

# Laparoscopic removal of a large abdominal foreign body granuloma using single incision laparoscopic surgery (SILS) and extraction bag in a cheetah (*Acinonyx jubatus*)

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## SUMMARY

This case presents a thorn-induced abdominal foreign body granuloma that was removed with single incision laparoscopic surgery and an extraction bag. An 11-year-old female cheetah presented for routine laparoscopic ovariectomy. Abdominal palpation detected a mid-abdominal mass. Differential diagnoses were neoplasia and foreign body. Laparoscopic exploration of the peritoneal cavity revealed an omentalised mass, which was successfully removed with the aid of bipolar electrocoagulation. Microscopic investigation intraoperatively and postoperatively confirmed extensive foreign body-induced granulomatous inflammation. The foreign body was well encapsulated by fibrous tissue with no adjacent stricture formation. The patient made a complete recovery, and this is the first case report of a thorn-induced abdominal foreign body removed with minimally invasive surgery in a wild African carnivore.

## BACKGROUND

Reports on gastrointestinal tract (GIT) foreign bodies (FB) in dogs are common and are typically associated with related clinical signs; conversely, reports in cats are rare and usually limited to linear FB. Various types of abdominal FB have been reported in dogs, which usually remain confined to the GIT lumen (Larson and Madsen 2010, Becker 2011, Creedy and Bates 2011, Battisti and others 2012, Allman and Pastori 2013, Nair and others 2013, Kassem and others 2014). GIT-related FBs are typically removed surgically (Kassem and others 2014) or less commonly endoscopically (Shin and others 2010, Baranidharan and others 2013). Moreover, after initial ingestion, GIT-related FB may penetrate through the muscular wall of GIT and migrate to their final location (Hunt and others 2004), where they may result in an extramural, omental pyogranulomatous (Papazoglou and others 2010, Nakata and others 2012) reaction or abscess (Spring 2011). A pyogenic granuloma, not caused by an FB, has also been reported in association with GIT in a dog (Nakata and others 2012). Once freed from GIT, the intra-abdominal FB may follow a migratory route, traverse vital structures (Kelly and others 2013) or create an enterocutaneous fistula (Brennan and others 2004, Wunderlin and others 2012). Intra-abdominal FB in animals have been described in strange locations. For example,

plant material has been found in the bladder of a dog (Barrault and Vedrine 2013) and the spleen of a cat (Culp and Aronson 2008). Metallic FB have been removed from a dog's spleen (Mahajan and others 2012) and have caused intramural pyogranuloma with GIT obstruction (Papazoglou and others 2010). In cattle, FB penetration of the reticulum is well known (Braun 2009, Debosri and Sonal 2013, Smolec and others 2013) and sharp FB penetration has also been reported in buffaloes (Aref and Abdel-Hakiem 2013). Spiked wooden objects, for example, kebabs, ice-lolly sticks, wooden skewers, a toothpick and a satay stick, have been found to penetrate GIT in dogs (Hunt and others 2004, Stander and Kirberger 2011).

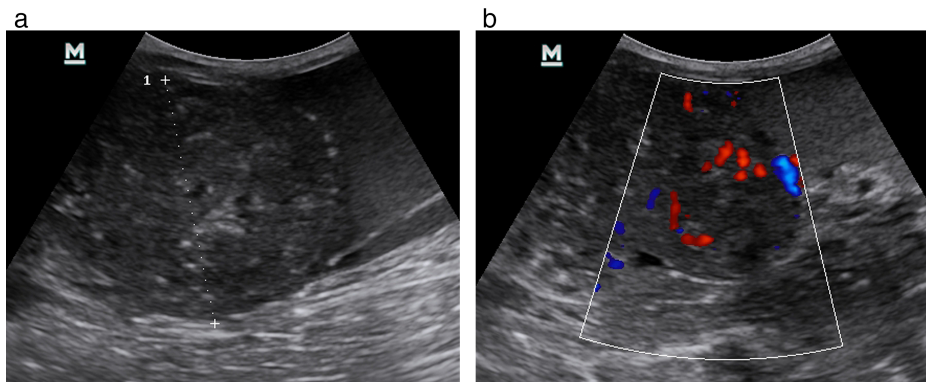
Iatrogenically induced FB such as textiloma or gossypiboma caused by retained surgical swabs (Deschamps and Roux 2009) is probably the most frequently reported coelomic cavity FB in dogs and is also of concern in human surgery (Yakasai and Abubakar 2011, Awowole and others 2014). In one case report, an abdominal swab migrated transmurally into the jejunum of a dog (Day and others 2012) and literature reports of retained surgical swabs or sponges resulting in abdominal fibrosarcoma exist (Haddad and others 2010; Rayner and others 2010). The ultrasonographic characteristics of textiloma and gossypiboma in dog have been well described (Choi and others 2011).

