Foreign body in the dog pericardium – a case report

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Abstract

This case report describes the diagnosis and subsequent surgical therapy of a foreign body in the pericardium in a young Small Münsterland Pointer. The patient was referred to our clinic for exercise intolerance and suspicion of pericardial effusion identified via thoracic radiography. Diagnostics including blood analysis and diagnostic imaging were made during the patient's hospitalisation. Presence of a foreign body passing from the stomach to the pericardium was suspected. To confirm the localisation of the foreign body, computed tomography was performed. Surgical treatment included an intercostal thoracotomy with partial bilateral pericardiectomy followed by laparotomy. The foreign body was surgically removed. The patient did not experience any complications during the postoperative period and was able achieve a full recovery.

Canine, small animal surgery, laparotomy

Foreign bodies in dogs most often include grass awn, wood fragments, wooden skewers, needles, and toothpicks (Choi et al. 2010). These foreign bodies can migrate in the thoracic cavity (Kolm et al. 2001; Sereda et al. 2009; Imazio and Adler 2013; Botha et al. 2017; Caivano et al. 2019), in the abdominal cavity (Hunt et al. 2004; Crosara et al. 2008), but also in the nasal cavity or the subcutaneous tissue (Crosara et al. 2008). Clinical signs depend on the localisation of the foreign body (Choi et al. 2010). Migration of foreign bodies in the thoracic cavity can cause pleuritis with pleural effusion, pneumonia or pericarditis with pericardial effusion.

Pericardial effusion in a dog can be of neoplastic, inflammatory or idiopathic origin (MacPhail and Fossum 2018). The most common causes of septic pericarditis are, for example, bite chest injuries, an intrapericardial foreign body or the administration of immunosuppressive drugs (Sereda et al. 2009; Imazio and Adler 2013; Botha et al. 2017; Caivano et al. 2019). The infection can spread to the pericardium from surrounding tissues, possibly by a haematogenous route (Botha et al. 2017). Clinical signs of pericardial effusion include weakness, exercise intolerance, dyspnoea, hypotension and increased jugular venous pressure (Hoit 2017; MacPhail and Fossum 2018). Effusions can also be diagnosed accidentally while evaluating other cardiopulmonary diseases (Imazio and Adler 2013). The priority in treating a foreign body is its surgical removal. Conservative therapy is ineffective in such cases.

Case presentation

An eleven-month-old, non-castrated, male Small Münsterland Pointer weighing 15 kg was presented to a private veterinary clinic with exercise intolerance. The patient showed reluctance to move, inappetence, dyspnoea and cough. The general condition gradually worsened. Upon clinical examination, the patient had a temperature of 40.1 °C and was tachycardic. The owner said that two skewers were endoscopically removed from the dog's stomach five months ago. Thoracic radiographs were obtained in private practice

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with the subsequent suspicion of pericardial effusion. Antibiotic therapy was initiated, and the patient was given non-steroidal anti-inflammatory drugs. Pericardiocentesis was performed in sedation, and approximately 500 ml of odourless brown-red effusion/fluid was evacuated from the pericardium. The sample of the effusion was sent for microbiological examination. The clinical condition continued to deteriorate, and therefore, the patient was referred to the Small Animal Clinic of the University of Veterinary Sciences Brno for further diagnosis and possible therapy.

At the clinic, the patient was active upon presentation, showing interest in the surroundings. Clinical examination revealed weak heart sounds synchronised with the peripheral pulse. The heart rate was 130 pulses per min. During auscultation of the lungs, bronchovesicular respiration was detected. The patient did not show signs of dyspnoea. The abdomen was palpable and painless, mucous membranes were pink, and the capillary refill time (CRT) was within 2 s. The rectal temperature was 38.0 °C. Haematological and biochemical blood analyses were performed. Blood for biochemical examination was analysed using ARCHITECT c4000 clinical chemistry analyser (Abbott Laboratories, IL, USA). Haematology was analysed using Sysmex XT – 2000iV (Sysmex Corporation, Kobe, Japan). Mild leukocytosis (17.9×10^9/l, reference range (RR) 6–17 $\times 10^9$/l) and monocytosis (2.86×10^9/l, RR $< 0.5 \times 10^9$/l) were detected. Biochemical examination revealed a slight decrease in albumin (22.3 g/l, RR 23–34 g/l) and urea (2.5 mmol/l, RR 3.3–8.3 mmol/l).

