**Clinical characteristics and long-term outcome of lung lobe torsions in cats: a review of ten cases (2000-2021).**

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**Abstract**

**Case series summary**

Lung lobe torsion is rare in cats. The aim of this multi-institution, retrospective study was to describe clinical and diagnostic findings, treatments and outcomes of lung lobe torsion (LLT) in ten cats.

Dyspnoea and tachypnoea were the most common clinical signs. Pleural effusion was present in nine cats at presentation. Fluid analysis confirmed chylothorax in three. Nine cats underwent computed tomography and five cats thoracic radiographs. A diagnosis was made preoperatively in six cats while in the other four cats it was made at exploratory thoracotomy. Affected lung lobes were the right cranial (4/11), left cranial (4/11) and right middle (3/11). One cat had a concurrent torsion of two lung lobes. Lung lobectomy was successfully performed in all cases. Based on clinical, diagnostic and lung histopathology findings three cats had idiopathic and seven cats secondary LLT. Intraoperative complications included hypotension and hypothermia in four and five cats, respectively. Postoperative complications occurred in six cats and lead to euthanasia or death in four cats, whereas complications resolved in the other two cats. Three cats were euthanised within five weeks of discharge. For the three cats surviving long term, including one euthanised at 252 days postoperatively, owner described outcomes and quality of life were considered good to excellent.

**Relevance and novel information**

Secondary LLT associated with underlying thoracic pathology was associated with high complication rates and poor outcomes. Long-term outcomes of cats undergoing surgery for LLT and surviving the perioperative period were deemed good to excellent.

**Key words:** Lung lobe torsion; chylothorax; pleural effusion; computed tomography, lung lobectomy

**Introduction**

Lung lobe torsion (LLT) is a rare life-threatening condition in dogs and cats. Axial rotation of the bronchovascular pedicle predominantly centred close to or at the hilus1 causes impaired bronchial, venous and lymphatic drainage and progressive lobar oedema, haemorrhage, necrosis and consolidation.2,3 Whilst the cause of LLT is unknown, increased lobe mobility associated with thorax conformation, increased perilobar space, bronchial cartilage dysplasia and lobar pathology have been linked to its occurrence in veterinary species.1,4–6

Only 20 cases of LLT in cats have been reported in the past 50 years.2,5,7–18 Aetiology is available for 15 of these cats, five were considered idiopathic and 10 secondary to underlying disease including: pulmonary carcinoma, mediastinal lymphoma, chronic asthma, fibrosing pleuritis, cardiac disease, chylothorax, pyothorax, chronic traumatic diaphragmatic hernia and peritoneopericardial diaphragmatic hernia (PPDH).2,5,7–18 Lung lobe torsion in humans is an uncommon condition predominantly occurring secondary to thoracic surgery (62%), with the right middle lung lobe being the most affected after right upper lobectomy or transplant.19 ‘Spontaneous’ LLT is seen in 29% of cases, with pneumothorax, pleural effusion, lobar atelectasis and pulmonary neoplasia suspected aetiologies.19–22

Lung lobe torsion is usually diagnosed using radiography or computed tomography (CT), which often reveals irregular bronchial tapering, bronchial displacement and consolidated or vesicular emphysematous pulmonary parenchyma. Thoracic ultrasonography often reveals a hypoechoic peripheral band sign and consolidated enlarged lobe,23 with absent blood flow on Doppler scanning.5,15 Assessment using conventional and virtual bronchoscopy have also been described.15 Rates of diagnosis using imaging investigations are variable and findings can be non-specific.1,5,15,19,24

Torsed lobe/s are removed without derotation, as derotation increases the risk of reperfusion injury and poorer outcomes in humans.19,25 The prognosis for cats undergoing surgical intervention is considered excellent, with all such cases described in previous reports surviving to discharge,2,7–14,18 and 87.5% of cats alive and clinically normal at 3-10 month follow up.8–14,18 However, when considering preoperative and post-discharge mortality, the overall mortality rate for cats with LLT is 37.5%.2,7–14,18

The aim of this study was to describe the clinical signs, diagnostic findings, treatments and outcomes of cats diagnosed with LLT.

**Case series description**

Ethical approval for this study was granted by the Royal Veterinary College (SR2020-0237). Electronic records for cases between January 2000 and September 2021 from six small animal referral hospitals were reviewed to identify cats with a diagnosis of LLT. Cats were included if they had a diagnosis of LLT confirmed through diagnostic imaging, surgery or histopathology, and had comprehensive medical records.