Obstructive GIT and abdominal FB are traditionally removed via celiotomy, but laparoscopic surgery is available as a less invasive surgical option. The concurrent use of extraction bags or pouches is aimed at reducing the size of the surgical incision and serves to avoid contamination or neoplastic seeding in the case of malignant neoplasia. To the author's knowledge, the use of an extraction bag for FB removal in a wild animal has not been reported previously.

## CASE PRESENTATION

An 11-year-old cheetah, weighing 31.1 kg with a packed cell volume (PCV) of 31 per cent, presented for routine laparoscopic ovariectomy during a cheetah sterilisation project in Namibia. All captive cheetahs in Namibia are required by law to be permanently sterilised. The cheetah was immobilised via remote injection with a combination of 1.2 mg/kg zolazepam/tiletamine (Zoletil, Virbac RSA,

**FIG 1:** Sagittal transabdominal ultrasound images of the thorn-induced granuloma. (a) The granuloma is seen between the measured callipers with the echogenic exudate caudal to the mass. (b) Image slightly more medially. Colour flow Doppler illustrates the vascularity of the mass



Centurion, South Africa) and 0.035 mg/kg medetomidine (Medetomidine 10 mg/ml, Kyron Laboratories, Johannesburg, South Africa) and transported to the clinic where it was intubated and maintained under anaesthesia with isoflurane (Forane, Abbott Laboratories SA, Roodepoort, South Africa) in oxygen. An 18-gauge intravenous catheter (Jelco, Smiths Medical, Croydon, South Africa) was placed in the cephalic vein and lactated Ringer's (Sabax Ringer-Lactate, Adcock Ingram Critical Care, Johannesburg, South Africa) was administered intravenously at a rate of 10 ml/kg/hour. A single 6 mg dose of meloxicam (Metacam 5 mg/ml, Ingelheim Pharmaceuticals, Randburg, South Africa) was given 30 minutes before surgery.

## INVESTIGATIONS

A mid-abdominal mass was palpated during clipping of the abdomen. Subsequently, abdominal ultrasonography found a round 6 cm diameter well-vascularised mass, not associated with any specific abdominal organ, in the mid right abdominal cavity (Fig 1). The mass had a fairly homogenous echo texture, which was isoechoic to the renal medulla with multiple small anechoic and hyperechoic areas throughout. Surrounding the mass, but mainly caudally, a moderate fairly echogenic, isoechoic to the spleen, abdominal effusion compatible with an exudate was present. Ultrasound-guided fluid aspiration revealed a cloudy and

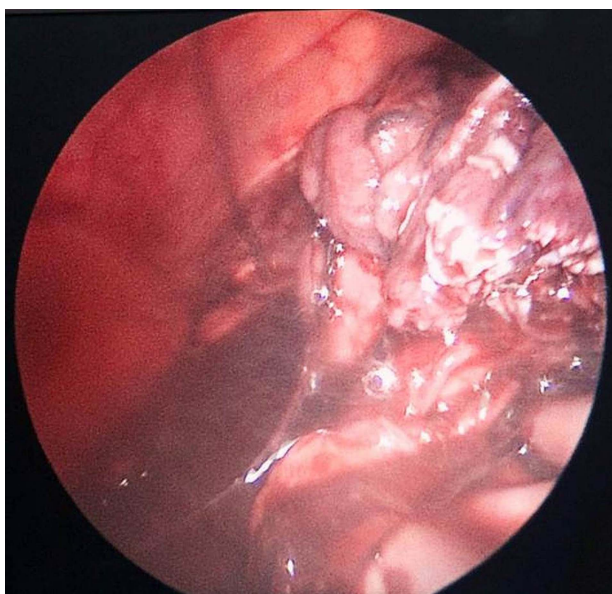
turbid-appearing fluid, which on centrifuging had a sizeable cellular pellet. Microscopic examination of cytological smears prepared from the effusion demonstrated a majority of degenerate neutrophils, with approximately 20 per cent large mononuclear cells. The mononuclear cells resembled macrophages with vesicular cytoplasm indicative of phagocytosed content. Additional ultrasound-guided fine needle aspiration of the mass showed similar microscopic features with sheets of large cells, consistent with macrophages and active fibroblasts. Many of the neutrophils and macrophages contained phagocytosed rod-shaped bacteria.

