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SURGICAL REMOVAL OF A TRACHEAL FOREIGN BODY FROM A WHOOPING CRANE (*GRUS AMERICANA*)

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Abstract: The left wing of a whooping crane (*Grus americana*) was amputated for treatment of severe nonunion and malunion fractures of the radius and ulna. During the postoperative convalescent period, the bird aspirated a corn kernel and subsequently suffered episodic bouts of dyspnea. The bird was anesthetized with tiletamine–zolazepam. Attempts to deliver the kernel through the glottis with endoscopic instruments were unsuccessful. The corn kernel was retrieved via a tracheotomy incision. Endoscopy of the trachea 2 mo postoperatively showed complete healing of the tracheal incision. Mucosal integrity had been reestablished, and tracheal lumen diameter was not compromised. The bird continues in good health 2.5 yr after surgery, shows no signs of respiratory disease, and currently is in a captive breeding program.

Key words: Whooping crane, *Grus americana,* tracheal foreign body, tracheotomy, tiletamine–zolazepam.

INTRODUCTION

The presence of a tracheal foreign body is a life-threatening medical problem, especially in many species of cranes that have extensive coiling of the trachea within the sternal bone, producing numerous "cul-de-sacs" where a foreign body can lodge and become irretrievable. Aspiration of foreign objects has been reported in pet birds and in wild turkeys (*Meleagris gallopava*).[2,6] Although specific cases were not cited, one report stated that foreign body retrieval could be accomplished using a biopsy forceps.[6] Lower tracheal foreign bodies are very difficult to remove. As a last resort, the foreign body should be pushed distally into the respiratory tree in an attempt to minimize compromise of the respiratory system.[6] In some cases, following this procedure the foreign body has been walled off and the bird has survived; however, the preferred treatment is to retrieve the foreign body from the trachea. This report describes the surgical removal of a tracheal foreign body in a whooping crane (*Grus americana*) after unsuccessful attempts at endoscopic retrieval and discusses the anesthetic management of a bird undergoing tracheal surgery.

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CASE REPORT

On 14 September 1988, a 5-yr-old male whooping crane in the flock at Grays Lake National Wildlife Refuge, Idaho, was observed with an injured left wing. The bird was captured on 16 September, and a fractured left wing was identified. The bird was flown to the National Wildlife Health Research Center (NWHRC), Madison, Wisconsin, for treatment and follow-up care. Physical examination of the bird at the University of Wisconsin Veterinary Medical Teaching Hospital (UWVMTH) revealed open fractures of the left radius and ulna. The severity and chronicity of the fractures warranted a poor prognosis for fracture healing and returning the bird to flight. The wing was amputated at the humeroradial–ulnar joint on 19 September 1988.

Postoperatively, the bird was housed in a 28-m^2 isolation room in the NWHRC research building and maintained on a 12-hr on–off light cycle. A formulated crane main-

tenance diet (International Crane Foundation Maintenance Diet, Garver Feed & Supply Co., Madison, Wisconsin 53707, USA) and water were provided daily in rubber buckets. The formulated diet was supplemented with 25–75 g of immature mice on a regular basis. Whole corn and barley also were offered to stimulate feeding.

During a physical examination 1 wk after surgery, the bird began open-mouth and stertorous breathing. Examination of the nares, oropharyngeal cavity, choana, and glottis was unremarkable. A 5–7-mm round cream-colored object was found lodged immediately posterior to the glottis. An attempt to remove the object with forceps was unsuccessful and the object was pushed deeper into the trachea. The bird was returned to the UWVMTH for endoscopic examination of the trachea. At presentation, the bird was agitated slightly and respiratory excursions were clearly audible.

The crane was given 10 mg/kg tiletamine–zolazepam (Telazol, A. H. Robins Co., Richmond, Virginia 23220, USA) i.m. and was recumbent within 5 min. The initial dose was sufficient for endoscopy for 1 hr, at which time an additional dose of 2 mg/kg i.m. tiletamine–zolazepam was administered.

Examination of the oral and pharyngeal cavities of the bird was unremarkable. A lubricated 4.8-mm-diameter pediatric fiber-optic endoscope (Pentax FB-15A, Pentax Precision Instrument Corp., Orangeburg, New York 10962, USA) was inserted through the glottis and into the trachea. A mass was observed approximately 4 cm distal to the larynx occluding nearly the entire diameter of the trachea. The mass had not adhered to the tracheal mucosa and could be pushed easily down the trachea with the end of the endoscope. Attempts to grasp the mass with an endoscopic biopsy forceps (Pentax Precision Instrument Corp.) were unsuccessful. An attempt to pass a deflated Foley catheter (Bard Urological Division, CR Bard, Murray Hill, New Jersey 07974, USA) beyond the mass only pushed the object farther down the trachea. A 5-mm spiral basket (Mill-Rose Spiral Baskets, Mill-Rose Laboratories, 7310 Corporate Blvd., Mentor, Ohio 44060, USA) was inserted through the biopsy port of the endoscope to the level of the obstructing mass. Careful manipulation allowed passage of the closed basket beyond the obstruction. The basket was opened and the endoscope, basket, and tracheal mass were withdrawn as a unit. The mass was brought to the level of the larynx where the pessulus[3] (midline laryngeal cartilage) dislodged the mass from the basket. Numerous attempts were made to remove the mass in this manner but each attempt to pass the pessulus was unsuccessful.

