Horses, also known as recurrent airway obstruction and chronic obstructive pulmonary disease, is an inflammatory condition of horses resulting from the inhalation of dust from hay and bedding. This condition affects primarily the small airways of horses and causes bronchospasm, mucus plugs, and pathologic changes of the bronchiolar walls, leading to small airway obstruction. The treatment of equine heaves is aimed at (1) preventing further exposure to dust, (2) decreasing inflammation of the lower airways, and (3) providing symptomatic relief of clinical signs. Although environmental dust control is pivotal to the long-term management of heaves, medications are often required for immediate improvement of airway function. Both corticosteroids and bronchodilators, the most commonly used drugs to treat heaves, have been administered by inhalation and shown to successfully improve airway function of affected horses.

Inhaled medication has the advantage of achieving a high drug concentration directly in the airways while minimizing its serum concentration and, therefore, systemic effects. Inhaled drugs can be delivered to horses using mechanical nebulizers and metered-dose and dry-powder inhalers. Corticosteroids, bronchodilators, and cromones are drugs that have proven effective for inhalation therapy in horses with heaves.

Environmental dust control plays an important role in the long-term management of heaves.

An important advantage of inhaled medications is that these agents enable a high concentration of drug directly at the level of the airways.

Corticosteroids and bronchodilators are the most commonly used drugs to treat equine heaves.
Drugs Used for Inhalation Therapy in Horses\(^a\)

**Corticosteroids**

- **Beclomethasone dipropionate**
  
  Initial dose, 3500 µg/horse q12h in MDI (Equine Aeromask\(^a\), Canadian Monaghan, London, Ontario, Canada)\(^1\)
  
  Initial dose, 1320 µg/horse q12h in MDI (3M Equine Aerosol Delivery System\(^a\), 3M Animal Care Products, St. Paul, MN)\(^2\)

- **Fluticasone propionate**
  
  Initial dose, 2000 µg/horse q12h in MDI (Equine Aeromask\(^a\))\(^3\)

**Bronchodilators**

- **Ipratropium bromide**
  
  2–3 µg/kg q6h using a mechanical nebulizer\(^4\)
  
  90–180 µg/horse q6h in MDI (Equine Aeromask\(^a\))\(^5\)

- **Fenoterol**
  
  1–2 mg/horse in MDI (Equine Aeromask\(^a\))\(^7\)

- **Albuterol**
  
  0.8–2 µg/kg in MDI (Equine Aeromask\(^a\) or 3M Equine Aerosol Delivery System\(^a\))

**Cromones**

- **Sodium cromoglycate**
  
  80 mg/horse q24h for 4 days prior to dust exposure, using a mechanical nebulizer; may prevent the appearance of clinical signs for up to 3 wk after horses were introduced to a dusty environment\(^10\)

  200 mg/horse q12h in MDI (Equine Aeromask\(^a\))\(^11\)

\(^{a}\)Indicated doses are suggestions only.

MDI = metered dose inhaler.

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years. When properly used, these devices can generate particles of adequate size. The disadvantages to using mechanical nebulizers are that these devices are cumbersome to use and expensive and the delivery of drugs may be time-consuming. In addition, variable particle sizes will be generated depending on the device, ambient temperature and pressure, auxiliary airflow, solute concentration and volume, and operating time. Therefore, delivery of drugs into the airway is likely to vary greatly with these devices. A jet nebulizer (Nebul, Agritronix Int, Meux, Belgium) has been specifically designed for use in horses.