## DIFFERENTIAL DIAGNOSIS

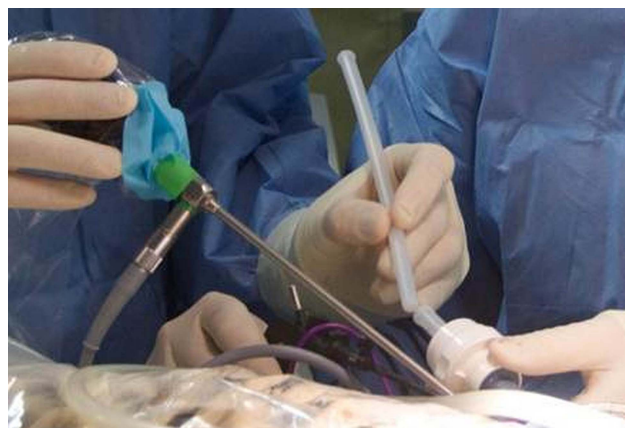
Differential diagnoses considered before surgery were intra-omental neoplasia or FB granuloma not associated with GIT.

## TREATMENT

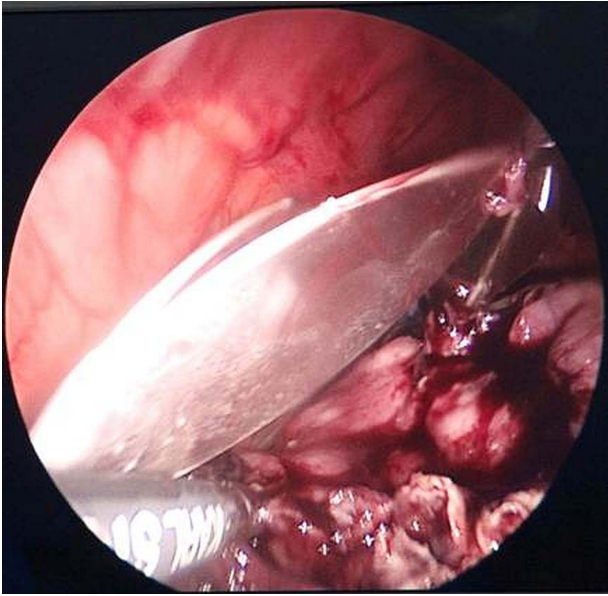
The patient proceeded to laparoscopy for ovariectomy and surgical removal of the mass. She was surgically prepared and draped and a single incision laparoscopic surgery port (SILS Port, Covidien, Mansfield, Massachusetts, USA) was placed immediately caudal to the umbilicus after local infusion with ropivacaine (Naropin, 7.5 mg/ml, AstraZeneca Pharmaceuticals, Sunninghill, Johannesburg, South Africa). The mass embedded in omentum (Fig 2) was found in the region of the nephrosplenic ligament. The mass was secured with an atraumatic Babcock forceps and the highly vascularised omentum was coagulated and cut using a 10 mm Ligasure handpiece (Valleylab). Extensive coagulation was required to free the mass; however, no major intraoperative haemorrhage was experienced. After introduction of the extraction bag (volume: 800 ml for use with



**FIG 2:** Ometalised granulomatous mass suspended by a Babcock forceps with some free blood in the peritoneal cavity



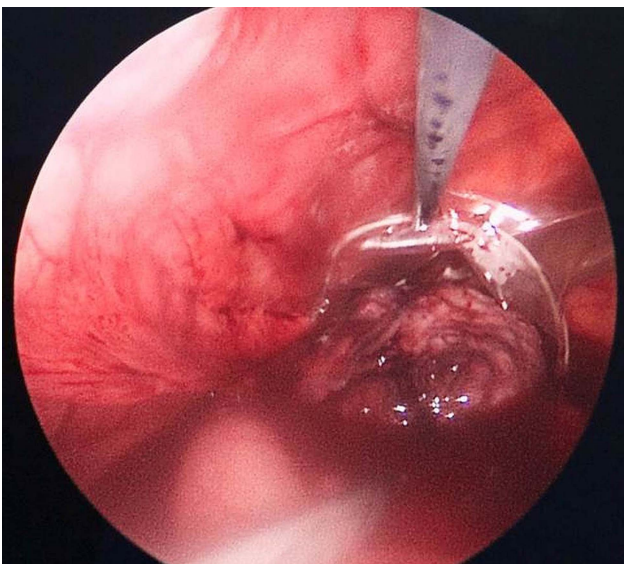
**FIG 3:** Introduction of an extraction bag via the 5-12 mm single incision laparoscopic surgery port



