The diagnosis and management of pneumothorax

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Introduction

Pneumothorax is an abnormal accumulation of air in the pleural space within the thoracic cavity. It can be severely debilitating and indeed life threatening. The successful management of pneumothorax relies on prompt recognition of the problem and timely and effective intervention. This article will review the pathophysiology of pneumothorax and discuss the clinical signs associated with the problem in dogs and cats and the treatment options available.

Pathophysiology

Pneumothorax is most commonly classified according to its aetiology or cause, i.e. traumatic, spontaneous, iatrogenic, or according to its pathophysiology or nature, i.e. open or closed and simple or tension. However, often a combination of these classification systems is used to describe an individual case.

The lungs and thoracic wall are covered in thin serous membranes called respectively, the visceral and parietal pleura. These pleurae form two pleural sacs or cavities around the lungs, the left, and the right, separated by the mediastinal pleura. Between the visceral and parietal pleura is a potential space called the pleural space or cavity. This is a closed space and the pleurae are kept in close apposition by a thin layer of pleural fluid. This close apposition allows a mechanical interaction between the lungs and the body wall, which is essential for normal breathing and ventilation. A simple illustration of this relationship is what happens when you place a drop of water on a glass slide and put another slide on top. While the two slides will move smoothly over one another, when you try to separate them, they stick together.

At rest, the pressure in the pleural space is sub-atmospheric, which keeps the lungs inflated by overcoming the inherent elastic recoil of the lung tissue. Atmospheric air (or gas) can gain entry into the pleural space by three different routes: through the body wall (pleurocutaneous), through the airways such as the trachea, bronchi or alveoli (pleuropulmonary) and through the oesophagus (pleuro-oesophageal). Because the pressure in the pleural space is sub-atmospheric, a breach in the pleurae for any reason results in an influx of air into the pleural space. This abnormal accumulation of air uncouples the mechanical relationship between the thoracic wall and the pulmonary parenchyma causing the lungs to collapse inward. The degree of lung collapse varies in severity with the volume of air in the pleural space. Pneumothorax usually, but not invariably, occurs bilaterally in dogs and cats.

Aetiology

Traumatic pneumothorax

Traumatic pneumothorax is the most common type of pneumothorax in dogs and may be either open or closed. It is less commonly reported in cats. This may be because their thoracic wall is more compliant (flexible) than that of dogs.

Closed traumatic pneumothorax tends to occur following blunt trauma such as a car accident, being kicked or falling from a height. As the chest wall deforms it can cause damage to the lungs and/or the bronchial tree, resulting in leakage of air into the pleural space. Open pneumothorax is less common and occurs

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from penetrating injures to the thoracic wall leading to direct communication between the pleural space and the external environment. Examples of such injuries include bite, gunshot and stab wounds.

Iatrogenic pneumothorax

Iatrogenic pneumothorax can also be open or closed. Open pneumothorax can occur following chest-drain removal or complications, dehiscence of thoracotomy incisions or inadvertent penetration of the diaphragm during abdominal surgery. Less commonly, closed iatrogenic pneumothorax can occur associated with thoracocentesis, tracheal rupture caused by tracheal intubation for general anaesthesia (especially in cats) or as a complication of bronchoscopy or positive pressure ventilation.

Spontaneous pneumothorax

Spontaneous pneumothorax is defined as an accumulation of air in the pleural space in the absence of traumatic or iatrogenic causes. It can be primary, i.e. there is no underlying disease identified, or secondary to pulmonary disease such as pneumonia, lung abscess or neoplasia.

Simple vs tension pneumothorax

Simple pneumothorax

Simple pneumothorax is non-progressive and free movement of air occurs through the defect in the body wall, airways or oesophagus during inspiration and expiration.

Tension pneumothorax

Tension pneumothorax is a life-threatening condition and can occur regardless of the aetiology of the pneumothorax. It happens when a flap of tissue acts as a one-way valve, allowing air into the pleural space during inhalation and preventing its escape during exhalation. This results in a progressive accumulation of air in the pleural space, culminating in severe respiratory distress, hypoxia and cardiovascular collapse. If left untreated it is rapidly fatal.

Diagnosis

It is important to take a thorough history in addition to performing a complete physical examination. Frequently this will alert the veterinary surgeon to the possibility of pneumothorax. While diagnostic imaging can be useful, a clinical diagnosis can often be made prior to imaging and confirmed by performing needle thoracocentesis. This has the added benefit of improving the patient's ability to breathe prior to further investigation.