Data retrieved from the medical records included clinical history, signalment, intercurrent illness, physical examination findings, preoperative blood test results, preoperative diagnostic imaging findings, pleural fluid analysis, time from presentation to surgery, surgical and anaesthetic time, surgical treatment, concurrent surgical procedures under the same general anaesthetic, time from surgery to discharge, whether the patient survived to hospital discharge, time and cause of death, bacteriology and histopathology results and recurrence of LLT. The potential inciting cause of LLT was determined based on clinical, diagnostic and histopathological findings.

Intraoperative and postoperative complications were recorded and information regarding outcomes and quality of life were obtained from clinical records or telephone interview of owners. Postoperative complications were defined as any complications occurring following recovery from general anaesthesia.

Ten cats met the inclusion criteria, summarised in Table 1. Seven cats were domestic shorthair, one Maine Coon, one domestic longhair and one British shorthair. Four were female (two neutered, two intact) and six male (five neutered, one intact). At presentation the median age was 84 months (range 67-148). Median body weight was 4.15 (range 2.9-5.2).

[Insert Table 1]

Six cats had at least one pre-existing comorbidity including structural cardiac disease (3), hyperthyroidism (1), nephroliths with intermittent dysuria (1), idiopathic feline lower urinary tract disease (1), PPDH surgically corrected less than four hours before presentation with development of postoperative pneumothorax (1) and feline upper respiratory tract disease (1). Cardiac abnormalities were hypertrophic cardiomyopathy (HCM) with atrial enlargement (1), HCM without atrial enlargement (1), and a double chambered right ventricle (DCRV), ventricular septal defect, systolic anterior movement and regurgitation of the mitral valve, dynamic left ventricular outflow tract obstruction, left sided ventricular hypertrophy and right sided chronic heart failure in one cat.

Median duration of clinical signs prior to presentation was two days (range, 1-44). Nine cats displayed respiratory signs at presentation including dyspnoea (8), tachypnoea (6) and cough (2). Anorexia (4), retching (2) and lethargy (2) were also reported. All cats had multiple clinical signs prior to presentation and in one cat, presented for anorexia and retching, no respiratory clinical signs had been reported.

Physical examination findings included tachypnoea (8), restrictive respiratory pattern (2), dyspnoea (2), pale mucous membranes (2) and heart murmur (2). Cardiothoracic auscultation revealed attenuated pulmonary sounds in six cats. Pyrexia was noted in the cat subsequently diagnosed with pyothorax. Clinical examination was unremarkable in two cats: one of these had thoracocentesis to drain the pleural effusion approximately 12 hours prior to presentation due to dyspnoea and the other was referred for tachycardia and a single episode of dyspnoea.

Complete blood count (CBC) and serum biochemistry were performed in eight cats. Lymphopenia (0.99, 0.66 and 0.5 x109/l; reference interval [RI] 1.5-7) was demonstrated in three cats and neutrophilia in two (18.61 and 11.89 x109/l; RI 2.5-12.5). Serum biochemistry was abnormal but nonspecific in five cats; an increased urea (14.1, 14.4 and 17.0 mmol/l; RI 2.5-9.9) in three cats, hyperglycaemia (10.3 and 38.2 mmol/l; RI 4.0-7.0) in two cats and hypoproteinaemia (59.0 g/l; RI 60-80), hyponatraemia (149 mmol/l; RI 153-162), hypokalaemia (2.8 mmol/l; RI 3.5-5.5) and hypoalbuminaemia (24 g/dl; RI 25-45) in one cat each. In two cats creatine phosphokinase (277 and 792 UI/l; RI 0-130), aspartate aminotransferase (80 and 107 UI/l; RI 0-40), and alanine transaminase (386 and 134 UI/l; RI 0-50) were increased, in one of these cats alkaline phosphatase (167 UI/l; RI 0-70) was also increased.

Fibrinogen and fibrin degradation products were assessed in one cat and both were elevated 551 mg/dl (RI 100-300) and 2.69 µg/ml (RI 0.1-2.5), respectively. In one of the cats with cardiac disease (case four) N-terminal pro B-type natriuretic peptide (ProBNP) was elevated (>1500 pmol/l) while cardiac troponin 1 was normal. In the cat with HCM without left atrial enlargement both ProBNP and cardiac troponin 1 were unremarkable.