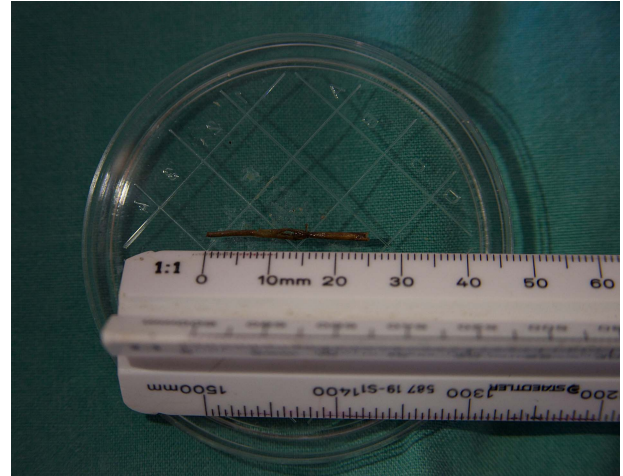
**FIG 4:** Deployment of the extraction bag inside the peritoneal cavity

10 mm trocars, Medical Technical Promotion GMBH, GewerbePark, Neuhausen) through the 5–12 mm SILS port (Fig 3) and intra-abdominal deployment (Fig 4), the mass was placed into the bag with one forceps while holding the bag with another (Fig 5). The tip of the noose from the extraction bag was retrieved through the 5–12 mm port and removed together with the SILS port. The incision was enlarged to permit retrieval of the bag and its contents (video clip). The SILS port was then replaced and temporary crossed mattress sutures were placed to create a tight seal around the port. The abdomen was re-insufflated and the resection site was inspected for signs of haemorrhage. Ovariectomy was completed as described elsewhere (Hartman, under review) and the peritoneal cavity was lavaged with 3 l of lukewarm Ringer's lactate solution. The SILS port was removed and the surgical site routinely closed.

The patient recovered uneventfully and was given a single 3.1 ml (248 mg) subcutaneous dose of cefovecin (Convenia, Zoetis, Sandton, South Africa).



**FIG 5:** Resected mass is placed into the extraction bag



**FIG 6:** Thorn foreign body removed from the granuloma

#### OUTCOME AND FOLLOW-UP

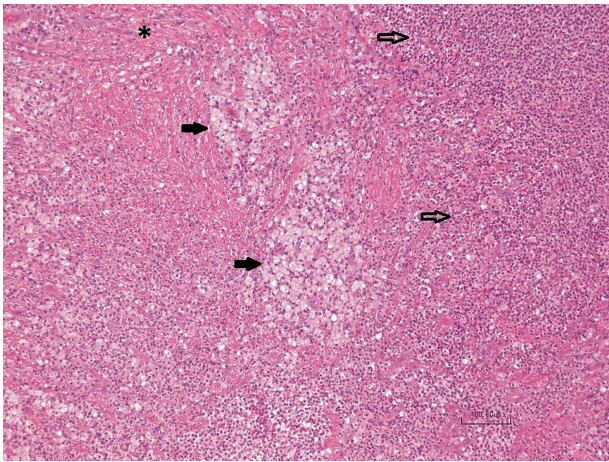
Subsequent macroscopic examination of the excised mass revealed a firm yellow-white soft tissue mass. On serial incision through the specimen, a 25 mm thorn-like structure (Fig 6) resembling that of *Dichrostachys cinerea* (Sickle or Chinese lantern bush), a common thorn tree in Northern Namibia, coated with puss was found in the central aspect of the soft tissue mass (Fig 7). Histological examination of the mass exhibited cellular immature and hypocellular mature connective tissue with pockets of subacute inflammatory cell infiltrates distributed throughout the fibro-fatty tissue. Microabscess formation with sheets of neutrophils, large collections of foamy histiocytes and bacterial colonies were seen on all the evaluated sections (Fig 8). No cellular proliferation suggestive of neoplasia was present, which was all in keeping with a reactive inflammatory process. The possibility of an inflammatory myofibroblastic tumour/inflammatory pseudotumour (neoplastic entity) was discarded due to the presence of the foreign material that was ostensibly responsible for the granulomatous mass.

