How to Perform Bronchoalveolar Lavage in Practice

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Bronchoalveolar lavage (BAL) is a safe, simple, and inexpensive technique that any equine practitioner can perform, without sophisticated equipment or advanced skills. The cytologic examination of the lavage fluid is a valuable means of diagnosing and monitoring various noninfectious lower airway diseases in horses. Authors’ addresses: Central Carolina Equine Practice, P.O. Box 4412, Chapel Hill, NC 27515-4412 (Mansmann) and P.O. Box 1771, Cary, NC 27512 (King). © 1998 AAEP.

1. Introduction
The cytologic examination of bronchoalveolar lavage (BAL) fluid samples can provide information that is useful in differentiating and evaluating various lower airway diseases in horses.1,2 Because the catheter is passed blindly and it is difficult to choose or determine which lung lobe is being sampled, BAL is of most use in conditions characterized by diffuse or multifocal changes.1 Chronic obstructive pulmonary disease (COPD), inflammatory (small) airway disease, and exercise-induced pulmonary hemorrhage (EIPH) are examples of conditions in which diagnosis and re-evaluation can be greatly facilitated by BAL.

The major advantage of BAL over other techniques that sample the lower airway (e.g., transtracheal or endoscopic tracheal aspiration) is that BAL directly samples the cells lining the bronchioles and alveoli—the sites of various lower airway diseases. While there is a good correlation between BAL cytology and pulmonary histopathology, transtracheal aspiration (TTA), as a sampling technique for cytologic evaluation, is less sensitive and does not seem to correlate well with BAL.2

A common question that practitioners unfamiliar with the procedure ask is “how do you decide when to use TTA and when to use BAL?” Basically, we use TTA whenever we want to culture the sample, i.e., when we suspect an infectious process such as bacterial or fungal pneumonia. We use BAL when we want to define or monitor a noninfectious lower airway process such as COPD or EIPH. In fact, we believe that BAL may be one of the most sensitive ways a practitioner can objectively monitor the response to therapy in a horse with lower airway disease. BAL is also useful in clinically normal horses presented for an investigation of poor performance.2

Many of the reports describing the use of BAL in horses are generated by veterinarians who practice in an academic setting, such as a university veterinary teaching hospital, and who use relatively large volumes (200–500 ml) of lavage fluid.1,2 However, we have found that by lavaging with only 60 ml of fluid, BAL can be a simple technique that is readily...
adapted to routine equine practice. This paper describes the BAL technique we use.

2. Materials and Methods

A. Practical Considerations

There are a few practical aspects to consider before a BAL is performed.

1. At least two, and preferably three, people are needed to perform the procedure expediently: one to restrain the horse, one to insert the catheter and maintain its position, and the other person to perform the lavage. The procedure can be performed with just two people (one restraining the horse and anchoring the catheter at the nostril and the other performing the lavage), although it can be very difficult if the horse is uncooperative.

2. Virtually all horses begin coughing (sometimes dramatically) when the catheter reaches the tracheal bifurcation (carina). Even though most horses stop coughing once the catheter passes into a bronchus, some clients are unsettled by the horse's reaction. When clients are to be present for the procedure, it is important to inform them that the horse probably will cough while the catheter is being passed.

3. Prior sedation usually reduces the amount of coughing; it also renders the horse more cooperative, allowing the procedure to be completed quickly. (In our experience, instilling lidocaine through the catheter does little to alleviate coughing.) We prefer to sedate the horse with xylazine (0.5–1.0 mg/kg IV), followed after 5 min by butorphanol (0.01–0.02 mg/kg IV). We feel that the addition of butorphanol, which is an effective cough suppressant in humans and small animals, is important. In most cases, the longer you wait between sedating the horse and performing the lavage, the less coughing you will encounter.

4. Consider the horse's performance schedule (with respect to drug-withholding times) before using sedatives. As long as restraint is adequate, the procedure can often be performed without sedation.

5. The entire procedure, including preparation, sedation, and sample preservation, takes approximately 30 min; the actual lavage takes only 5–10 min.

B. Equipment and Supplies

The equipment and supplies for BAL are as follows.

- equine BAL catheter\(^a\) with three-way stopcock
- 6-ml syringe (to inflate the cuff at the distal end of the catheter)
- one 20-ml and one 60-ml syringe (for lavage)
- 150 ml of sterile 0.9% saline (or polyionic solution), at room temperature or slightly warmed; in most cases only 80 ml is needed
- 2 red-top vacutainers (or other anticoagulant-free vials), each filled to halfway with a 50% ethanol solution for sample preservation (100-proof vodka is 50% ethanol and is suitable for sample preservation)\(^3\)
- twitch
- xylazine and butorphanol for sedation

C. Preparation

The preparation is as follows.

1. Sedate the horse, if indicated.
2. Check the catheter cuff by inflating it with 5 ml of air; completely deflate the cuff before inserting the catheter.
3. Draw up sterile saline into the 20-ml and 60-ml syringes.

D. Technique

The technique is as follows.

