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Clinical Report

Surgical Repair of True Abdominal Wall Hernias in Two Budgerigars (*Melopsittacus undulatus*)

Kazumasa Ebisawa, Shin-ichi Nakamura, Shunya Nakayama, and Hiroshi Koie

Abstract: Two budgerigars (*Melopsittacus undulatus*) were presented for coelomic distension. Contrast barium gastrointestinal radiographic examination showed that both birds had abdominal wall hernias containing intestinal loops. Tenesmus was observed in both patients, and hernia repair surgery was performed. In case 1, an X-shaped incision was made in the skin covering the patient's hernia. This was followed by a transverse incision of the hernial sac and removal of the oviduct, as the hernial contents exceeded the capacity of the intestinal peritoneal cavity. The intestine was reduced into the peritoneal cavity, and the hernial ring was closed. In case 2, a ring-shaped skin incision was made over the patient's hernia and hernial sac. The removal of the oviduct followed this because the hernial contents could not be reduced to the intestinal peritoneal cavity. Because of the intestinal enlargement, it could not be completely reinserted into the cavity and the hernial ring could not be closed. In both patients, the hernial ring was formed by a transverse rent in the aponeurosis between the distal pubic bones. The hernial sac consisted of double-layered septae composed of fibrous connective and adipose tissue, with no muscular tissue. The hernial sac was likely formed in the parietal peritoneum of the ventral body wall, based on its anatomical location and histopathological characteristics. These findings confirm that both patients had true hernias. This report describes the site of formation of the hernial ring and the structure of the hernial sac in budgerigars.

Key words: hernia, avian, budgerigar, *Melopsittacus undulates*, psittacine, birds

CLINICAL REPORT

Case 1

A 9-year-old, 45-g female budgerigar (*Melopsittacus undulatus*) was presented to the Yokohama Bird Clinic (Kanagawa, Japan) for coelomic distention. The bird was in good general health with a body condition score of 4 of 5. The bird was fed an unrestricted diet of mixed seeds, including millet, canary seed, and oats. The skin covering the distended abdominal region was substantially thicker than normal and had a yellow hue. The bird exhibited persistent reproductive behavior and gradual coelomic distention over the previous 3 months. The most recent oviposition occurred 4 months before the consultation, and the owner believed that the coelomic distension might be due to egg binding.

Radiography with oral barium contrast was performed to evaluate the viscera within the coelomic cavity. The bird was administered 0.8 mL of barium sulfate (100% wt/vol; Baritop P powder, Kaigen Pharma, Osaka, Japan) into the crop via a feeding tube and radiographed 90 minutes later. The ventrodorsal image showed polyostotic hyperostosis and no reduction in the air sac space. In contrast, the right lateral image showed that most of the intestines had herniated out of the abdominal wall into the subcutaneous space (Fig 1). Based on these clinical findings, a diagnosis of abdominal wall hernia was confirmed.

The bird was placed on a restricted diet to reduce body weight. The owner declined the recommendation for use of a GnRH agonist. One week later, the bird weighed 43 g; however, tenesmus, reduced defecation, and anorexia were observed. Tenesmus, caused by the herniation of the intestine or cloaca into the hernial sac, was suspected. The patient was hospitalized, and although assisted defecation was

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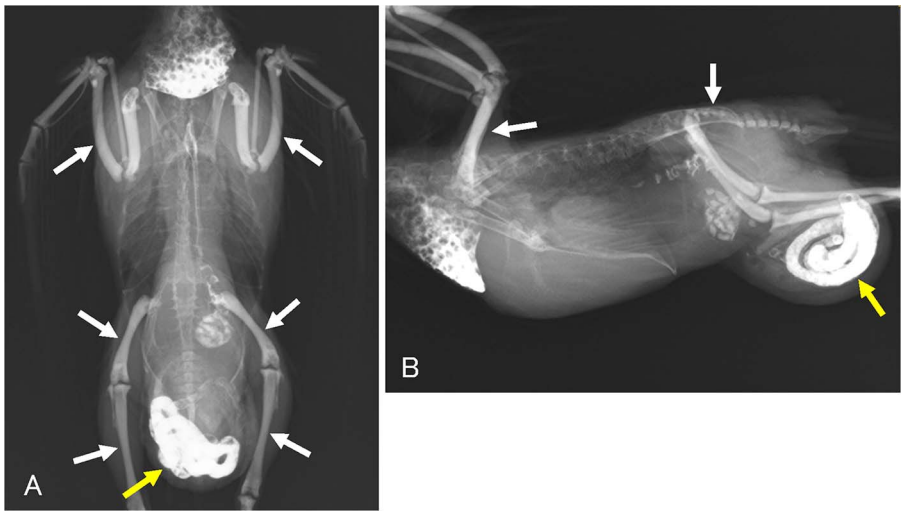

Figure 1. (A) Ventrodorsal and (B) right lateral contrast barium gastrointestinal radiographs of the 9-year-old female budgerigar (*Melopsittacus undulatus*) from case 1. Polyostotic hyperostosis (white arrows) was identified in the humeri (B), ulnae (A), femurs (A), tibiotarsi (A), and pelvis (B), and most of the intestines have herniated through the body wall (yellow arrows).

