

## Pneumomediastinum, pneumothorax and pneumoretroperitoneum following endoscopic retrieval of a tracheal foreign body from a cat

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### ABSTRACT

A 6-year-old entire male cat was presented with a 1-week history of severe dyspnoea without coughing. Upon auscultation, an inspiratory and particularly pronounced expiratory wheeze was noted, with severe dyspnoea. The minimum database was normal. Plain thoracic radiographs showed signs of a mural or intraluminal intrathoracic (T1–T4) tracheal narrowing. A dynamic collapsing trachea was ruled out using fluoroscopy. Bronchoscopy was performed and a dark green and brown spiculated foreign object was found just cranial to the carina. Following removal, the cat rapidly developed extensive truncal subcutaneous emphysema and oxygen-responsive dyspnoea and cyanosis. Follow-up radiographs demonstrated unilateral pneumothorax and lung collapse, marked pneumomediastinum and dissection of air through the tracheal wall. A thoracic drain was placed and the pneumothorax resolved rapidly. Follow-up radiographs demonstrated resolution of pneumothorax and development of extensive retroperitoneal air. The cat made an uneventful recovery. The foreign object was the calyx and stem of a flower. This article emphasises the importance of diagnostic imaging in the dyspnoeic patient, both for confirming initial suspicions of respiratory tract disease, and in managing and charting post-therapy resolution or complications.

**Key words:** cat, endoscopy, foreign body, pneumomediastinum, pneumothorax, radiography, trachea.

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### INTRODUCTION

Respiratory foreign objects are not common in canine and feline patients. In the latter species, foreign material (particularly plant material) usually enters the upper respiratory tract, particularly the nasopharynx, as a sequel to gagging and gastrointestinal expulsion of grasses. Owing to their fastidious eating habits and differences from dogs (*i.e.* they are not used for hunting), they rarely inhale grass awns or such like into the lower respiratory tract<sup>1</sup>.

Inhalation of foreign objects into the lower airways can be expected to cause variable degrees of coughing, dyspnoea, stridor, panic and cyanosis. Objects may alight in terminal bronchioles and initiate local inflammatory and infectious processes, resulting in limited disease (*e.g.* a lobar abscess) or such processes may extend and cause serious and life-threatening disease (*e.g.* pyothorax, abscessa-

tion or atelectasis of an entire lobe or lung)<sup>8</sup>. Normally, a strong cough reflex would be expected to expel smaller particles, although larger objects are not likely to be removed. A complete or near-complete occlusion of a major airway may result in catastrophic panic and death.

This case report focuses on the radiographic findings of a plant foreign body in the trachea of a cat, both pre- and post-removal, as well as the findings of iatrogenic pneumothorax caused by its retrieval.

### CASE HISTORY

A 6-year-old, entire male domestic shorthair cat was presented with a 1-week history of dyspnoea. He was non-febrile and had a normal respiratory rate (22/min). His respiratory pattern was one of deep inspiration and strained expiration and a wheeze could be heard in both cycles of breathing, even without a stethoscope. His left kidney was palpably larger than expected, but not painful. No other information was gained from physical examination. A minimum database was performed consisting of blood

smear, urine dipstick, specific gravity and sediment analysis, faecal flotation and wet prep, haematology, serum albumin, globulin and creatinine concentrations. All parameters were within normal limits.

Radiographs of the thorax and abdomen were performed. The cat was manually restrained without sedation, following 5 minutes pre-oxygenation in a Perspex oxygen chamber.

Survey lateral views of the thorax revealed partial tracheal occlusion by a 6 × 50 mm, spindle-shaped tissue-level radio opacity confluent with the ventral tracheal border in the region of the first to fourth intercostal spaces (Fig. 1). The caudal lung fields showed a moderate bronchial pattern; this was also evident in the cranial lung fields on the DV view (Fig. 2). The lung fields appeared hyperinflated, with a scalloped costophrenic angle noticeable especially on the left lateral view. This was judged to be due to hyperinflation in the non-dependent right lung. On the right lateral view there was a gas-tissue interface with a scalloped border, running from the sternum in the area of the fourth sternocostal junction, up and across the cardiac apex, before joining the sternum again at the costophrenico-xiphisternal intersection. This was considered to represent over inflation and rightward deviation of the left caudal lung lobe. Abdominal radiographs only demonstrated aerophagia and large pockets of colonic gas. Subjective renal size measurement proved to be normal.