Because the mass could not be removed by endoscopy, a tracheostomy was performed. The mass was manipulated into the proximal trachea by holding the bird in an inverted vertical position while percussion (coupage) was performed on the chest wall. The mass was confined to the proximal trachea by inserting a 22-gauge spinal needle (B-D Spinal Needle, Becton, Dickinson and Co., Rutherford, New Jersey 07070, USA) percutaneously transversely through the trachea.

The bird was positioned in left lateral recumbency and the ventral aspect of the neck was prepared for surgery. A 2-cm skin incision was made on the ventral midline over the underlying trachea approximately 3 cm distal to the larynx. Sharp dissection was continued through the subcutaneous tissues to expose the cartilaginous rings of the trachea. A transverse incision was made between adjacent cartilaginous rings for approximately ⅓ the circumference of the trachea. Stay sutures of 4-0 nylon (Ethicon, Sommerville, New Jersey 08876, USA) were placed around the tracheal rings adjacent to the incision to permit atraumatic manipulation of the trachea. The endoscope was inserted through the glottis and into the proximal trachea to push the foreign body into the surgical site. The foreign body, a kernel of corn, was grasped with forceps and removed. Once the foreign body and spinal

needle were removed, anesthesia was maintained with 2% isoflurane (AErrane, Anaquest, Madison, Wisconsin 53713, USA) in oxygen via an anesthetic mask connected to a nonrebreathing apparatus.

The tracheotomy incision was closed by preplacing four 4-0 nylon sutures in an interrupted pattern around the cartilaginous rings adjacent to the incision. The sutures were tied sequentially to close the tracheal incision. The subcutaneous tissue was apposed with 4-0 polyglactin 910 suture (Vicryl, Ethicon) placed in a continuous pattern. The surgical procedure was completed with the placement of 4-0 nylon skin sutures in a simple interrupted pattern. The trachea was evaluated postoperatively with the endoscope to ensure the tracheal lumen diameter had not been compromised.

Circulatory function was supported throughout the anesthetic period with 120 ml of 2.5% dextrose in 0.45% saline (Travenol Laboratories, Deerfield, Illinois 60015, USA) administered s.c. The total anesthesia time was 2.5 hr, and the crane made a rapid and smooth recovery. No residual effects of tiletamine–zolazepam were apparent.

The bird was returned to the NWHRC for postoperative care following recovery from anesthesia. The bird received 2 mg/kg dexamethasone (Azium, Schering Corp., Kenilworth, New Jersey 07033, USA) i.m. once postoperatively and a decreasing oral dose (Dexon Tablets, Reid-Rowell Laboratories, Marietta, Georgia 30062, USA) for the following 2 days. The bird was also given 100 mg/kg ampicillin (Amcill, Parke-Davis, Morris Plains, New Jersey 07950, USA) orally in feed mice b.i.d. for 7 days.

The corn kernel was submitted to the NWHRC diagnostic microbiology laboratory. Impression smears and a culture of the kernel demonstrated heavy growth of *Aspergillus fumigatus*. There was no evidence of clinical aspergillosis based on physical examination and hematologic evaluations. Nevertheless, considering the potential deleterious consequences of an *Aspergillus* nidus in the respiratory tract, the bird was treated prophylactically with 200 mg/kg 5-fluorocytosine (Ancobon, Roche Laboratories, Nutley, New Jersey 07110, USA) placed in feed mice b.i.d. for 23 days.

Laparoscopy was performed 2 mo after the tracheotomy to confirm the bird's sex and to examine the abdominal viscera for evidence of avian tuberculosis. The bird had not exhibited respiratory distress and had resumed a normal activity level. The crane was anesthetized with 10 mg/kg tiletamine–zolazepam i.m., providing a level of anesthesia adequate for endoscopy for 30 min. After that period, an additional 2 mg/kg i.m. dose was administered. Using a four-lead ECG (Vitatek-514 Patient Monitor, Spacelabs, Hillsboro, Oregon 97123, USA) to monitor cardiac function, occasional premature ventricular contractions were noted. Systolic blood pressure ranged from 200 to 220 mm Hg, as monitored by doppler (Park's Electronics, Aloha, Oregon 97006, USA). Spontaneous ventilation was approximately 12 breaths per minute for the entire anesthetic period.

