Therapeutic Use of Regional Limb Perfusion in a Chicken

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Abstract
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Keywords
cellulitis, tenosynovitis, regional limb perfusion, distal limb, avian, chicken

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Therapeutic Use of Regional Limb Perfusion in a Chicken

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Abstract: A 2-year-old, 3.8-kg male Rhode Island red rooster was examined for lameness and progressive swelling of the right foot of several month’s duration. Radiographs of the right foot demonstrated soft tissue swelling and a smoothly margined periosteal reaction evident of inflammation affecting the bones. Results of a complete blood count showed a moderate leukocytosis and an elevated total protein concentration. Systemic antibiotic and anti-inflammatory therapy was started, but the bird had not improved at recheck examination. After intravenous catheterization of the medial metatarsal vein and placing a tourniquet at the femoral-tibiotarsal joint of the right leg, regional limb perfusion with amikacin and flunixin meglumine was performed. Dimensions of both feet were measured with digital calipers, and surface temperatures of the feet were measured with an infrared thermometer. The rooster had improved activity level with decrease in lameness and measurable decrease in swelling of the right foot. Regional limb perfusion with intravenous antibiotics and nonsteroidal anti-inflammatory drugs is a viable treatment modality in avian species for suspected distal limb infection and cellulitis. This technique has potential valuable implications for a variety of avian species. Fluid support should be provided if using nephrotoxic drugs.

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Clinical Report

A 2-year-old male Rhode Island red rooster was presented to the Iowa State University Lloyd Veterinary Medical Center for chronic swelling of the right foot of several month’s duration. The rooster had been housed with 12 other hens in a backyard coop and was fed a diet of commercial layer ration pellets.

On examination, the chicken showed reluctance to ambulate, and the right foot was markedly swollen and warm to the touch (Fig 1). No external lesions were seen on any aspect of either foot. The rooster’s body condition was adequate judging by keel musculature, and body weight was 3.8 kg. No other abnormalities were observed on physical examination.

Radiographs showed soft tissue swelling at the right distal tarsometatarsus and digits, with a smoothly margined periosteal reaction primarily affecting the phalanges of digit 2, best seen on the dorsoplantar projection (Fig 2). Radiographic findings were more consistent with cellulitis or deep pododermatitis, as opposed to osteomyelitis. Results of a complete blood count (CBC) and serum biochemical analysis showed leukocytosis (39.6 × 10³ cells/µL; reference interval, 9–32 × 10³ cells /µL)¹ with mature heterophilia and monocytosis and increased total protein (6.8 g/dL; reference interval, 3.3–5.5 g/dL).¹ All other blood test parameters were within reference intervals. A fine needle aspirate was taken from the plantar aspect of the right foot for cytologic analysis, which showed marked heterophilic inflammation, with no etiologic agents seen. On the basis of the inflammatory leukogram, the rooster was treated empirically with clindamycin (50 mg/kg PO q12h for 14 days) and meloxicam (2 mg/kg PO q24h for 14 days).

At a follow-up appointment 1 month later, the swelling of the right foot showed no improvement. The owner reported continued decreased activity and ambulation. After discussion of alternative treatment options, regional intravenous perfusion of antibiotics and anti-inflammatory medication into the right distal pelvic limb was elected by the owner.
A complete physical examination was performed, with no abnormalities observed except for the previously described swollen right foot. Vital parameters were within reference limits. The chicken was observed standing and walking and exhibited marked lameness of the right foot. A blood sample was collected for measurement of uric acid concentration before therapy. External temperatures of the feet were taken with a digital infrared thermometer (Reptitemp, Zoo Med Laboratories, San Luis Obispo, CA, USA) 0.5 cm away from the skin surface at multiple locations, with the highest value being recorded for each foot (left foot = 38.3°C [101.0°F], right foot = 41.9°C [107.5°F]). A tourniquet was placed just proximal to the femoral-tibiotarsal joint of the right leg. The right medial metatarsal vein was catheterized with a 23-gauge butterfly catheter. Amikacin (5.3 mg/kg IV once) was injected intravenously through the butterfly catheter. The catheter was then flushed with 0.5 mL of heparinized saline before injection with flunixin meglumine (1.3 mg/kg IV once). After injections were completed, a timer was set for 15 minutes to mark when the tourniquet was to be removed. Medial-lateral and dorsal-plantar dimensions of the feet were measured with digital calipers (left foot = 25.1 × 21.0 mm, right foot = 38.7 × 37.7 mm), and the skin was marked at this location with a permanent marker for future reference. A warm, balanced electrolyte solution (32 mL/kg; Plasma-Lyte A, Abbott Laboratories, North Chicago, IL, USA) was delivered subcutaneously, evenly distributed between the right and left inguinal region. An additional 60 mL of warm tap water was gavaged orally into the crop with an 11-French red rubber catheter. The tourniquet was left in place for 15 minutes before removal. No further treatments or environmental changes were initiated, and the rooster was to be reevaluated in 2 weeks.