A provisional diagnosis of intratracheal foreign body or mural tracheal neoplasm or granuloma was made. For this reason, fluoroscopy was performed to rule out the slight possibility of dynamic tracheal compression in a cat, but the tracheal narrowing was consistently observed throughout the respiratory cycle.

Endoscopy using a 2.7 mm diameter bronchoscope was carried out the following day.<sup>8,14</sup> The cat was prepared using the same oxygen chamber and induced and maintained on a 2:1 v/v mixture of 2 mg diazepam (Tranject, Merck) and 10 mg ketamine (Anaket-V, Bayer AH) administered *via* a cephalic catheter. Ten minutes after induction, 0.1 mg of intravenous

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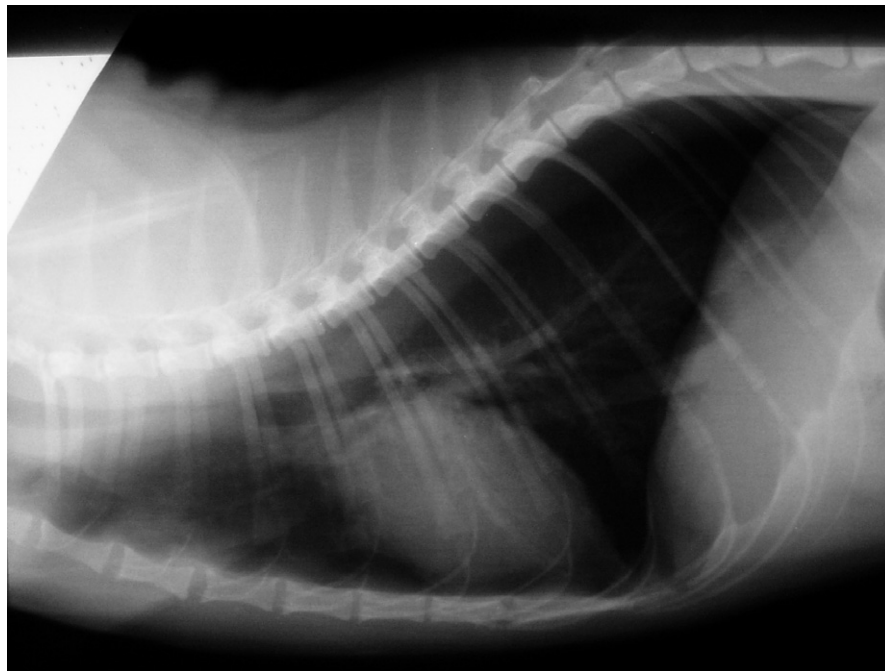
medetomidine (Domitor, Novartis AH) was added; this was antagonised at the end of the procedure with an equal volume of intramuscular atipamezole (Antisedan, Novartis AH). Oxygen was supplied by tracheal insertion of a 4 FG plastic feeding tube coupled to a humidified oxygen source, administered at 3 l/min. The larynx was anaesthetised using a lignocaine spray (Xylocaine, Astra-Zeneca). This was repeated 60 minutes later. At the end of the procedure, beclomethazone spray (Beclate-200, Cipla Medpro) was used to reduce laryngeal oedema, along with 0.4 mg of dexamethazone (Kortico, Centaur) administered intramuscularly. Oxygen saturation was monitored throughout the procedure using a lingual sensor attached to a pulse oximeter (Nonin, Kyron, Johannesburg)

A green-brown, spiculated object was seen in the trachea in front of the carina, corresponding to the radiographic stenosis. It was enmeshed in mucous and granulation tissue. It was retrieved in two pieces by means of a flexible 2 mm endoscopic forceps passed alongside the oxygen tube and endoscope. The object was revealed to be the calyx and first 15 mm of the stem (Fig. 3) of a flower.

Immediately after the procedure, subcutaneous emphysema was noted. Initially, penetration of an airway with the forceps was suspected and radiographs of the thorax were taken (Figs 4, 5). Marked subcutaneous emphysema extended from the cervical tissues to the cranial abdominal region. Owing to a marked pneumomediastinum and pneumothorax, the entire thoracic oesophagus, aorta, cranial and caudal venae cavae, azygos vein, and collapsed right caudal and accessory lung lobes were all clearly demarcated. The trachea was highlighted and, in the area where the foreign body had been, was thickened ventrally, with three 1–2 mm diameter radiolucencies within the ventral wall (Fig. 6). These were suspected to be the actual source of the pneumomediastinum and pneumothorax and surmised to be the result of tugging free a foreign object enmeshed in granulation tissue overlying a weakened tracheal wall.

