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Chronic osteomyelitis in canine penile bone: case report

[*Osteomielite crônica em osso peniano canino: relato de caso*]

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ABSTRACT

A 10-year-old male mixed-breed dog was admitted for recurrent signs of urinary tract infection (UTI). Urinary bladder ultrasonography revealed decreased thickness of its wall with floating hyperopic particles within its lumen. Ultrasonography revealed a structure invading the dorsal wall of the penile urethral lumen, located in a segment distal to the bladder. Radiographies showed bone resorption with proliferation at the caudal aspect of the penile bone, stricture of the final aspect of the penile urethra, and no radiopaque images compatible with a urethrolith. Computed tomography showed bone proliferation causing stricture of the urethral lumen at two different sites. Presumptive diagnosis of penile neoplasia was considered more likely and the dog underwent penectomy along with orchiectomy and scrotal urethrostomy. *Enterobacter* spp. was cultured from the urine sample and antibiotic sensitivity tests revealed that the bacterium was susceptible to amikacin, imipenem, and meropenem. Histopathology revealed severe suppurative urethritis, bone resorption, and hyperostosis, suggestive of osteomyelitis of the penile bone. Neoplastic cells were not observed at any part of the examined tissue. The findings in the present case suggest that osteomyelitis of the penile bone should be included in differential diagnosis for partial and complete urethral obstruction in dogs with recurrent UTI.

Keywords: dog, urinary tract infection, urethritis, bone resorption, *Enterobacter* spp

RESUMO

Um cão mestiço, com 10 anos, foi admitido por sinais recorrentes de infecção do trato urinário (ITU). A ultrassonografia da bexiga urinária revelou diminuição da espessura de sua parede com partículas flutuantes dentro de seu lúmen. A ultrassonografia demonstrou estrutura invadindo a parede dorsal do lúmen da uretra peniana, localizada em segmento distal à bexiga. Radiografias evidenciaram reabsorção óssea com proliferação no aspecto caudal do osso peniano, estenose do aspecto final da uretra peniana e ausência de imagens radiopacas compatíveis com uretrólito. Pela tomografia computadorizada, observou-se proliferação óssea causando estreitamento da luz uretral em dois locais diferentes. Diagnóstico presuntivo de neoplasia peniana foi considerado mais provável e o cão foi submetido à penectomia, juntamente com orquiectomia e uretrostomia escrotal. Enterobacter *spp. foi cultivada da amostra de urina e testes de sensibilidade revelaram susceptibilidade ao amicacina, imipenem e ao meropenem. A histopatologia revelou uretrite supurativa grave, reabsorção óssea e hiperostose compatível com osteomielite do osso peniano. Células neoplásicas não foram observadas em nenhuma parte do tecido examinado. Os achados do presente caso sugerem que a osteomielite do osso peniano deve ser incluída no diagnóstico diferencial de obstrução uretral parcial e completa em cães com ITU recorrente.*

Palavras-chave: cão, infecção do trato urinário, uretrite, reabsorção óssea, Enterobacter spp

INTRODUCTION

Complete urethral obstruction is a veterinary emergency that, if left untreated, typically results in uremia within 24 hours, and death in 3 to 6 days (Cuddy and McAlinden, 2017). The reported causes of urethral obstruction in dogs include uroliths, plugs, neoplasms, trauma, cystocele, and granulomas (Burrows *et al*., 2011;

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Cuddy and McAlinden, 2017), with urolith formation secondary to urinary tract infection (UTI) being the most common cause (Inkelmann *et al*., 2012).

Osteomyelitis is an inflammatory condition of the bone. Posttraumatic and direct inoculation is thought to be the most common source of osteomyelitis in dogs and cats (Cuddy and McAlinden, 2017). Hematogenous routes are less common and occur most frequently in young and immunocompromised animals (Rabillard *et al*., 2011). In rare cases, osteomyelitis can be the result of a direct spread from an adjacent soft tissue infection (Siqueira *et al*., 2014; Cuddy and McAlinden, 2017). In one study, only 5% of the isolates among 52 cases of bacterial osteomyelitis occurred due to an ascending infection (Siqueira *et al*., 2014).

