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Article

Laparoscopic-assisted ovariohysterectomy for the treatment of pyometra in a Bengal tiger *(Panthera tigris tigris)*

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Abstract — A laparoscopic-assisted ovariohysterectomy was performed in a 19-year-old intact, female Bengal tiger *(Panthera tigris tigris)* presented for surgical treatment of pyometra. A multi-port technique was used with intra-corporeal sealing of the ovarian pedicles and extra-corporeal ligation of the uterine vessels and body. The tiger recovered from surgery and anesthesia without complication, was released into its enclosure the same day, and has remained clinically normal. Laparoscopic-assisted ovariohysterectomy may have advantages over open ovariohysterectomy for treatment of pyometra in the tiger.

Résumé — Ovario-hystérectomie assistée par laparascopie pour le traitement de pyométrite chez un tigre du Bengale *(Panthera tigris tigris).* Une ovario-hystérectomie assistée par laparascopie a été réalisée sur un tigre du Bengale femelle intacte âgée de 19 ans *(Panthera tigris tigris)* présentée pour le traitement chirurgical d'un pyomètre. Une technique multi-ports a été utilisée avec le scellement intracorporel des pédicules ovariens et la ligature extracorporelle des vaisseaux et du corps utérins. Le tigre s'est rétabli de la chirurgie et de l'anesthésie sans complication, a été remis en liberté dans son enclos le même jour et est demeuré cliniquement normal. L'ovario-hystérectomie assistée par laparoscopie peut avoir des avantages par rapport à l'ovario-hystérectomie ouverte pour le traitement du pyomètre chez le tigre.

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Pyometra is a common disorder of intact domestic canines and, to a lesser extent, felines (1–4). This condition also occurs in large, exotic, captive felids such as tigers and lions, with various reports indicating a prevalence between 5.5% and 17%, with lions possibly having an increased prevalence (2,5,6). Pyometra in companion animals and large, exotic felids occurs when there is cystic endometrial hyperplasia due to the effect of progesterone on the superficial epithelium and endometrial glands of the uterus (1,3,4,7,8).

Pyometra primarily impacts large, exotic felids that are more than 10 y of age (2,5–7). The presence of cystic endometrial hyperplasia and pyometra is complicated in large, exotic felids in captivity by the interplay between the age of the animal and the use of contraceptive implants (2,5–7). Melengesterol acetate (MGA) is a progestin that has been commonly used as a contraceptive implant in large, exotic felids in captivity (2,5–7,9). It is an effective and cost-efficient method of contraception, and most importantly is reversible if it is decided that the animal is genetically valuable (6). However, there is some evidence suggesting that it may increase the prevalence of cystic endometrial hyperplasia, and thereby predispose animals to pyometra (2,6,7).

Current standard of care for the treatment of open and closed pyometra in non-breeding companion animals is ovariohysterectomy (OVH) *via* laparotomy (3,10–12). There has been a movement towards the use of minimally invasive surgery in veterinary medicine as it provides improved visualization of internal structures, reduced incision size and subsequent reduction in soft tissue trauma, reduced postoperative pain, and possible reduction in prevalence of infection associated with the surgical site (9–11,13–16). Recently, the use of single- (11) and multi-port (10) techniques for laparoscopic-assisted ovariohysterectomy (LAOVH) has been described for pyometra in dogs (10,11).

Laparoscopic surgery has previously been reported in large, exotic felids. Multi-port laparoscopic-assisted ovariohysterectomy (LAOVH) in lions was first described by Aguilar et al in 1997 (17) and then Kolata in 2002 (18). Recent reports described single- and multi-port laparoscopic ovariectomy (LOE) in tigers (13,16), lions (19), and cheetahs (19). Laparoscopic salpingectomy (LS) has also been described in lions, leopards, and cheetahs (9,19). Laparoscopic-assisted ovariohysterectomy for the treatment of pyometra in a large, exotic felid has not previously been described. The purpose of this

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report is to describe the technique of LAOVH for the treatment of pyometra in an adult Bengal tiger *(Panthera tigris trigris)*.