The DV view (Fig. 5) demonstrated severe unilateral pneumothorax on the right with complete collapse of all right lung lobes. The feeding tube (for oxygen supplementation) was visible on both views. On the lateral view, the heart was elevated off the sternum and gas was seen in the caudodorsal area, possibly extending into the abdomen.

A thoracic drain was immediately placed in the right hemithorax while the cat was maintained on oxygen and



**Fig. 1: Left lateral view of the thorax. The partial tracheal occlusion caused by a soft-tissue opacity at the level of T1–T4 is evident. There is a mild bronchial pattern in the caudal lung fields, and the scalloped costophrenic interface is particularly noticeable.**

continuous positive-pressure ventilation. Following removal of the endotracheal tube, radiographs of the abdomen and thorax were retaken (Figs 7–9).

Even though less than 5 ml of air could be removed via the drain, the atelectasis, pneumothorax and most of the pneumomediastinum had nearly completely resolved (Fig. 8). This probably occurred during drain placement through the action of the ventilator. Radiographic

contrast in the chest was still excessive (Fig. 7), but less marked than in Figs 4 and 5. A pneumoretroperitoneum, with enhancement of the kidneys, colon, bladder and sublumbal muscles, was now evident on the abdominal view (Fig. 9). This resulted from dissection of air alongside the aorta, azygos vein and thoracic duct, which traverse the aortic hilus of the diaphragm and travel in the retroperitoneal space<sup>8</sup>. The cat made an



**Fig. 2: Dorsoventral radiograph, pre-endoscopy. There is a moderate bronchial pattern in the cranial lung fields.**

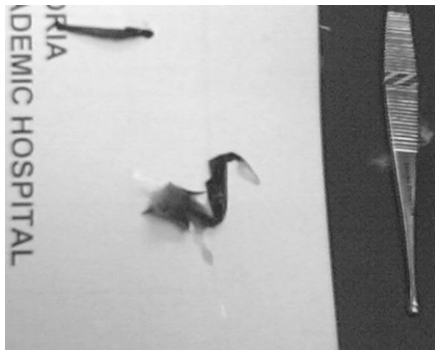


Fig. 3: The foreign body in two parts; the lower part consisting of the calyx and most of the retrieved stem of a flower, with another segment of the stem lying just above.

uneventful recovery and the thoracic drain was subsequently removed and the patient discharged two days later.

## DISCUSSION

Tracheobronchial foreign bodies are an infrequent but serious occurrence in veterinary medicine. They are one of many differential diagnoses for a cat presenting with symptoms such as those demonstrated by this patient<sup>7,14</sup>. After obtaining the minimum database, imaging forms an important first step in the extended database, and survey thoracic radiographs are the technique of choice. Although ventrodorsal views are the standard for evaluation of the lungs in the author's hospital (and not dorsoventral as in this case)<sup>6,16</sup>, dyspnoeic cats rarely tolerate (or survive) this manipulation, or even lateral radiographs in severely sick patients, therefore proper patient preparation (sedation, preoxygenation, handling) is paramount if the patient is to survive diagnostic procedures.

Radiographic indications of foreign bodies alighting in airways may include one or more of:

- A radiodensity (the object itself, or the inflammatory exudates gathered around it) or radiolucency (a filling defect, or bacterial gasses surrounding it) or a combination (*e.g.* a pulmonary abscess or airway neoplasm)<sup>3,7</sup>;
- Tracheal or bronchial narrowing (non-dynamic, unlike some cases of tracheal collapse)<sup>8</sup>;
- 'Downstream' atelectasis if a bronchus is occluded and the lobe or lung collapses<sup>8</sup>;
- A bronchial or lobar radiographic lung pattern in the affected lobe(s)<sup>10</sup>;
- Diaphragmatic flattening (due to hyperpnoea)<sup>17</sup>;
- A negative contrast gastrogram (aerophagia)<sup>13</sup>;
- Cystic, bullous, nodular disease of a

