



CAT RESCUED VIA DECORTICATION OF THE LUNG LOBE AND PLEURA FOR MATURED PYOTHORAX: A CASE REPORT

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Summary

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This report describes a cat rescued from a severe pyothorax with decortication. A 3-year-old cat was presented with severe dyspnea. Radiography revealed pyothorax and a chest tube was placed, followed by administration of antibiotics. With treatment, the dyspnea temporarily improved, but the cat presented again with dyspnea and a pleural effusion. The severe effusion caused respiratory distress and the cat developed life-threatening dyspnea. A median sternotomy was performed, and the entire lung lobe was found to be shrunken with fibrous membrane coverage. Decortication, a gentle peeling of the membrane from the lung lobe, significantly improved its expansion and dyspnea improved after surgery. Pyothorax is successfully treated with antibiotics and effusion drainage. However, patients who do not respond to conventional treatment should be treated aggressively with surgery, which is the last option despite the risk of anesthesia or surgery itself. Therefore, this case supports the use of surgery for severe pyothorax.

Key words: cat, decortication, dyspnea, median sternotomy, pyothorax

Pyothorax is a common condition in cats and is rarely fatal with appropriate treatment such as thoracostomy tubes (Barrs *et al.*, 2005). The basic management of pyothorax includes administration of antibiotics and drainage of pleural effusions. However, if initial treatment fails, pyothorax can be intractable. The chronic contact of pleural effusions causes the accumulation of fibrin on the surface of the lung

lobes, and the fibrin eventually matures into fibrous membranes that prevent the lung lobes from expanding. In such cases, antibiotics and drainage are no longer effective, and in the worst case, death may occur due to severe dyspnea. In such cases, it is common in humans to access the thoracic cavity through thoracotomy or thoracoscope and perform decortication; e.g. peeling off the fibrous membra-

ne covering the surface of the lung (Okiror *et al.*, 2014; Zhu *et al.*, 2022). However, in veterinary medicine, decortication is not common, and to the author's knowledge, there is only one successful case of decortication applied on a cat with chylothorax (Sack *et al.*, 2021), but no case of decortication applied on a severe pyothorax. This report describes the first case of life-threatening pyothorax treated by decorticating the fibrous film in a cat.

Case description

A 3-year-old neutered male Bengal cat weighing 3.5 kg visited a private clinic due to dyspnea. However, the possibility of a pyothorax was ignored and the veterinarian did not investigate the specific cause of the dyspnea, only prescribing steroids. After 2 days, dyspnea did not improve. Thus, the cat was taken to another clinic where it underwent chest radiography and echocardiography. The collected effusion by thoracentesis was pus-like, possibly indicating pyothorax. The patient's respiratory condition did not improve for 10 days after the start of combined antibiotic treatment with enrofloxacin and cefpodoxime. The pleural effusion volume was continuously increasing. Therefore, the patient was referred to Kitasato University Veterinary Medical Hospital.

Upon presentation at our hospital, the patient had laboured breathing, and chest radiography showed a large pleural effusion. A pleural drain was placed under sedation with combination of 0.002 mg/kg dexmedetomidine (Dexdomitor® 0.1; Zoetis Inc; USA) and 0.01 mg/kg buprenorphine (Lepetan injection; Otsuka Pharmaceutical Co., Ltd.; Japan), and a smear of the collected pleural fluid confirmed pyothorax. The microbiological identification test detected infection with three

anaerobic bacterial species (*Peptostreptococcus sp.*, *Bacteroides sp.* and *Porphyromonas sp.*). Then, 25 mg/kg cefazolin sodium hydrate (Cefazolin Sodium for Injection; Otsuka Pharmaceutical Inc; Japan) and 5 mg/kg enrofloxacin (Baytril 2.5% Injection; Elanco Animal Health Inc; Japan) were administered, and the patient was admitted to the hospital and managed under FiO₂ 0.3. The patient's general condition and respiratory status improved from the day of hospitalisation, and the pleural effusion volume decreased significantly over 12 days. However, 14 days after treatment, the pleural fluid reappeared. The CT scan under general anaesthesia maintained with 2–2.5% isoflurane (Isoflurane; MSD Animal Health Co., Ltd; Japan) showed severe lung atrophy and cystic fluid retention (Fig. 1). To improve dyspnea, the pleural effusion was drained via thoracentesis for 2 days. After 18 days of treatment, the cat developed life-threatening dyspnea. An emergency median sternotomy was performed to secure expansion of the lung lobes. Anaesthesia induction was achieved with 0.1 mg/kg midazolam (Doromicum Injection; Maruishi Pharmaceutical Co., Ltd; Japan), 0.005 mg/kg of fentanyl (Fentanyl injection; Daiichi Sankyo Co., Ltd; Japan), and alfaxalone (Alfaxan® Multidose; Zoetis Inc; USA). General anaesthesia was maintained with 2–2.5% isoflurane. Moreover, 0.005–0.02 mg/kg/h fentanyl and 0.5 mg/kg/h ketamine (Ketarrar for intravenous injection; Daiichi Sankyo Co., Ltd; Japan) were administered during surgery. The patient was managed with mechanical ventilation. However, the patient's oxygen saturation and end-tidal carbon dioxide concentration indicated severe dyspnea.

