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Bronchoscopy: equipment, preparation and complications

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ABSTRACT: Bronchoscopy is a useful diagnostic and therapeutic tool for a variety of respiratory diseases and disorders. Due to the wider range of endoscopes available on the veterinary market it is becoming more common, so a good knowledge of the equipment required, and patient preparation is extremely useful. Although usually a routine procedure, some quite serious complications can occur. The veterinary nurse plays a key role during the bronchoscopy procedure and this article aims to outline this role alongside discussion of equipment requirements, patient preparation and to provide an overview of the potential complications that may occur.

Keywords: bronchoscopy; preparation; bronchoalveolar lavage; hypoxaemia; bronchospasm; pneumothorax

Bronchoscopy is a procedure that involves the passage of a camera through the mouth and down the airway to examine the larynx, trachea and bronchi. It is useful as both a diagnostic tool, for example to diagnose airway collapse, and as a therapeutic tool such as foreign body removal. Bronchoscopy can become a stressful procedure if complications arise due to involvement of the airway and the key to reducing this stress is to be aware of the potential complications and how to attend to them should they arise. This article will outline the registered veterinary nurse's (RVN) role while discussing equipment requirements, patient preparation and the uncommon but important complications that may arise during and after the procedure.

Equipment

Endoscope

A flexible endoscope ([Figure 1](#)) is most commonly used for bronchoscopy and must be visually examined for damage and leak-tested prior to every use. Due to the risk of introducing bacteria into the airways and to prevent contamination of samples it is recommended to disinfect the scope immediately prior to the procedure ([Levitan & Kimmel, 2008](#)). It is important to consult the manufacturer when developing an appropriate disinfectant protocol to ensure it is suitable for the individual endoscope,

but an example protocol is included as [Figure 2](#). There are two types of flexible endoscope (discussed in another article) and due to the small size of some patient airways a fiberoptic scope may be the only option available. There are some smaller size videoscopes available but the size of the video chip, located in the distal end of the endoscope, may be a restricting factor in the size of videoscopes ([Forman & Merrill, 2012](#)).

Ancillary equipment

Alongside the endoscope, ancillary equipment will be required to perform the procedure and an important piece is a mouth gag which is cleaned and sterilised between each patient. A mouth gag is essential to prevent accidental damage from the patient biting down onto the insertion tube of the endoscope if they become reactive under anaesthesia. It is important to avoid overextension of the jaw with a mouth gag as this can cause neurological abnormalities and blindness due to cerebral hypoxia, particularly in feline patients ([Garcia *et al.*, 2013](#)) and in these cases, a modified gag such as a cut down needle cap to fit each individual patient may be used.

Dependant on the indication for the procedure, other equipment may be required. A bronchoalveolar lavage (BAL) sample may be collected and this allows for sampling of the lower airways avoiding contamination

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■ **Figure 1.** A flexible endoscope is used for bronchoscopy.

- After cleaning (above) the endoscope is immersed in a large tube of disinfectant made to the correct dilution and all buttons/caps are added to the tub.
- Disinfectant is flushed through all channels of the endoscope – it is important to make sure no air pockets are present.
- Soak for the recommended amount of time.
- Flush all channels with clean (or distilled) water and rinse all immersed parts thoroughly.
- Purge air through the channels to remove all water.
- Dry the exterior of the endoscope and hang with the insertion tube vertical to dry.

■ **Figure 2.** Example disinfection protocol (Forman & Merrill, 2012). It is important to consult the endoscope supplier or manufacturer to develop the most appropriate protocol for your endoscope.

from the upper respiratory tract (Tappin, 2010). The following equipment will need to be prepared for BAL sampling:

- Sterile NaCl 0.9% fluid – 100ml bag
- Sterile wash trap (Figure 3) and suction
- Sterile BAL catheter (Figure 3) – this must be the correct size to be passed down the instrument channel
- Sterile syringes and needles – either 2ml, 5ml or 10ml syringes depending on patient size and typically 1ml/kg NaCl 0.9% is instilled (Tappin, 2010)
- Sterile EDTA tubes are needed for sample cytology and sterile plain tubes for sample culture.

