Use of a duodenal serosal patch in the repair of a colon rupture in a female Solomon Island eclectus parrot

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Case Description—A 444-g (0.98-lb) 4-year-old sexually intact female Solomon Island eclectus parrot (Eclectus roratus solomonensis) was referred and evaluated for a suspected colonic obstruction.

Clinical Findings—The parrot had a 3-day history of not passing feces and lack of appetite following treatment of dystocia that included percutaneous collapse of the egg and manual removal of egg fragments via the cloaca. During this procedure, a tear in the cloacal mucosa developed. The tear was repaired via a midline cloacotomy. Although clinically stable at the time of referral, the parrot became lethargic and bradycardic and had delayed crop emptying.

Treatment and Outcome—A midline celiotomy and cloacotomy were performed to relieve the colonic obstruction, during which the severely distended colon ruptured. The colonic defects were closed in a simple interrupted pattern, and a serosal patch was applied by use of the adjacent duodenum. The bird recovered uneventfully from anesthesia and was passing voluminous feces with mildly increased effort within 1 hour after surgery. At 2 weeks after surgery, the parrot was passing feces with no increase in effort and had a normal appetite.

Clinical Relevance—Application of a duodenal serosal patch for repair of a colon rupture was successful in this parrot. Gastrointestinal obstruction is rare in birds, but should be considered in birds that have regurgitation, decreased fecal production, and gastrointestinal dilation. Because birds lack an omentum, serosal patching with adjacent duodenum should be considered as a viable option in avian surgery. (J Am Vet Med Assoc 2011;238:922–926)

A 444-g (0.98-lb) 4-year-old sexually intact female eclectus parrot, Solomon Island subspecies (Eclectus roratus solomonensis), was evaluated by a referring veterinarian after an episode of weakness, regurgitation, and trembling. According to the owner, for 1 month prior to evaluation, the bird had been displaying nesting behavior (ie, paper shredding and hiding under a cabinet in the living room). Coelomic swelling was palpated on physical examination; a soft-shelled egg within the oviduct was detected on abdominal ultrasonography. The bird underwent general anesthesia, and a soft-shelled egg was removed through the cloaca, substantial hemorrhage from the vent was observed. A ventral midline cloacotomy was performed to evaluate the source of the bleeding, and a small, 5-mm-long cloacal tear was identified in the area of the coprourodeal fold between the opening into the coprodeum and the uterine opening into the urodeum. The tear was sutured and the cloacotomy site was closed. During the 2 days that the bird was hospitalized after surgery, it did not regain its appetite and passed urates and urine, but no feces. Two days after the surgery, the bird received a suspension of 100% barium sulfate (20 mL/kg [9 mL/lb], PO, via a gavage tube) for its purported therapeutic value in psittacines with gastrointestinal inflammation.1

The next day, the bird was referred to the Special Species Service of the Matthew J. Ryan Veterinary Hospital of the University of Pennsylvania for presumed colonic obstruction because the bird had not passed feces for > 36 hours. The referring veterinarian suspected that one of the sutures placed in the cloaca to stop the bleeding might have been looped into or around the rectum, thus obstructing the colon.

On initial physical examination, the bird was bright, alert, and estimated to be about 9% dehydrated. The crop was slightly distended and doughy on palpation. Four sutures in a simple interrupted pattern were present in the skin along the caudal ventral abdominal midline, and the feathers in this area had been removed. The vent was slightly swollen and bruised.

Blood was collected (0.4 mL) from the right jugular vein for a CBC, a plasma biochemical analysis, and plasma protein electrophoresis, which revealed a regenerative anemia (PCV, 32% [reference interval, 42% to 55%]; reticulocyte count, 3.40 × 10³ cells/μL [16.9% reticulocytes; reference interval, 1% to 3%]), leukopenia (WBC count, 2.64 × 10³ cells/μL; reference interval, 4 × 10³ cells/μL to 14 × 10³ cells/μL), relative monocytes (monocytes, 8%; reference interval, 0% to 3%), and mild hyperkalemia (potassium, 6.5 mmol/L; reference interval, 3.0 to 5.5 mmol/L). Plasma creatine phospho-

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kinase and aspartate aminotransferase activities were outside the dynamic range of the machine and were therefore likely high. Although the bird’s total plasma calcium concentration was within the reference interval (10.7 mg/dL; reference interval, 7.6 to 12.0 mg/dL), it was low for an ovulating hen.