attempted by applying abdominal pressure, it was unsuccessful. Therefore, hernia repair was recommended, and the owner approved surgery for the following day. The bird was fasted for 3 hours the following morning to allow for crop emptying. Before surgery, Lactated Ringer's solution (20 mL/kg SC; SOLULACT Infusion, Terumo, Tokyo, Japan) and enrofloxacin (15 mg/kg SC; Baytril 2.5% Injection, Elanco Japan, Tokyo, Japan) were administered.[1] Sedation of the bird was achieved using midazolam (2 mg/kg IM; Dormicam, Maruishi Pharmaceutical, Osaka, Japan) and butorphanol tartrate (2 mg/kg IM; Butorphanol, Meiji Seika Pharma, Tokyo, Japan).[1] Anesthesia was induced using an acrylic box delivering 3% isoflurane (Isoflu, Zoetis Japan, Tokyo, Japan) in 100% oxygen (1 L/min). Anesthesia was maintained using 1.5–2.0% isoflurane in 100% oxygen at 1 L/min administered via a face mask. The original face mask consisted of a cylindrical tube, tailored in length and diameter to fit the budgerigar's head. A diaphragm was created using 0.5-mm rubber sheeting. After application of the face mask, surgical tape (Multipore, 3M Japan, Tokyo, Japan) was used to seal the gap between the neck and diaphragm to minimize anesthetic gas leakage. Positive pressure ventilation resulted in moderate expansion of the bird's thorax. Additional intermittent positive pressure ventilation was provided using a mechanical ventilator (COMPOS X, Metran, Saitama, Japan). The electrocardiogram, heart rate, and body temperature were monitored every 5 minutes using a biological monitor (AM140 Type2, FUKUDA ME, Tokyo, Japan). Because the temperature sensor was too large to fit into the patient's cloaca, it was placed in the left axilla, and the reading was used as a reference value. The respiratory rate was recorded every 5 minutes. Because polyostotic hyperostosis was observed, intraosseous fluid administration was not performed.

The bird was placed in dorsal recumbency on a heating pad with a thermal water circulation system (Circulating Thermal Water System T-CARE, KIMURAMED, Tokyo, Japan). The surgery was performed using a 1.6× surgical loupe. The surgical field was plucked and aseptically prepared. The skin covering the hernia was marked with an X-shape using surgical skin markers, and incisions were made along the marked lines using McPherson straight bipolar forceps (VET-SURG Surgitron FFPF, Elman Japan, Osaka, Japan). The skin was detached from the hernial sac, and the resulting skin flap was retracted in 4 directions using forceps. The hernial sac was composed of thin tissue, and the hernial ring was formed by a transverse rent in the body wall tissue. The hernial sac was transversely incised using bipolar forceps to expose the hernial contents, which included the oviduct and intestines. The intestinal serosa was covered with yolk material. The hernial content exceeded the capacity of the intestinal peritoneal cavity, so the oviduct was removed to allow closure of the peritoneal cavity. To facilitate the resection of the oviduct, an additional incision was made in the left upper abdominal wall and the hernial ring incision was expanded. The oviduct was removed after coagulative cutting of the ventral and dorsal ligaments of the oviduct using a semiconductor laser fiber (Intelligence Diode Laser D-Lase V 20, Asuka Medical, Kyoto, Japan), and ligation of the uterovaginal junction was performed using non-absorbable sutures (Nylon 4-0, Matsuda Medical, Tokyo, Japan).

