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Clinical Report

Successful Treatment of Ureteral Obstructive Lithiasis by Ureterotomy in a Domestic Hen

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Abstract: A 2-year-old domestic hen was presented for a 15-day history of intermittent left leg lameness. The owners also observed a decrease in egg quality during that period. Physical examination of the bird revealed a generalized weakness with a flattened pale comb. Neurological evaluation of the left leg found a proprioceptive deficit with no loss of pain sensitivity. Whole body radiographic images showed a marked reduction of abdominal detail, a large amount of “grit” (mineral opacity) in the ventriculus, intestinal dilation, and a metallic foreign body (nail) in the digestive tract. Abnormal results from a plasma biochemistry panel were hypercalcemia, hypertriglyceridemia, hyperglobulinemia, hypophosphatemia, increased creatine kinase, and decreased uric acid. After initial stabilization of the patient, a computed tomographic scan was obtained, which revealed multiple right-sided ureteral calculi, the largest of which measured 10 mm in diameter, and changes compatible with cystic right renal nephrosis. Suspected compensatory enlargement of the left kidney was also observed. Considering the renal lesion and associated neurological limb impairment, surgery was recommended and approved by the owner. A right lateral approach was used for the coeliotomy, and a ureterotomy was performed to remove all calculi. Analysis of the ureteral stones confirmed they were 100% uric acid salts. The hen fully recovered left leg function 1 week postsurgery. Urolithiasis is well described in hens, but surgical treatment is uncommon. This report describes the successful removal of ureteral stones by ureterotomy in a domestic hen.

Key words: ureteral lithiasis, urinary obstruction, ureterotomy, avian, domestic hen

Clinical Report

A 2-year-old domestic hen was presented for a 15-day history of intermittent left leg lameness. The owners also observed a decrease in egg quality over the 15-day period. During the first year of its life, the patient was a caged hen, living in poor conditions at an intensive production facility. The

environment and food were improved and adapted for better care of the bird after its current owners adopted it, 8 months before the presentation.

During the physical examination, the bird had a generalized weakness and a flattened pale comb. Several areas on the body had scars, consistent with her past life in the production facility. The animal weighed 2.44 kg and had a good body condition score (5/9). Some discomfort and mild distention were noted on abdominal palpation. The neurological evaluation revealed a proprioceptive deficit in the left leg and decreased motor reflexes attributed to the lumbosacral plexus area. The neurological evaluation was consistent with lower motor neuron damage of the lumbosacral plexus.

Whole body survey radiographic images were obtained under general anesthesia. Anesthesia was

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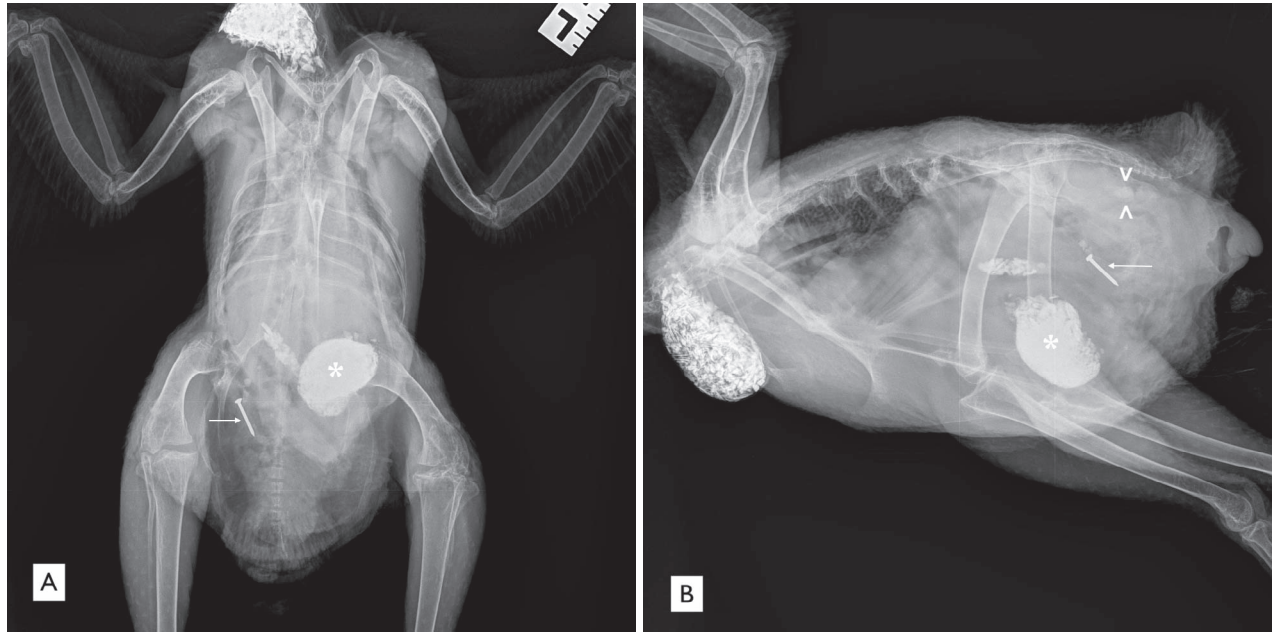