Standing fluoroscopy was performed where contrast material was identified in the crop, ventriculus, small intestine, and colon, despite the barium having been administered by the referring veterinarian 12 hours prior (Figure 1). On the basis of the lack of barium evident within the cloaca, a terminal colonic-rectal obstruction or stricture was suspected.

After fluoroscopy, warmed crystalloid fluid (20 mL/kg [9.1 mL/lb], SC, q 12 h) was administered to address the bird’s dehydration. Broad-spectrum antimicrobials were administered, consisting of enrofloxacin (20 mg/kg, IM first dose, then PO, q 24 h) and cefotaxime (75 mg/kg [34 mg/lb], IM, q 8 h), along with meloxicam (0.5 mg/kg [0.2 mg/lb], PO, q 12 h) and buprenorphine (0.03 mg/kg [0.01 mg/lb], IM, q 12 h) for analgesia. After the fluoroscopic evaluation, the bird was observed eating, intermittently preening, and vocalizing. Medical management was elected over surgical intervention in case the obstruction was partial or secondary to postoperative inflammation.

Although the bird initially improved clinically, on the morning of the third day, the bird regurgitated barium contrast material and became dull and lethargic. On physical examination, dehydration was estimated at 8% to 10% and the bird was bradycardic (heart rate, 120 beats/min; reference range for resting heart rate, 150 to 300 beats/min). The crop contained a moderate amount of fluid, and the coelom was slightly distended.

Another blood sample was obtained and revealed a leukocytosis (WBC count, 22 $\times 10^3$ cells/μL) and hyperuricemia (uric acid, 10.1 mg/dL; reference interval, 2.0 to 10 mg/dL) in addition to previous findings of a relative monocytosis (4%), hyperkalemia (potassium, 7.5 mmol/L), and high in aspartate aminotransferase and creatine phosphokinase activities. On the basis of the clinical deterioration of the bird, a celiotomy was planned to address the gastrointestinal obstruction.

Anesthesia was induced with 5% isoflurane in oxygen delivered by face mask; the bird was then intubated and maintained on isoflurane in oxygen. A 24-gauge catheter was placed in the right medial metatarsal vein, and a warmed crystalloid solution was administered throughout the anesthetic period (10 mL/kg/h [4.5 mL/lb/h]). The bird was positioned in dorsal recumbency. A 4-cm ventral midline skin incision was made by use of bipolar radiofrequency, extending caudally to the vent and cranially toward the keel. The caudal incision was then extended laterally along the left pubic bone. Once the intestinal peritoneal cavity was entered, the wall of the abdominal air sac was located and retracted with warm saline (0.9% NaCl) solution-soaked gauze and cotton-tipped applicators. The entire intestinal tract was severely distended, and the colon appeared thin and translucent. There was a portion of suture material surrounding the distal colon near its junction with the cloaca causing an obstruction to flow and preventing passage of feces into the coprodeum (Figure 2).

During manipulation of the intestinal tract to allow exposure, the colon ruptured in 2 places, and fecal material was observed extruding through the tears. The fecal material was removed with gauze sponges and cotton-tipped applicators, and the sites of rupture were débrided and closed with 5-0 polydioxanone in a simple interrupted pattern. By use of 8-0 nylon, the intact serosa of the adjacent duodenum was sutured circumferentially over the repaired colonic defects in a simple interrupted pattern at 2-mm intervals. Sutures were placed into the colonic serosa approximately 2 mm from the sutured defects and did not pass through the lumen of either the duodenum or the colon (Figure 3). The cranial portion of the body wall was closed with 5-0 polydioxanone in

Figure 1—Lateral contrast fluoroscopic image of an eclectus parrot while standing that was evaluated for suspected colonic obstruction. Notice the distended crop (C), dilation of the intestines (I), and the absence of contrast material at the level of the cloaca (Cl).

Figure 2—Photograph of a midline celiotomy in an eclectus parrot with iatrogenic colonic obstruction. Notice the distention of the small and large intestines and suture placed around the junction between the colon and the cloaca (arrowhead).
a simple continuous pattern in preparation for cloacal evaluation through the previous cloacotomy incision.

Sutures placed by the referring veterinarian for the cloacotomy were removed. The suture material constricting the colon was cut, and feces were immediately observed entering the cloaca. The cloacal wall was closed with 5-0 polydioxanone in a simple continuous pattern, and the skin was closed with a 4-0 polyglactin 910 in a Ford interlocking pattern.