Endoscopic examination revealed complete healing of the tracheal mucosa with no evidence of stricture of the tracheal lumen. The nylon sutures were still present. The bird continues in good health 2.5 yr after surgery, shows no signs of respiratory disease, and currently is in a captive breeding program.

DISCUSSION

Retrieval of tracheal foreign bodies from a bird presents unique challenges in anesthetic and surgical management. Although blind retrieval of a foreign object is possible, this technique could cause iatrogenic damage to the trachea. Endoscopy permits direct examination of the tracheal lumen for observation of the foreign object. Tracheal foreign bodies in dogs have been removed with a wire basket or grasping forceps through a rigid hollow bronchoscope[11] or pediatric fiber-optic endoscope.[7] Foreign bodies also have been removed by passing a Fogarty catheter beyond the mass and inflating the

balloon cuff on the catheter. The foreign object is pulled ahead of the balloon as the catheter is removed.[8] Endoscopic retrieval of tracheal foreign bodies avoids the otherwise necessary tracheal surgery.

In the case, the corn kernel could not be grasped with biopsy forceps because of its firmness, and the midline laryngeal cartilage, the pessulus, prevented the kernel from being delivered into the oral cavity when the spiral basket was used. Surgical retrieval of the corn kernel was considered only after removal of the foreign body with endoscopic equipment was unsuccessful and the duration of general anesthesia was becoming excessive.

The avian trachea has complete tracheal rings that are cartilaginous in many species. Calcification of the tracheal rings occurs in adult Amazon parrots (*Amazona* spp.)[10] and has been noted in adults of many crane species (FJD, pers. obs.). Annular ligaments are present between the tracheal rings.[12] The trachea of some crane species is encased within the sternum and coils back on itself, making retrieval of distal tracheal foreign bodies more difficult.

There are few references to avian tracheal surgery in the literature. Tracheotomies in which longitudinal incisions were made to gain access to the lumen of the trachea have been described.[9,13] Transection of the trachea has been recommended in preference to longitudinal bisection because bisection reportedly results in limited surgical exposure and occasional tearing of tracheal tissues and anastomosis of the trachea is more difficult following longitudinal bisection than it is following transection.[5] Furthermore, following repair of a longitudinal bisection, scar tissue may reduce the size of the lumen and impair breathing.[5,14] Tracheotomies using a longitudinal incision have been performed in red-tailed hawks (*Buteo jamaicensis*) (MacCoy, pers. comm.). The tracheas were not sutured and healed successfully by second intention.

In this crane, a transverse incision in the annular ligament between two adjacent tracheal rings was chosen to gain access to the tracheal lumen. Complete transection of the trachea was avoided to maintain alignment, to prevent disruption of the blood supply, and to reduce tension on the suture line.

Nylon was selected to close the tracheal incision because of its strength, ease of handling, and nonreactive properties. Both absorbable and nonabsorbable suture materials have been recommended for tracheal closure;[1] however, braided nonabsorbable suture material has a higher incidence of granuloma formation.[4] Because there was no evidence of suture reaction, granuloma formation, or tracheal stricture at the 2-mo postoperative examination of the crane's trachea, no attempt was made to remove the nylon suture material. Sutures can be placed either through or around the tracheal rings. In this case, encircling sutures were placed carefully to prevent overriding of the tracheal rings. Tension relieving sutures were not indicated because none of the trachea had been removed. All knots were tied outside the lumen of the trachea.

Tiletamine–zolazepam provided adequate anesthesia and muscle relaxation for the procedures performed. An injectable anesthetic was chosen to allow unobstructed access to the larynx and trachea for removal of the foreign body. Alternative anesthesia choices for a tracheotomy include another injectable anesthetic combination such as ketamine and xylazine or gaseous anesthesia using air sac cannulation.[13] Premature ventricular contractions were noted during the third anesthetic period, but a cause was not apparent. Tiletamine–zolazepam was supplemented with isoflurane once the airway became available. The crane recovered from anesthesia rapidly, indicating that the anesthetic effects of tiletamine–zolazepam were no longer present after the 1.5–2.5-hr procedures.

The circumstances under which the crane aspirated the corn kernel are unknown but may be similar to those in other reported cases of corn kernel aspiration. Whole kernel corn has been implicated in fatal cases

of tracheal obstruction in turkeys captured with cannon nets.[2] The turkeys may have aspirated whole kernels that were in their mouths when they were startled by the gun's discharge. Although disturbance of the whooping crane was kept to a minimum, a similar startle response may have been the cause of the aspiration. Substitution of cracked corn for those species that seem susceptible to kernel aspiration is advisable.

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