Figure 1. Ventrodorsal (A) and lateral (B) radiographic views of the coelomic cavity of an adult domestic hen that presented with intermittent lameness of the left limb. A full abdomen with loss of abdominal detail and a large amount of mineral-attenuating material in the ventriculus (asterisk) and crop are noted. A nail is noted in the right caudal aspect of the coelomic cavity (arrow). At least 1 rounded structure of soft tissue to mineral opacity is noted caudal to the kidneys in the lateral view (arrowheads).

induced with 3.0% isoflurane (Isoflutek, Laboratorios Karizoo SA, Caldes de Montbui, Barcelona, Spain) in a 2.0 L/min flow of oxygen delivered by facemask. Anesthesia was maintained with 2.5% isoflurane in a 2.0 L/min flow of oxygen during the procedure. Radiographic images showed a distended abdomen with loss of abdominal detail, suspicion of intestinal dilation, and a large amount of mineral-attenuating material in the crop and ventriculus, with a smaller amount in the intestinal tract. A 2.2-cm nail was also noted in the right, caudal aspect of the coelomic cavity (Fig 1). While anesthetized, blood was collected for a plasma biochemistry panel. After the radiographic imaging procedure and blood collection, the bird recovered uneventfully from anesthesia.

Abnormal results of the plasma biochemistry included hypophosphatemia (0.66 mg/dL, reference interval 1.6–7.2 mg/dL), hyperglobulinemia (4.7 g/dL, reference interval 1.6–4.3 g/dL), and a decrease in uric acid (0.7 mg/dL, reference interval 0.9–8.9 mg/dL).¹ Hypertriglyceridemia (>4.23 mmol/L, reference interval unknown) was also suspected. These results were considered nonspecific for any disease condition but were consistent with a chronic inflammatory response.

A computed tomographic (CT) study (Brilliance CT 64 Channel DS, Philips NV, Brussels, Belgium)

was performed 24 hours after the radiographic imaging to further examine the lumbosacral area and the coelomic cavity (especially the urinary tract system) and to determine the exact location of the nail. The bird was anesthetized as previously described, and a 26-gauge polypropylene IV catheter was placed into the right ulnar vein for contrast administration. On CT evaluation, the 2 cranial lobes of the right kidney were enlarged and appeared to be partially filled with fluid. The caudal lobe was considered of normal size and attenuation on noncontrast CT images. After contrast administration, only minimal enhancement was noted in the right kidney (Fig 2) while the left kidney enhanced in a normal fashion. The right ureter was dilated proximally and filled with fluid. It also contained a number of small structures of mineral opacity in its lumen, the largest measuring 10 mm in diameter (Fig 3). A metal structure resembling a screw was noted within the ventriculus and was surrounded by a large amount of mineral-attenuating material. The screw was substantially shorter and not compatible with the nail noted on the radiographs. The nail noted in the radiographic images was not observed on the CT scan. Otherwise, the gastrointestinal tract was considered normal. After the CT scan, the hen recovered uneventfully from anesthesia.