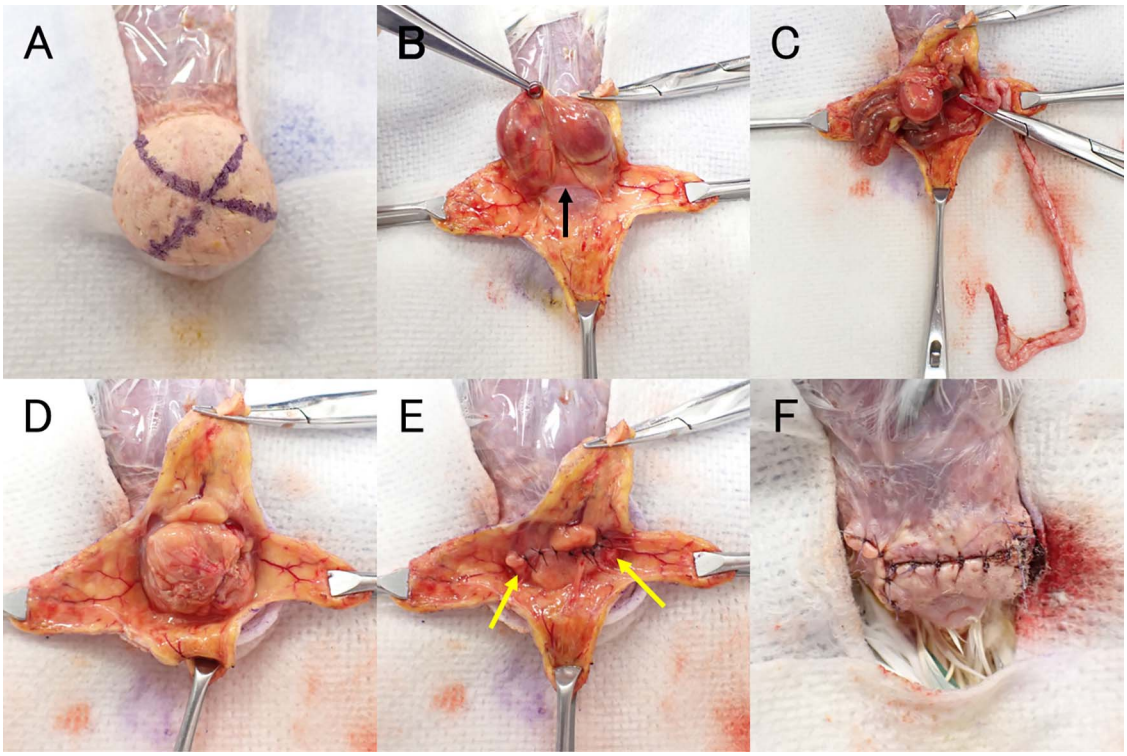

Figure 2. Abdominal wall hernia repair surgery images of the 9-year-old female budgerigar (*Melopsittacus undulatus*) from case 1. (A) The skin is marked with an X using a sterile marker. (B) Retracting the skin to expose the hernial ring (black arrow). (C) A transverse incision was made in the hernial sac, and the oviduct was removed. (D) The herniated intestines were reinserted into the intestinal peritoneal cavity. (E) The hernial ring, formed by a transverse rent of the ventral abdominal body wall (yellow arrows), was closed with simple interrupted nonabsorbable sutures. (F) The skin was partially excised and sutured in an H-shaped pattern.

The herniated intestines were rinsed with sterile saline and reinserted into the intestinal peritoneal cavity. The hernial sac was partially excised. Following the suturing of the left upper abdominal wall using nonabsorbable sutures (Nylon 6-0, Matsuda Medical), the hernial ring was closed using simple interrupted nonabsorbable sutures. The skin was partially excised, reshaped using bipolar forceps, and sutured in an H-shape using absorbable sutures (Emsorb 6-0, Matsuda Medical) (Fig 2). To limit postoperative pain, bupivacaine (Marcain Injection 0.125%, Sand Pharma, Tokyo, Japan) was administered using a splash block technique at a dose not exceeding 2 mg/kg before suturing of the abdominal wall and skin.[2] After surgery, the patient was fitted with a natural rubber Elizabethan collar because of attempted automutilation of the surgical wound and sutures. During a 5-day hospitalization period, the patient was administered enrofloxacin (15 mg/kg PO q24h; Baytril 50 mg tablet [compounded to a 15mg/mL solution], Elanco Japan) and meloxicam (0.5 mg/kg PO q24h; Metacam 0.05% Oral Suspension for Cats, Nippon Zenyaku Kogyo, Fukushima, Japan).[1] When the Elizabethan collar was removed before discharge, the patient was observed to be chewing at the wound and sutures again, so the collar was replaced until the incision site healed. After discharge, the patient was administered amoxicillin trihydrate (1500 mg/L; Amoxicillin Soluble Powder 10%, Kyoritsu Seiyaku, Tokyo, Japan) via drinking water for 10 days[1] because the owner did not handle the bird. The bird recovered uneventfully. The owner was advised to convert the bird to a formulated diet to help it maintain an appropriate weight. Eight months later, the bird showed no recurrence of the abdominal distension, and physical examinations, including radiography and blood tests, revealed no abnormalities. The transition to a formulated diet was successful, and body weight was maintained between 37 and 38 g. No reproductive behaviors were observed during this period.

Case 2

A 3-year-old, 52-g female budgerigar was also presented to the same clinic for coelomic distention. The bird had a good appetite and body condition score of 5 of 5. The patient was being fed an unrestricted diet of mixed seeds, including millet, canary seed, rapeseed,

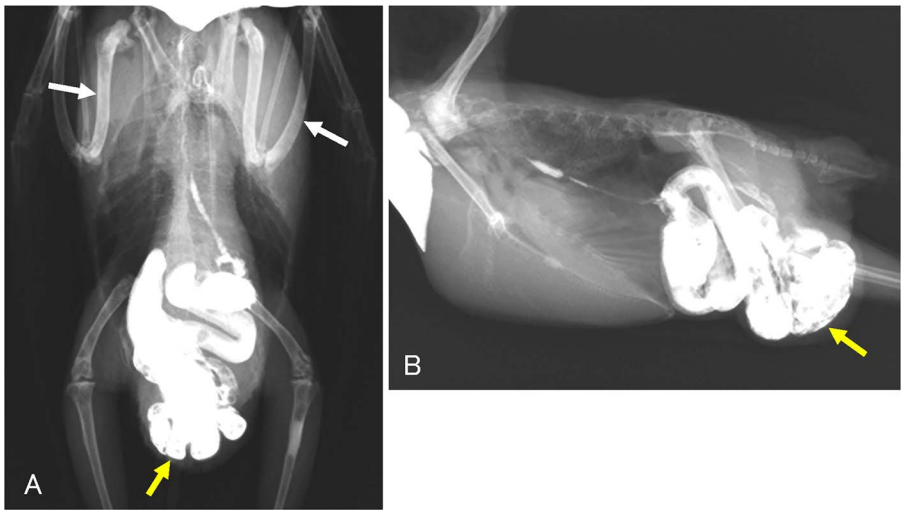

Figure 3. (A) Ventrodorsal and (B) right lateral contrast barium gastrointestinal radiographs of the 3-year-old female budgerigar (*Melopsittacus undulatus*) from case 2. Hyperostotic polyostosis, primarily in the humeri and ulnae (white arrows), was seen, and approximately half of the intestines herniated through the body wall (yellow arrows).

and hemp seed. The skin of the distended coelom was thickened, yellow, and uneven. The bird had exhibited chronic reproductive behaviors, including monthly egg-laying and mating behavior directed toward its owners. The owners had noticed gradual abdominal distension over the past year. However, because she appeared to be in good health, they had opted to monitor the situation.

