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Keywords

cerebral cyst, computed tomography, craniectomy, avian, crested pekin duck, Anas platyrhynchos f dom

Disciplines

Poultry or Avian Science | Veterinary Pathology and Pathobiology

Comments

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Removal of a Presumed Peripheral Cerebral Cyst via Craniectomy in a Crested Pekin Duck (*Anas platyrhynchos* f dom)

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Abstract: A juvenile, male crested pekin duck (*Anas platyrhynchos* f dom) was presented for neurologic signs suggestive of cerebellar disease. Physical examination revealed microphthalmia, erratic head movements, and ataxia. Computed tomography scan of the head and neck regions revealed 2 full-thickness skull-bone defects within the caudal portion of the cranium. The cerebellum appeared to be ventrally compressed by a homogeneous, triangular, fluid-attenuating region (0–10 Hounsfield units). A craniectomy was performed, and a presumed peripheral cerebral cyst was removed with suction and gentle dissection. No postoperative complications occurred, and the patient showed clinical improvement for 5 months after surgery. However, after 5 months, the owners elected euthanasia because of poor prognosis after finding the duck minimally responsive in a water enclosure. At necropsy, a thin-walled, epithelial structure was present in meninges and was adhered to the skull at the presumed surgical site.

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Clinical Report

A 2.2-kg, 10-week-old, male crested pekin duck (*Anas platyrhynchos* f dom) was presented to the Iowa State University Hixson-Lied Small Animal Hospital (Ames, IA, USA) for evaluation of neurologic signs. The duck was purchased by the owners 4 days after hatching, and they reported the duck had always had a mild head tilt and ataxia when ambulating. Two days before presentation, the duck had trouble supporting itself, and its appetite had decreased.

On physical examination, the duck was alert and well hydrated and had adequate body condition. On first observation from a distance, the duck was ataxic and fell to the left when ambulating. It had constant arrhythmic head bobbing, but it was responsive to both visual and auditory stimuli. The duck was able to visually track dropped food. When the duck tried to pick up food, intention tremors were noted and the duck frequently missed the intended target. An ophthalmic examination was performed, revealing microphthalmia of the right eye. The cranial nerves appeared to be intact, without any apparent deficits. On palpation, legs and wings had symmetric versus symmetrical muscle mass with adequate tone. The overall feather quality was diminished with lack of barbule integrity because the duck was unable to properly preen itself without falling.

A central nervous system deficit localized to intracranial structures was suspected because no peripheral neurologic deficits were observed. The most likely localization for a lesion, based on results of clinical examination, was the cerebellum. Differential diagnoses considered with history and observed neurologic signs were congenital intracranial malformations, metabolic disease (renal disease, liver disease, hypocalcemia), toxins (lead), and infectious causes (infectious meningitis, chla-

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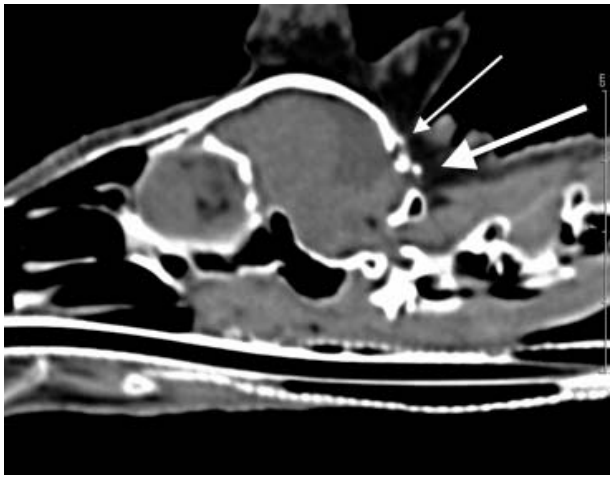

Figure 1. Computed tomographic image of the skull of a juvenile male crested pekin duck that exhibited ataxia, erratic head movements, and microphthalmia. Note the malformation of bone (white arrows) in the caudal aspect of the cranium.