Nine cats had a CT scan. Pleural effusion was the most common finding (8), described as marked (6), moderate (1) and mild (1). The affected lobe was consolidated in six cats and collapsed in one. An absent lobar bronchus, lobar contrast enhancement and vesicular gas pattern were each seen in two cats (Figures 1 and 2). Other findings included pneumothorax (1), right thyroid mass (1), bilateral adrenal hyperplasia (1), sternal lymphadenopathy (1) and aortic valve mineralisation (1). Based on the CT findings, LLT was radiographically diagnosed in six cats and suspected in one. Virtual bronchoscopy was performed in one cat revealing an oval shaped ‘fish mouth’ opening of the affected lobar bronchus (Figure 3).

[Insert Figures 1-3]

Thoracic radiography was performed in five cats with evidence of pleural effusion (3), consolidation of the affected lung lobe (2) and pneumothorax (1). Thoracic ultrasonography was performed in eight cats and pleural effusion was noted in all cases. B-lines, hepatised lung and multifocal nodular consolidation were reported in one cat each. Echocardiography was performed in five cats, confirming structural heart disease in the two cats with pre-existing cardiac disease (cases four and eight). Mild mitral and tricuspid regurgitation were identified in the cat presenting with tachycardia and electrocardiogram confirmed sinus tachycardia (case three). Echocardiography in the remaining two cats was unremarkable.

Nine cats had pleural effusion at presentation, classified as chyle (3), transudate (2), modified transudate (2), non-septic exudate (1) and septic exudate (1). Preoperative aerobic and anaerobic bacterial cultures and antimicrobial susceptibility from the pleural effusion were performed in eight cats. In the cat with septic exudate the bacterial culture revealed *Pasteurella multocida*.

Surgery was performed in all cats. In six cats surgery was performed for management of the suspected or confirmed LLT. In two cats surgery was performed for further assessment of the abnormal lung lobe on imaging. In case one, surgery was performed for management of pyothorax after 7 days of unsuccessful medical management and in case four, surgery was scheduled for correction of DCRV; the lobar torsion was found incidentally in both cases. Median time from presentation to surgery was two days (range, 4 hours-7 days). Median surgical time was 100 minutes (range, 55-200) and median anaesthetic time was 200 minutes (range, 70-345). Intercostal thoracotomy was performed in seven cats and median sternotomy in three cats. Lung lobectomy was performed in all lobes with torsion using a stapling device in five cats, sutures only in four cats (polydioxanone [3], silk [1]) and titanium hemoclips in one cat. Derotation of the affected lobe prior to lobectomy was not performed in any cat. Thoracostomy tubes were placed in all cats and removed between one and five days postoperatively.

Affected lung lobes were the right cranial (4), left cranial (4) and right middle (3). One cat had concurrent torsion of the right cranial and right middle lung lobes.

Nine concurrent procedures were performed in five cats including thoracic duct ligation (TDL) and subtotal pericardiectomy for management of chylothorax (1), partial right ventriculectomy with graft placement for correction of DCRV (1), resection of abnormal mediastinum (1), partial lobectomies of the right cranial, middle and caudal lung lobes due to air leakage (1), and TDL, subtotal pericardiectomy, cisterna chyli ablation for chylothorax management with concurrent exploratory laparotomy due to chyloabdomen (1). All cats received perioperative antibiotics including ampicillin (1), amoxicillin-clavulanate (2), or cefuroxime (7).

Surgery was uncomplicated in five cats. However, five cats suffered at least one intraoperative complication. Intraoperative hypothermia was recorded in five cats and hypotension in four cats, with one cat requiring a whole blood transfusion for persistent hypotension. Due to ongoing air leakage, one cat (case six) required partial lobectomy of the right cranial, middle and caudal lung lobes. All cats survived surgery and six cats survived to discharge.

Six cats suffered at least one postoperative complication. Case one, diagnosed with pyothorax, had recurrent pleural effusion within two days of surgery which was managed with 21 days of amoxicillin clavulanate. Case five developed ongoing pleural effusion and a mild subcutaneous fluid accumulation at the site of the thoracostomy tube. Case eight developed a self-limiting chylothorax 36 hours after surgery which resolved in 48 hours.

During hospitalisation, complications led to the death or euthanasia of the cat in four cases. Case four experienced hypotension on recovery resulting in cardiopulmonary arrest (CPA) at 4 and 5.5 hours postoperatively, cardiorespiratory resuscitation was ultimately unsuccessful. Case five had ongoing pleural effusion with evidence of dyspnoea and the cat experienced CPA nine days after surgery. Case six, the cat with preoperative pneumothorax managed with multiple partial lobectomies at surgery, developed recurrent intractable pneumothorax 3.5 hours postoperatively and was euthanised four hours after surgery. Case ten had ongoing pleural effusion postoperatively with development of chylothorax three days post operatively; the cat underwent TDL four days postoperatively but suffered CPA three days later.