**Metered-Dose Inhalers**

Metered-dose inhalers (MDI) are sealed canisters containing a drug and a propellant kept under pressure. The drug is delivered manually by activating a demand valve. MDI are easy to use, and the amount of drug delivered is constant. These inhalers, however, require coordination between activation and inhalation for effective drug delivery. To decrease the dependency on synchronization with the beginning of inspiration and improve the characteristics of the aerosol, MDI should be attached to spacers (chamber or a similar device). MDI containing a number of drugs are readily available, but they are generally more expensive than conventional therapies. When drugs are administered with MDI directly into the nostrils, a minute amount of drug is likely to reach the lung, potentially leading to treatment failure. A mask and a spacer (Equine Aeromask\(^a\), Canadian Monaghan, London, Ontario, Canada) have been designed for the use of MDI in horses (Figure 1), and a hand-held device (3M Equine Aerosol Delivery System\(^a\), 3M Animal Care Products, St. Paul, MN) is also under investigation. This latter system has been shown to deliver approximately five times more drug to the lungs than the Aeromask\(^a\). Therefore, dosages determined to be effective with one device may not be suitable when using a different method of administration.\(^12,13\) To date, MDI are driven by chlorofluorocarbon propellants, which are being withdrawn for ecologic reasons. Newer propellants being investigated greatly improve the drug delivery of some agents, suggesting that current dosages may need to be reevaluated in coming years. Various alternatives to conventional MDI are being investigated in humans, including dry-powder inhalers, breath-activated devices, and a soft mist inhaler. To my knowledge, the latter two devices have not been studied in horses.

**Dry-Powder Inhalers**

Dry-powder inhalers are made of numerous capsules containing a single dose of drug and a rotor. During inspiration, the rotor is activated, thereby dispersing the powder within the inspired air. This system allows for perfect coordination between inspiration and drug delivery; however, the required high flow rate necessitates a mask (EquiPoudre, Agritronics Int, Meux, Belgium) designed to allow a perfect seal with the face.

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**Figure 1**—Horse wearing the Aeromask\(^a\) (Canadian Monaghan, London, Ontario, Canada) with a spacer.
Masks used in combination with MDI or dry-powder inhalers will increase the resistance to airflow and, therefore, may not be suitable and well tolerated for the initial treatment of horses with labored breathing. I have treated a few horses that became reluctant to inhale the medication after a few days. Replacing the poorly tolerated drug with another of the same class will often correct this problem.

Medications
Although numerous agents may technically be aerosolized using mechanical nebulizers, improper selection and management of drugs can lead to airway inflammation, infections, and bronchospasms.

Corticosteroids
Corticosteroids are the most effective drugs available to treat equine heaves. Inhalation therapy is compatible with corticosteroid administration because of the large amounts of glucocorticoid receptors in bronchial epithelium and pulmonary vascular endothelial cells. Corticosteroids designed for inhalation have potent antiinflammatory effects locally and the property of being rapidly eliminated when they reach the systemic circulation, greatly reducing their systemic life span and side effects. The information currently available on horses suggests that short-term administration of inhaled corticosteroids is both efficacious and well tolerated, but this method has little residual effects when treatment is discontinued. A delayed response of 4 days or longer should be expected with inhaled corticosteroids; therefore, their administration should be combined with faster-acting drugs (e.g., bronchodilators, systemic corticosteroids) in horses presenting with labored breathing. To date, the only documented side effect attributed to inhaled corticosteroids in horses is a reversible decrease in serum cortisol, but long-term studies are lacking.

Bronchodilators
Bronchodilators are used to relieve the obstruction of the small airways caused by the airway smooth muscle contraction and thus improve ventilation. The use of bronchodilators is considered symptomatic therapy, and their administration as sole therapy for the treatment of heaves is not recommended unless the underlying cause of airway obstruction is treated. When properly used, however, these drugs may rapidly improve airway function in horses with heaves. Bronchodilators may also increase the delivery of drugs to the lower airways when used immediately prior to inhaled corticosteroids. The most commonly used agents administered by inhalation for bronchodilation in horses are β2-agonists (e.g., fenoterol, albuterol, pirbuterol) and anticholinergic agents (e.g., ipratropium bromide). Compared with β2-agonists, ipratropium bromide produces bronchodilation in a slower but more protracted manner.

Cromones
The mechanism of action of cromones in equine heaves is unknown but may include stabilization of inflammatory cells and a local effect on nerve endings. Sodium cromoglycate is most effective when administered to asymptomatic horses with heaves before exposure to dust. A linear relationship exists between the number of treatment days and the duration of remission of clinical signs.

References