Published data regarding urethral obstruction secondary to penile bone abnormalities are restricted to one case of hemangiosarcoma (Bolfer *et al*., 2015), two osteosarcomas (Bleier *et al*., 2003; Peppler *et al*., 2009), one ossifying fibroma (Mirkovic *et al*., 2004), and several cases of fractures (Burrow *et al*., 2011). However, urethral obstruction occurring secondary to chronic osteomyelitis of the penile bone has never been reported in the veterinary literature. Therefore, we aimed to describe the clinical, ultrasonographic, radiographic, and computed tomographic findings, as well the treatment adopted in a dog presenting urethral obstruction caused by chronic osteomyelitis of the penile bone.

CASE REPORT

A 10-year-old male mixed-breed dog weighing 19kg was admitted at the Veterinary Teaching Hospital of the Federal University of Mato Grosso for inappetence, lethargy, and pollakiuria of one-week duration. The medical records of the patient showed recurrent episodes of cystitis and three previous cystotomies for calculi removal. In addition, the medical records showed that although further tests to fully investigate the UTI episodes had been recommended, the owner always declined to perform them.

Physical examination showed that the dog was lethargic with a body condition score of 2 out of 5 and the following findings: cardiac rate of 128 beats per minute, a palpable femoral pulse, respiratory rate of 60 movements per minute, and 38.7°C of temperature. Pollakiuria was documented by the attending veterinarian during the clinical examination, but after that episode, the urinary bladder was still palpable and moderately filled. The dog showed mild pain during caudal abdominal palpation, but manipulation of the penis did not elicit pain at any time. Hematologic evaluation revealed mild leukocytosis ($19x10^3/\mu l$; reference range, 6 – 17 x $10^3/\mu l$) with left shift (neutrophils: $17.9/10^3/mm^3$; reference range: 3.0 – 11.5 x $10^3/mm^3$). Mild normochromic, and normocytic anemia were also observed (erythrocytes: 4.79 $x10^6/\mu l$, reference range: 5.5 – 8.5 $x10^6/\mu l$; hemoglobin 11,7g/dL, reference range: 12-18g/dL; hematocrit: 33.8%, reference range: 37 – 55%; MCV: 70.6 fl, reference range: 60 – 77 fl; MCHC: 34,6g/dL, reference range: 32 – 36g/dL). Serum biochemical analysis revealed increased alanine transaminase levels 208IU/L (reference range: 21 – 73IU/L), with blood urea (22.9mg/dL), and creatinine (0.9mg/dL) levels within the respective reference ranges for the species (Blood urea: 21.4 – 59.92mg/dL, serum creatinine: 0.5 – 1.5mg/dL).

Ultrasonography showed a hyperopic structure measuring 0.34cm located approximately at the middle aspect of the penile bone. The structure was invading the dorsal wall of the urethral lumen (Figure 1-A). Abdominal ultrasonography revealed decreased thickness of the urinary bladder wall and floating hyperopic particles within its lumen (Figure 1-B). On the basis of these findings, penile urethral obstruction caused by urethrolithiasis was initially suspected. However, the results of radiographic examinations showed bone resorption with proliferation at the caudal aspect of the penile bone, stricture of the final aspect of the penile urethra, and no radiopaque images compatible with a urethrolith (Figure 1-C).

Intravenous chloramphenicol (50mg/kg) was administered every 12h to treat the UTI. Cystocentesis was performed to alleviate the signs related to bladder repletion once urethral catheterization was not successful (the catheter did not advance more than 7cm). Since the serum urinary biochemical profile did not revel azotemia and the dog still presented pollakiuria, the patient was hospitalized for further

investigation. During this period, the dog received fluid therapy with saline solution (10mL/kg/h), food, and water *ad libitum*. On the next day, the patient was anesthetized and contrast computed tomography was performed. The images showed bone proliferation causing stricture of the urethral lumen at two different sites (Figure 1-D). On the basis of these findings, presumptive diagnosis of penile neoplasia was considered more likely.