Radiography revealed a significant amount of subcutaneous fat and herniation of the intestines into the hernia. The bird was administered 0.8 mL of barium sulfate (100% wt/vol) into the crop via a feeding tube, and radiographs were collected 90 minutes later. The ventrodorsal image showed hyperostotic polyostosis, primarily in the humeri and ulnae, with no reduction in air sac space. In contrast, the lateral image showed that approximately half of the intestines were herniated through the abdominal wall into the subcutaneous space (Fig 3). Based on the clinical and diagnostic findings, a diagnosis of abdominal wall hernia was confirmed.

Because the bird was obese, the owner was advised to stop feeding it rapeseed and hemp seed and to restrict its diet. However, as it was not tame and the owner could not handle it, weighing it at home was impossible. Therefore, the owner was advised to restrict the bird's diet to 4.5 g of mixed seed per day, and its progress was monitored at the clinic. The owner declined the recommendation for use of a GnRH agonist. Two weeks later, the bird's weight had decreased to 48 g. However, the coelomic distention had worsened, and tenesmus, reduced defecation, and anorexia were observed. Tenesmus, caused by herniation of the intestine or cloaca into the hernial sac, was suspected. The patient was hospitalized, and although assisted defecation was attempted by applying abdominal pressure, it was unsuccessful. Therefore, hernia repair was recommended, and the owner approved surgery for the following day. The bird was fasted for 3 hours the following morning to allow for crop emptying. Before surgery, Lactated Ringer's solution (20 mL/kg SC) and enrofloxacin (15 mg/kg SC) were administered.[1]

Sedation, anesthesia, and surgical preparation were achieved using the same methods described in the first case. Owing to the high risk of bleeding associated with skin incisions covering the hernia, a circular incision was made around the thickened skin using McPherson straight bipolar forceps. Given that the hernial sac exhibited fat accumulation and detachment from the skin, which could result in bleeding, the hernial contents, including the intestines and moderately developed oviduct, were exposed through a ring incision along the skin incision line using bipolar forceps. The hernial ring was formed by a transverse rent in the body wall, like case 1. Again, the intestinal serosa was covered with yolk material. The hernial contents exceeded the capacity of the intestinal peritoneal cavity, so oviduct resection was performed using the methods described in case 1. The intestines could not be completely reinserted into the peritoneal cavity due to enlargement, likely caused by prolonged herniation. Therefore, the hernial ring could not be sutured closed, and the hernial sac was partially excised before suturing with absorbable sutures (Emsorb 6-0, Matsuda Medical). After minor reshaping, the skin was sutured using absorbable sutures (Emsorb 6-0, Matsuda Medical) (Fig 4). A splash block of bupivacaine was again used at a dose not exceeding 2 mg/kg before suturing of the