The bird recovered uneventfully from anesthesia and was passing voluminous feces with mildly increased effort within 1 hour after surgery. The preoperative treatment protocol as already described was continued. Approximately 2 hours after surgery, the bird began eating, vocalizing, and preening. On the third postoperative day, SC administration of fluids was discontinued, and metronidazole was added to maintain coverage against anaerobic bacteria. Buprenorphine administration was also discontinued, and the bird was eating and drinking well and passing droppings of normal consistency. Cefotaxime remained within the gastrointestinal tract of the reported animal. It was found that transit time through the proventriculus, ventriculus, and intestines of a 1:1 dilution of iohexol with water was 15 to 30 minutes when gavaged at a dose of 25 to 30 mL/kg. The contrast material reached the cloaca after 30 to 60 minutes. In a study with blue-fronted Amazon parrots, a 25% barium sulphate suspension was gavaged into the crop at a dose of 20 mL/kg. Thirty minutes after administration, the barium was outlining the ventriculus, and at 60 minutes, barium was found in the small intestine in most of the birds. The crop emptied of barium within 180 minutes, and the colon and cloaca filled with barium after 120 to 300 minutes. The facts that barium remained within the gastrointestinal tract of the reported bird here and was not in the cloaca after nearly 4 days were indications of decreased motility, the most likely cause being an obstruction at the level of the cloaca.

Based on the stability of the avian patient, medical management of gastrointestinal disease is preferred to surgery because the prognosis for recovery from such a surgical procedure has been reported to be poor to grave. Postoperative complications after gastrointestinal surgery include dehiscence, adhesion formation, incisional leakage, and fatal coelomitis. Birds in a debilitated state or that do not receive adequate postoperative nutritional support have poorer prognoses.

In a report of 2 cockatoos with colonic entrapment after cloacopexy, 1 bird died during anesthetic induction before surgery, and the other bird died 5 days after surgery was performed to relieve the entrapment. During surgery on the second bird, colonic and cloacal tears were repaired with 4-0 polydioxanone in a simple interrupted inverting pattern. On postmortem evaluation, extensive adhesions between the colon, cloaca, and body wall were found, indicating possible dehiscence of the surgery sites.

Surgical procedures for removal of lower intestinal obstructions caused by foreign body impaction include proventriculotomy and a combination of rigid endoscopy and proventriculotomy. Intrususception, a coelomic mass, or obstruction of unknown origin are approached via a left paramedian laparotomy incision or cloacal surgery or to adhesions resulting from it. On examination 2 weeks after the salpingohysterectomy, the bird was doing well, and the incision was healing appropriately. The owners reported that the bird had a normal activity level, attitude, and appetite. On follow-up examination 3 years after the salpingohysterectomy, the bird was in good health with no signs of disease.

**Discussion**

Findings in the bird of this report highlight a complication associated with cloacal surgery in birds: colonic entrapment resulting in gastrointestinal obstruction. Successful surgical approaches to relieve colonic entrapment have been described in mammals but such surgeries in birds have been rarely described. To our knowledge, this is the first report of successful repair of a colonic tear in a bird.

Definitive diagnosis of a gastrointestinal obstruction can be difficult in psittacines because of a limited understanding of normal gastrointestinal transit times and motility. In a study of the transit time of iohexol in psittacines, it was found that transit time through the proventriculus, ventriculus, and intestines of a 1:1 dilution of iohexol with water was 15 to 30 minutes when gavaged at a dose of 25 to 30 mL/kg. The contrast material reached the cloaca after 30 to 60 minutes. In a study with blue-fronted Amazon parrots, a 25% barium sulphate suspension was gavaged into the crop at a dose of 20 mL/kg. Thirty minutes after administration, the barium was outlining the ventriculus, and at 60 minutes, barium was found in the small intestine in most of the birds. The crop emptied of barium within 180 minutes, and the colon and cloaca filled with barium after 120 to 300 minutes. The facts that barium remained within the gastrointestinal tract of the reported bird here and was not in the cloaca after nearly 4 days were indications of decreased motility, the most likely cause being an obstruction at the level of the cloaca.