The patient was hospitalised for further diagnosis. Three-view thoracic and abdominal radiographic studies were performed. Thoracic radiographs identified a generalized enlarged cardiac silhouette with a poorly delineated heart silhouette ventrally and reduced detail in the abdominal cavity in abdominal radiographs (Plate VI, Fig. 1). Thoracic ultrasound showed presence of an anechogenic fluid in the pericardium. Abdominal ultrasound showed presence of an anechogenic pleural fluid. Amoxicillin clavulanate 25 mg/kg intravenously (i.v.) (Amoksiklav 600 mg inj. Plv. Sol., Pharmaceuticals, Ljubljana, Slovenia) was administered to the patient every 8 h during the hospitalisation. The patient was sent for a cardiology examination under sedation. The patient was given butorphanol 0.2 mg/kg (Butomidor 10 mg/ml, Richter Pharma, Wels, Austria) and diazepam 0.4 mg/kg i.v. (Apaurin 10 mg/2 ml, Krka, d.d., Novo mesto, Slovenia) followed by a dose of propofol 1–3 mg/kg i.v. (Proposure 10 mg/ml, Axience, Pantin, France). The echocardiography examination revealed a large amount of pericardial effusion, a collapsing right atrium, and free fluid in the pleural space. Pericardiocentesis was performed, during which 500 ml of bloody fluid was evacuated. The collected fluid was sent for cytological examination which showed a high cellularity of the sample, 69% neutrophils. Exudate had a purulent character. Electrocardiography was performed without pathology.

On the following day of hospitalisation, a control radiological and ultrasonographic examination was performed. Compared to previous examinations, the cardiac silhouette was less enlarged. Abdominal ultrasound revealed the presence of a linear, hyperechogenic object extending from the parenchyma of the liver through the diaphragm to the pericardium, with a minimum length of 6.5 cm. A foreign body was suspected. To confirm and determine the foreign body's location, computed tomography with contrast was performed (Plate VI, Fig. 2). Intravenous nonionic iodinated contrast medium at a dose of 640 mg/kg (Xenetix 300 mg/ml, Guerbet, Roissy Charles de Gaulle Cedex, Francie) was used. During the examination, a large amount of hypodense pericardial effusion was found. Ventrally, in the region of the heart apex, the pericardium was thickened on the post-contrast study enhancement. A thin foreign body was detected in the pericardium. It was localised paramedially to the left and ventrally to the apex of the heart, where it was in direct contact with the cardiac silhouette, extending from the pericardium caudolaterally to the left through the caudoventral mediastinum and the accessory pulmonary lobe to the hepatic parenchyma, caudolaterally extending into the fundus of the stomach. The sternal lymph nodes were enlarged with homogeneous contrast enhancement.

The diagnosis of a foreign body penetrating the pericardium from the abdominal cavity was confirmed and surgical treatment was elected. The patient was premedicated with fentanyl 0.01 mg/kg i.v. (Fentanyl Torrex 50 μg/ml, Chiesi Pharmaceuticals GmbH, Wien, Austria) and acepromazine 0.01 mg/kg i.v. (Sedan 10 mg/ml, Bioveta a.s., Ivanovice na Hané, Czech Republic), and 2 mg/kg propofol i.v. was used for anaesthesia induction. Inhalation anaesthesia was further conducted with a mixture of sevoflurane (1–1.5 vol.%, Sevoflurane, Baxter Czech spol. s.r.o., Prague, Czech Republic), air and oxygen. During anaesthesia, sufentanil 0.001 mg/kg/h (Sufentanil Torrex 5 μg/ml, Chiesi Pharmaceuticals GmbH) and lidocaine 1 mg/kg/h (Lidocaine Egis 20 mg/ml, Egis Pharmaceuticals PLC, Budapest, Hungary) were administered to the patient in a continual rate infusion together with an infusion of crystalloid solution at a dose of 5–10 ml/kg/h (Hartmann's solution, B. Braun, Melsungen, Germany). Prior to the start of the procedure, atracurium 0.4 mg/kg i.v. (Tracrium 50, Aspen Pharma Trading Limited, Dublin, Ireland) was administered. The patient was, during anaesthesia, connected to a monitor of vital signs, and the vitals were recorded at ten-minute intervals.