Figure 2. Oblique, dorsal reconstruction of a computed tomography study (after contrast administration) at the level of the kidneys of the hen described in Figure 1. Image shows renal asymmetry, with considerable enhancement of the left kidney (asterisk). The right kidney shows decreased enhancement after contrast administration, compared with the left kidney, which is also enlarged in size.

Heavy metal blood measurements were recommended, but the owner declined.

On the basis of renal lesions observed in the CT images, the large size and number of uroliths, and the clinical signs (including lameness of the left leg), surgery was recommended to the owner and approved. At this point, it was suspected that the left leg lameness was secondary to neurological impairment of the lumbosacral nerve plexus by the compensatory enlarged left kidney or associated with pain, which justified the priority given for removal of the ureteral obstruction. A ventriculotomy was not considered at this stage, given the absence of clinical signs associated with the screw.

A right lateral approach was used to perform the coeliotomy, for the ureterotomy to remove the calculi. The patient was premedicated with midazolam (0.3 mg/kg IM, Midazolam Mylan, Mylan, Hoeilaart, Belgium), morphine (1 mg/kg IM, Morphine HCL Sterop, Laboratories Sterop NV, Brussels, Belgium), and meloxicam (1 mg/kg IM,

Metacam, Boehringer Ingelheim, Ingelheim, Rhein, Germany). Anesthesia was induced with 2.5% isoflurane in a 2.0 L/min flow of oxygen delivered by facemask. Next, the patient was intubated with a 4.0-mm uncuffed endotracheal tube. During the surgical procedure, anesthesia was maintained with 2–2.5% isoflurane in a 2.0 L/min flow of oxygen, and the patient was monitored with a Doppler, capnograph, pulse oximeter, and esophageal temperature probe. Thermal support (heating mat, 3 hot water bags, and fluid heater) and crystalloid fluid therapy (10 mL/kg per hour IV; Ringer's Lactate, Ecuphar NV/SA, Oostkamp, Belgium) were provided throughout the procedure.

The surgical procedure was performed with the patient in left lateral recumbency and the right leg pulled forward. The incision of the cutaneous and muscular layers was performed between the sixth rib and the pubic bone. After incision of the different tissue planes, a Lone Star Retractor System (Cooper Surgical, Trumbull, CT, USA) was applied to improve visualization of the coelomic organs. The fat and digestive organs were pushed ventrally to allow access to the urinary system. The dilated right ureter was visualized on the ventral medial surface of the right kidney, deep in the coelomic cavity (Fig 4). The ureteral calculi were palpable along a large section of the right ureter. Two incisions were made through the wall of the right ureter to remove all of the calculi (Fig 5). The ureterotomy allowed the removal of a 10-mm-diameter calculus and numerous millimetric stones (Fig 6). Three cruciate sutures (Glycomer 631, Biosyn 4-0; Covidien, Mansfield, MA, USA) were used to close the incisions in the right ureter. The muscle layer was closed with a simple continuous suture pattern (Glycomer 631, Biosyn 3-0), and the skin incision was closed by an interrupted horizontal mattress pattern with synthetic nylon (Monosof 3-0; Covidien). The calculi were analyzed by the Minnesota Urolith Center (St Paul, MN, USA) and found to comprise 100% uric acid salts. Anesthetic recovery was uneventful and the patient ate pellets 24 hours after the surgical procedure.