Clinical presentation and signs

Most animals present with varying degrees of respiratory distress, tachypnoea, anxiety, and lethargy and may have a history of exercise intolerance, coughing and vomiting. Mucous membranes may be pale or, if the patient is hypoxic, they may appear cyanotic. Most animals have a restrictive respiratory pattern (rapid, shallow breathing) in an attempt to compensate and maintain adequate ventilation. The degree of respiratory distress depends on the severity and the duration of the pneumothorax. Dogs can tolerate a much larger pneumothorax than people due to their remarkable ability to increase their chest expansion.

Decreased to absent lung sounds, particularly dorsally, and muffled heart sounds ventrally may be noted on thoracic auscultation. There may be hyper-resonance on thoracic percussion. Subcutaneous emphysema can be present.

With traumatic pneumothorax there is often evidence of other physical injuries associated with the inciting trauma, such as skin wounds or bruising, open 'sucking' wounds (associated with open pneumothorax) or flail chest. Flail chest develops where at least two adjacent ribs are fractured with each rib fractured in at least two places. This results in a 'floating' segment of chest wall, which moves paradoxically on inspiration tending to collapse inwards as the chest wall moves out. In animals with tension pneumothorax the chest can rapidly become barrel shaped in appearance as it becomes maximally expanded.

Investigation

Thoracocentesis

Needle thoracocentesis is a procedure with both diagnostic and therapeutic value. While it is the initial principal step in the treatment of patients with pneumothorax, it also has a vital diagnostic role in confirming the presence of air in the pleural space where the history and clinical examination of the patient raises this possibility.

Imaging

Diagnostic imaging, including radiography and ultrasound, are useful diagnostic aids but are often not part of the emergency assessment of the patient and should not be performed in unstable patients. Doing so can increase morbidity and even mortality and these procedures should be delayed until after the patient has been stabilised.

Positioning for imaging that results in further distress or anxiety should be avoided, and generally dorsoventral and lateral views of the thorax are preferred. Radiographic signs of pneumothorax include: retraction of the lung lobes from the thoracic wall, leaving a radiolucent area of free air most evident in the caudal dorsal thorax, and collapse of the lung lobes, seen as increased radiopacity of the lung tissue. On lateral views, the heart may appear to be elevated from the sternum (**Figure 1**) In severe cases, and cases of tension pneumothorax, the diaphragm may appear to be flattened or displaced caudally.

Radiographs should also be evaluated for underlying pulmonary diseases such as abscesses orneoplasia, as well as injuries associated with trauma (for example rib fractures, pulmonary contusions or subcutaneous emphysema). Patients with pulmonary, tracheal or oesophageal leakage may also have a pneumomediastinum (air within the mediastinum) (**Figure 2**). Computed tomography may be chosen in preference to radiography to aid in the further diagnosis of pneumothorax in selected cases (**Figure 3**).

Figure 1. A left lateral thoracic radiograph of a dog with traumatic closed pneumothorax;note the elevation of the heart from the sternum and the retraction of the lung lobes from the thoracic wall

Figure 2. A right lateral cervical and cranial thoracic x-ray showing subcutaneous emphysema and pneumomediastinum

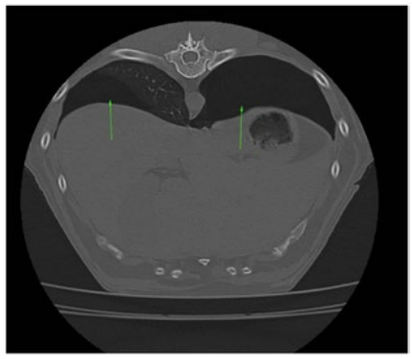

Figure 3. A CT image of a dog with bilateral pneumothorax (green arrows), more obvious on the left; a collapsed lung lobe is visible on the right

Ultrasound is increasingly used to aid in the diagnosis of pleural diseases, including pneumothorax. It offers a number of advantages compared to radiography at the time of initial presentation, and in experienced hands is more sensitive at detecting small air leaks.

Serum biochemical and haematological abnormalities specific to the diagnosis of pneumothorax are uncommon. However, blood gas derangements such as hypoxaemia and respiratory acidosis are commonly present (**Table 1**).

Treatment and nursing support

The treatment of pneumothorax depends on the cause, severity and clinical presentation of the animal. In a dyspnoeic patient treatment, including oxygen supplementation and thoracocentesis, should be implemented immediately. Oxygen can be delivered by a number of methods, including flow-by, mask, nasal cannula or oxygen tent/cage. It is important that the method chosen does not cause the patient to struggle and consequently increase its oxygen demand.