The skin was clipped on the left side of the thorax (3^{rd}–13^{th} rib) and on the ventral side of the abdomen from the sternum to the inguinum. The surgical field was washed with a betadine soap, disinfected with chlorhexidine spray, and then draped. Thoracotomy was performed in the sixth left intercostal space. During the exploration of the thoracic cavity, an enlarged pericardium was found from which a fistula was leading ventrally to the phrenic nerve and then caudally to the diaphragm. The mediastinum was macroscopically altered – brown in colour and fragile in consistency. Partial bilateral pericardiectomy was performed (Plate VII, Fig. 3), and approximately 500 ml of sanguineous effusion was evacuated from the pericardium during the procedure. The pericardium was thickened and tightly adhered to the myocardium in the cardiac apex region. The myocardium was altered due to traumatisation by the foreign body and secondary inflammation. The myocardial wall was flaccid. The adhesion to the myocardium was bluntly dissected. Fistula resection revealed a foreign body penetrating the abdominal cavity through the diaphragm into the thoracic cavity. The foreign body was subsequently removed (Plate VII, Fig. 4). It was an approximately 15 cm long skewer which irritated the pericardium with its blunt end. Subsequently, the edges of the fistula in the diaphragm were revived, and the defect in the diaphragm was sutured in two layers with a simple continuous suture pattern using non-absorbable monofilament suture material (Prolene 2/0, Ethicon). The thoracic wall was closed with several simple interrupted circumcostal sutures using non-absorbable monofilament suture material (Prolene 0, Ethicon). Muscles were sutured in two layers, and subcutaneous tissue was sutured in one layer with a simple continuous suture pattern using absorbable polyfilament suture material (Vicryl 2/0, Ethicon). A simple interrupted suture pattern and non-absorbable monofilament suture material were used for skin suture (Ethilon 3/0, Ethicon). A chest drain was placed, and 900 ml of air and 35 ml of haemorrhagic fluid were aspirated from the thoracic cavity.

Subsequently, cranial laparotomy was performed in the linea alba. During exploration of the abdominal cavity, a fistula leading from the stomach and continuing further cranially through the liver to the diaphragm was found. The fistula was resected and the stomach was sutured in two layers; a simple continuous suture pattern was used in the first layer, and an inverting suture pattern was used in the second layer. Absorbable monofilament suture material was used for both layers (PDS 2/0, Ethicon). Concurrently, partial torsion of the spleen and its solid adhesion to the peritoneum in the dorsal part of the abdominal cavity was detected. The adhesions were bluntly dissected, and the spleen was placed in its proper position. After a detailed revision, the abdominal wall was closed with a simple continuous suture pattern using absorbable polyfilament suture material and the subcutaneous tissue (Vicryl 2/0, Ethicon). A simple interrupted suture pattern and non-absorbable monofilament

suture material were used to suture the skin (Ethilon 3/0, Ethicon). The wound was covered with the Novikov tincture. Postoperatively, the patient received meloxicam 0.1 mg/kg subcutaneously (s.c.) (Metacam 5 mg/ml, Boehringer Ingelheim, Rhein, Germany).

During the procedure, 5.85% sodium chloride (Sodium chloride 5.85%, B. Braun) was administered to the patient due to hypotension, atropine sulphate 0.2 mg/kg (Atropine Biotika 1 mg/ml, BB Pharma, Prague, Czech Republic) was administered for the correction of bradycardia and etamsylate 12.5 mg/kg i.v. (Dicynone 250 mg, OM Pharma S.A., Lisbon, Portugal) was also administered due to increased bleeding. Due to the perioperative finding of an infected fistula in the thoracic cavity, the patient was administered enrofloxacin 10 mg/kg s.c. (Enroxil 50 mg/ml, Krka, d.d.).