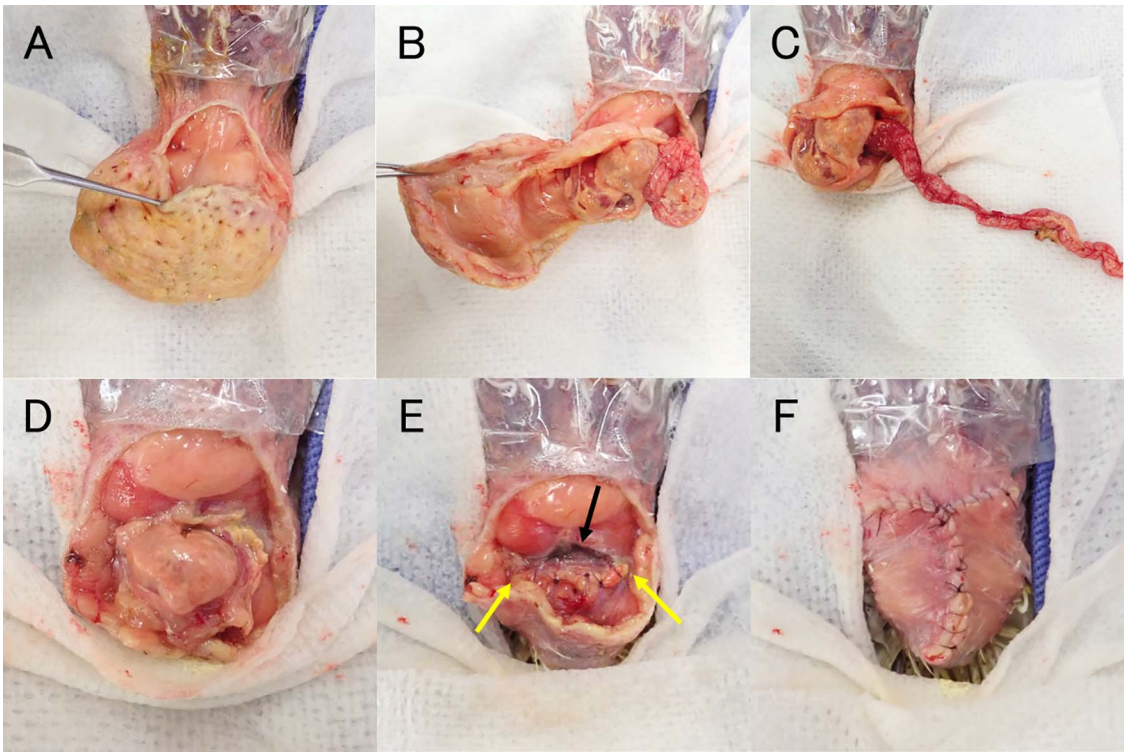

Figure 4. Abdominal wall hernia repair surgery images of the 3-year-old female budgerigar (*Melopsittacus undulatus*) from case 2. (A) A circular incision was made around the thickened skin, (B) followed by an incision of the hernial sac along the line of the skin incision. (C) The oviduct was removed. (D) The herniated intestines were reinserted into the intestinal peritoneal cavity. (E) The hernial ring, formed by a transverse rent of the ventral abdominal body wall (yellow arrows), was not sutured, while the hernial sac was closed using absorbable sutures (black arrow). (F) The skin was sutured using absorbable sutures after minor reshaping.

skin.[2] After surgery, this patient was also fitted with a natural rubber Elizabethan collar because of attempted automutilation of the surgical wound and sutures; the collar remained in place until the incision healed. During the 5-day hospitalization, the patient was administered enrofloxacin (15 mg/kg PO q24h) and meloxicam (0.5 mg/kg PO q24h).[1] After discharge, the patient was administered amoxicillin trihydrate (1500 mg/L) via drinking water for 10 days,[1] and the bird recovered uneventfully. The owner was advised to feed the bird a limited amount of mixed seed, as it did not accept a formulated diet, and to monitor its weight at routine clinic visits. The bird maintained a weight of 36–37 g, with an adequate body condition score (3 of 5), and the obesity improved. Leuprorelin acetate (1650 μg/kg IM; LEUPLIN FOR INJECTION 3.75 mg, Takeda Pharmaceutical, Osaka, Japan) was administered when reproductive behavior, including mating behavior directed toward its owners, was observed in the bird.[1] Reproductive behavior was observed at intervals of approximately 3–4 months and was successfully suppressed by repeated administration of leuprorelin acetate. One year later, the bird showed no recurrence of the abdominal distension, and physical examination, radiography, and blood tests revealed no abnormalities.

The surgically excised hernial sacs and skin samples from cases 1 and 2 were submitted for histopathologic examination, which confirmed identical diagnoses of abdominal wall hernias in both cases. The hernial sac consisted of a double-layered septa composed of fibrous connective and adipose tissue, without any muscular tissue. Yolk protein was observed adhering to the parietal intestinal peritoneum, accompanied by infiltration of foamy macrophages. Furthermore, the skin samples from both cases exhibited dermal xanthomas, characterized by multifocal-to-coalescing infiltration of foamy macrophages and multinucleated giant cells containing cholesterol crystal deposits (Figs 5 and 6).

DISCUSSION

Abdominal wall hernias are common in birds and can be either congenital or acquired.[3] Congenital hernias may occur in any bird species or sex. They typically present at hatching or shortly thereafter,[4] and are