An intravenous catheter should be placed at the earliest practicable time. Open thoracic wounds should be covered by an occlusive dressing, thus creating a closed pneumothorax and facilitating thoracocentesis. Temporary wound closure can also be achieved with sutures, towel clamps or petrolatum-impregnated gauze.

Thoracocentesis

Thoracocentesis is the technique used to remove air or fluid from the pleural space. It is important that the RVN ensures that everything is prepared before this procedure commences, ensuring access to all necessary equipment (**Figure 4** and **Box 1**).

Box 1. Equipment required when performing thoracocentesis

- Clippers
- Materials for aseptic surgical preparation of the proposed site
- Sterile gloves
- Butterfly needle/hypodermic needle/over-the-needle catheter
- IV extension set
- 3-way stopcock or needle-free valve
- Selection of syringes (20–60ml depending on size of patient)
- Measuring bowl/jug for any fluid collected
- Sterile sample pots (plain and EDTA)
- Microscope slides in case of need for cytology

Table 1. Example of a blood gas report from a dog with pneumothorax. The low pH, hypoxia, hypercapnia and normal bicarbonate indicate a respiratory acidosis with no metabolic compensation

Parameter	Abnormal Value	Reference Range
pH	7.25↓	7.35–7.45
pCO_2 (mmHg)	60.1↑	34–40
pO_2 (mmHg)	79↓	85–100
HCO_3 (mmol/l)	24	20–24

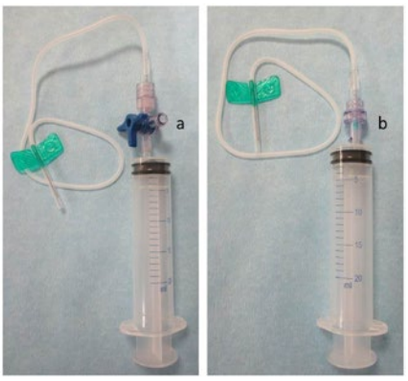

Figure 4. A simple set-up for thoracocentesis using a butterfly needle and either a three-way tap (a) or a one-way valve (b)

A wide area on the lateral thorax from the sixth to ninth intercostal spaces should be clipped and aseptically prepared. The patient should be restrained gently in a position that minimises stress while maximizing its ability to breathe. Most patients tolerate sternal recumbency, and this position has the benefit of allowing access to both sides of the chest if required. However, the patient may be allowed to stand, sit, or be placed in lateral recumbency if these positions are tolerated better.

The chosen needle or catheter should be long enough to penetrate the patient's pleural space – an important consideration in patients that may be overweight or obese. Butterfly needles have a short length of tubing attached, which is useful if the patient moves slightly during the procedure. When using either hypodermic needles or over-the-needle catheters, connecting a short IV infusion extension set will have the same effect. A three-way tap or needle-free valve allows a syringe of suitable size to be attached without the risk of entraining further air. Some veterinary surgeons believe over-the-needle catheters to be a safer option,however, they are likely to cause iatrogenic pneumothorax and have a tendency to kink. The authors prefer to use butterfly needles for thoracocentesis when possible.

The needle should be gently inserted into the seventh, eighth or ninth intercostal space along the cranial border of the rib to avoid the intercostal vessels and nerves that run immediately caudal to the rib. The needle is inserted at the mid-thoracic level, if fluid and air are expected, or in the dorsal third of the thorax where only air is anticipated. The syringe may be gently aspirated as the needle is advanced through the soft tissues of the chest wall to

allow appreciation of accurate placement of the needle.

Once the needle is within the pleural space it is stabilised to allow drainage of air. Some clinicians reposition the needle to flatten it against the rib cage to reduce the risk of trauma to the lungs, however, perversely; this procedure can lacerate lung tissue if the needle has been inadvertently placed into the lung during placement.

The pleural space is then completely evacuated of air or gas, which should be measured and recorded in the clinical record. During thoracocentesis you can usually appreciate an improvement in the patient's ability to breathe. When negative pressure is achieved, the needle is simply withdrawn from the chest.

Complications

Thoracocentesis carries the risk of iatrogenic pneumothorax, lung laceration, haemorrhage and pyothorax.

Chest-drain placement

Depending on the rate of air accumulation, thoracocentesis may not be adequate for drainage and chest-drain placement (tube thoracostomy) may be required.