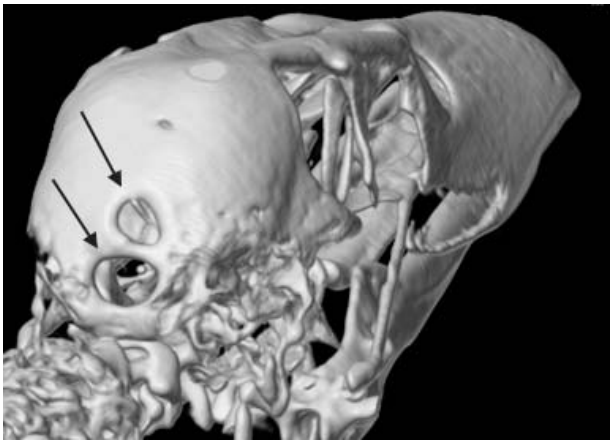

Figure 2. Three-dimensional volume–rendered model from the skull of the juvenile male crested pekin duck described in Figure 1. Note several small bone defects throughout the cranium. The 2 largest (denoted by black arrows) were the sites of cerebral tissue herniation.

mydiosis, aspergillosis, viral).[1] A congenital malformation was suspected because of the patient's age and presence of clinical signs since hatching. Additionally, multiple congenital pathologic changes in the cranium and the brain have previously been described in crested domestic ducks.[2–7] Results of a complete blood cell count and serum biochemical profile were within reference intervals, aside from an increased creatinine kinase activity (attributed to tissue damage from falling).

A computed tomography (CT) scan was performed to look for malformations in the skull and intracranial structures. Before the CT scan, food was withheld for 16 hours, and water was withheld for 3 hours because the patient was maintained under gas anesthesia for the procedure. Full-body contiguous computed tomographic pre- and post-contrast images were acquired (Fig 1) at 0.5-mm slice thickness with tube parameters of 200 mAs, 120 kV, 0 pitch on a 16-slice multidetector scanner (Toshiba Aquilion, Toshiba American Medical Systems, Irvine, CA, USA). Three-dimensional volume–rendered models were also created to obtain a better sense of the lesions present within the cranium (Fig 2).

Several partial-thickness bone defects were visible throughout the skull. Two large, round bone defects in the caudal portion of the cranium were of most significance because they were full-thickness defects through the bone. The largest area was immediately dorsal to the foramen magnum and craniospinal column junction. The smaller defect was dorsal to the first, and both were along the midline of the cranium (Fig 2). Intracranially, soft tissue–attenuating tissue, suggestive of cerebellar tissue (Hounsfield units, range 25–50), extended across the caudoventral cranium to the largest cranial defect. At the most caudal margin, the cerebellum was elongated with encroachment of tissue into the defect. The spinal cord ventral to the cerebellum was normal. Surrounding the caudal and dorsal aspects of the cerebellum, a homogeneous, fluid-attenuating region (Hounsfield units, range 0–10) was visible, and a moderately sized, spherical gas-attenuating focus was present on the right at the soft tissue and fluid interface. The gas attenuation was not gravity dependent. The cerebrum had homogeneous soft tissue attenuation with no evidence of mass effect.

After iohexol contrast (Omnipaque 240, GE, Milwaukee, WI, USA), administration at 1.5 mL/kg IV, the cerebrum and cerebellar tissue were similarly, homogeneously enhanced (Hounsfield units, 60 and 70, respectively). The fluid-attenuating material did not change in attenuation after contrast administration. During the procedure, the patient regurgitated fluid, and the oral cavity was suctioned along with the cranial aspect of the trachea after the patient was extubated. The patient was subsequently treated with potentiated amoxicillin/clavulanic acid (125 mg/kg PO q12h $\times$ 2 wk).

One week after the CT scan, the patient was anesthetized for a craniectomy with removal of the intracranial, fluid-filled structure. Food and water were withheld for 24 hours before the surgical

Figure 3. The crested pekin duck described in Figure 1 was prepared and positioned for intracranial surgery. Note the placement of a bite block for patient stability and fine positional manipulation during surgery.

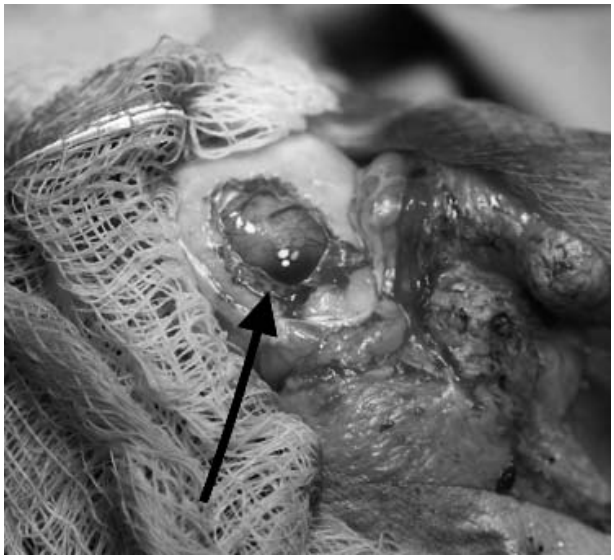

Figure 4. Exposure of the peripheral cerebral cyst (black arrow) in the cranium of the pekin duck described in Figure 1. Note the large amount of cerebral vasculature surrounding the cyst.

procedure. The bird was premedicated with midazolam (2 mg/kg IM once) and butorphanol (1 mg/kg IM once). General anesthesia was achieved with isoflurane (1%–3%) in oxygen delivered via facemask. End-tidal CO_2 was maintained between 20 and 40 mm Hg. The bird was monitored by electrocardiogram, end-tidal CO_2, esophageal thermometer probe, and pulse oximetry, and warmed crystalloid fluids (5 mL/kg/h IV) were administered throughout the procedure.