Median sternotomy was challenging to perform due to bleeding on the thickened

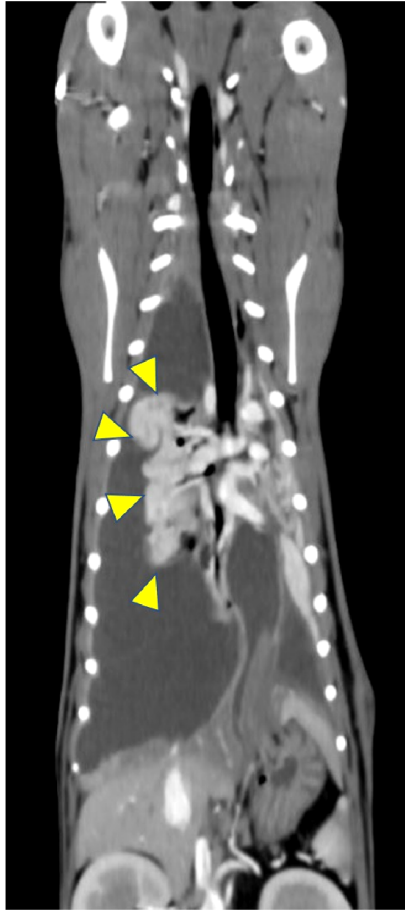


Fig. 1. Horizontal computed tomography images of the thoracic region; severe right lung lobe atrophy (yellow arrowhead) and cystic fluid retention were observed; the cranial aspect of the patient is at the top of the image.

pleura, and the thoracic cavity was filled with a highly viscous pus separated by the septum (Fig. 2). After the purulent effusion was removed, the patient's respiratory status improved slightly. Exploration of the chest cavity revealed that all lung lobes were atrophic with fibrous deposits on the surface, which were white in colour and significantly prevented lung expansion. In addition, the chest wall, pericardium, and diaphragm were similarly covered.

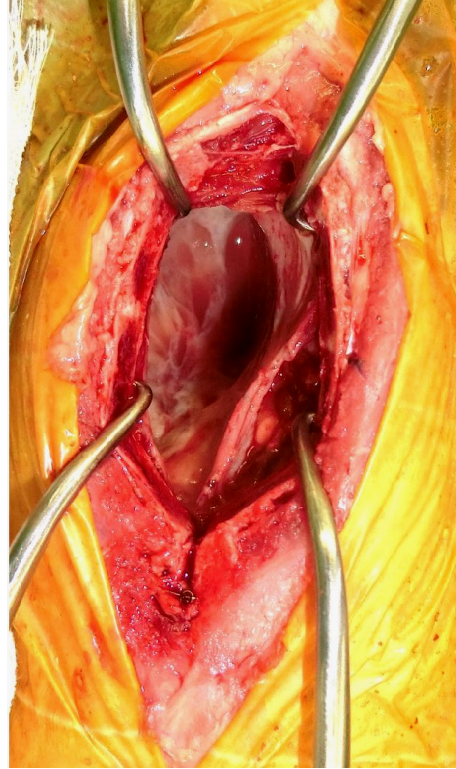


Fig. 2. Photograph of the thoracic cavity of a 3-year-old cat with pyothorax; median sternotomy was performed. Abscess and fibrous adhesions encased the pericardium, mediastinum, and lung lobes. The cranial aspect of the patient is at the top of the image.

Therefore, to re-expand the lung lobes, the films on the surface of the lung lobes were cautiously peeled off with a forceps and cotton swabs to prevent lung lobe damage (Fig. 3). However, the portion of the left anterior lobe firmly adhered to the chest wall; hence, it was resected by ligation of the bronchus and lung lobe with 4-0 Copolymer of glycolide and L-lactide absorbable thread (Bicril®; Shofu Inc.; Japan). After removing most of the film from the whole lung lobe, the collapsed lung lobe improved and re-expanded, and all ventilation values returned within the