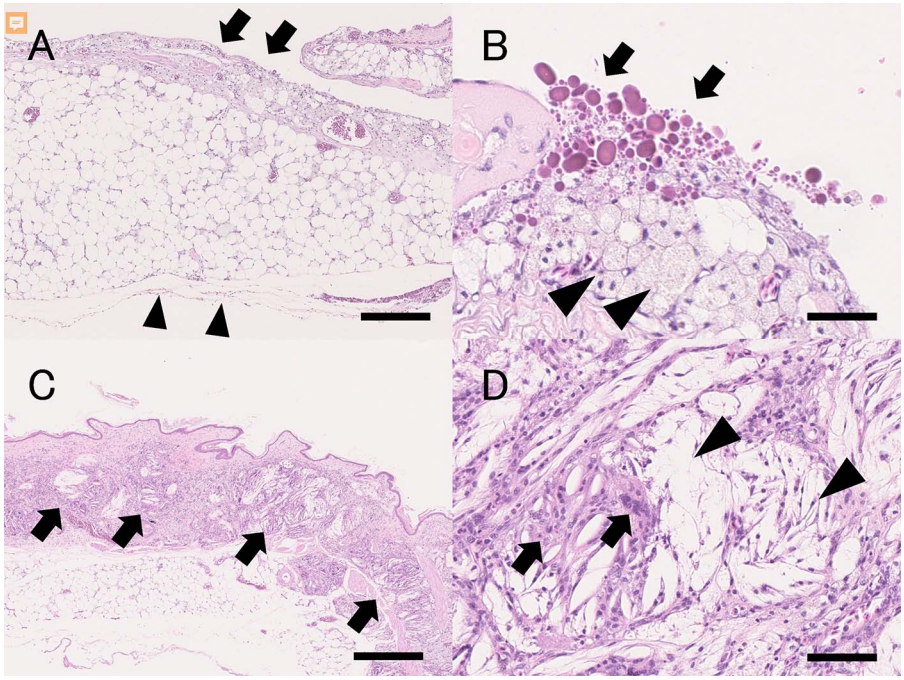

Figure 5. Histopathology of the hernial sac (A, B) and skin (C, D) of the 9-year-old female budgerigar (*Melopsittacus undulatus*) with an abdominal wall herniation from case 1. (A) The hernial sac consisted of double-layered septae composed of fibrous connective tissue and adipose tissue, without any muscular tissue. The arrows indicate the intestinal peritoneal cavity, and the area outside the intestinal peritoneal cavity is indicated by the arrowheads (hematoxylin and eosin; bar = 250 μm). (B) On the parietal intestinal peritoneum, the yolk protein (arrows) was adherent, and foamy macrophage infiltration was evident (arrowheads) (hematoxylin and eosinl bar = 50 μm). (C) Multifocal to coalescing granulomatous lesions were observed in the dermis (arrows) (hematoxylin and eosin; bar = 500 μm). (D) Foamy macrophages and multinucleated giant cells (arrows) with cholesterol crystal deposits (arrowheads) were observed in the dermis, and xanthomas had formed (hematoxylin and eosin; bar = 50 μm).

caused by incomplete closure of the abdominal wall at the umbilicus after the yolk sac is incorporated into the intestinal peritoneal cavity, or by a defect in the abdominal muscle itself.[5,6] Most abdominal wall hernias are acquired and occur in the ventral midline or around the vent (ventral, lateral, or dorsal).[4,7,8] These acquired abdominal wall hernias occur most commonly in budgerigars, cockatiels (*Nymphicus hollandicus*), and cockatoos (*Cacatua* spp),[9–12] but have also been reported in yellow-crowned Amazon parrots (*Amazona ochrocephala*),[13] nanday parakeets (*Aratinga nenday*), eclectus parrots (*Eclectus roratus*),[7] red lories (*Eos bornea*),[14] pigeons (*Columba livia*),[15–18] common mynas (*Acridotheres tristis*),[19,20] northern pintails (*Anas acuta*),[21] and ducks (*Anas platyrhynchos*).[22]

Abdominal wall hernias most often occur in overweight, reproductively active females, such as the cases presented here.[4] Although the exact etiology is not fully understood, factors such as elevated intraperitoneal pressure due to chronic reproductive organ stimulation, chronic high circulating concentrations of estrogen, egg binding, myotonia resulting from calcium imbalance, trauma, or the presence of a space-occupying intestinal peritoneal mass may lead to abdominal muscle splitting or atrophy.[3,23] The hernial ring of a true abdominal wall hernia is reportedly formed by detachment of the aponeurosis along the median line of the abdominal muscles.[4,9] However, in both of the current cases, a transverse rent was observed between the distal pubic bones rather than at the median line of the rectus abdominis muscles. The rectus abdominis muscle originates in a dense aponeurosis that extends between the ventral portion of the distal pubis and dense connective tissue between the distal pubic bones.[24] In budgerigars, a hernial ring may result from a rent in the aponeurosis between the distal pubic bones. The exact mechanism of this rent is not well understood, although it occurs at the umbilicus, where the yolk sac enters the intestinal peritoneal cavity before hatching.[25] As females become more reproductively active, their abdomens distend and relax, and the pubic bones exhibit an increase in flexibility and spacing,[26,27] weakening the aponeurotic connections and potentially leading to a rent.

There are two types of abdominal wall hernias in birds: true hernias and pseudohernias. A true hernia is