The patient was hospitalized for 13 days because the owners elected for the postoperative treatments to be performed at the clinic. Postoperative treatments consisted of fluid therapy (2 mL/kg per hour IV \times 3 days) with lactated Ringer's solution, telmisartan (1.6 mg/kg PO q12h \times 13 days; Semintra, Boehringer Ingelheim, Ingelheim, Rhein, Germany), trimethoprim and sulfamethoxazole (30 mg/kg PO q12h \times 13 days; Eusaprim, Aspen Pharma Trading Limited, Dublin, Ireland),

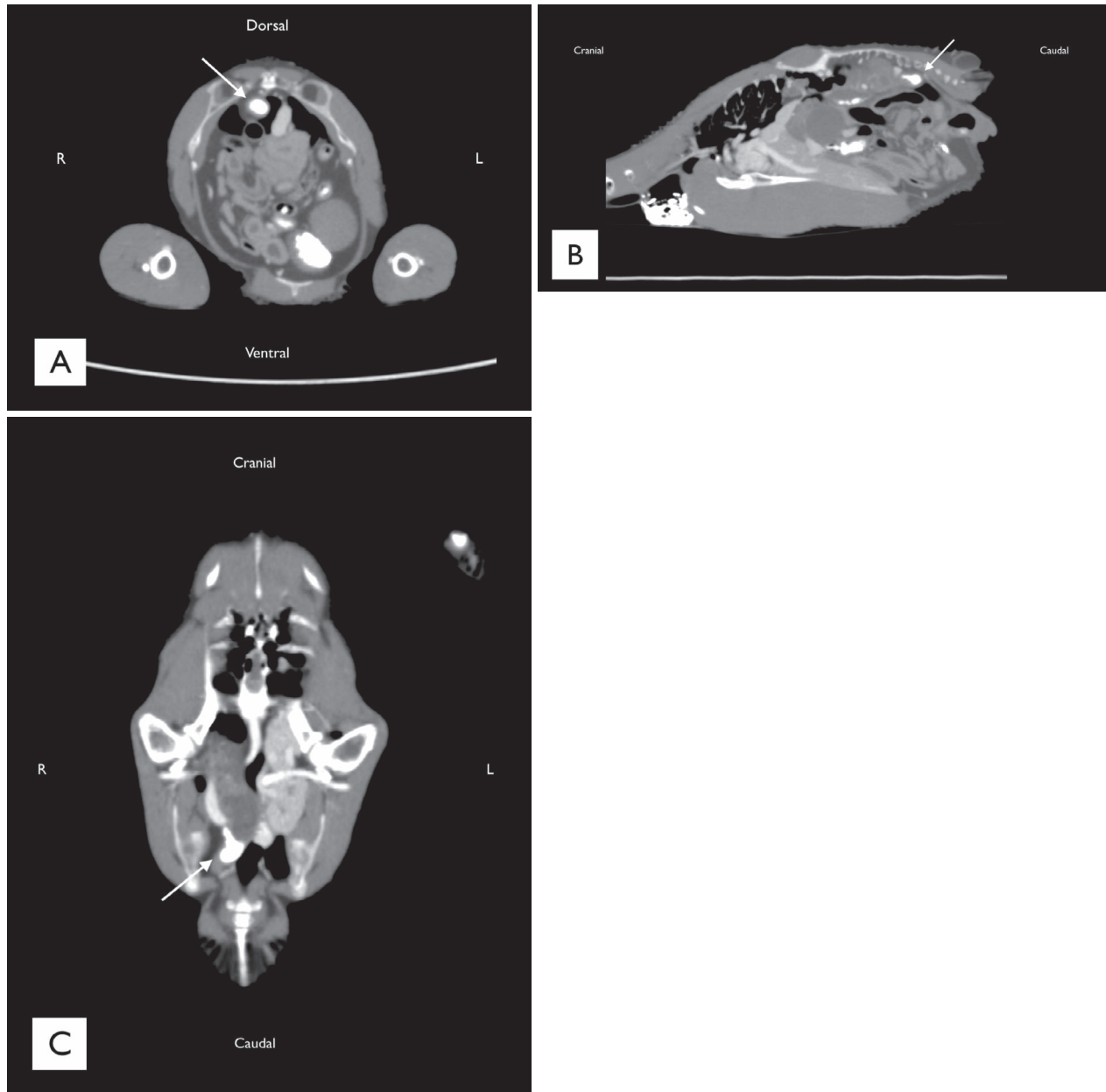


Figure 3. Computed tomographic images of the coelomic cavity with transverse (A), sagittal (B), and oblique (C) reconstruction of the hen described in Figure 1. The right ureter is proximally enlarged, dilated with fluid, and contains a number of small mineral opacities, the largest of which measures 10 mm in diameter (white arrow).