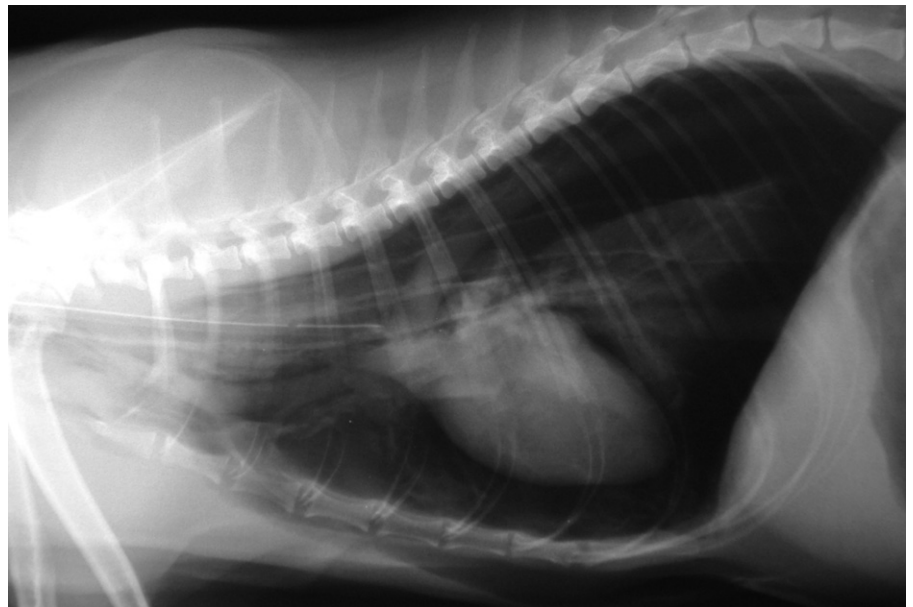


Fig. 4: Left lateral thoracic view, post-endoscopy. The endotracheal feeding tube supplying oxygen is visible. The pronounced pneumomediastinum and pneumothorax have resulted in a clearly visible aorta, venae cavae, trachea, oesophagus and other mediastinal structures. The heart is elevated off the sternum. Note the collapsed lung lobes.

lobe or lung<sup>21</sup>;

- Pneumothorax (from a ruptured bronchus or lung, with or without a mediastinal shift)<sup>9</sup>;
- Pneumomediastinum<sup>11,12,15,19-22</sup>;
- Pyothorax (fluid in the thorax revealed as purulent by centesis)<sup>8,9,20</sup>;
- Elevation of the heart off the sternum (due to shifting of air in the pleural space when the heart is displaced to the recumbent side of the animal)<sup>8</sup>.

Tracheal narrowing on a radiograph may be the result of a static or dynamic abnormality. An example of the latter is tracheal collapse, which is rare in cats<sup>7,8,14</sup>. Some examples of static tracheal occlusions are extramural causes such as thymoma and mediastinal lymphoma; mural causes such as granulomas, tracheal neoplasms and strictures; and intraluminal causes such as foreign bodies<sup>5,7,8</sup>. A dynamic disease was ruled out by fluoroscopy,



Fig. 5: Dorsoventral thoracic view, post-endoscopy. The marker in the tube supplying oxygen can be seen just right of the midline. There is a pronounced right-sided pneumothorax, with complete collapse of all the right lung lobes.

where only a static, unchanging, mural or intraluminal defect was observed. Extratracheal masses tend to create a clear gas-trachea-tumour radiographic interface and the surrounding gas of the lungs. Masses in the cranial mediastinum tend to cause deviation of the trachea more frequently than outright stenosis or compression<sup>2,5,8,10</sup>. Only bony or metallic objects can be distinctly detected as such by radiography or fluoroscopy; objects and masses composed of soft tissue, and many plant and synthetic materials all have soft-tissue-like radiodensities. The surrounding air in the airways may highlight them, but deeply lodged bronchial objects can potentially collapse the dependent lung and therefore vanish radiographically. Their presence must then be inferred from the changes they cause in the atelectatic lung, while other differential diagnoses such as bronchial adenocarcinoma should also be considered<sup>5,8,14,16</sup>.

The mechanism of pneumomediastinum following foreign body aspiration is well described in human medicine, where such cases occur frequently<sup>12,20,22</sup>. An endoluminal foreign body causing partial or complete occlusion will produce an interstitial emphysema by causing rupture of alveoli in the over-inflated lung. This air then travels along the sheaths of the pulmonary blood vessels to the hilus of the lung, and from there into the mediastinum and ultimately the thorax<sup>6,10,21,22</sup>.

Following radiographs and fluoroscopy, tracheobronchoscopy was clearly indicated in this patient. Retrieval of tracheobronchial foreign bodies can be challenging, therefore meticulous attention to anaesthetic technique and gentle handling of instruments to avoid laryngospasm or tracheobronchial perforation are essential<sup>14,16</sup>. Alternatively, the use of suction devices and Foley's catheters for object removal has also been described in the literature<sup>16,18</sup>. Rigid bronchoscopes may allow better airway control in paediatric cases of foreign body inhalation patients, and bronchoscopy is advisable even when radiography is negative for foreign body inhalation, but clinical signs are still suggestive<sup>12,14,16,20,22</sup>.