The rooster was seen for reevaluation 15 days later. The owner reported dramatic improvement in the rooster’s mobility and noticeable decrease in swelling. The patient had gained 170 g in body weight from 15 days before. A blood sample was collected for a CBC and serum biochemical analysis from the right medial metatarsal vein. Total white blood cell (WBC) count had decreased from 39.6 × 10⁳ cells/µL before treatment to 34.1 × 10³ cells/µL, and total protein decreased from 6.8 to 6.0 g/dL after treatment. Surface temperatures of both feet were measured (left foot = 35.6°C [96.0°F], right foot = 38.6°C [101.5°F]) and compared with previous values. Dimensions of the feet were measured (left foot = 22.4 × 17.4 mm, right foot = 30.2 × 28.2 mm) and compared with previous values for the same location.

Discussion

In this chicken, regional limb perfusion (RLP) was performed to treat lameness and distal limb swelling of an undiagnosed cause. After treatment, decreases were seen in the total WBC count, total protein concentration, surface temperature of the limbs, and swelling of the affected foot. RLP is a technique that is useful in treating distal limb infections because it allows for a high local...
concentration of medications within deep tissues. This technique is used routinely in equine medicine, but it has also been reported in various other species, including rabbits, elephants, wallaby, and kudu. Indications for RLP range from osteomyelitis to cellulitis, septic arthritis, tenosynovitis, and sole abscesses. Amikacin is a commonly used antibiotic in RLP, with concurrent administration of anti-inflammatory drugs documented as well.

To our knowledge, RLP has not been reported in an avian species. Aside from lack of familiarity with a technique that is more commonplace in large-animal medicine, RLP may be perceived as difficult to perform. Because venous access is necessary for RLP, it becomes technically difficult in smaller animals; however, it is feasible in birds as long as the medial metatarsal vein can be accessed for injection. Provided proper occlusion of vessels proximally, this technique could reasonably be considered for distal wing lesions through catheterization of the basilic vein.

Historically, the presence of a renal portal system in avian species has led to cautious use of potentially nephrotoxic drugs such as aminoglycosides and nonsteroidal anti-inflammatory drugs, particularly precluding administration of such drugs in the caudal half of the body where drugs are subject to first-pass through the kidneys. However, debate is ongoing as to the significance of the presence of a renal portal system, especially in euhydrated animals. Fluid support at daily maintenance volume was provided to ensure adequate hydration status and increase blood volume to minimize the effect of the renal portal system and the use of potentially nephrotoxic drugs.

Both amikacin and flunixin meglumine are considered nephrotoxic in avian species, but some species are more sensitive to adverse renal effects. Although less toxic than gentamicin, owing to its short half-life, amikacin, like other aminoglycosides, can still accumulate in the kidneys and cause renal damage. Flunixin meglumine at a minimal dose was shown to cause glomerular lesions in northern bobwhite quail (Colinus virginianus), however, these birds were dehydrated and treated systemically for 7 consecutive days. Even when administered together, the nephrotoxic effect of amikacin and flunixin meglumine may be mitigated by instituting fluid therapy and decreasing the dosing frequency. Amikacin and flunixin meglumine administration must be separated by complete flushing of the catheter fluid line, because the 2 drugs precipitate when combined.

Uric acid was measured as an indicator of renal function in this bird. Initial uric acid measured immediately before RLP was 4.5 mg/dL (reference interval, 2.5–8.1 mg/dL), and at the 15-day recheck after a single RLP treatment, it was measured again at 2.0 mg/dL, so there was no detectable renal disease on the basis of this test. A normal level of serum uric acid does not exclude histopathologic changes in the kidneys, because severe renal compromise must be present to increase uric acid levels significantly. Future studies aimed at establishing specific dosages for RLP should pair serial uric acid measurements with renal histopathologic findings in lieu of a more sensitive biomarker for avian renal function. Theoretically, the effect of potentially nephrotoxic drugs on the kidneys should be less with RLP than with systemic administration because RLP allows for a lower dose of aminoglycosides and nonsteroidal anti-inflammatory drugs while still achieving a higher tissue concentration at the target site. Future pharmacokinetic and safety data need to be accumulated to derive proper dosages for RLP, whether in chickens or in other avian species.

Bacterial culture and susceptibility testing was not performed before treatment with RLP. In horses, inference of septic arthritis has been made based on clinical findings and cytologic evidence of inflammation. Despite finding no causative agent on cytologic examination, empirical treatment with an oral antibiotic and nonsteroidal anti-inflammatory drug was initiated, and no clinical improvement was seen. Because of the possibility of an infection affecting deep tissues and synovial structures, RLP was chosen to achieve high drug concentrations in these poorly perfused areas. Sampling of the deeper tissues of the right foot for bacterial culture was not attempted for fear of damaging synovial structures or introducing bacteria into a currently nonseptic joint. Furthermore, cultures are often negative, and negative results would not eliminate the possibility of infection.

Staphylococcus species of bacteria are commonly implicated in cases of arthritis and tenosynovitis in poultry; however, it is difficult to sample and culture reliably, because routine aerobic culture of joints experimentally injected with Staphylococcus species in dogs was shown to have false negative rates greater than 50% of the time. Mycoplasma synoviae, another organism that can cause infection and swelling of distal limbs in avian species, is difficult to culture without the use of special growth media.

As popularity of backyard poultry increases, RLP may potentially emerge as a viable option in...
treat distal limb morbidities, including difficult to treat cases of deep pododermatitis or osteomyelitis. When used in tandem with fluid support, RLP should be considered an option for unresolved distal limb infections in any avian species where venous access is available. Further controlled studies with a larger sample size including different avian species are warranted.

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References