methadone (1 mg/kg IM q4h; Comfortan, Eurovet Animal Health BV, Bladel, The Netherlands) for 12 hours and then tramadol (7.5 mg/kg PO q12h \times 2 days; Tramadol EG, Eurogenerics NV, Brussels, Belgium), sucralfate (50 mg/kg PO q12h \times 5 days; Ulcar, Sanofi-Aventis, Gentilly, France), and meloxicam (1 mg/kg PO q12h \times 5 days; Loxicom, Norbrook Laboratories, Monaghan, Ireland). Supplemental feeding (20 mL/kg PO q8h \times 1 day; EmerAid omnivore, Lafeber International

Ltd, Swindon, Wiltshire, UK) was also necessary after the surgical procedure.

Postoperatively, hematuria was present for 60 hours. Throughout hospitalization, the left leg lameness progressively diminished. The hen fully recovered left limb motor function 1 week after surgery. A plasma biochemistry panel submitted 13 days postsurgery showed an increase in uric acid toward normal values (2.9 mg/dL, reference interval 0.9–8.9 mg/dL). The hen continued to walk in a normal manner.

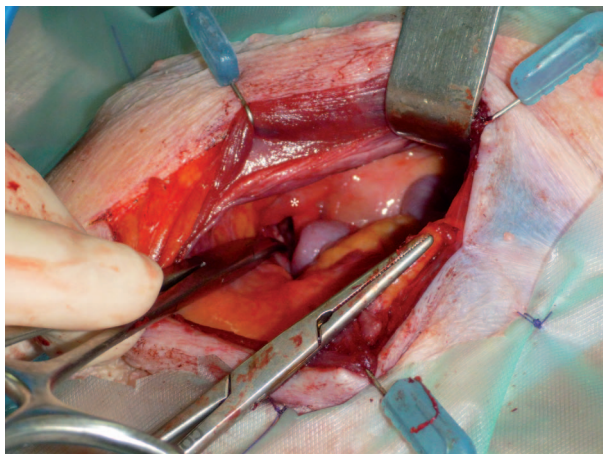


Figure 4. Coelomic cavity of the domestic hen described in Figure 1. Visualization of the right ureter (asterisk) during the coeliotomy, procedure by a right lateral approach (left lateral recumbency). Intestines are observed ventral to the ureter, which is surrounded by fat.

The owner observed (blood in the feces) hematochezia a few days after discharge. Treatment prescribed for the hematochezia consisted of sucralfate (50 mg/kg PO q12h \times 3 days) and a probiotic supplement (20 g PO q8h \times 3 days; AviPro Avian, Vetark, Winchester, UK), until the clinical signs resolved.

The chicken was re-presented 31 days after surgery for an examination, blood testing, and radiographic imaging. The owner reported no further bleeding after the treatment with sucralfate and the probiotic supplement. The radiographic images of the hen still showed no evidence of the nail, the screw was not present, and no other

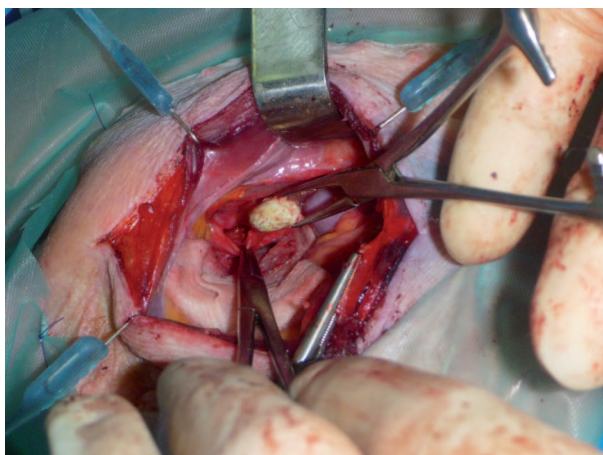


Figure 5. Coelomic cavity of the domestic hen described in Figure 1 showing the removal of a 10-mm mineralized structure obstructing the right ureter.