The development of subcutaneous emphysema was rapid and sudden in this case and not presaged by any drop in respiratory function or haemoglobin saturation (as measured by pulse oximetry). In such instances, rapid radiographic follow-up is necessary and was essential in the management of this patient. It allowed diagnosis of the underlying problem, facilitated ongoing management of interventions, and monitor-

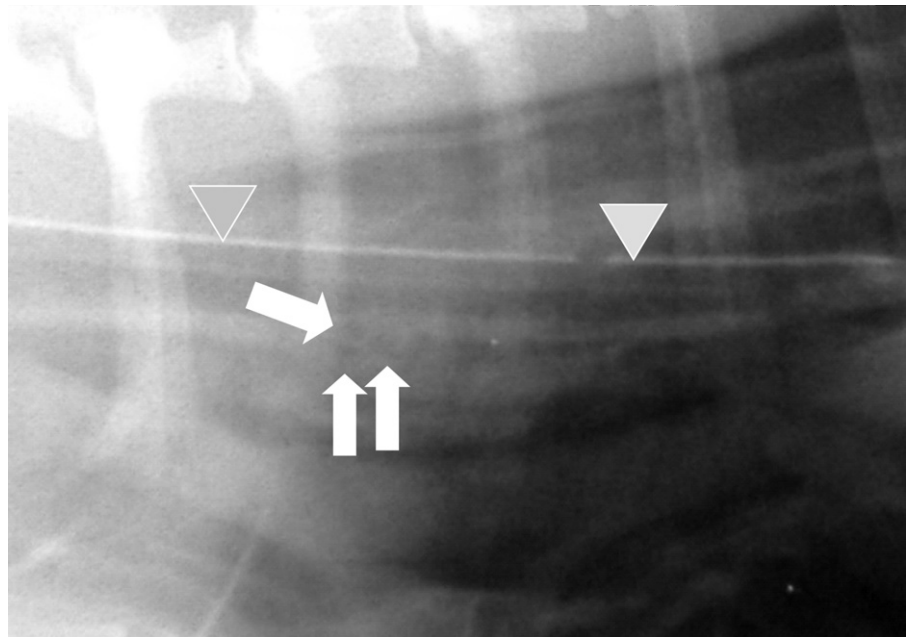


Fig. 6: Close-up of ventral trachea from Fig. 4, showing the three intramural radiolucencies (white arrows) thought to be the source of the pneumomediastinum. The resolution of the tracheal occlusion following foreign body removal is also noticeable. The feeding tube used for oxygen supplementation is also demarcated (grey arrowheads).

ing thereof. The development of the pneumomediastinum, arising from a small tracheal tear, was exacerbated by the supplementation of high-oxygen flow rates using a feeding tube. This also caused pneumothorax, apparently only on the right side. Although repeat endoscopy was not performed, the original procedure demonstrated a ventrolateral, right-sided mass; and radiographically demonstrated radiolucencies in the ventral trachea following removal (Fig. 6). This defect was therefore presumably caused by the removal of a firmly adhered

and enmeshed foreign object, since pre-endoscopy radiographs demonstrated no air in the thoracic or abdominal cavities.

## CONCLUSIONS

To the author's knowledge, this is only the third described case of plant material in a feline trachea<sup>4,18</sup>, and the first case report with subsequent pneumomediastinum, pneumothorax and pneumoretroperitoneum, documented by serial radiography. This case report emphasises the importance of diagnostic imaging and