Three cats were euthanised after discharge within five weeks of surgery. Case three represented six days postoperatively for dyspnoea and a recurrent pleural effusion, confirmed as a protein rich transudate, was documented. Despite improvement in the effusion, dyspnoea recurred and 11 days postoperatively the cat developed acute hindlimb paraparesis with cold extremities and absent femoral and pedal pulses; aortic thromboembolism (ATE) was suspected and the cat was euthanised. Case seven developed a recurrent chylothorax three days postoperatively and was euthanised 21 days postoperatively. Case nine represented 35 days postoperatively with respiratory distress and a marked pleural effusion. Cytology of the pleural effusion was consistent with malignancy of epithelial origin, suspected to be pulmonary carcinoma.

The time to onset of complications postoperatively ranged from immediately postoperatively to 11 days, two of the catastrophic complications occurred in less than six hours.

Histopathological evaluation of the lung lobe was performed in all ten cases. The most common abnormalities included haemorrhage (10), necrosis (8), fibrosis (6), pleural fibroplasia (6), atelectasis (4), proteinaceous fluid accumulation within the air spaces (4), type two pneumocyte hyperplasia (3), congestion (3), pleuritis (3) and granulation tissue (2). The cause of pneumothorax following PDDH correction in case six was not determined, although widespread fibroplasia was noted. Postoperative aerobic and anaerobic bacterial cultures and antimicrobial susceptibility was performed in four cats (lung parenchyma and pleural effusion [2], lung parenchyma [1] and of undocumented source [1]). Culture was negative in all cases.

Lung lobe torsion was deemed idiopathic in three cases. In the remaining six cats the condition was suspected to be secondary to idiopathic chylothorax (2), cardiac disease with chylothorax (1), pyothorax (1), pleural effusion secondary to pulmonary carcinoma (1), pneumothorax following PPDH repair (1) and pleural effusion (1).

Owner perception of outcome of the surgical procedure and quality of life in the two surviving cats, at last follow up, and the cat euthanised 252 days postoperatively (case eight), at 247 days postoperatively, was described as excellent (1) or good (2). The median follow up for all cats surviving to discharge was 4.9 months (range 11 days-10 months).

**Discussion**

Lung lobe torsion is a rare condition in cats, causing respiratory signs, and frequently occurring secondary to an underlying thoracic pathology. In this case series cats undergoing lung lobectomy for LLT suffered a high rate of complications with a high mortality rate compared with previously reported cases.2,7–14,18

Lung lobe torsion primarily presents with respiratory signs and can affect cats at any age without a clear sex predilection as previously described.1,2,11,16 As reported previously, the predominant breed affected in this study was the domestic shorthair.2,5,7–10,15,16

Lung lobe torsion is diagnosed using thoracic radiographs, thoracic ultrasound, CT, bronchoscopy or a combination of these modalities.15,18 Pleural effusion and increased lobar opacity are the most common radiographic findings whereas vesicular emphysematous pattern and a proximally displaced or narrowed bronchus are the most specific findings.12,18

Although torsion of the right cranial,5,14 left cranial,10–12,16,18 and left caudal lung lobes is reported,2 the right middle lobe is predominantly affected in cats with LLT.5,7–10,13,17,18 A possible explanation is that the cranial and middle lung lobes are prone to torsion as they lack supportive pulmonary ligaments which secure the caudal lung lobes to the caudal mediastinum.14 In this case series there was no obvious predilection for a particular lung lobe, therefore LLT should be suspected irrespective of which lobe appears involved.

In this study, seven LLTs were deemed secondary to an intrathoracic disease, resulting in marked pleural effusion increasing lung lobe mobility or altering the spatial relationship of the intrathoracic structures. In three cases of idiopathic LLT no underlying pathology was found. Pleural effusion was present in all three cats; establishing whether the pleural effusion was the cause or the consequence of the LLT remains unclear.

Most reported LLT in cats are of secondary aetiology (67%),2,5,7–18 in contrast to in dogs (24-38%).1,6,24 Given the predominance of secondary LLT in cats, a thorough search for a possible underlying disease should be performed in cats with a suspected LLT.