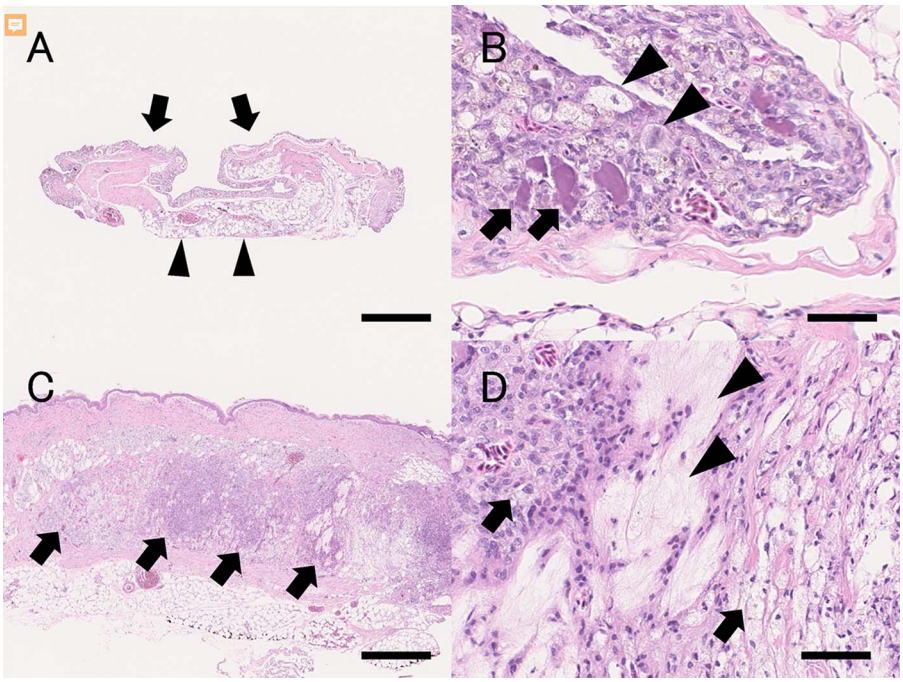

Figure 6. Histopathology of the hernial sac (A, B) and skin (C, D) of the 3-year-old female budgerigar (*Melopsittacus undulatus*) with an abdominal wall herniation in case 2. (A) The hernial sac consisted of double-layered septae composed of fibrous connective tissue and adipose tissue, without any muscular tissue. The arrows indicate the intestinal peritoneal cavity, and the area outside the intestinal peritoneal cavity is indicated by the arrowheads (hematoxylin and eosin; bar = 500 μm). (B) Yolk protein (arrows) was adherent to the parietal intestinal peritoneum, and foamy macrophage infiltration was visible (arrowheads) (hematoxylin and eosin; bar = 50 μm). (C) Multifocal to coalescing granulomatous lesions were observed in the dermis (arrows) (hematoxylin and eosin; bar = 500 μm). (D) Foamy macrophages (arrows) with cholesterol crystal deposits (arrowheads) were observed in the dermis, and xanthomas had formed (hematoxylin and eosin; bar = 50 μm).

a herniation of organs or tissues through an anatomical opening in the abdominal wall, lined by a hernial sac, which consists of peritoneum or a similar membrane.[4,7,9] A pseudohernia refers to an apparent distention or protrusion that resembles a hernia but lacks a true hernial sac, does not involve the formation of an actual opening in the abdominal wall, and results from the stretching of muscle tissue and peritoneum.[14–17,20,21] In both of the current patients, the presence of a hernial ring, consisting of a transverse rent in the aponeurosis, and a hernial sac formed by peritoneum without muscles, confirmed the diagnosis of a true hernia.

Avian peritoneal cavities are more complicated than the abdominal cavities of other vertebrates. Avian peritoneal cavities include the intestinal, left and right ventral hepatic peritoneal, and left and right dorsal hepatic peritoneal cavities.[28] These peritoneal cavities are separated by double-layered septa consisting of membranes formed by a thin band of fibrovascular stroma lined by mesothelium.[28] The intestinal peritoneal cavity is an unpaired, elongated median cavity located between the left and right hepatic cavities, extending from the liver to the caudal extremity of the gizzard.[29,30] It contains the gastrointestinal tract from the proventriculus to the rectum, the gonads, the spleen, and the abdominal air sacs,[29] and is lined dorsally by the parietal peritoneum of the dorsal body wall. The body wall is formed cranially by the caudoventrally directed post-hepatic septum and caudally by the parietal peritoneum of the ventral body wall.[29,30] In both patients, the hernial sac was likely formed in the parietal peritoneum, based on its anatomical location and histopathological characteristics. The hernial sacs were adhered to the hernial ring, possibly due to an inflammatory reaction that caused the detached aponeurosis to adhere to the hernial sac. However, the exact mechanism underlying abdominal wall hernia formation remains unclear and requires further investigation.

In both patients, a face mask was used to maintain anesthesia. Intubation may be challenging in species with unique oropharyngeal anatomy or in small birds like budgerigars, as the glottis is difficult to visualize because it lies at the base of the humped, fleshy tongue.[2] Furthermore, there is concern about the increased resistance associated with the small

endotracheal tube sizes required for small birds and the challenge in maintaining adequate ventilation. Fluid infusion during anesthesia is useful for fluid replacement, maintaining blood pressure, and preserving renal perfusion, and it can be administered via the intravenous or intraosseous route.[31] In small birds, intravenous catheter placement is often challenging, making intraosseous catheters the preferred option. However, in both patients, intraosseous catheter placement was not performed due to observed polyostotic hyperostosis in the ulnae and tibiotarsi.

In case 1, the hernial ring was closed using longitudinal nonabsorbable sutures due to a transverse rent of the hernial ring. However, if intraperitoneal pressure is elevated because of the closure of the hernial ring, as observed in case 2, there is a risk of postoperative abdominal compartment syndrome.[3] This condition can reduce venous return via the caudal vena cava, leading to reduced cardiac output, hypotension, arrhythmia, and potentially rapid fatality.[3] If the hernial contents cannot be completely reinserted into the intestinal peritoneal cavity, careful consideration must be given before proceeding with hernial ring closure. Because the hernial ring was formed by a rent in the aponeurosis, connected to the distal pubis, and positioned near the cloaca on the caudoventral side of the body wall, freshening of the edges was not performed before suturing. Therefore, nonabsorbable sutures were used to close the hernial ring.