The RVN may be required to *coupage* during BAL sample collection and this is achieved by using a cupped hand against the thoracic wall. It is important the RVN knows how to apply *coupage* prior to participating in any procedure. The indication of a good BAL sample (Figure 4) is that it has

a frothy appearance which confirms it has been obtained from the alveoli as it contains surfactant (Tappin, 2010).

If an airway foreign body (FB) is suspected or has been observed on imaging (radiography or computed tomography), FB retrieval forceps should be ready to use and must be cleaned and sterilised between use as they are generally multi-use forceps. They should be of an appropriate size for the endoscope instrument channel and are visually checked prior to each use to inspect the shaft and hinges for any damage or defect that may either traumatise the endoscope channel or prevent them from working when inside the airway.

Other types of endoscopic instrument that may be required include biopsy forceps, cytology brushes and aspiration needles. Usually these are single-use only and discarded after each patient, however, if they are not, they must be thoroughly cleaned and sterilised between patients. As with the FB forceps these are all inspected prior to use and discarded if any damage or defect is discovered.

Oxygen delivery

Equipment enabling oxygen delivery to the patient during the procedure is crucial. In larger patients it may be possible to pass the endoscope down the inner lumen of the endotracheal tube (ETT), if at least 25% of the tracheal lumen remains clear around the endoscope for oxygen to pass, but small patients will require extubating once stable under general anaesthesia (GA) for the endoscope to fit down the trachea – it is important not to pass the endoscope alongside the ETT as this can lead to trauma. One method of supplying oxygen during the procedure is to pass a sterile oxygen catheter through the instrument channel and deliver oxygen through the endoscope. If the patient remains intubated an airway connector is attached to allow the ETT to remain connected to the anaesthetic circuit with a port allowing the endoscope to pass (Figure 5).

Monitoring equipment

As bronchoscopy must be performed under GA, it is important that all anaesthetic monitoring equipment is checked and prepared prior to patient induction. Alongside basic vital parameter monitoring (heart rate (HR), respiratory rate (RR), pulse quality, membrane colour and depth of anaesthesia) oxygen saturation is an important parameter to monitor to assess for hypoxaemia so a pulse oximeter (SpO₂) should be setup also. Capnography is a useful tool to inform the RVN on status of ventilation but remember if the circuit is open, by extubation of the patient or introduction of the endoscope into the airway, it will no longer be a reliable indicator.

Patient preparation

Most patients undergoing bronchoscopy will have some form of respiratory compromise and usually the procedure is required to obtain a diagnosis for these patients. With this in mind, these patients will benefit from pre-GA oxygenation via either flow-by or face mask and a rapid induction and intubation.

Anaesthetic preparation

Premedication will be prescribed by the veterinary surgeon (VS) but may include an anti-tussive such as butorphanol if indicated. A bronchodilator e.g. terbutaline may be administered during the 24-hour period prior to the procedure or at the time of induction to reduce the risk of bronchospasm, a particular risk in cats.

The preferred method of GA for these patients is total intravenous anaesthesia (TIVA) and this can be achieved with either propofol or alfaxalone – the choice of agent depends upon familiarity with the

drug and any patient contraindications. TIVA allows achievement of a stable plane of anaesthesia while avoiding environmental contamination with volatile anaesthetic agent when the closed system is breached

by introduction of the endoscope. When intubating the patient, following induction, it is preferable to use a sterile ETT to reduce the risk of contamination of any samples collected during the procedure.