Figure 6. Photograph of the 10-mm diameter calculus and numerous smaller stones removed from the ureter during the coeliotomy, of the hen described in Figure 1.

abnormalities were noted. The complete blood count and plasma biochemistry panel results were all considered within normal ranges. The hematochezia noted by the owner was believed to be associated with the passing of the screw through the digestive tract.

The hen was re-presented 11 months after the surgical procedure for a routine physical examination. The owner reported that the hen was in good condition, presented no more proprioceptive deficit, and had normal egg laying behavior. Complete blood count and plasma biochemistry results were unremarkable. Ultrasonographic examination of the hen's coelomic cavity revealed a smaller right kidney without any other abnormalities. The left kidney was considered normal size, measuring 12 mm at the thickest part that could be evaluated during the ultrasound examination. Ultrasonographically, both kidneys had normal urine flow. The animal remains free of any clinical disease signs 43 months after the ureterotomy.

Discussion

Ureterolithiasis are well described in galliform birds.²⁻⁵ Ureterolithiasis was first reported in 2 flocks of laying hens of 6–15 months of age, with a monthly increase of 2.5% in mortality attributed to the disease.⁶ Postmortem examination revealed concomitant renal lesions (eg, interstitial nephritis, nephrosis);⁶ however, none of the renal diseases appeared to be associated with the urolithiasis. A high-calcium diet was believed to be the underlying cause of the disease conditions and mortalities in the 2 flocks of laying hens.⁶

The formation of urinary stones in hens has been correlated with several factors, including

water deprivation,⁷ excess dietary calcium,^{8–12} excess dietary protein,¹² infectious bronchitis virus infection,^{8,13–15} and dietary electrolyte imbalances.^{4,8} Some reports suggest ureterolithiasis may result from multiple renal insults.¹⁶ Nevertheless, long-term consumption of excess dietary protein or excess dietary calcium with low available phosphorus are critical factors contributing to the incidence of urolithiasis.^{11,12,17} In the hen described in this report, the underlying etiology for the disease was not clearly identified, but its past history in a production facility may have contributed to the formation of ureteroliths.

Ureterolithiasis is an uncommon disease condition in other avian species but has been described in a double yellow-headed Amazon parrot (*Amazona oratrix*) and a lesser seed finch (*Sporophila angolensis*). The Amazon parrot was 21 years old and presented for depression and inappetence.¹⁸ The etiology was unknown for the parrot, but vitamin A deficiency was suspected.¹⁸ The ureteral stones in the lesser seed finch were diagnosed postmortem.¹⁹ The death was attributed to acute respiratory failure secondary to ascites from urinary blockage by ureteral calculi.¹⁹ The suspected etiology for the ureteral calculi in the finch was the high-protein diet.¹⁹

Birds with urolithiasis generally show nonspecific clinical signs of disease. The unaffected renal tissue appears to have a high compensatory capacity, explaining why birds with urolithiasis may have no overt signs of disease.²⁰ A prospective study performed on 2- to 3-week-old chickens evaluated renal function through plasma values 12 weeks after ligation of the caudal renal vein and the ureter.²⁰ Kidney function comparisons revealed a significant reduction in sodium and potassium excretion by the ligated group, but other renal function parameters did not significantly differ.²⁰ These investigations demonstrate that chickens have a remarkable capacity to survive a significant reduction in renal mass and adapt to major changes in renal blood flow patterns. In another study, compensatory renal hypertrophy was evaluated in 2- to 3-week-old chickens by either transient or permanent loss of approximately 60% of the right kidney; this was achieved through ureteral transection or by removing a 1-mm segment of ureter at the level of the ischiatic artery, respectively.²¹ The study concluded that permanent loss of functional renal mass in young birds produces significant compensatory renal hypertrophy that is due to enlargement of existing nephrons rather than formation of new nephrons.²¹ Furthermore, the study also demonstrated

that in domestic fowl, similar to mammals, removal of the stimulus for hypertrophy is followed by prompt reversal of hypertrophic changes.²¹ In our case, ureteral obstruction resolution led to a rapid and complete recovery of the posture and gait. Consequently, the left kidney compensatory enlargement was believed to induce compression of the lumbosacral plexus, causing the proprioceptive deficit that affected the left leg.