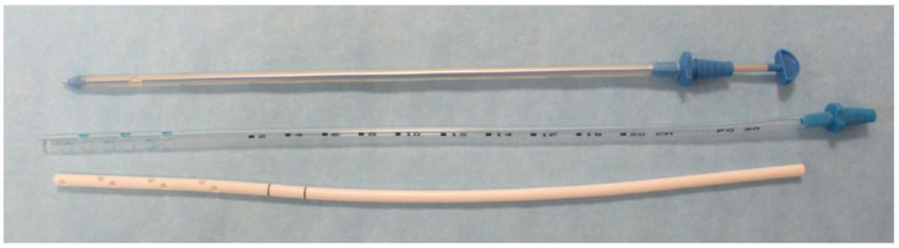

Figure 5. Examples of traditional large gauge chest drains: trocar drain (top) has fewer drainage holes than a non-trocar drain (bottom two images)

There are no specific guidelines for veterinary patients when placement of a chest drain is preferred over repeated thoracocentesis, however, chest drains must be considered where:

- air or gas accumulates rapidly, necessitating thoracocentesis more than twice within a 24-hour period
- negative pressure cannot be achieved during thoracocentesis
- if tension pneumothorax is present

There are a wide variety of chest drains available, including trocar drains, non-trocar drains (**Figure 5**) and drains that can be inserted using a Seldinger (over the wire) technique. The latter are particularly useful in cases of pneumothorax and will be discussed in more detail below.

The small-diameter drains introduced using the Seldinger technique are purchased as a kit that contains most of the necessary equipment for placement of the drain (**Figure 6** and **Box 2**). A drain of appropriate diameter, length and additionally that is *fenestrated* to an appropriate length is selected for the patient, for example 14G x 20cm fenestrated up to either 4 cm or 8 cm or 12G x 30cm fenestrated to 15cm.

Box 2. Equipment required for placing a wire-guided chest drain using the Seldinger technique

- Clippers
- Materials for aseptic surgical preparation of the proposed site of thoracocentesis
- Sterile skin drapes, e.g. an aperture drape or a transparent, adhesive aperture drape such as Visu-Drape™
- Sterile gloves
- Sterile pack containing appropriate-sized drain, guide wire, catheter-over-needle introducer, suture wings for the catheter and closed, one-way valve, e.g. Mila® Guidewire Inserted Chest Tube
- No. 11 scalpel blade
- Syringe (20–60ml)
- Local anaesthetic, e.g. lidocaine
- Suture materials, e.g. polyamide
- Sterile dressing materials

As for thoracocentesis, it is important that the RVN ensures that everything is fully prepared and that the clinician has access to all the necessary equipment before this procedure commences.

Heavy sedation and/or local anaesthesia are generally used for placement of wire-guided chest drains, although the patient may be anaesthetised if preferred. The patient is placed in sternal or lateral recumbency and the lateral thorax clipped and aseptically prepared from ribs 5–13,