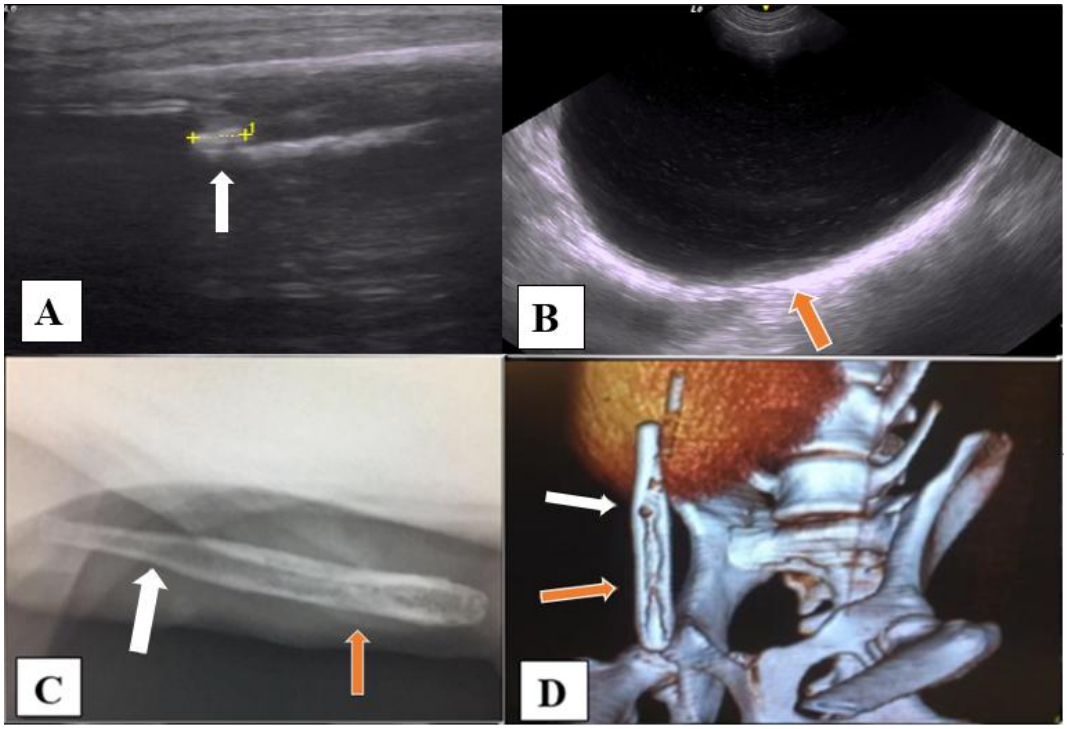

Figure 1. Ultrasonography of the penile urethra showing a hyperopic structure measuring 0.34cm (white arrow) at its dorsal wall protruding into its lumen (A). Ultrasonographic examination of the urinary bladder showing floating hyperopic particles within the lumen, and decreased thickness of the wall (orange arrow) (B). Radiographic image showing bone resorption and proliferation at the caudal aspect of the penile bone (orange arrow) and stricture of the final aspect of the urethra (white arrow) (C). Contrast computed tomography revealing stricture of the urethral lumen caused by bone proliferation at two different sites (D). The first stricture prevented catheter progression (white arrow); the second stricture can be seen more caudally (orange arrow).

Total penile amputation along with orchiectomy and scrotal urethrostomy were performed using a previously described technique (Burrow *et al*., 2011). During surgery, a urine sample was collected in a sterile container to investigate bacterial growth and antibiotic sensitivity; urinalysis was not performed due to the owner's financial constraints. The excised penis was fixed in 10% formalin, and submitted for routine histopathological evaluation.

In the post-operative period, intravenous chloramphenicol (50mg/kg) was maintained every 12h, until the results of antibiotic sensitivity tests were obtained. Pain was managed with intravenous meloxicam (0.1mg/kg), every 24h and subcutaneous tramadol (4mg/kg) every 8h, for four consecutive days. The patient also received intravenous omeprazole (1mg/kg) as a gastric mucosal protectant every 24h until discharge. Commercial dippers were used to control bleeding at the urethrostomy site and were changed every 12h. During dipper changing, the surgical wound fistula was cleansed with 0.02% povidine. During this period, the dog was fed a mixture of commercial and homemade food.

Enterobacter spp. was cultured from the urine sample and antibiotic sensitivity tests revealed

that the bacterium was susceptible to amikacin, imipenem, and meropenem. Partial susceptibility to neomycin, polymyxin B, and amoxicillin/clavulanic acid was also observed. Histopathological assessments revealed a urethral stricture caused by severe suppurative urethritis, bone resorption, and hyperostosis, suggestive of osteomyelitis of the penile bone. Neoplastic cells were not observed in any part of the examined tissue (Figure 2).