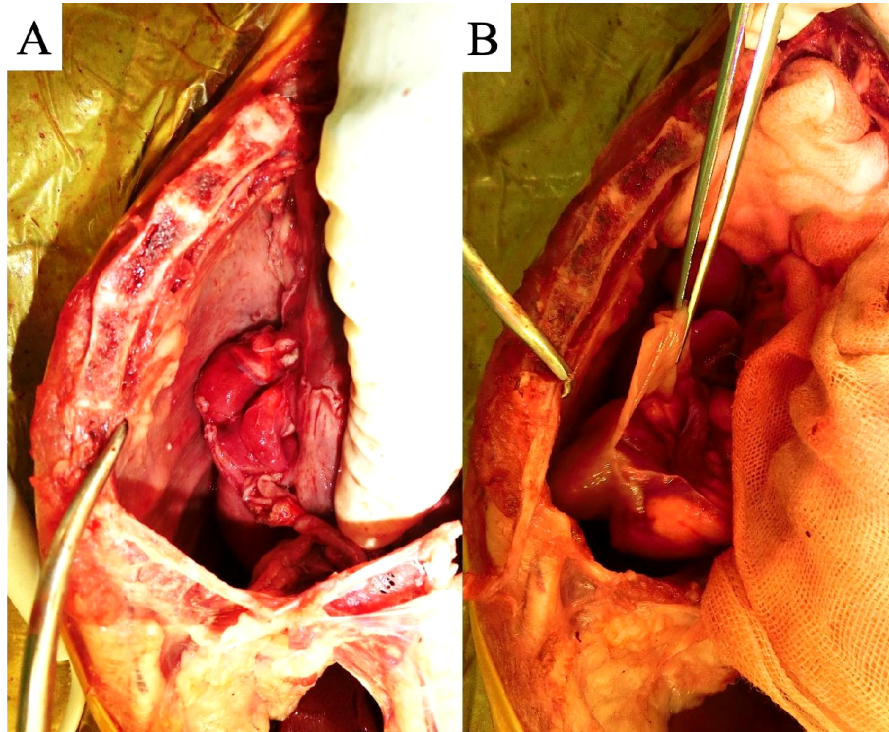


Fig. 3. Collapsed left lung lobe covered by a fibrous film (A); separation and peeling of the fibrous film resulted in the release of the lung lobes (B). The cranial aspect of the patient is at the top of the image.

normal range. However, based on dissecting films, the surface of the lung lobe was damaged, and air leaked from multiple fistulas. By suturing the fistula with a 5-0 polydioxanone thread (PDS® II; Johnson & Johnson Inc; Japan), leakage from the fistula has disappeared. To expose the diaphragm, the sternal incision line was extended to the abdomen. The thick film covering the diaphragm was removed via curettage, the elasticity of the diaphragm improved, and an active drain was placed in the thoracic cavity to close the wound. Postoperatively, the patient was managed with FiO₂ 0.3, and its respiratory status then improved. However, pneumothorax was observed due to a slight leakage from

lung lobe. The colour of pleural effusion after surgery became clear. Then, the effusion volume gradually decreased, and effusion was barely observed 5 days after surgery. Radiography showed that lung expansion and pneumothorax improved. On postoperative day 8, the patient was weaned from the oxygen chamber because his energy and appetite were improved, and fluid and air from the drain were no longer aspirated. On postoperative day 11, the drain was removed, and the patient was discharged. Moreover, the patient's prognosis was good and he did not experience any dyspnea for >860 days after surgery (Fig. 4).

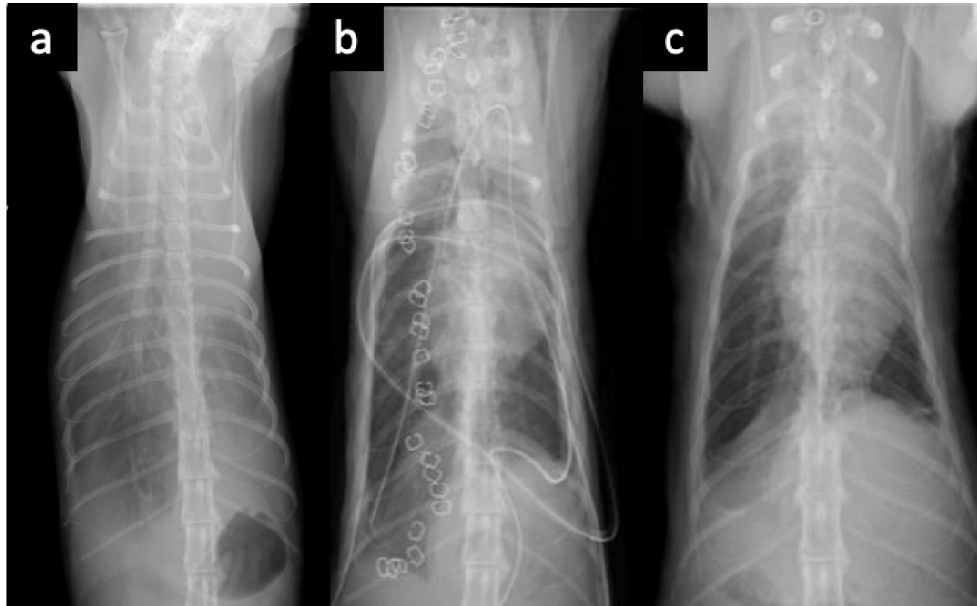


Fig. 4. Ventro-dorsal thoracic radiograph image obtained prior to (A), immediately after (B), and 2 weeks after surgery (C).