#### DISCUSSION

This is the first report to describe the laparoscopic removal of an FB-induced granuloma from the abdomen of a cheetah. Granuloma formation in this species has not been well described. Similarly, reports on laparoscopic surgery in this



**FIG 7:** Incised granuloma revealing the foreign body



**FIG 8:** Microscopic image demonstrating clusters of foamy histiocytes (closed arrows) in a background of acute inflammation with puss (open arrows) and early fibrosis (asterisk) (scale bar: 100  $\mu$ m)

species are sparse, particularly those describing the laparoscopic excision of abdominal masses.

The cheetah is known for its strong cellular immune system and probably limited requirement for a humoral response to bacterial infection (Wachter 2014). In this cheetah, a well-encapsulated and omentalised FB was detected by ultrasound before surgery and confirmed by intraoperative cytology. The small amount of free peritoneal fluid was indicative of the marked extent to which this patient could encapsulate FB.

Standard straight laparoscopic instruments have been reported to create instrument clattering when applied through a single access port (Manassero and others 2012, Runge and others 2012, Wilson and Monnet 2012, Runge and Mayhew 2013) and curved or articulated instruments have been suggested to improve ease of surgery (Runge and Mayhew 2013). However, this does require additional instrumentation and surgical skills. We experienced minimal surgical restraint as a result of instrument clattering during this procedure. The use of extraction bags or pouches to remove abdominal structures has not been described in large cats. They have however been used for laparoscopic cryptorchidectomy (Spinella and others 2003), adrenalectomy (Naan and others 2013), nephrectomy (Kim and others 2013), cholecystectomy (Lee and others 2011) and splenectomy (Bakhtiari and others 2011) in dogs and ovariectomy in horses (Hanrath and Rodgeron 2002, Rodgeron and others 2002, Hoogmoed and Galuppo 2005, Bont and others 2010) and tigers (Emerson and others 2013) using three or four separate ports. The use of these bags or pouches has also not been described with SILS. Commonly with smaller ports, the surgical incision size has to be increased to allow retrieval of the bag and its contents. Depending on the structural content size, the 20 mm SILS incision might be large enough for retrieval compared with a 10 mm incision for individual ports; however, this has not been determined. Morcellators have been used during granulosa-theca cell tumours resection (Kummer and others 2010) and laparoscopic ovariectomy (Lund and others 2014) in mares. During this procedure, tissue is morcellated (minced) inside a bag or pouch and suctioned out to avoid enlargement of the incision site. Although its application has not been described in carnivores, the use of a morcellator could have been considered in our patient. However, the equipment was not available on site and would have destroyed the macroscopic structure of the mass, limiting the diagnostic value of the tissue.

In our case, the incision had to be enlarged in order to retrieve the bag and its content, which measured 6 cm in diameter on ultrasound. This did create the need to place temporary abdominal wall sutures to recreate a tight seal around the SILS port in order to complete ovariectomy. Performing ovariectomy before granuloma retrieval could have prevented this situation; conversely, removing the space-occupying lesion from the peritoneal cavity first did restore some normal visceral anatomy and made subsequent ovariectomy easier.

Entrance of the thorn into the abdominal cavity remains speculative, but it could have either entered percutaneously or via the gastrointestinal tract (Hunt and others 2004, Stander and Kirberger 2011). Intra-abdominal granuloma or abscess formation as a result of an FB penetrating from outside the body wall has not been reported in dogs or cats. Both routes of entry by the thorn into the abdominal cavity of this wild felid were however considered. No clinical evidence of an entry port was noted on either the skin or inside of the abdominal wall or on the intestinal serosal surface. Admittedly, these surfaces were not subjected to an exhaustive search for such an entry wound, given the limitations and exigencies of the surgical procedure, which took precedence in this patient. Given the discriminate nature of feline feeding behaviour, it is interesting that this thorn could have been ingested by the cheetah, migrated through the fundic region of the stomach wall and terminated in the nephro-splenic ligament. Considering the amount of mature connective tissue formation around FB, it is possible that the entry point, wherever it was situated, has healed completely in this time frame. Vigorous connective tissue formation associated with FB in this cheetah is more consistent with the response expected in cattle than domestic felidae (Braun 2009).

The lower than expected PCV in this patient was probably due to numerous haematophagus flies (*Hippobosca longipennis*) present in its fur.

Herein we report the successful laparoscopic removal of an FB granuloma from the abdomen of a wild captive cheetah applying SILS and an extraction bag. In wild carnivores, this surgical technique is especially useful in allowing rapid recovery and lowering the risk of postoperative surgical wound complications.

**Contributors** MJH is the main and corresponding author and acts on behalf of all authors.

**Competing interests** None.

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