Case description

A 19-year-old, intact female, Bengal tiger *(Panthera tigris tigris)* residing in a privately owned animal sanctuary was presented to the Ontario Veterinary College Health Sciences Centre (OVCHSC) for surgical treatment of an open pyometra. The tiger had a 10-day history of decreased appetite, lethargy, and sanguinopurulent vulvar discharge and was not receiving contraceptives. Cytological evaluation of the vaginal discharge performed by the primary veterinarian revealed the presence of degenerative neutrophils and rod-shaped bacteria. Bacterial culture of the sample isolated *Escherichia coli,* which was susceptible to a variety of antimicrobials. Given the history, signalment, and clinical signs, an open pyometra was diagnosed. The tiger was sedated and blood samples were obtained for complete blood (cell) count (CBC), and serum biochemistry. The results were mostly unremarkable, with a mild neutrophilia of 12.97×10^9/L [reference interval (RI): 2.5 to 12.6×10^9/L]. One week before presentation, the tiger had received trimethoprim/sulfonamide (Tribrissen 48%; Merck Animal Health, Kirkland, Quebec), 30 mg/kg body weight (BW), IM, and procaine penicillin G (Pen Aqueous; Zoetis Canada, Kirkland, Quebec), 15 mg/kg BW, IM, and meloxicam (Metacam; Boehringer Ingelheim, Burlington, Ontario), 0.1 mg/kg BW, PO, q24h for 3 d. Two days later enrofloxacin (Baytril; Bayer, Toronto, Ontario), 5 mg/kg BW, PO, q24h, was commenced as no improvement in clinical signs had been noted. Seven days following initiation of antimicrobial therapy, the tiger was sedated and administered a second IM injection of procaine penicillin G and trimethoprim/sulfonamide at the same dose as initially administered, as well as 3 L of isotonic saline and 1 L of Lactated Ringer's solution subcutaneously. Because of a lack of improvement in clinical signs, the tiger was referred to the OVCHSC for an ovariohysterectomy for treatment of the pyometra.

Upon presentation to the OVCHSC, the tiger was quiet, but alert and responsive with a body condition score of 4/9. Body weight was estimated at 150 kg. Visual examination revealed a hemorrhagic discharge from the vulva and normal respiratory rate. Thoracic auscultation and abdominal palpation were not performed prior to sedation.

The tiger was sedated with xylazine (Bayer, Mississauga, Ontario), 0.7 mg/kg BW, IM, ketamine (Bioniche Animal Health, Belleville, Ontario), 2.7 mg/kg BW, IM, and midazolam (Sandoz, Boucherville, Quebec), 0.07 mg/kg BW, IM, administered by a single manual injection. Once heavy sedation was achieved, endotracheal intubation was conducted; anesthesia was maintained with isoflurane (Baxter, Mississauga, Ontario) in oxygen with mechanical ventilation. Physical examination revealed pale pink mucous membranes and the tiger was estimated to be 7% dehydrated. Abdominal palpation was challenging due to the size of the animal. Once the tiger was intubated a partial dose of atipamazole (Antisedan; Zoetis Canada), 0.05 mg/kg BW, IM, was given due to bradycardia. An IV catheter was placed in the lingual vein through which the tiger received Lactated Ringer's Solution (Baxter), 10 mL/kg BW per hour) throughout the procedure. A catheter was placed in the right metatarsal artery to allow direct blood pressure monitoring. Esophageal temperature, end-tidal carbon dioxide, and electrocardiography were all used for intraoperative monitoring. Hydromorphone (Knoll Pharma, Markham, Ontario), 0.03 mg/kg BW, IV, was given for intraoperative analgesia. In addition, ampicillin (Hanford Pharmaceuticals, Syracuse, New York, USA), 23.3 mg/kg BW, and enrofloxacin (Baytril; Bayer), 1 mg/kg BW, were also given IV before surgery.