The feathers were plucked over the cranium, including the crest, and the skin was aseptically prepared with chlorhexidine scrub and sterilized water. The patient was placed in ventral recumbency with a metal bite rod (for stability) wrapped in adhesive tape placed in the mouth (Fig 3). A left paramedian incision over the dorsum of the skull was made with a number 15 scalpel blade. The defects in the skull were avoided for entry into the cranium because soft tissue (suspected connective and fat tissue) was visibly protruding from these openings. A 3-mm bone burr was used to thin the bone over the left caudal aspect of the cranium, and the thin inner cortical bone remaining was removed with rongeurs. The approach site measured approximately 2 × 1 cm from cranial to caudal and side to side, centered under the crest. The dura mater was incised with a 22-gauge hypodermic needle. A fluid-filled structure was revealed in the caudal portion of the cranium between the cerebrum and cerebellum (Fig 4), suspected to be a peripheral cerebral cyst because of its positioning in the cranium. An attempt was made to collect the fluid with a 25-gauge needle, but after the fluid-filled structure was punctured, no fluid was able to be harvested because the structure collapsed in on itself. Attempts were made to retrieve portions of the structure for analysis, but none were found because of its small size and proximity to vital organs. Light suction, a dental probe, and sterile saline flush were used to try to remove the remaining structures of the presumed cyst. The cerebellum appeared to have been ventrally compressed by the cystic structure. After close examination for any remaining cystic structures and flushing, the dura mater was closed with a simple interrupted pattern with 6-0 polydioxanone suture. The subcutaneous tissue was closed with 4-0 polydioxanone suture in a simple, interrupted pattern over the area of the craniotomy and a simple continuous pattern over intact cranium. A simple continuous pattern with 4-0 polyethylene suture was used to close the skin. Total surgical time was 45 minutes, and total anesthesia time was 95 minutes. Recovery was uneventful, and the patient remained in the hospital for 48 hours after surgery. Meloxicam (0.5 mg/kg PO q24h × 10 d) and butorphanol (1 mg/kg IM q6h × 2 d) were used for pain management.

No clinical improvements were noted at discharge 2 days after surgery. The erratic head movement and moderate amount of ataxia continued. Two weeks after the procedure, the patient was presented for a follow-up appointment. Although still present, the duck's clinical signs were dramatically improved. The duck was able to preen itself and was observed standing on one foot

for the first time without falling over. When food was made available, movements to obtain the food were executed with more accuracy than before the surgery. Ambulation was also subjectively more coordinated, although the patient continued to have a head tilt to the left and would occasionally fall to the left. The duck was reintroduced back into the owner's flock for supervised periods throughout the day. During the next 5 months, the duck was allowed full access to the flock and was able to accomplish most normal duck behaviors.

Five months after surgery the duck was found minimally responsive at the bottom of a water tank within its enclosure. Because of the poor prognosis and financial constraints, the owner elected euthanasia.

At necropsy, fibrin thrombi were found in the lungs, liver, kidneys, and right heart. The thrombi were likely sterile because periodic acid–Schiff staining failed to reveal any fungal structures within the thrombi, and the lack of granulocytes within the thrombi did not support a bacterial etiology. The thrombi were not fully occlusive; the laminated appearance suggested the thrombi were enlarging over time, allowing the vascular lumen to expand. Isolated foci of lymphocytic perivascular cuffing were present in the cerebrum, and mild neuronal satellitosis was present throughout the brain. Decalcified sections of the skull were examined, and a moderate layer of fibrous tissue was present at the surgical site. The surgical site was a noncontinuous area of flat bone. At both ends, a layer of fibrous tissue was present, with a protruding, perpendicular fibrous enclosure that extended beyond the margins of the bone to the subcutaneous tissue. No cerebral tissue was present in this potential space outside of the cranium.

Cerebral tissue was attached to the surgical site, and the remaining suture material was surrounded by an intense lymphogranulomatous reaction. Beneath the surgical site, there appeared to be a syrinx-like structure that was not well defined because it occurred within the cerebral neuropil and may have extended into the meninges. The structure was surrounded by a very narrow band of cerebral cortical neuropil. Similar cystic spaces were not observed grossly or histologically anywhere else in the brain. Brain and lung sections were submitted for immunohistochemical staining for influenza virus. An immunohistochemical marker specifically for avian influenza virus was unavailable, so a swine influenza virus antigen was used because of likely strong cross-reactivity. All sections submitted were negative for influenza virus.