Diagnosis of urolithiasis in veterinary medicine can be obtained through the use of diagnostic imaging.²² However, the value of diagnostic imaging in birds is different from mammals because of anatomic differences, avian urinary physiology, and stone composition.²³ Unfortunately, studies on lithiasis in birds are scarce. Cross-sectional imaging, such as CT and magnetic resonance imaging, offers many benefits, such as the possibility of multiplane reconstructions, 3-dimensional imaging, and avoidance of summation effects.²³ Uroliths of all compositions are easily visualized by CT, compared with radiographic imaging where stones composed of uric acid are radiolucent.²⁴ Ultrasonography can be used to assess renal vessels, parenchymal changes, or obstructive calculi but remains more challenging.²³ The ingesta-filled gastrointestinal tract and air sacs can hinder the penetration of ultrasound waves from the head of the transducer.²³

In mammalian species, the sensitivity of abdominal radiographs for ureteral calculi is reported to be 81% in cats and 88% in dogs.²⁵ For abdominal ultrasound, the sensitivity is 77% in cats and 100% in dogs.²⁵ Unfortunately, sensitivity assessments for similar diagnostics in avian medicine do not exist, nor does a sensitivity assessment for these methods for characterizing uric acid salt calculi.

In human medicine, diagnosing uric acid stones is primarily done with CT, and this method is preferred over other diagnostic techniques.²² In our case, the CT study was found to be diagnostic for urolithiasis, and no clinical complications were observed during or after contrast medium administration. In human medicine, the use of dual-energy, dual-source CT permits accurate in vivo differentiation between uric acid and non-uric acid urinary stones by a noncontrast enhanced protocol.²⁶ This procedure, also described in veterinary medicine, could potentially aid in determining the composition of lithiasis in avian species.²⁷

In our case, radiographic imaging revealed the presence of a nail in the digestive tract. When the CT examination was performed 24 h after the radiographic imaging procedure, the nail was not present within the coelom. Hens are known to

ingest many different objects and pass this foreign material easily through the digestive system. We believe the nail was excreted in the time period between the 2 imaging procedures.

Surgical treatment of an avian patient diagnosed with ureterolithiasis has only been reported once.¹⁸ A double yellow-headed Amazon parrot had 2 surgical procedures to remove 2 monosodium uric acid crystal stones.¹⁸ The surgeries were curative with no observed recurrence. Surgical removal was also an effective treatment option for the hen described in this case.

Although lithotripsy has been reported to manage renal stones in a Magellanic penguin (*Spheniscus magellanicus*), no other such reports exist for managing uroliths in birds.²⁸ The efficiency of lithotripsy is questionable in avian species. Most tissues allow unattenuated propagation of shock waves, except for lungs.²⁹ Extracorporeal shock wave lithotripsy would not be effective in most birds, because the air sacs would interfere with shock wave propagation. Moreover, shock waves may have an adverse effect on the avian respiratory tissue, as has been found regarding alveoli in rabbits.³⁰

Urolithiasis is well described in poultry but is considered a rare disease condition in other birds. The etiology(ies) for the development of ureteral stones remains unclear, but high dietary calcium intake, dehydration, infectious bronchitis virus, and dietary electrolyte imbalances are suggested as possible causes. Clinical signs are usually absent or nonspecific, possibly because of the high compensatory renal capacity found in chickens. Computed tomography is considered the gold standard for a definitive diagnosis of urolithiasis. A ureterotomy was effective in treating this hen diagnosed with urolithiasis. Ureterotomy should be considered as a treatment in birds that show discomfort, compromised renal function, or neurological impairment secondary to the presence of uroliths.

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