The patient was placed in dorsal recumbency and the ventral abdomen was aseptically prepared for surgery. A 3-cm incision was made mid-way between the umbilicus and the pubis and a single incision, multi-cannulated port (SILS port; Medtronic/Covidien, Minneapolis, Minnesota, USA) was introduced (11). Two 5-mm cannulas and one 15-mm cannula were inserted through the single port. The abdomen was insufflated with carbon dioxide to 10 mmHg using a mechanically regulated insufflator (Endoflator; Karl Storz Veterinary Endoscopy, Goleta, California, USA) and a 10-mm, 30°, 31-cm laparoscope (Hopkins II 0° and 30° 10-mm, 31-cm Telescope; Karl Storz Veterinary Endoscopy) was introduced into the abdomen through the 15-mm cannula. Both the left and right uterine horns were markedly distended and manipulation of the uterus through the single port was performed but found to be challenging because of the large size and weight of the uterine horns. A 10-mm instrument portal was thus placed at the level of the umbilicus on the ventral midline (Figure 1). The patient was tilted 45° laterally from dorsal to expose the left ovary and its pedicle and 5-mm laparoscopic Babcock forceps (Clickline, 5 mm, Straight Babcock Forceps; Karl Storz Veterinary Endoscopy) were introduced through the single port and used to grasp and elevate the proper ligament. A vessel-sealing device (Ligasure, 10 mm; Covidien, Mansfield, Massachusetts, USA) was used to seal and divide the ovarian pedicle and the broad ligament. The tiger was tilted to the opposite side and the procedure was repeated to seal and divide the right ovarian pedicle. The instruments and laparoscopic ports were removed from the abdomen and the carbon dioxide was purged. To successfully remove the uterus without its rupture the 2 port incisions were connected resulting in an approximately 15-cm incision. Because of the size of the uterus, it could not be removed through this incision and, therefore, it was extended another 10 cm caudally. The uterus was exteriorized, and the uterine vessels were sealed and divided with the vessel-sealing device (Figure 2). The uterine body was double ligated with #2 PDS (Polydiaxanone; Johnson and Johnson, Markham, Ontario), using a circumferential and transfixing ligature. The abdomen was copiously lavaged with warm physiologic saline and closed routinely in 3 layers without external skin sutures. To provide additional perioperative analgesia, incisional infiltration of bupivacaine (Hospira, Lake Forest, Illinois, USA), 0.07 mg/kg BW, was performed in the rectus abdominus fascia at the time of closure of the linea alba. Histopathological evaluation and bacterial culture of the uterus were declined for financial reasons.

Total surgical time was 150 min. A second dose of hydromorphone of 0.03 mg/kg BW, IV, was administered before recovery

Figure 1. Intra-operative image showing placement of the portal during LAOVH. A single incision, multi-channeled port has been placed in a subumbilical location and a 10-mm port has been placed 10 cm cranial to this port. All portals are inserted in the ventral midline.

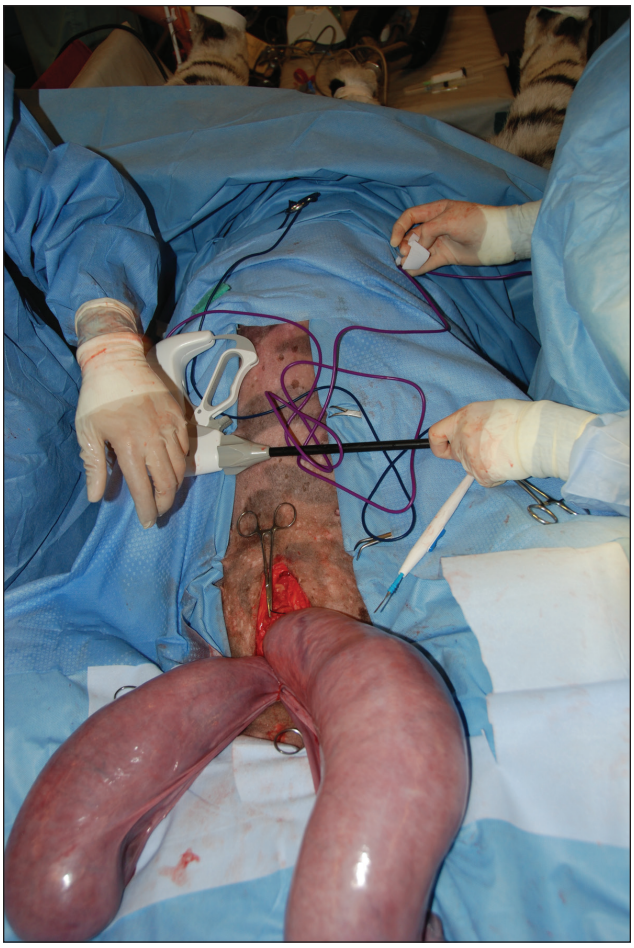

Figure 2. Intra-operative image showing exteriorization of the uterus through the mini-laparotomy.

and a second dose of atipamezole of 0.05 mg/kg BW, IM, was used for complete reversal of the xylazine sedation before extubation. The tiger recovered from anesthesia in the transport cage without complication and was alert and responsive 60 min after surgery. The tiger was returned to the sanctuary upon recovery from anesthesia. Her keepers reported that she was comfortable and mobile within her enclosure and that she was eating the following day after surgery. At time of telephone follow-up 574 d after surgery, the tiger was clinically normal.