Discussion

In this report, we describe the surgical treatment via craniectomy of a presumed cyst in the peripheral cerebral cortex of a juvenile crested pekin duck. Although clinical signs returned, removal of the presumed peripheral cerebral cyst resulted in marked clinical improvement in this duck for 5 months.

Domestic crested ducks are described as having a high incidence of pre- and postnatal mortality and central nervous system malformations.[2–7] Although the cause of these malformations are not fully understood, they are believed to be linked to an incomplete, dominant, autosomal gene. Viable crested domestic ducks are thought to be heterozygous for the gene because homozygous offspring have several malformations (large encephaloceles and malformed beaks) that cause failure to hatch.[8] Previous studies have focused mainly on the diagnosis of intracranial lesions through advanced imaging techniques and histopathologic examination.[2–7] Most of the intracranial lesions described histologically are lipomas consisting of fatty tissue separated into lobules by strands of connective tissue.[9] The fat bodies of crested ducks have varied from 0.3% to 41% of total brain volume, and ducks with motor incoordination show significantly larger fat bodies.[7]

The juvenile crested pekin duck we describe did not show evidence of an intracranial fat body with advanced imaging or visualization during surgery. However, a presumed fluid-filled peripheral cerebral cyst was visualized on advanced imaging and during surgery. At necropsy, there appeared to be a syrinx-like structure that was not well defined because it occurred within the cerebral neuropil and may have extended into the meninges below the surgical site. Because of the age of the animal, the peripheral cerebral cyst was suspected to be a congenital malformation. Congenital cysts are typically an incidental finding diagnosed with advanced imaging modalities. Whether a cyst was responsible for the presenting clinical signs is a question that is often answered retrospectively after a cyst is removed.[10] Although clinical improvement was observed in this duck with removal of this cyst, the neurologic signs were not completely resolved. It was unclear after diagnostic tests and necropsy if the cyst-like structure was the sole cause of clinical signs.

In human patients with intracranial cystic structures, the 2 principal methods of surgical intervention are cyst fenestration via craniotomy and cystoperitoneal shunting.[11,12] Proponents of fenestration argue that this obviates shunt complications, and proponents of cystoperitoneal shunting report decreased cyst recurrence rates compared with fenestration. Both procedures are associated with high success rates, and whether one is superior remains undetermined.[11,12] One shunt has been successfully placed and documented in a cat, but no reports, to our knowledge, indicate successful shunt placement in any avian species to date.[13]

Although this case emphasizes the use of surgical management for a peripheral cerebral cyst located in the peripheral cerebral cortex, crested pekin ducks with other intracranial masses, such as lipomas, could also serve as possible surgical candidates in an effort to alleviate associated clinical signs. Another viable method to address these problems is through selective breeding. Behavioral testing has been used to select breeding stock resulting in an increased hatching rate and decreased number of ducklings with malformations or motor incoordination.[7]

The chosen fasting times for this patient were aggressive but were well within recommended fasting periods for the size of this bird and for the order Anseriformes.[14] Although attention was given to positioning, this patient still regurgitated under anesthesia during CT evaluation. Gauze could have been placed into the pharynx in an attempt to further mitigate negative consequences of potential regurgitation.

No causative agent was identified for the postmortem changes observed at necropsy and histopathologic examination. Because a bacterial component could not be confirmed, avian influenza testing was pursued because the duck was housed outdoors during a recent epidemic in the Midwest. Test results were negative, but this was interpreted cautiously because we were unable to find documented evidence of cross-reactivity between the avian influenza virus and the swine influenza virus. Because of financial constraints, the owner declined further testing, therefore, other infectious agents could not be ruled out.

An intense lymphogranulomatous reaction was present surrounding the internal cerebral suture site. Whether this reaction was associated with the duck's presenting signs at the time of euthanasia is unknown. All suture material can cause some degree of reaction. In a study involving suture placement in rock doves (*Columba livia*), polydioxanone suture was shown to cause minimal tissue response.[15] However, that study was conducted over 120 days and only looked at suture placed into the ventral body wall. It is reasonable to conclude that the reactivity of tissue within the cranium would be difficult to compare with that of the soft tissue structures of the body wall.

This case report of removal versus craniectomy craniectomy of a presumed cyst in the peripheral cerebral cortex of a pekin duck highlights the ability to perform, and help an avian patient recover from, intracranial surgery. Advanced imaging in conjunction with surgery may assist in providing improved quality of life in some cases of intracranial disease in ducks.

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