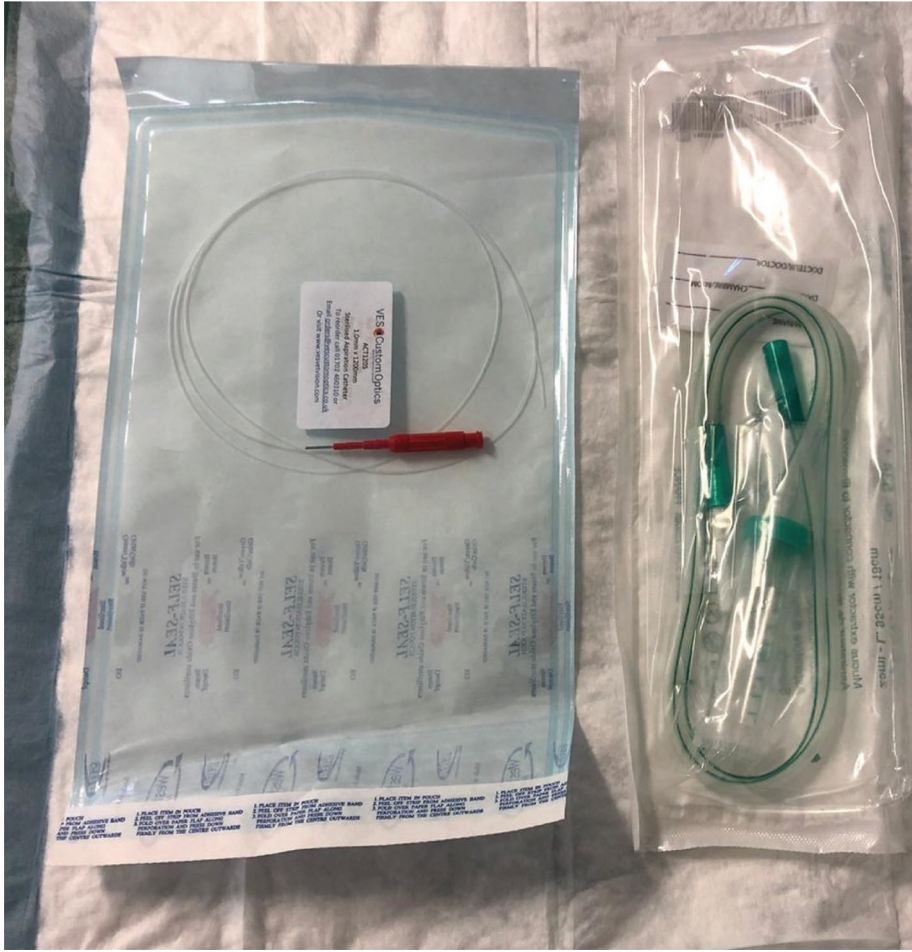


Figure 3. A sterile BAL catheter and wash trap is required for sampling.

When assembling the team taking part in the procedure, it is important to remember that careful monitoring of any patient under GA is critical. The RVN responsible for monitoring the patient must be completely focused and not be asked to assist in any other capacity. A second RVN is necessary to assist the VS in managing the bronchoscopy.

Complications

Although uncommon, complications can happen with any procedure and because bronchoscopy involves a patient’s airways these complications can be catastrophic if not identified and treated promptly. Table 1 serves as a basic guide to complications that can occur during bronchoscopy.

Airway irritation may occur if the depth of GA is insufficient, this may show as the patient gagging or coughing when the endoscope is in the airway. The RVN should perform regular assessment of the patient’s anaesthesia depth by checking for any changes to HR or RR/effort which may indicate a light plane of GA and also eye position, jaw tone and palpebral reflex. Communicating any changes to the VS is vital – they may need to remove the endoscope to allow alterations to the GA depth.

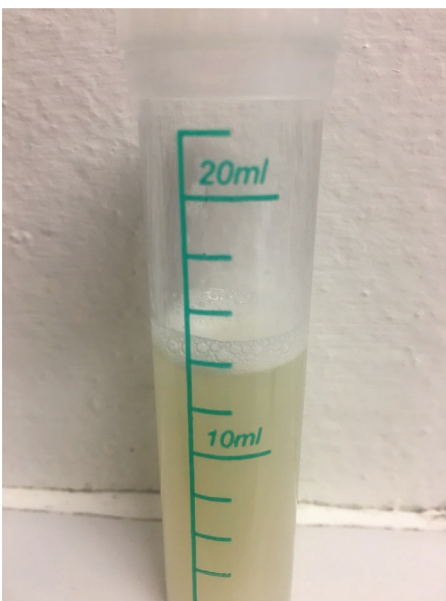


Figure 4. A good BAL sample is frothy confirming it is an alveolar sample. Picture courtesy of Ferran Valls Sanchez DVM DipECVIM-CA MRCVS.



Figure 5. ETT connector that allows a breathing circuit to be connected, for oxygen delivery, and for an endoscope to be passed down the ETT.