The skin overlying the hernia often becomes stretched and thin but may also develop a thick layer of xanthomatous tissue.[4] Xanthomas are caused by hyperlipidemia that develops from disturbances in lipid synthesis, metabolism, and transport.[32] Hyperlipidemia in birds is caused by both obesity and persistent female reproductive activity.[27] Dietary restriction is effective in preventing obesity. Improving nutrition, particularly limiting fat intake, and increasing exercise, are necessary to enhance lipid metabolism. Owing to the increased bleeding tendency of skin thickened by xanthoma, great care must be exercised during incision. In case 1, a radiosurgical device was used to minimize bleeding, and the skin was incised in an X-shaped pattern to achieve the desired suturing shape. The skin flaps created by the X-shaped incision were shaped and sutured in an H-pattern to prevent the formation of dog ears. However, in case 2, the skin was severely thickened due to the xanthoma, and detachment of the skin from the hernial sac posed a risk of bleeding. Therefore, an incision was made at the border between the xanthomatous tissue and normal skin. Although extensive skin excision was necessary, complete primary closure was possible. The skin incision site should be carefully selected to minimize blood loss, particularly in surgeries involving small birds.

After surgery, the patients were fitted with an Elizabethan collar due to automutilation of the wound and sutures. The use of a collar is intrusive and should be approached with caution for ethical reasons. Local anesthetics were applied during suturing, and multimodal analgesics were used postoperatively; however, the patients continued to bite their wounds and sutures. The use of additional analgesics, such as opioids (eg, tramadol) or gabapentin, might have helped avoid the need for an Elizabethan collar. Postoperative bleeding in small birds should be minimized as much as possible, and since bleeding after discharge could not be immediately addressed, the collars were kept in place until the incisions healed. The collar was made of natural rubber, had no tube structure to extend the neck, and was horizontally shaped and soft. It had an outer diameter of 6.5 cm, an inner diameter of 1 cm, and a slit for easy removal in case of emergency. The patients accepted the collar immediately, with no feather plucking observed around the neck, and no issues with feeding or daily activities.

The control of reproductive activity may be effective in preventing recurrent abdominal wall hernias. Because long photoperiods are reproductive stimuli for most psittacine birds, rearing them under short photoperiods may help reduce reproductive activity.[33] However, in conditions where food is provided in sufficient quantities, photoperiod adjustment may be ineffective.[34] Therefore, a combination of photoperiod and dietary adjustments is suggested.[33] If the diet is seed-based, modifying it to a formulated diet with a restricted fat content is recommended. If the bird is obese, its weight should be reduced to an appropriate level, and physical activity increased. Because budgerigars in desert or semi-arid regions have adapted their reproductive physiology to take advantage of unpredictable rainfall, reducing humidity may also reduce reproductive activity.[35] The presence of a nest box stimulates reproductive activity, so it is necessary to prevent birds from accessing areas that resemble nesting sites.[35] Hand-reared birds may develop sexual imprinting on their caregivers and tend to choose humans as mates.[36] In the cases reported here, salpingectomy was performed, but the ovary was not removed. Leuprorelin acetate and deslorelin acetate are GnRH agonists that may temporarily reduce reproductive activity.[37,38] Furthermore, the use of a GnRH agonist may significantly reduce the size of the ovary, thereby creating more space in the peritoneal cavity and

possibly alleviating the tenesmus. Repeated use of a GnRH agonist when reproductive behavior is observed may therefore be effective in preventing recurrence of postoperative abdominal wall hernias.

Surgical intervention in small birds carries inherent risks and must be approached with caution. In particular, the risk of intra- and postoperative bleeding is significant due to the small body size and limited total blood volume of these patients. The decision to perform hernia repair should be based on a comprehensive evaluation. If the bird is obese, preoperative weight reduction through dietary restriction is recommended to reduce coelomic pressure and surgical difficulty. In some cases, the use of GnRH agonists and careful dietary control can suppress reproductive activity and may prevent the progression of the hernia, making surgery unnecessary. However, if reproductive activity is not controlled, the hernia may worsen over time.

Additionally, as seen in case 2, when intestinal structures prolapse and remain outside the intestinal peritoneal cavity for an extended period, they may become distended, which can prevent successful hernia closure. In both cases, hernia repair surgery was ultimately performed because the patients showed a sudden onset of tenesmus, reduced fecal output, and anorexia that did not improve with supportive care. These clinical signs indicated a need for prompt intervention despite the known surgical risks in small avian patients. In both cases, oviduct removal was performed to create additional space in the intestinal peritoneal cavity. In case 1, this allowed for successful closure of the abdominal wall. In case 2, although closure of the abdominal wall was not possible due to intestinal distension, the cloaca and intestines could be reduced into the intestinal peritoneal cavity, allowing the patient to defecate.

This report describes the surgical repair and outcomes of true abdominal wall hernias in 2 budgerigars presenting with abdominal distention. In both cases, the hernial ring was identified as a transverse rent in the aponeurosis between the distal pubic bones, and histopathologic examination confirmed true hernias, with hernial sacs consisting of double-layered septae of fibrous connective and adipose tissue lacking muscular tissue. Although complete hernial closure was achieved in 1 case but not in the other due to intestinal enlargement, both birds demonstrated good postoperative recovery and improvement in clinical signs. These cases highlight the diagnostic criteria for true abdominal wall hernias in budgerigars and emphasize the clinical importance of meticulous surgical planning and postoperative management in achieving favorable outcomes in small avian species.

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