Most cats (7) in this study experienced intraoperative and/or postoperative complications. Six of these cats had secondary LLT. Whilst some complications such as hypothermia, hypotension, development of chylothorax and persistent pleural effusion were consistent with previous reports1,2,6,24 others were novel including ATE and persistent pneumothorax. While aortic thromboembolism is common in cats secondary to cardiac disease,26 and cerebral infarction due to thrombi is reported in human patients following lobar derotation after LLT,21 the cause of ATE could not be determined in this cat. No structural cardiac changes were documented during preoperative echocardiography and it is unknown if the ATE was the result of the LLT and associated surgery. Prognosis for ATE is poor and this cat was euthanised 11 days after surgery.26,27 Pneumothorax following surgical correction of PPDH has been previously reported in one case, as has pneumothorax with concurrent LLT in another case. Alveolar emphysema was documented in both cases, with grave prognosis.13,28

Prognosis following lung lobectomy for LLT is described to be good in small animals with all cats undergoing lobectomy reported in the veterinary literature surviving to discharge and 86-95% of dogs surviving to discharge.1–3,6,24,29,30 In this study the outcome following surgical management of LLT was poor for seven of the ten cases. This appears higher than previously reported. We could speculate that the high mortality rate was associated with the higher proportion of secondary LLT in the present study, a factor previously shown to correlate with worse outcome in dogs,6 as well as with a higher rate of complications.1,6,11,13,24 Another possibility is that cats treated for LLT have not been previously reported if the final outcome was poor.

The owner perceived outcome for the three cats that survived long term was considered good to excellent. Two had idiopathic LLT: their good outcome is consistent with a recent study that revealed that dogs undergoing lung lobectomy for idiopathic LLT have a better prognosis and outcome, with a longer survival time compared with dogs experiencing secondary LLT.6 The other cat had a pyothorax, which is usually associated with a good outcome in cats, including cases treated surgically, and has been described previously in a cat in conjunction with LLT with good long-term outcome.10,31

**Conclusion**

In this study, LLT in cats secondary to underlying thoracic pathology appears to have high rates of complications and poor outcomes. Preoperative chylothorax was commonly seen and resulted in a poor prognosis in all cases. Of those cats surviving to follow up, outcomes were good. Whilst it is uncommon in cats, LLT should be considered as a differential diagnosis in cats presenting with clinical signs of lower respiratory tract or pleural space disease.

**Conflict of interest**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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**Ethical Approval**

The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards (‘best practice’) of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in JFMS. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

**Informed Consent**

Informed consent (either verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (either experimental or non-experimental animals) for the procedure(s) undertaken (either prospective or retrospective studies). No animals or people are identifiable within this publication, and therefore additional informed consent for publication was not required.

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**Table 1**

Descriptive analysis of ten cats with LLT. Abbreviations: DCRV, double chambered right ventricle; VSD, ventricular septal defect; SAM, systolic anterior movement; MVR, mitral valve regurgitation; DLVOTO, dynamic left ventricular outflow tract obstruction; CHF, chronic heart failure; ATE, aortic thromboembolism; CPA, cardiopulmonary arrest; TDL, thoracic duct ligation; SP, subtotal pericardiectomy; CCA, cisterna chyli ablation; y, years; m, months; d, days; h, hours; M, male; F, female; N, neutered; DSH, domestic shorthair; DLH, domestic longhair

**Figure 1**

CT, dorsal, pre contrast image of the thorax (case nine). Note the proximal aspect of the left cranial bronchus visible, abruptly terminating (arrow). Aerated bronchus is noted more distally within the lobe (arrowhead). There is consolidation of the affected lobe (asterisk). R, right; L, left

**Figure 2**

CT, transverse, pre contrast image of the thorax (case nine). The cranioventral aspect of the left cranial lobe has a vesicular gas pattern (arrow). R, right; L, left

**Figure 3**

Image of virtual bronchoscopy from case four, demonstrating the oval shaped, collapsed right cranial lobar bronchus (arrowhead) and the normal patent right middle and caudal bronchi (arrow) consistent with a right cranial lung lobe torsion. R, Right