1. Clean the horse's nostril and apply either a few milliliters of saline or a small amount of lubricant to the cuffed end of the catheter. Apply the twitch.
2. Pass the cuffed end of the BAL catheter into the ventral nasal meatus and advance it toward the larynx.
3. Have the person holding the twitch extend the horse's head as much as possible to facilitate the passage of the catheter into the trachea. (Some horses cough at this point.) It is easier to pass the catheter through the glottis if the catheter has been stored coiled up and is inserted into the nasal passage with the tip curling downward. Do not attempt to force the catheter through the glottis.
4. Advance the catheter down the trachea until resistance is felt. There should be no resistance as the catheter passes down the trachea (unlike esophageal passage of a nasogastric tube). Advancing the catheter quickly past the carina helps to minimize coughing; however, do not be too aggressive, and be ready for the tip of the catheter to lodge in a bronchus.
5. Have someone maintain the catheter's position by gently pressing it against the floor of the nostril or the nasal septum with his or her thumb.
6. Inflate the cuff with 5 ml of air.
7. Attach the 20-ml syringe to the stopcock, open the valve, and steadily infuse the saline into the catheter, filling the dead space.
8. Detach the 20-ml syringe, replace it with the 60-ml syringe, and steadily infuse the full volume of saline. It is important at this point that the person stabilizing the catheter at the nostril does not allow it to slip back.
9. Immediately apply negative pressure on the plunger and aspirate fluid into the syringe.
10. Either disconnect the syringe or use the stopcock valve to expel the air from the syringe. Repeat the aspiration two or three times until no further fluid is retrieved.
11. Lavage is considered successful when 30–50 ml of fluid is retrieved. The lavage fluid is capped with froth (surfactant) and can be turbid. If less
than 30 ml is retrieved and the fluid is clear (i.e., mostly saline from the catheter dead space), then the lavage should be repeated with a second 60-ml volume of saline.

12. When an adequate sample is collected, detach the syringe from the catheter, deflate the cuff with the 6-ml syringe, and steadily withdraw the catheter. Release the twitch.

13. Mix the BAL fluid sample well; then add approximately 5 ml to each vacutainer (i.e., a 50:50 ratio of BAL fluid to 50% ethanol).

14. Clean the exterior and lumen of the catheter with dilute chlorhexidine solution, rinse with water, and dry; expel any fluid from the lumen with an air-filled syringe. Ideally, the catheter is sterilized after each use. If not, it should be stored either coiled or hung over a hook in a clean, dust-free area.

15. Submit the sample to a cytologist who is experienced in examining equine lower airway samples. Request a differential count (expressed as relative percentages of cell types) and a qualitative assessment of cell morphology.

3. Results and Discussion

Between us, we have performed over 150 BAL's on athletic horses, including racehorses in training, and sedentary horses, and we have encountered no significant problems. Various studies have demonstrated that, even with weekly lavage, this procedure causes little, if any, gross or histologic lower airway inflammation or damage.4,5

Paroxysmal coughing during the procedure sometimes occurs in horses with COPD. In comparison with racehorses that have mild lower airway inflammation, horses with COPD seem to have more reactive airways and may cough throughout lavage. Some clinicians recommend pretreatment with albuterol or aminophylline in these horses,2 but so far we have not found this necessary. Coughing could be detrimental in horses with pneumonia or pulmonary abscesses, so BAL probably should not be used in horses suspected of having these conditions. Furthermore, a culture of a sample obtained by TTA is more valuable than BAL cytology in these cases.2

Another problem that each of us has encountered once is retroflexion of the catheter into the oropharynx. In both instances the horse chewed the cuffed end, necessitating purchase of a new catheter. This problem can be prevented by taking care when advancing the catheter through the glottis. Unless well sedated, many horses close their glottis, effectively preventing passage of the catheter. If the catheter is advanced too vigorously, it can coil in the caudal pharynx and may enter the oropharynx.

In an academic setting, where equipment, stocks, and personnel are readily at hand, lavage volumes of 200–500 ml often are used.1,2 We have found this volume impractical in most instances. Sweeney et al.6 showed that the volume infused influences the differential cell count of the retrieved fluid. In particular, the percentage of neutrophils was higher in samples obtained with 50 ml of lavage fluid than in those in which 350 ml was used. However, we have found that, provided the technique used is consistent (i.e., the same volume is used each time), the smaller volume we advocate provides meaningful and reliable results.

As indicated in step 11 (above), occasionally the volume retrieved is inadequate. Rather than being a result of too small an infusion volume, this problem is, we believe, more often a result of failing to wedge the tip in a bronchus, insufficient cuff inflation (or cuff leakage), or failure of the assistant to prevent the catheter from slipping back. Rarely have we needed to repeat the lavage to obtain a suitable sample.

Past experience has shown us that more useful information is obtained when polychrome stains are used on alcohol-fixed specimens than when other stains are used on air-dried smears. Submitting alcohol-fixed samples is also more convenient for the practitioner than preparing air-dried smears. In addition to providing differential cell counts, an interpretation of polychrome-stained specimens by an experienced cytopathologist can provide information about the type and degree of inflammation, amount and character of mucus, epithelial abnormalities indicating the level of involvement (bronchus, bronchiole, or alveolus), and the severity or chronicity of irritation.3

4. Conclusions

In summary, we have found that BAL is a valuable addition to our arsenal of diagnostic and monitoring techniques for the management of noninfectious lower airway disease in horses. It is a procedure that any equine practitioner can safely and expeditiously perform in a practice setting, with a minimal outlay of money and time.

References and Footnotes


*Equine bronchoalveolar lavage catheter, Bivona, Inc., 5700 W. 23rd Ave., Gary, IN 46406 (1-800-348-6064; item no. VBAL30).