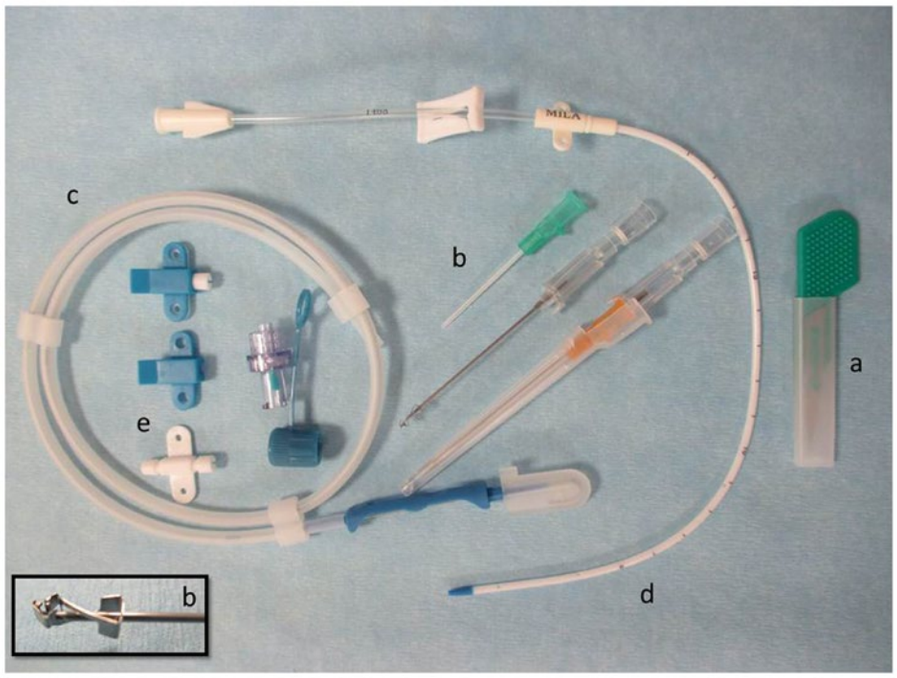

Figure 6. Equipment for placing small-gauge chest drain using the Seldinger technique: (a) No. 11 scalpel; (b) over the needle catheters; (c) guide wire in plastic sheath with blue thumb-guide; (d) chest drain; (e) additional flexible (white) and rigid (blue) suture wings. Suitable suture material, for example polyamide, should also be available to secure the drain (note the safety cap that prevents replacement of the catheter stylet once it has been withdrawn [inset])

to include skin within a 10 cm radius of the proposed site of insertion of the drain. The site of insertion is covered with a fenestrated sterile drape (**Figure 7**).

A small incision is made with a No. 11 scalpel blade at the eighth intercostal space in the dorsal third of the thorax. The over–the-needle catheter is advanced into the pleural space along the cranial border of the rib and the needle removed. The wire is threaded through the catheter into the thorax in a cranioventral direction, taking care to hold the wire at all times when it is partially within the thorax. The catheter is then removed and the drain advanced into the pleural space over the guide wire (**Figures 8a, 8b** and **8c**).

The drain can be introduced to the level of the suture wing in larger patients or a shorter length of catheter introduced, and subsequently secured with the additional suture wings provided, in smaller patients. The wire is removed and the drain is secured to the skin by passing suture material through holes in the suture wing. The drain is closed with a three-way stopcock or needle-free valve.The thorax is then drained of air.

A sterile dressing should be placed around the drain insertion site and the tubing secured to the thorax with a non-restrictive dressing or stockinette to prevent patient interference (**Figure 9**). An Elizabethan collar is also required at all times.Thoracic radiographs should be taken to confirm the correct placement of the drain(s) (**Figure 10**).

Complications

Iatrogenic pneumothorax, laceration of a lung lobe or vessel and drain migration are all potential complications of wire-guided chest-drain placement. In patients where a shorter length of catheter is introduced, drainage of unexpectedly large volumes of air immediately following placement of the drain should alert the veterinary surgeon and RVN to the possibility that one of the drain fenestrations may be located in the subcutaneous space or even outside the thoracic wall.

Drainage and equipment monitoring

Drainage

Placement of chest drains allows ongoing drainage of air accumulation within the thorax. This can be achieved using either manual, intermittent systems, for example the Heimlich valve (**Figure 11**), or continuous-drainage grenade and low-pressure suction systems (**Figure 12**).

When using a syringe for manual, intermittent drainage it is important that the veterinary surgeon or RVN does not apply excessive negative pressure. This can cause the chest drain to be sucked against the pleura and is not only uncomfortable for the patients but can result in lung injury. In most cases of pneumothorax, initially only air will be withdrawn. However, as the volume of air in the pleural space reduces, small amounts of pleural fluid or blood may be noted in the drain and syringe. This should alert the veterinary surgeon and RVN that the chest drainage procedure is almost complete and they should then be more vigilant to avoid applying excessive negative pressure.

Using a syringe appropriate to the patient's size can help to reduce the risk of applying excessive negative pressure, for example, using a 5–10 ml syringe in patients <15kg, applying no greater than 1–2ml of

Figure 7. A transparent, adhesive fenestrated drape in place on a sedated patient during chest drain placement using the Seldinger technique

Figure 8a. Creating a small incision in the skin at the site of planned drain placement (inset); passing an over-the-needle catheter cranial to the rib at the selected site of drain placement

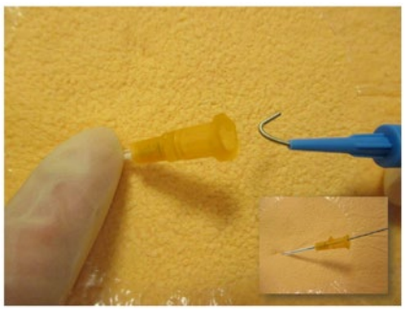

Figure 8b. Preparing to pass the guide wire through the over-the- needle catheter once the stylet has been removed. Some guidewires have a J-shaped tip, which straightens by pulling the wire back into the graduated tip of the blue thumb guide