After the surgical procedure, the patient was transferred to an intensive care unit. The patient's recovery from anaesthesia was slow, complicated by hypothermia (33.6 °C) and hypotension (95/46 mmHg). The patient was heated until restoration of physiological body temperature, and a bolus of 20 ml of 5.85% sodium chloride and crystalloids of 10 ml/kg (Plasmalyte solution, Baxter Czech spol. s.r.o., Prague, Czech Republic) was applied to increase the blood pressure. Subsequently, a continual rate infusion of crystalloids (Plasmalyte) and a combination of ketamine 0.2 mg/kg/h (Narkamon 50 mg/ml, Bioveta a.s.) with lidocaine 0.6 mg/kg/h for pain management was administered to the patient. During hospitalisation, amoxicillin clavulanate 25 mg/kg *per os* (p.o.) every 12 h (Synulox 250 mg, Zoetis Česká republika, s.r.o., Prague, Czech Republic), metamizole 33 mg/kg i.v. every 8 h (Rivalgin 500 mg/ml, Richter Pharma), etamsylate 12.5 mg/kg i.v. every 8 h and enrofloxacin 10 mg/kg s.c. every 24 h were administered to the patient. A small amount of fluid and air was evacuated/aspirated from the thoracic drain with an average of 70 ml of liquid and 50 ml of air per day. The drain was removed after three days when fluid production decreased below 2 ml/kg/day. A control blood analysis was performed on the third day after the surgery. Leukocytosis (21.64×10^9/l, RR 6–17×10^9/l), mild anaemia (erythrocytes 6.32×10^{12}/l, RR 5.5–8.5×10^{12}/l; haemoglobin 107 g/l, RR 120–180 g/l; haematocrit 0.31 l/l, RR 0.37–0.55 l/l) and monocytosis (1.51×10^9/l, RR < 0.5×10^9/l) were detected. Biochemical examination showed hypoalbuminaemia (17.6 g/l, RR 23–34 g/l) and mild hypoproteinaemia (51 g/l, RR 55–75 g/l). The patient was discharged from the hospital four days after surgery. The following medication was prescribed: amoxicillin clavulanate 15 mg/kg p.o. 2 × a day for the next 6 days and enrofloxacin 10 mg/kg p.o. 1 × a day for 6 days (Enroxil Flavour 150 mg, Krka, d.d.). For pain management, metamizole 33 mg/kg p.p. 3 × a day (Novalgin 500 mg, Opella Healthcare Czech s.r.o., Prague, Czech Republic) was recommended.

The patient was brought to the clinic for a follow-up 10 days after the surgery. The wound was healed *per primam intentionem* and skin stitches were removed. The owners were contacted six months after the surgery. In their words, the dog was not showing any clinical signs.

Discussion

The digestive tract is the most common localisation of foreign bodies in small animal practice. Patients with gastrointestinal foreign bodies can be presented with various clinical signs (vomiting, inappetence, weight loss, diarrhoea) (Hayes 2009). It has been stated that foreign bodies can migrate from the stomach or small intestine into the abdominal cavity (Hunt et al. 2004) or also by transoesophageal route into the thoracic cavity (Kolm et al. 2001; Sereda et al. 2009; Imazio and Adler 2013; Botha et al. 2017; Caivano et al. 2019). For example, foreign bodies that migrate into the thoracic cavity can cause traumatic pericarditis, which occurs more frequently in cattle, less frequently in horses, and very rarely in small animals (Kolm et al. 2001).

The typical symptoms of traumatic pericarditis caused by a foreign body migration include apathy, inappetence, anorexia, cough, fever, vomiting and recurrent diarrhoea (Kolm et al. 2001; Sereda et al. 2009; Botha et al. 2017; Caivano et al. 2019; Sheehan et al. 2019). Hunt et al. (2004) describe several cases of foreign body migration in dogs. One of the cases reports a dog that was presented to the clinic with forelimb lameness. Subsequent examination revealed the presence of a foreign body in the thoracic cavity that had migrated from the abdominal cavity (Hunt et al. 2004).

During auscultation of the thorax, muffled heart sounds are commonly detected caused by pericardial effusion, although heart sounds can also be unchanged by auscultation (Shaw and Rush 2007). Patients commonly present with tachypnoea, tachycardia, pale mucous membranes, prolonged CRT, weak and irregular peripheral pulse, or arrhythmias (Kolm et al. 2001; Shaw and Rush 2007; Crosara et al. 2008; Sereda et al. 2009; Botha et al. 2017; Caivano et al. 2019; Seehan 2019). Mild anaemia accompanied by neutrophilia can be found during blood analysis (Kolm et al. 2001; Sereda et al. 2009; Botha et al. 2017). The biochemical blood analysis is usually without alteration, except for the elevated urea and/or creatinine (Kolm et al. 2001) in patients with prerenal azotaemia, which may develop because of reduced cardiac output (Shaw and Rush 2007). Anaemia and thrombocytopaenia are more common in dogs with pericardial effusion due to haemangiosarcoma (MacPhail and Fossum 2018).