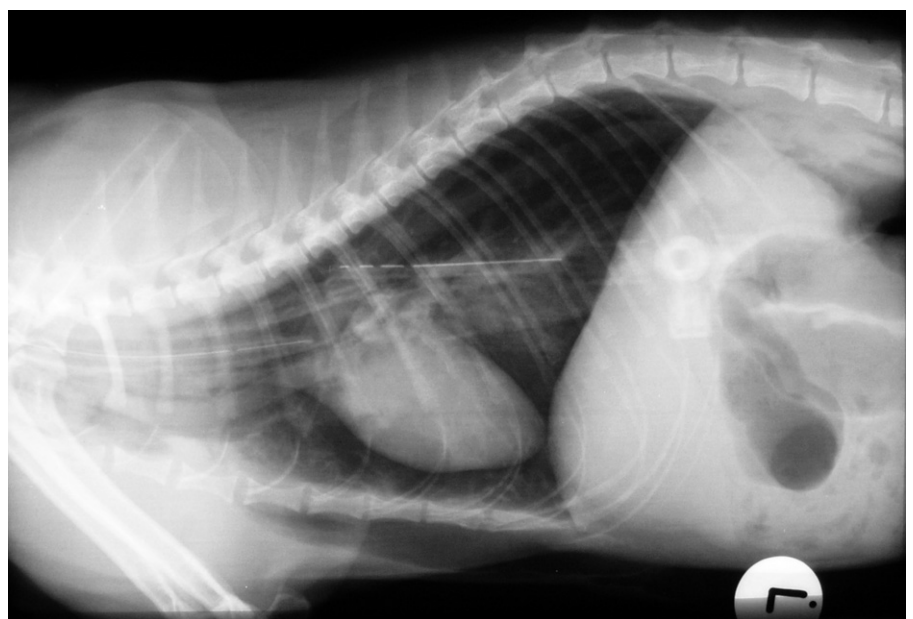


Fig. 7: Left lateral thoracic radiograph. The thoracic drain is evident entering two-thirds up the thoracic wall, in the eighth intercostal space. Negative contrast from the pneumomediastinum is still evident, but less marked than in Figs 4 and 5.



Fig. 8: Dorsoventral radiograph, post-thoracic drain placement. There is marked resolution of the pneumothorax. Subcutaneous emphysema can be seen on this view.

careful patient anaesthesia, handling and monitoring when managing a dyspnoeic cat. The inherent challenges in accurately and rapidly diagnosing a foreign body of non-metallic and non-osseous radio-density are apparent in this location and this species, where plant material is rarely the culprit. It is reasonable to advise that all foreign objects be removed with due care and attention to the possibility of adherence to the tracheal wall. Foreign

objects remaining in the airways may lead to a number of serious consequences, such as bronchopneumonia, lung abscessation, pneumothorax and pneumomediastinum, chronic lung or airway disease, pyothorax, haemoptysis, and eventually, surgical lobectomy<sup>4,11,12,18,21</sup>. Removal without careful monitoring afterwards may overlook the possibility of tears in the trachea, resulting in fatal pneumothorax<sup>20</sup>.

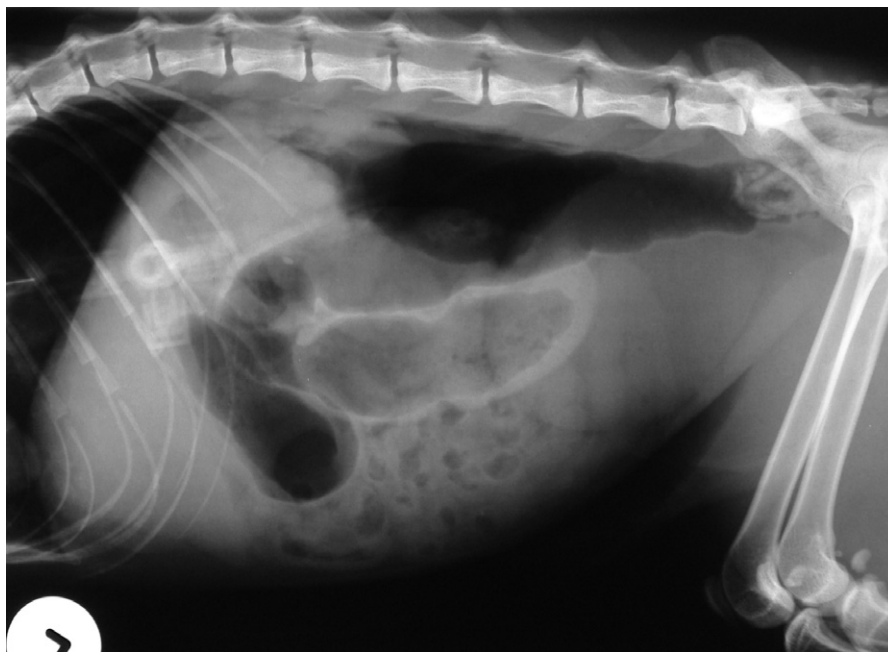


Fig. 9: Left lateral abdominal radiograph. Excellent detail of retroperitoneal organs is apparent due to negative contrast provided by dissection of air from the mediastinum and thorax through the diaphragmatic hilus.

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