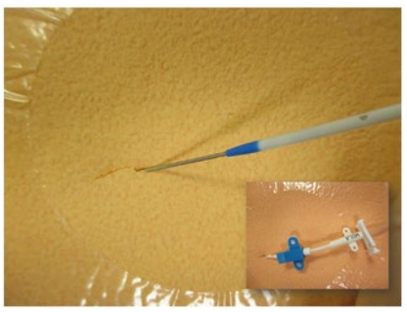

Figure 8c. Placing the small-gauge chest drain over the guide wire into the pleural space (note the clamp is closed on the drain as soon as the guide wire is removed [inset])

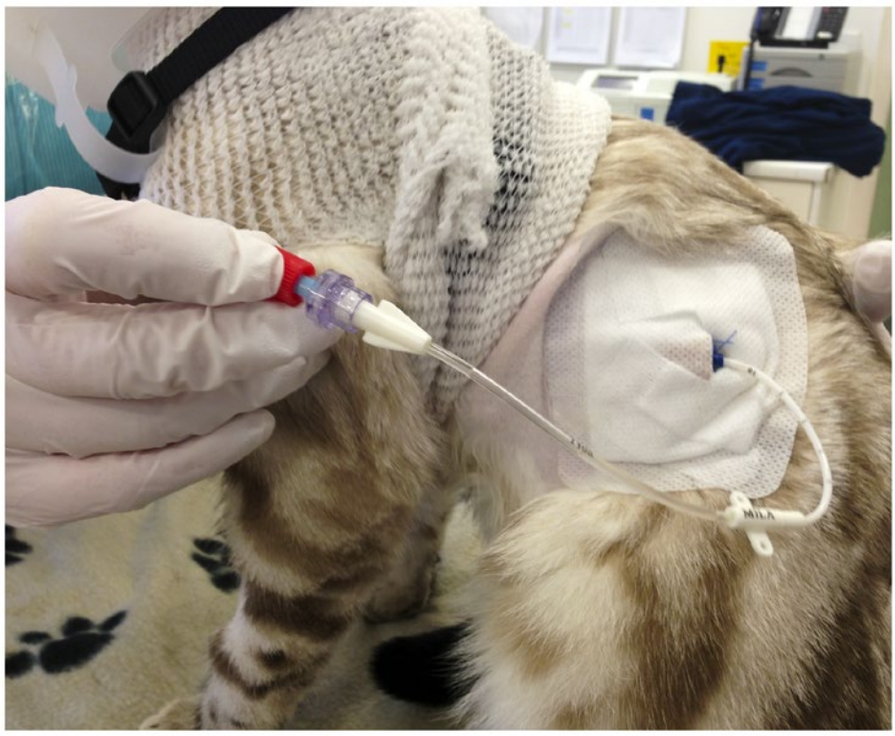

Figure 9. Chest-drain entry site protected by a sterile dressing (note the stockinette, which has been pulled forward to expose the drain, and the Elizabethan collar on the patient to prevent patient interference)

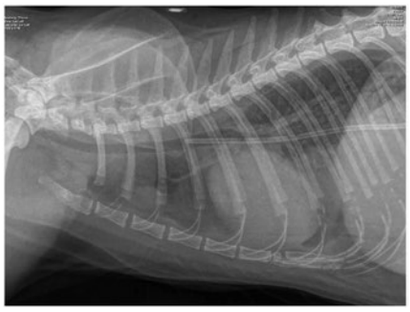

Figure 10. A lateral thoracic radiograph showing a chest drain in place; orthogonal views are required to confirm the drain is in the pleural space

Figure 11. A Heimlich valve

Figure 12. A low-pressure, three-bottle, continuous-suction system in use (black arrow)

negative pressure and a 20–60 ml syringe in patients >15kg, applying no more than 3–5ml of negative pressure.

A continuous-suction unit should be used if air continues to accumulate rapidly within the pleural space. Two-bottle and three-bottle systems are available. Approximately 15–20 cm of negative pressure is applied to the pleural space to remove air. These units should be kept below the level of the patient if possible. This facilitates drainage of any fluid that may be present and helps to limit the possibility of reflux of fluid into the thorax.

Equipment monitoring

Fluid levels in the water-seal and suction-control chambers of such units need to be monitored. Fluid in either chamber can evaporate, so may need to be topped up periodically. The water seal chamber prevents back flow of air or fluid into the pleural space and fluctuations in this chamber during breathing are normal. If this is not observed, the chest drain or associated tubing may be kinked or clamped shut. Intermittent bubbling in the water-seal chamber during breathing indicates an ongoing air leak into the pleural space. This should diminish and then stop as the air leak seals. If the bubbling in the water-seal chamber is continuous, this indicates an unresolved pneumothorax or alternatively that there is a leak in the chest drain or associated tubing. The system must be constantly assessed for leaks, as failure of the system can result in acute respiratory distress.