The basic treatment of pyothorax is appropriate antibiotic therapy and drainage. Delayed treatment or inadequate drainage of the pleural effusion would not sufficiently eliminate the bacteria, and long-term use of antibiotics is often required. In addition, the surviving bacteria may develop tolerance to antibiotics, especially the agents are not effective once bacteria constructed biofilm. This failure of treatment may lead to the emergence of resistant bacteria such as methicillin-resistant *Staphylococcus aureus*. Therefore, treatment should not be delayed after the diagnosis of pyothorax. In the current case, the patient could have been cured immediately if appropriate treatment had been provided before it was brought to our hospital. However, in this case, 14 days had elapsed from the first visit to the private clinic to treatment initiation at our hospital. Steroids were administered at the clinic that was initially

visited. Hence, the infection persisted and could not be treated using the common methods. The patient's symptoms temporarily improved after treatment with a chest tube and antibiotics at our hospital. However, the patient did not improve sufficiently.

Pyothorax in humans is commonly managed via curettage. However, in veterinary medicine, there are no reports on the treatment of pyothorax, and only a few cases of chylothorax treatment in cats have been reported (Sack *et al.*, 2021). The lack of information about the surgical treatment of pyothorax in cats and the reports that the timing of surgery greatly affects the prognosis in humans made it difficult to determine the appropriate timing of surgery in the current case. The American Thoracic Society classification is widely acknowledged for the staging of pyothorax in humans, and the condition is classified into stage I (exudative stage),

stage II (fibrinopurulent stage), and stage III (organising stage) according to the intertumoural characteristics. In general, pyothorax progresses from stage II to III within approximately 3–4 weeks after pyothorax onset (Okiror *et al.*, 2014). Nevertheless, it is difficult to clearly classify the stage in individual cases because of the continuous change in intrapleural condition (Mackinlay *et al.*, 1996). If the symptoms do not respond to medical therapy surgery is required. However, its timing influences the surgical approach and prognosis. In cases of stage I pyothorax, wherein acute inflammation makes the tissues fragile, haemorrhagic and the alveoli are severely affected, surgical procedures should be avoided. In stage III and later-stage pyothorax, if the pleura becomes thickened and more organised, it is challenging to dissect. Poor residual lung expansion and residual dead space can be an issue, leading to recurrent pyothorax (Mackinlay *et al.*, 1996; Weissberg *et al.*, 1996; Karmy-Jones *et al.*, 1997). Therefore, the appropriate timing of surgery is specified as stage II, which is approximately 2–14 days after symptom onset (Ashbaugh, 1991; Weissberg *et al.*, 1996). Previously, we had performed decortication 1 week after the onset of respiratory distress in a cat that had not responded to pleural drainage and antibiotic treatment. During surgery, peeling away the immature, fragile fibrous membrane on the surface of the lung lobes was so difficult that the procedure severely damaged the lung lobes. Unfortunately, the cat died post-operatively due to severe respiratory distress and a haemorrhage caused by the lobar damage. The high risk associated with early decortication was acknowledged. In the current case, more than 3 weeks had passed since disease onset, and the condition progressed to stage III,

which is an organising stage and could not be managed surgically. This was because the patient's condition temporarily improved with drainage and antibiotic treatment. Hence, the decision to proceed with surgery was delayed. If the chest was opened, as a result of inflammation from bacterial infection of the pleural space, the pleura could thicken, and the fibrous membrane on the surface of the lung lobes could thicken and peel off, causing a fistula in the lung lobes. In addition, part of the lung lobe was organised and adhered to the chest wall, and had to be partially resected. To secure visualisation, laparotomy should be performed to restore the elasticity of the diaphragm. Hence, if the patient is not initially subjected to drainage and treatment with antibiotics, it is important to determine when to perform surgery for stage II disease and when to proceed to aggressive surgery, even though it is an invasive and high-risk procedure. In case of delayed and outdated treatment, there is still a good chance of improvement with cautious removal of the pisiniform membrane and repair of the lung lobes. Although prompt diagnosis and treatment should be made before such a situation arises, we did not give up although the patient unfortunately did not respond to treatment and had a prolonged disease. However, despite the risk of anaesthesia, aggressive surgical treatment, which is the last option, may save the patient's life. This report is an evidence encouraging decortication against the later stage of pyothorax in cats.

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