Discussion

While laparoscopic surgery has previously been reported in large, exotic felids for various sterilization procedures, to our knowledge this is the first report describing LAOVH for the treatment of pyometra in a Bengal tiger. Perioperative complications were not encountered, aside from the need to extend the access incision larger than anticipated based on the massive distension of the uterine horns. A previous study of open OVH for pyometra in large exotic felids had reported an incision length between 12 cm and 20 cm depending on size of the animal (13). Despite extension of the surgical incision to ~25 cm, the authors believe the size of the incision was considerably reduced compared to what would have been necessary if a full exploratory laparotomy had been performed as the ovarian pedicles were sealed intracorporeally with laparoscopic techniques. The surgical time for the LAOVH was similar to previously reported times for ovariohysterectomy for pyometra in tigers *via* open surgery (2).

Pyometra is uncommonly reported in large, exotic felids (2,5,7,20). Interestingly, the systemic effects seen in these species appears to be much less severe than in the bitch, with lethargy and fever being the primary signs reported, as well as vomiting and anorexia less commonly (2,7). Identification of pyometra in these animals is based primarily on visualizing mucopurulent or mucohemorrhagic vulvar discharge suggesting that most pyometras diagnosed in large, exotic felids are open, with closed pyometra likely being underdiagnosed (2,7). Only 1 report of closed pyometra in a large, exotic felid (leopard) exists, which resulted in septic peritonitis from uterine rupture and was identified postmortem (20). Caretakers of large, exotic felids may experience difficulty in diagnosing a closed pyometra, as lethargy followed by vaginal discharge, may be the only clinical signs witnessed. This is further complicated by the fact that large, exotic felids in captivity are not in regular close contact with their handlers making detection of subtle changes that may occur with this disease harder to identify. The tiger in this report had lethargy and vaginal discharge and she was intact; pyometra was

assumed. Like their domestic counterparts, large, exotic felids typically have *E. coli* and less commonly *Pseudomonas aeruginosa* identified as the primary pathogen in pyometra (2,5,7,20). The tiger in this report had *E. coli* identified *via* bacterial culture of the vaginal discharge.

The use of LAOVH in treating pyometra *via* single-port (11) and multi-port techniques (10) has been explored in dogs, and found to be successful in treating both open and closed pyometras (10,11). These studies established a guideline that LAOVH should be used in cases in which the uterine horn diameter was no larger than 4 cm (10,11). This guideline is difficult to extrapolate to large, exotic felids; however, had diagnostic imaging been performed preoperatively, a minimally invasive approach may not have been attempted based on the marked dilation of uterine horns with purulent material. However, the reduction in incision size which resulted from LAOVH was desirable in the tiger of this case as incisional complications are difficult to assess and treat in large, exotic felids.

Laparoscopic-assisted ovariohysterectomy was initially attempted in this case using a single port approach. However, based on the marked distention of uterine horns from pyometra a second portal was quickly established to help with careful manipulation. Single-port LOE has been reported in tigers with good success (16); however, this platform has not been described for routine OVH or OVH for pyometra. The authors believe that if uterine distention had been mild, single-port LAOVH could have been performed as described by Wallace et al (11) in dogs. Based on sheer size of the animal, it would be unlikely that the uterus, even with mild uterine distention, could have been extracted through the ~3 cm single-port access incision. Furthermore, placing a second instrument port to help with manipulation of pertinent structures and relieve the loss of triangulation that occurs with single-port platforms would not result in greater soft tissue trauma since the 2 portal incisions can be connected to allow for uterine extraction. This was the strategy performed in the tiger of this report and we recommend a multi-port approach for LAOVH in tigers and other large, exotic felids for routine OVH or OVH for pyometra.

The use of LOE and LS in groups of free-roaming large, exotic felids has been well-described by Hartman et al (9,19). This research group found that the benefits of shorter surgical times and decreased incision size make laparoscopic techniques extremely valuable in populations of free-roaming large felids in conservation and game farms in Africa (19). Generally, when groups of free-roaming animals are to be sterilized, they are captured as a group and remain together following recovery from anesthesia (19). This strategy is used to prevent aggression towards group members following reintroduction of individuals, a challenging situation that can also occur in captivity when groupmates are reintroduced following separation (13,19). The tiger of this report did have several groupmates at the sanctuary where she resided, and was returned to them the same day of surgery without complication. The use of laparoscopic-assisted techniques for OVH may have reduced post-operative pain and allowed for a more rapid reintegration with her groupmates compared to an open OVH.

In summary, to our knowledge, this is the first reported case of LAOVH for the treatment of pyometra in a Bengal tiger *(Panthera tigris tigris)*. The surgical technique was performed without complication despite markedly distended uterine horns secondary to pyometra which resulted in a larger access incision. Recovery was uneventful, and the tiger continued to do well 574 d after surgery. Laparoscopic-assisted ovariohysterectomy should be considered for the treatment of pyometra in large exotic felids in captivity. CVJ

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