Patient monitoring

Patients with pneumothorax and chest drains in place require constant supervision to monitor respiration, ensure security of the drain connections, and prevent patient interference with the drain. The veterinary surgeon should be alerted to any significant changes in patient assessments over time.

The RVN should be aware of the need to closely monitor levels of pain as pain

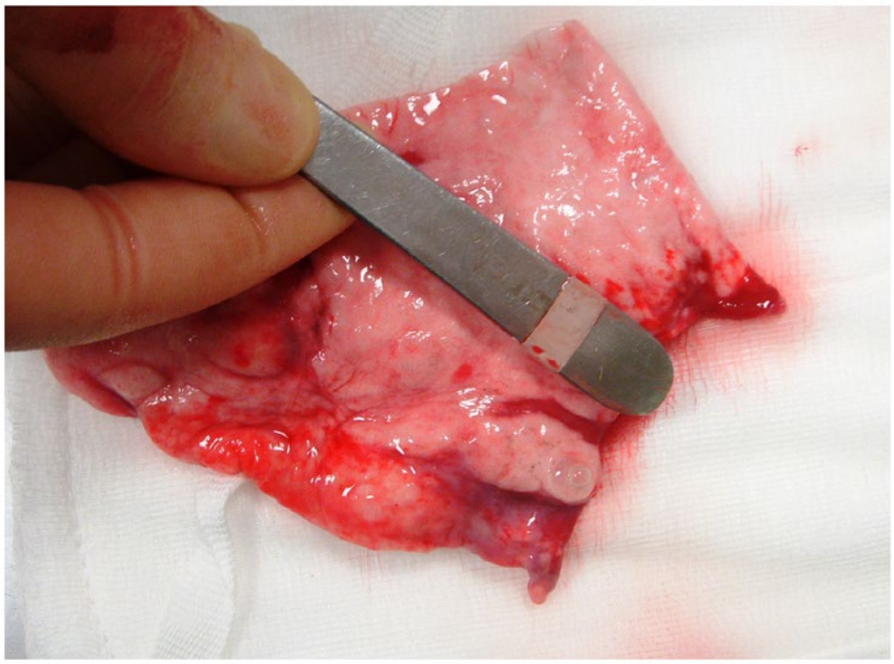

Figure 13. Lung lobe following resection in a patient with spontaneous pneumothorax secondary to a ruptured pulmonary bleb

management is of utmost importance in patients who have sustained thoracic trauma as well as any patient with a chest drain in place. The veterinary surgeon will generally opt for a multimodal approach, which may include systemic analgesia, intrapleural local anaesthesia and intercostal blocks.

At least every four hours the heart rate, pulse rate and respiratory rate and effort should be assessed and recorded. The patient should be carefully evaluated for the development, or progression, of subcutaneous emphysema. The patient's posture and demeanour should be noted. An increase in respiratory rate could be indicative of recurrence or progression of pneumothorax. Animals standing, sitting, or lying in sternal recumbency with an extended neck, flared nostrils and open-mouth breathing are in respiratory distress and these signs should be reported to the clinician immediately. Thoracic auscultation is used to detect changes in lung sounds.

Pulse oximetry and blood-gas analysis are additional useful tools for ongoing monitoring in these patients. Conscious animals can have the SpO_2 probe placed on toe webs, ears or lips and rectal probes are also available. Patients with a SpO_2 measurement of less than 95% should receive supplemental oxygen and the veterinary surgeon alerted.

Blood-gas analysis gives important information about both pulmonary function and acid-base status. As mentioned previously, changes associated with pneumothorax usually include hypoxaemia and hypercapnia, resulting in respiratory acidosis (**Table 1**).

Chest drains and connectors should be handled in an aseptic manner at all times. The chest drain and any associated tubing should be examined for evidence of kinking or occlusion each time the patient is assessed. The dressing covering the drain exit site should be clean and intact and any sutures holding the drain in place should be intact and secure. The RVN should change the dressing as instructed by the veterinary surgeon and when it is no longer dry and intact. When the dressing is changed, the RVN should assess the drain exit site for signs of excessive inflammation or infection such as pain, redness, swelling, and exudate. If this is identified the veterinary surgeon should be informed. If the drain exit site is infected the dressing will need to be changed at least daily or when wet and soiled.