The basis of the diagnosis is the patient's history and clinical examination. To confirm the diagnosis, radiological and/or ultrasonographic examination of the thorax and abdominal cavity is performed. On thoracic radiographs, a mild to severe enlargement of the cardiac silhouette is commonly observed (Shaw and Rush 2007). Abdominal radiographs can reveal hepatomegaly or ascites if right-sided congestive heart failure occurs due to pericardial effusion (Shaw and Rush 2007). Computed tomography can be performed to confirm the diagnosis. Differential diagnoses include dilated cardiomyopathy and peritoneopericardial diaphragmatic hernia (MacPhail and Fossum 2018).

The abnormal fluid accumulation in the pericardial sac is called pericardial effusion. With a small/lesser amount of fluid in the pericardial sac, the heart is capable of normal contraction and normal function. However, with more fluid accumulation in the pericardium, intrapericardial pressure may increase to the level where the right atrium of the heart collapses and cardiac failure occurs. This condition is called the cardiac tamponade. Pericardiocentesis is indicated as an emergency treatment for the patient's initial stabilisation. Electrocardiographic monitoring of the patient should be maintained during pericardiocentesis, as premature ventricular complexes may occur if the needle contacts the heart unintentionally (MacPhail and Fossum 2018). Complications associated with pericardiocentesis include premature ventricular complexes, laceration of the coronary artery, and sudden death (Shaw and Rush 2007). With the recurrence of pericardial effusion, the method of choice becomes surgical treatment – pericardiectomy (Shaw and Rush 2007). Pericardiectomy has proven to be an effective treatment for dealing with septic pericarditis (Botha et al. 2017).

This method lets the accumulated fluid in the pericardium drain freely into the pleural space, from where it can be absorbed, preventing the recurrence of cardiac tamponade (Shaw and Rush 2007). The traditional surgical approach includes median sternotomy (Caivano et al. 2019; MacPhail and Fossum 2018; Sheehan et al. 2019) or intercostal thoracotomy (Shaw and Rush 2007; Crosora 2008; Sereda et al. 2009; MacPhail and Fossum 2018), thoracoscopy may also be elected (Shaw and Rush 2007; MacPhail and Fossum 2018). Pericardiectomy can be subtotal (subphrenic) or total. Usually, for animals with pericardial effusion, subphrenic pericardiectomy is preferable (MacPhail and Fossum 2018). As a part of the surgical treatment, the chest drain should be placed, and a regular suction should be performed (every hour) with subsequent quantification

of the amount of pleural fluid (MacPhail and Fossum 2018). The drainage frequency depends on the amount of effusion. The usual frequency of effusion evacuation is between 2–6 h. Since the drain is a foreign body, it can cause thoracic irritation and fluid production in the thoracic cavity over time. Therefore, the drain should be removed at the time of minimal fluid production when the fluid production drops to less than 2 ml/kg/day (Marques et al. 2009). Postoperative complications associated with surgical therapy of the pericardial effusion include the development of arrhythmias, especially atrial fibrillation or ventricular tachycardia. In addition, the patient may develop acute respiratory distress due to the recurrence of pleural effusion, pulmonary oedema or pulmonary thromboembolism (MacPhail and Fossum 2018).

The prognosis for dogs with pericardial effusion depends on the primary cause. If the main cause is of neoplastic origin, the prognosis is generally poor. On the contrary, pericardial effusion of infectious origin has a good prognosis. Infectious pericardial effusion usually requires surgical treatment in the form of pericardiectomy in combination with antimicrobial therapy (Shaw and Rush 2007).