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| **Case**  | **Age**  | **Breed** | **Sex** | **Body Weight (kg)** | **Presenting Signs** | **Pre-existing Comorbidities** | **Physical Examination** | **Diagnostic Imaging** | **Lung Lobe Affected** | **Concomitant procedures**  | **Surgical Approach** | **Suspected LLT Aetiology** |  **Complications (intraoperative)** | **Complications (postoperative)** | **Time of Complications** | **Survival to discharge** | **Outcome** | **Cause of death** |
| 1 | 4y2m  | DSH | FN | 3.7 | Dyspnoea, tachypnoea, anorexia | - | Tachypnoea, restrictive respiratory pattern, attenuated pulmonary sounds (generalised; bilateral), pyrexia | Radiographs, Ultrasound, CT | Left Cranial | Mediastinum resection | Median Sternotomy | Pyothorax | Hypothermia | Pleural effusion | <30h | Y | Good, 9m | - |
| 2 | 7y0m | DSH | FN | 3.1 | Dyspnoea, tachypnoea | - | Tachypnoea | Ultrasound, Echocardiogram, CT | Right Cranial  | - | R 5th intercostal thoracotomy | Idiopathic | - | - | - | Y | Good, 10m | - |
| 3 | 8y0m | DSH | F | 2.9 | Dyspnoea (single episode), tachycardia | - | - | Ultrasound, Echocardiogram, CT | Right Middle | - | R 5th intercostal thoracotomy |  Idiopathic | - | - | - | Y | Euthanised, 11d | Pleural effusion, ATE |
| 4 | 2y8m  | Maine Coon | M | 3.5 | Dyspnoea, tachypnoea | DCRV, VSD, SAM with MVR, DLVOTO, left sided ventricular hypertrophy and right CHFFeline upper respiratory tract disease | Tachypnoea, restrictive respiratory pattern, attenuated pulmonary sounds (ventral), cardiac murmur | Echocardiogram | Right Cranial | Partial right ventriculectomy with graft placement | L 5th intercostal thoracotomy  | Cardiac disease and chylothorax | Hypothermia, Hypotension | Hypotension | 0h | N | CPA, 5.5h | Hypotensive Crises |
| 5 | 11y7m  | DSH | MN | 4.9 | Dyspnoea, cough, retching, anorexia, lethargy | Nephroliths and intermittent dysuria | - | Radiographs, Ultrasound, CT | Right Cranial and Right Middle | TDL, SP and CCA.Exploratory laparotomy.  | Median Sternotomy | Idiopathic chylothorax | - | Persistent pleural effusion, subcutaneous fluid accumulation at thoracostomy tube site | 6d | N | CPA, 9d | Persistent pleural effusion |
| 6 | 2y0m  | British Shorthair | MN | 4.9 | Retching, anorexia | PPDH | Dyspnoea, tachypnoea, attenuated pulmonary sounds (ventral) | Radiographs, CT | Left Cranial | Right cranial, middle and caudal stapled partial lobectomy | Median Sternotomy | Pneumothorax/PPDH repair | Hypothermia, Hypotension, Pneumothorax | Pneumothorax | 3.5h | N | Euthanised, 4h | Recurrent pneumothorax |
| 7 | 3y0m | DSH | MN | 3.6 | Dyspnoea, tachypnoea | - | Tachypnoea | Ultrasound, Echocardiogram, CT | Right Middle | TDL, SP | L 5th intercostal thoracotomy  | Idiopathic chylothorax | Hypothermia, Hypotension | - | - | Y | Euthanised, 21d | Recurrent Chylothorax |
| 8 | 9y2m  | DSH | MN | 5.0 | Dyspnoea, tachypnoea, cough | HCM | Tachypnoea, attenuated pulmonary sounds (generalised; bilateral) | Radiographs, Ultrasound, Echocardiogram, CT | Right Cranial | - | R 5th intercostal thoracotomy | Idiopathic | - | Chylothorax | 36h | Y | Euthanised Excellent, 252d | -  |
| 9 | 9y8m | DLH | MN | 5.3 | Tachypnoea | Idiopathic feline lower urinary tract disease | Tachypnoea, attenuated pulmonary sounds (ventral; bilateral), pale mucous membranes | Ultrasound, CT | Left Cranial  | - | L 5th intercostal thoracotomy  |  Pleural effusion, Pulmonary carcinoma | - | - | - | Y | Euthanised, 35d | Recurrent pleural effusion, pulmonary carcinoma |
| 10 | 12y4m | DSH | F | 4.6 | Dyspnoea, anorexia, lethargy | Hyperthyroidism, HCM with left atrial enlargement | Dyspnoea, tachypnoea, attenuated pulmonary sounds (generalised; left), cardiac murmur, pale mucous membranes | Radiographs, Ultrasound, CT | Left Cranial  | - | L 5th intercostal thoracotomy | Pleural effusion | Hypothermia, Hypotension | Chylothorax | 3d | N | CPA, 7d | Pleural effusion, Hypotensive crisis |

**Table 1**