COMPARISON OF COMPUTED TOMOGRAPHIC IMAGES OF BIRDS OBTAINED WITH SEDATION VS GENERAL ANESTHESIA

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Abstract

Computed tomography (CT) is an increasingly available and valuable imaging modality for the diagnosis of companion avian pets. Previously, CT studies of birds required general anesthesia with inhalant anesthetics. Owing to the risks associated with general anesthesia, the authors of this article investigated the effect of sedation on birds during a CT examination. In this study, 10 psittacine birds were imaged using a 40-slice helical CT scanner. Birds were sedated with midazolam and butorphanol and placed in a positioning device. Following the initial study, birds were removed from the device and placed under general anesthesia with isoflurane. A second study was then performed. Two radiologists, blinded to the identity of the birds and partially blinded to the conditions of the study, reviewed the images. Studies were evaluated using a questionnaire consisting of 18 questions. Each question was scored on a Likert scale. A Wilcoxon signed rank test compared scores of sedated and anesthetized birds. A significant difference ($P = 0.05$) between sedated and anesthetized studies was found for 2 of 18 (11.1%) questions for radiologist 1 and 1 of 18 (5.5%) questions for radiologist 2, with differences identified in the scleral ossicles and the femoral heads. Interrater agreement for all questions using a linearly weighted κ was 0.334 and 0.311 for sedated and anesthetized birds, respectively, indicating fair agreement. The interrater agreement, excluding the head and musculoskeletal system, was 0.381 for sedated animals, indicating fair agreement, and 0.404 for anesthetized birds, indicating moderate agreement. Based on our results, performing CT studies in birds with sedation is a viable alternative to studies performed under general anesthesia.

Key words: avian; butorphanol; computed tomography; midazolam; psittacine; sedation

Computed tomography (CT) represents an invaluable diagnostic tool in assessing and determining disease diagnosis of avian patients. The increasing availability and affordability of CT have increased the usage of this diagnostic imaging modality in veterinary hospitals. Several studies have been published on the normal tomographic and CT anatomy of birds.[1-7] Digital radiography is an important imaging technique used for avian patients; however, there are limitations associated with traditional radiography, including the following: (1) general anesthesia is usually required during radiographic procedures owing to the temperament of birds and the difficulties associated with manual restraint, and (2) radiographic evaluations are an insensitive means of detecting pathology in areas with significant superimposition of anatomic structures.[8] One scientific study compared conventional radiographs with CT in imaging of the head in both raptors and psittacines.[9] This study concluded that radiographic images were only able to

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detect disease of the sinuses when bony change was present.[9] Conversely, CT imaging was more sensitive at detecting disease involving soft tissue by measuring the pneumatized volume of the skull.[9] Other investigations have reported on the superiority of CT in showing subtle lesions associated with disease of the lower respiratory tract in psittacines.[10,11] Additionally, CT has been used for detecting pathology within the musculoskeletal system that might be otherwise missed by conventional radiographic imaging techniques (e.g., discospondylitis and coxofemoral injuries).[12,13] CT is an invaluable diagnostic tool and is preferable to traditional radiographic imaging techniques.

Recent advances in CT technology have allowed for improved image quality and shorter scanning times. Two studies have been published using CT in conscious cats.[14,15] These studies employed a novel device (e.g., VetMouseTrap™) that allowed imaging of alert cats with minimal motion artifact.[14,15] In both studies, diagnostic quality CT images were obtained.[14,15] A recent CT study evaluating awake swans found similar results.[13]

The authors hypothesize that diagnostic quality CT studies can be obtained in birds using a sedation protocol of midazolam and butorphanol. Moreover, the authors believe that the images obtained from the sedated birds would be comparable to images obtained from birds under general anesthesia; thereby avoiding the clinical risks often associated with the use of inhalant anesthetics (e.g., apnea, bradycardia, and hypotension).[16] It has been suggested that sedation may be safer than general anesthesia in dogs, cats, and rabbits,[17] and this protocol may also be true for birds.[18] Midazolam, a benzodiazepine, has been shown to provide reliable sedation and muscle relaxation in a number of avian species without significant cardiopulmonary depression.[19-21] Butorphanol, a mixed κ agonist/μ antagonist opioid, is widely used as an analgesic in avian species, but at an appropriate dose can result in sedation of the patient.[22-24] This is the first study to evaluate the diagnostic quality of CT images of birds under general anesthesia vs midazolam and butorphanol sedation.

MATERIALS AND METHODS

All procedures were approved by the Institutional Animal Care and Use Committee at the Texas A&M University, College of Veterinary Medicine (College Station, TX USA). All birds were part of a teaching/research flock belonging to the Schubot Exotic Bird Health Center and either had positive results for avian bornavirus via polymerase chain reaction testing performed on cloacal swabs or had negative results but had a history of exposure. At the time of the study, none of the birds used in this investigation exhibited clinical signs of disease.

Ten psittacine birds (4 severe macaws, *Ara severus*; 2 blue and gold macaws, *A. ararauna*; 2 green wing macaws, *A. chloropterus*; and 2 scarlet macaws, *A. macao*) were included in the study. The mean body weight was 864 g (range 360 to 1578 g), and the median approximate age was 12 years (range 7 to 20 years). There were 4 males and 6 females.

Birds were fasted for approximately 2 to 4 hours before sedation. The birds were injected with butorphanol (0.86 to 2.55 mg/kg intramuscularly, Dolorex; Intervet/Merck, Summit, NJ USA) and midazolam (0.86 to 1.53 mg/kg intramuscularly, Versed; Hospira, Lake Forest, IL USA). Some birds required supplemental dosing of either midazolam or butorphanol to attain adequate sedation. After sedation, the birds were placed on a perch located within the minimal x-ray attenuating positioning device (a standard cardboard pet carrier modified to exclude light and a slit cut into the positioning device at one end to allow the tail feathers to rest comfortably). Light packing material consisting of towels and nonabsorbent pads were then placed around the birds to minimize motion. The positioning device was then scanned using a 40-slice helical CT scanner (Siemens somatom; Siemens, Erlangen, Germany). The CT scans were performed at 120 kV and 240 mA with a pitch of 0.6, rotation speed of 0.5 seconds, and slice acquisition thickness of 1.0 mm. The scan range and field of view was determined based on the length, width, and height of the positioning device. When the scan was completed, the birds were removed from the positioning device. For the general anesthetic protocol, the birds were induced with 3% to 5% isoflurane (IsoFlo; Abbott Laboratories, Abbott Park, IL USA) and maintained at 2% to 3% isoflurane delivered via facemask. A second scan was performed in dorsal recumbency with the birds fully anesthetized. The settings for the CT scans were the same for each individual bird and were similar for all the test subjects aside from the scan range and field of view, which varied owing to size differences between birds.

Following the acquisition of the primary data set for the sedated and anesthetized CT scans, all