Conclusion

The present case draws attention to the danger of foreign bodies that can migrate into the patient's body. In the presented patient, the foreign body migrated from the abdominal cavity to the thoracic cavity, specifically from the stomach to the pericardium, where it subsequently caused septic pericarditis. This foreign body was one of the skewers that the dog ingested five months before the presentation at our clinic. The other two were extracted from the stomach endoscopically five months prior. In this case, the therapeutical method of choice was intercostal thoracotomy with partial bilateral pericardiectomy and laparotomy with the resection of the fistula and removal of the foreign body. In cases of foreign bodies, it is important to have a thorough diagnosis and to pay close attention to whether all of them have been evacuated. The presented case report demonstrates the necessity of proper diagnostics of foreign bodies in the organism.

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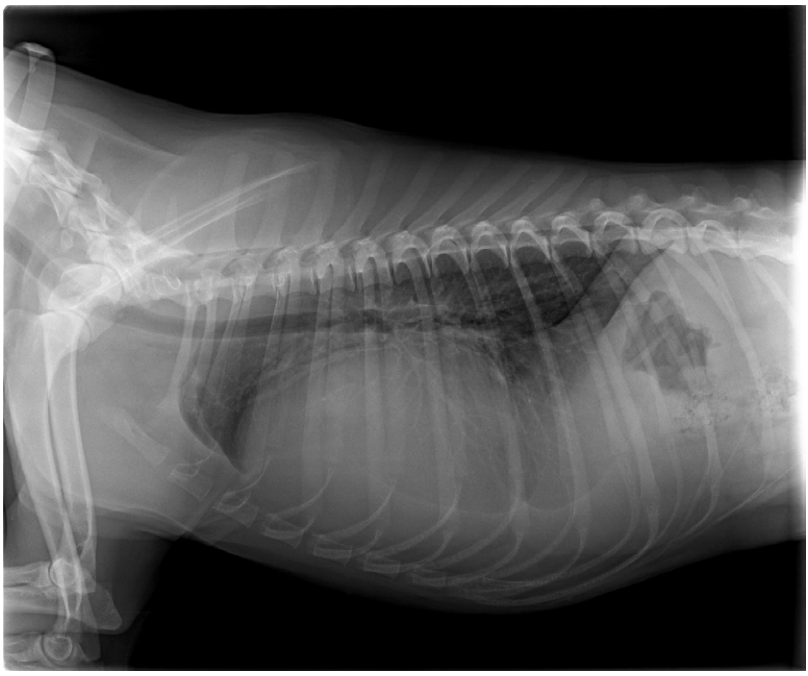

Fig. 1. Right lateral thoracic radiograph showing a generalized enlarged cardiac silhouette and pleural effusion

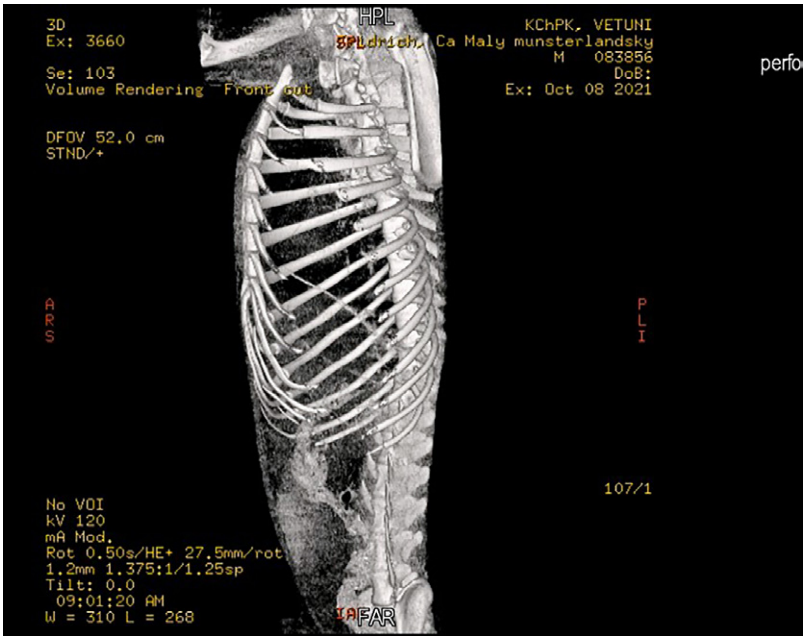

Fig. 2. Computed tomography angiography 3D projection showing a foreign body passing from the stomach through the diaphragm into the thoracic cavity