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a ventral midline celiotomy.8,10 The use of radiosurgery is recommended to control hemorrhage.20 Microsurgical technique is required because the avian intestine is thinner than that of mammals; thus, 6-0 to 10-0 monofilament absorbable suture material on a quarter-circle atrumatic needle, such as the 8-0 polydioxanone used in the bird of this report, is recommended.11 Similar to mammals, pigeons displayed a prolonged rate of absorption and minimal tissue reaction to polydioxanone suture material placed in the body wall, compared with that to chronic catgut, polyglactin 910, nylon, and stainless steel suture material.21

In mammals, the use of an omental patch over sites of intestinal surgery can decrease the risk of incisural dehiscence.25–26 Birds lack an omentum and have short, well-developed mesenteric attachments,20,21,27 making such a procedure impossible and increasing the postoperative risk of peritonitis after intestinal surgery.20 The use of a porcine-derived collagen patch over ventriculotomy incisional repair in quail was shown to impair wound healing and possibly lead to an inflammatory reaction severe enough to cause perforation.22

The serosal patch makes use of the serosal surface of adjacent abdominal structures in a manner similar to the omentum to reduce the risk of dehiscence, provide structural support, limit leakage from perforations of hollow visceras, and promote healing by increasing blood supply to areas where it is placed.26,28,29 In mammals, typically the antimcesenteric border of the jejunum is tacked over the area in question by use of monofilament suture material placed in a simple interrupted pattern.23,30 Sutures must pass through the submucosal, muscularis, and serosal layers but ideally not enter the intestinal lumen.23 Because it has a higher percentage of collagen than the other intestinal layers, the submucosa is the holding layer for intestinal surgery.20,23

In humans, colonic surgery is associated with an increased risk of intestinal leakage when bacterial peritonitis is present.31 Serosal patching has been shown to be successful in preventing intestinal leakage in 8 dogs and 1 cat with evidence of bacterial peritonitis.20

The bird of this report clearly had fecal contamination of the coelom due to the colonic rupture. This fact, along with the recommendation that serosal patching be used when omentum is not available—as is the case in birds—made this surgical technique viable for use in this bird.

The duodenal loop is U shaped, located on the right side of the ventriculus, encloses the body of the pancreas, and is the largest and most ventral intestinal loop.32 making it ideal for use in creating a serosal patch over the colon as it enters the ventral aspect of the cloaca at the coprodeum. In mammals, the jejunum is most commonly used for serosal patching, but the avian jejunum is arranged in several narrow loops and is attached along with the ileum dorsally by a long mesentery;32 so it is less accessible.

Reports of the use of serosal patching in avian coelomic surgery are rare. In a blue and gold macaw (Ara ararauna), surgical repair of a duodenal adhesion causing ileus involved suturing another portion of the duodenum over the exposed serosal surface where the adhesion was bluntly lysed, creating a duodenal serosal patch.19 To our knowledge, the description of the colonic patch used in this eclectus parrot is the first report of the use of a duodenal serosal patch to protect repair of a ruptured colon in a bird. This procedure resulted in no clinically apparent effect on postoperative gastrointestinal motility, and follow-up 3 years later found the bird in good health and able to pass feces normally. The successful outcome in this bird indicates the potential for a serosal patch to improve the prognosis for recovery from gastrointestinal surgery in birds; however, more affected birds need to be evaluated.

References

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**From this month’s AJVR**

**Determination of lying behavior patterns in healthy beef cattle by use of wireless accelerometers**

Bradley D. Robért et al

**Objective**—To describe daily, hourly, and animal-to-animal effects on lying behavior in steers.

**Animals**—25 crossbred beef steers.

**Procedures**—Wireless accelerometers were used to record behavioral data for cattle housed in a drylot cattle research facility during two 20-day periods (winter 2007 [n = 10 steers] and spring 2008 [15]). Behavioral data were categorized into lying, standing, and walking behaviors for each time point recorded. Logistic regression models were used to determine potential associations between the percentage of time spent lying and several factors, including time (hour) of day, day of trial, and steer.

**Results**—Lying behavior was significantly associated with hour of day, and a distinct circadian rhythm was identified. Steers spent > 55% of the time between 8:00 am and 4:00 am lying and were most active (>30% lying behavior) during feeding periods (6:00 am to 7:00 am and 4:00 pm to 5:00 pm). Model-adjusted mean percentage of time spent lying was significantly associated with study day and was between 45% and 55% on most (27/40 [67.5%]) days. Lying behavior varied significantly among steers, and mean ± SD percentage of time spent lying ranged from 28.9 ± 6.1% to 66.1 ± 6.6%.

**Conclusions and Clinical Relevance**—Cattle had distinct circadian rhythm patterns for lying behavior, and percentage of time spent lying varied by day and among steers. Researchers need to account for factors that affect lying patterns of cattle (ie, time of day, day of trial, and individual animal) when performing research with behavioral outcomes. (Am J Vet Res 2011;72:465–471)

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