Drain removal

There is little published information regarding the precise timing of removal of chest drains. However, in cases of pneumothorax it is prudent to leave a period of 12–24 hours after the time when no further air accumulation is detected prior to removal of the drain. Removal of chest drains is considered painful and so additional analgesia should be provided at that time. To remove the drain, one continuous, steady motion is used and the exit site immediately covered with a sterile adhesive dressing.

Surgical management of pneumothorax

Closed traumatic pneumothorax rarely requires surgical correction, with many cases responding to thoracocentesis and conservative management alone. In patients where this is not the case and where air continues to accumulate after repeated thoracocentesis, chest drains maybe used while the pulmonary lesions heal (usually within 3–5 days). In rare cases, exploratory thoracotomy is indicated to identify and manage the underlying injuries.

Open pneumothorax requires surgical intervention. In certain cases, surgery may be required on an emergent basis, but otherwise wound exploration and definitive closure are performed once the patient has been stabilised.

Spontaneous pneumothorax is considered to be a surgical disease and often requires exploratory thoracotomy for resection of affected lung tissue (**Figure 13**). Similarly, penetration of the oesophagus and large airways requires surgical intervention.

Prognosis

The prognosis for animals with traumatic pneumothorax is excellent if no other life-threatening injuries are present. The prognosis for iatrogenic and spontaneous pneumothorax depends on the cause and on the underlying disease process. The method of treatment of spontaneous pneumothorax greatly affects the prognosis, with recurrence rates reported to be 3.3% in surgically treated dogs and 50% in dogs managed medically (Smith & Byers, 2009).

Conclusion

Pneumothorax is a common and potentially life-threatening condition that occurs in our patients. A thorough understanding of the pathophysiology, clinical findings, diagnostic techniques and treatment options outlined in this article will help the RVN to manage the nursing support of these patients successfully.

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Multiple Choice Questions

1. What causes a pneumothorax?

(a) An accumulation of pus in the thoracic cavity

(b) An accumulation of fluid in the thoracic cavity

(c) An accumulation of air in the thoracic cavity

(d) An accumulation of blood in the thoracic cavity

2. What can cause a closed pneumothorax?

(a) Gun shot

(b) Blunt trauma

(c) Thoracocentesis

(d) Bite wound

3. What pattern of breathing may indicate the presence of a pneumothorax?

(a) Slow and regular breathing

(b) Rapid and shallow breathing

(c) Rapid and deep breathing

(d) Slow and deep breathing

4. What causes a tension pneumothorax?

(a) When air can enter into the pleural space but it cannot escape

(b) When air can enter into the pleural space and move freely

(c) When air cannot enter into the pleural space

(d) When air cannot enter or escape from the pleural space

5. What may be heard on thoracic auscultation in a patient with a pneumothorax?

(a) Increased lung sounds as the patient struggles to breathe

(b) Increased heart sounds

(c) Decreased or absent lung sounds

(d) Absent heart sounds

6. What area of the skin should be surgically prepared for thoracocenteis?

(a) Between the 6th and 9th intercostal spaces

(b) Between the first and last intercostal space that you can easily palpate

(c) Between the trachea and the 7th intercostal space

(d) Between the 4th and 5th intercostal space

7. Which of the following are potential complications of thoracocentesis?

(a) Anaemia

(b) Heart based tumours

(c) Lung laceration

(d) Kennel cough

8. When using a chest drain, why is it important not to apply excessive negative pressure?

(a) It may cause the chest drain to block

(b) It may dislodge the chest drain

(c) It may cause a pyothorax

(d) It may cause a lung injury

9. Which of the following is an indication for a continuous suction unit to be used with a chest drain?

(a) If the patient has chewed the last chest drain and pulled it out

(b) If air continues to accumulate rapidly after the placement of a chest drain

(c) If air removal has slowed down

(d) If the patient is critically unstable

10. In a patient with a pneumothorax, what is the function of using blood gas analysis?

(a) To monitor the level of infection in the blood

(b) To monitor if the chest drain is in the correct position

(c) To monitor the pulmonary function and acid base

(d) To monitor the patients level of pain

11. When should the chest drain be removed?

(a) 12–24 hours after no further accumulation of air in the drain

(b) A chest drain must only stay in a patient for 24 hours

(c) 48 hours after no further accumulation of air in the drain

(d) As soon as air stops draining

12. How often should a set of observations be recorded on a patient with pneumothorax?

(a) Every 6 hours

(b) Every 4 hours

(c) Every hour

(d) Every 12 hours

For the answers to the MCQs, please go to: http://www.bvna.org.uk/publications/veterinary-nursing-journal