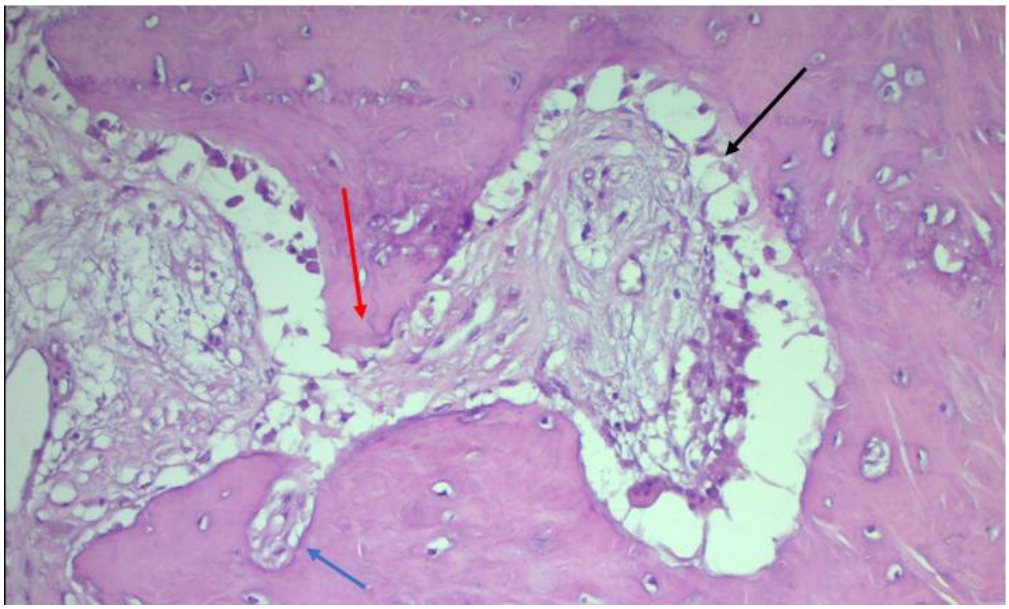

Figure 2. Penile urethral mucosa showing a neutrophilic infiltrate distending the lamina propria (black arrow). The irregular penile bone was projecting into the urethral lumen resulting in partial obstruction (red arrow). Wide and irregular bone gaps, with several osteoclasts in the vicinity of the osseous trabeculae, were also seen (blue arrow).

Six days after surgery, the urethrostomy site did not present signs of bleeding or infection, and signs of dysuria were not observed, although slight pigmenturia was still observed. No further clinical complications were noticed during hospitalization. A new blood cell count revealed that the leukocytosis had increased to $27x10^3/\mu l$. Considering the improvement in clinical signs, the dog was discharged with oral ofloxacin (20mg/kg) every 12h for 10 consecutive days. Ofloxacin was prescribed since all of the antibiotics that were effective against *Enterobacter* spp. were of high-cost to the owner. In addition, monitoring of micturition frequency and empirical diet for urinary diseases (Royal Canin Urinary Canine S/O) were prescribed.

On the re-check, that occurred 15 days after the discharge, the owner complained that the urine was still slightly dark, but no signs of stranguria or pollakiuria were observed. The dog was alert, had a normal appetite, and had gained weight. The wound had healed, and the sutures were removed. Due to financial constraints, the owner declined to bring the dog for further follow up assessments, and reported that he would be unable to follow the treatment prescribed.

DISCUSSION

We present the first case of partial urethral obstruction occurring secondary to chronic osteomyelitis of the penile bone in a dog. To date, penile bone abnormalities related to total or partial urethral obstruction had been associated with tumors or fractures as the underlying cause (Bleier *et al*., 2003; Mirkovic *et al.*, 2004; Peppler *et al*., 2009; Burrow *et al*., 2011; Bolfer *et al*., 2015). One large study of 4,872 necropsied dogs performed in Brazil showed that only 0.39% of this population presented urethral obstruction; in none of those cases osteomyelitis of the penile bone was reported to be the underlying cause (Inkelmann *et al*., 2012).