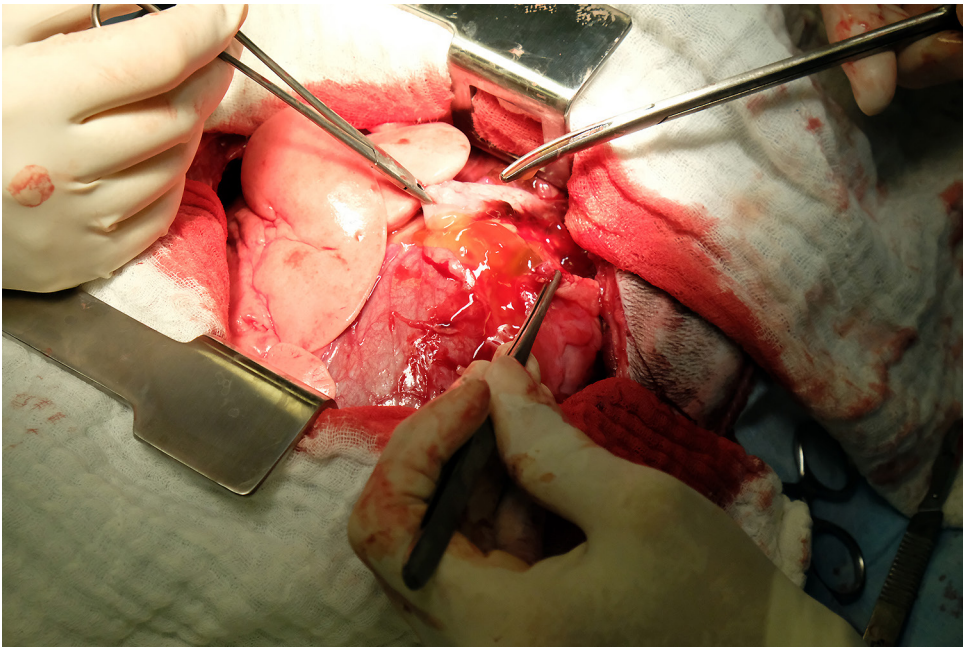

Fig. 3. Partial bilateral pericardiectomy showing haemorrhagic effusion

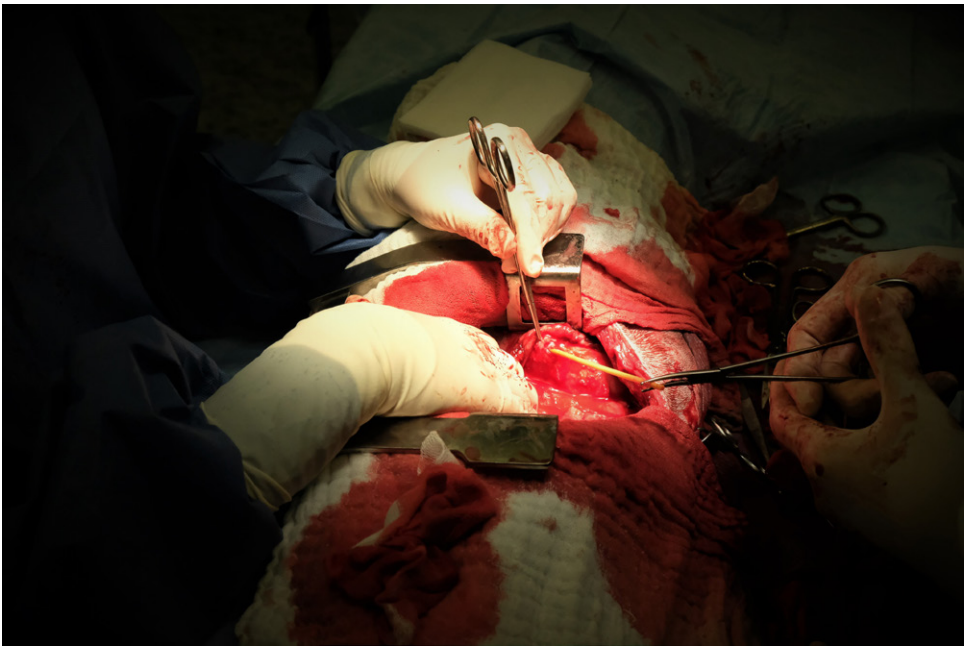

Fig. 4. Removal of the foreign body