Table 1. Brief summary of complications that may occur during bronchoscopy and the potential steps the VS may take to treat them.

Complication	Clinical signs	Emergency treatment
Airway irritation	<ul style="list-style-type: none"> · Increased HR/RR · Return of palpebral reflex · Gagging/coughing · Patient 'light' under GA 	<ul style="list-style-type: none"> · Inform VS · Remove endoscope from airway · +/- increase GA depth
Bronchospasm	<ul style="list-style-type: none"> · Increased RR · Dyspnoea · Cyanosis · Wheezing/coughing · Desaturation on pulse oximeter 	<ul style="list-style-type: none"> · Inform VS · Bronchodilators (if not already received) · Steroid injection · Repeat GA & intubation if extubated · Oxygen therapy
Hypoxaemia	<ul style="list-style-type: none"> · Cyanosis · Desaturation on pulse oximeter 	<ul style="list-style-type: none"> · Inform VS · Remove endoscope from airway · Place patient in sternal recumbency · Oxygen therapy – flow by/nasal cannulae · Repeat GA & intubation for ventilation
Tension pneumothorax	<ul style="list-style-type: none"> · Increase RR · Dyspnoea · Difficult to manually ventilate 	<ul style="list-style-type: none"> · Inform VS · ThoracocentesisSterile needles <ul style="list-style-type: none"> o Sterile syringes o 3 way tap/centesis valve o Sterile gloves o Skin prep

Bronchospasm is a complication of bronchoscopy and BAL sampling where the bronchi narrow due to the smooth muscles of the airway. As mentioned above, the VS may elect to pre-treat a patient with bronchodilators if they feel the patient is at particular risk of this complication e.g. feline patients, it is good preparation to have the drug dosage pre-calculated and the drug to hand so it can be drawn up and administered rapidly. If bronchospasm occurs in the recovery period following extubation then patient may require repeat GA induction and intubation for ventilation to allow the airways to stop spasming.

Hypoxaemia is a low concentration of oxygen in blood (Dugdale, 2010) and is defined as an SpO₂ < 95%. Hypoxaemia can occur both during and after bronchoscopy in the recovery period. If hypoxaemia occurs during the procedure, the endoscope is removed, the patient intubated if not already and 100% oxygen supplied. The procedure continues once SpO₂ has normalised. The recovery environment should be calm and quiet and on-going oxygen supplementation is provided until the patient is ambulatory. Pulse oximetry should also remain

connected monitoring for hypoxaemia. If hypoxaemia occurs in recovery, then flow-by oxygen can be provided progressing to nasal prongs and nasal cannulae if not improving. In patients where an unstable recovery is thought likely, it is sometimes beneficial to place nasal cannulae prior to recovering from GA so oxygen can be provided efficiently throughout recovery. It is also advisable to have equipment prepared for emergency GA and intubation for ventilation if required. If possible, hypoxaemia will be confirmed by arterial blood gas sampling and testing to establish the degree of hypoxaemia and to assess the patient's ventilation status.

Tension pneumothorax develops when a pulmonary leak acts like a one-way valve allowing air to enter the thoracic cavity during inspiration (or ventilation under GA) but prevents air from leaving during expiration leading to an increased interpleural pressure (Waddell & King, 2018) and, although a rare complication of bronchoscopy, can occur if diseased lung parenchyma ruptures. The RVN monitoring GA will notice a change in a patient's RR and effort with the patient showing dyspnoea or being difficult to ventilate

with manual ventilation. Rapid recognition of a tension pneumothorax is vital as the patient can deteriorate to respiratory arrest followed by cardiac arrest. Emergency thoracocentesis will need to be performed by the VS so preparing a small tray with a selection of sterile needles and syringes with a centesis valve/3-way tap should be included during any bronchoscopy setup – taking these additional steps during the setup period could improve how efficiently we can deal with complications and reduce stress in an emergency situation.

Conclusion

Whilst bronchoscopy can seem like an intimidating procedure, having an idea of the potential complications and being prepared can minimise stress levels. For the reasons discussed in the article, it is good practice to have an allocated RVN designated to the GA and an assistant to help the VS, thus allowing the RVN to focus solely on the GA and to spot any potential complications quickly allowing for rapid treatment.

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