Approximately half of the dogs diagnosed with recurrent or persistent UTI are asymptomatic on presentation (Thompson *et al*., 2011; Wong *et al*., 2015). In the present case, however, the patient showed signs of recurrent cystitis, which is the most common disease of the lower urinary tract of dogs (Thompson *et al*., 2011; Wong *et al*., 2015). The most frequent pathogen isolated from the canine urinary tract is *Escherichia coli*, which accounts for 33–80% of isolates obtained from UTIs (Thompson *et al*., 2011; Wong *et al*., 2015). In the present report, the patient underwent evaluations because of pollakiuria caused by recurrent UTI, and *Enterobacter* spp. was isolated.

Members of the genus *Enterobacter* are Gram-negative bacilli that inhabit terrestrial and aquatic environments including water, sewage, and soil, as well as the intestinal tracts of mammals (Weese, 2008). *Enterobacter cloacae* is the most medically important species in the genus and is responsible for nosocomial infections in humans (Weese, 2008). In companion animals, this bacterial species is rarely associated with UTIs, accounting with an overall incidence rate of 1.2 cases per 1000 admissions (Weese, 2008). In one large study that evaluated 1,636 bacterial isolates from 1,028 dogs with UTI, *Enterobacter* spp. accounted for only 1.8% of the isolates (Wong *et al*., 2015).

The unavailability of previous culture results prevented us from determining if *Enterobacter* spp. was present in the previous UTI episodes in our patient. Nonetheless, the dog underwent three previous surgeries for calculi removal, with two of these surgeries being performed at our institution. Medical records showed that after the last cystotomy, the dog was hospitalized for 10 days. Severe underlying illness, hospitalization for more than three days, and surgical intervention have been reported to be common in dogs with extraintestinal infections of multidrug-resistant to *Enterobacter* spp. (Wong *et al*., 2015). Therefore, the recurrent UTI presented by the dog as well as the multidrug resistance showed by the *Enterobacter* spp. isolated could be associated with the hospital environment.

In rare cases, osteomyelitis can be the result of direct spread from an adjacent soft tissue infection (Cuddy and McAlinden; 2017). Siqueira *et al*. (2014) reported that only 5% of isolates from 52 cases of bacterial osteomyelitis occurred due an ascending infection; however, the authors did not show which bacteria were isolated in those cases (Siqueira *et al*., 2014). In the same study, Siqueira *et al*. (2014) revealed that *Enterobacter* spp. comprised only 3.8% of all bacteria isolated from long bone fractures of dogs. In the patient of the present report, the most likely source of penile bone contamination was the direct spread of *Enterobacter* spp. from the penile urethral mucosa.

In the present case, the images raised the suspicion of penile bone neoplasia as the presumptive diagnosis. There was also concern over the possibility that the partial urethral obstruction could evolve to complete urethral obstruction; therefore, total penile amputation with scrotal urethrostomy was the treatment of choice. If osteomyelitis was initially suspected, urinary flux deviation by a cystostomy tube and specific antimicrobial therapy could have been attempted (Cuddy and McAlinden; 2017). Rabillard *et al*. (2011) reported that concomitant long-term antimicrobial therapy and surgical curettage of the affected bone were curative in 2 of 3 dogs with hematogenous osteomyelitis. However, surgical access to the penile bone for curettage could induce significant hemorrhage and extensive bone hyperostosis, which could completely obstruct the urethral lumen. In addition, tube cystostomy placement is a risk factor for recurrent UTI in dogs (Thompson *et al*., 2011).

In all previously described cases of penile bone abnormalities related to total or partial urethral obstruction, neoplastic cells were encountered during routine histological examination (Bleier *et al*., 2003; Mirkovic *et al.*, 2004; Peppler *et al*., 2009; Bolfer *et al*., 2015). In other cases, urethral rupture and a visible fracture were reported (Burrow *et al*., 2011). The absence of neoplastic cells, combined with the imaging findings and a site of recurrent UTI allowed us to diagnose the condition in this case.

CONCLUSION

The findings in the present case suggest that osteomyelitis of the penile bone should be included in differential diagnosis for partial and complete urethral obstruction in dogs with recurrent UTI.

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