

Alveolar clearance in horses with chronic obstructive pulmonary disease

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Objective—To assess sensitivity of scintigraphic alveolar clearance rate as an indicator of alveolar epithelium damage in horses.

Animals—5 healthy horses (group A) and 5 with chronic obstructive pulmonary disease (COPD; group B).

Procedure—Horses underwent clearance rate (k [%/min]) determination. Clearance rate of group-B horses was determined after remission of the disease following 2 months at pasture (remission 1), stabling in a controlled environment (remission 2), and during crisis induced by exposure to moldy hay and straw. Methacholine challenge test was performed at each investigation period to determine nonspecific pulmonary airway hyperresponsiveness. Pulmonary function tests (PFT) also were performed, and cell populations in bronchoalveolar lavage (BAL) fluid were determined on another occasion.

Results—Group-B horses had significantly faster mean clearance rate during crisis ($k = 4.30 \pm 0.95\%/min$), compared with that for remission 1 ($k = 1.98 \pm 0.55\%/min$), which did not differ from the rate in group-A horses ($k = 1.95 \pm 0.33\%/min$). Despite lack of clinical signs of COPD during remission when stabled in a controlled environment, an intermediate value was found ($k = 3.20 \pm 0.72\%/min$).

Conclusions—This technique allowed grading of lung damage induced by COPD, whereas use of PFT and determination of BAL fluid cell populations failed to differentiate between remission 1 and remission 2.

Clinical Relevance—Determination of alveolar clearance rate by use of scintigraphy is a sensitive indicator of lung damage. A modified clearance rate was found despite the lack of clinical and functional changes. (*Am J Vet Res* 1999;60:495-500)

diffuses through the tight intercellular junctions of the alveolar-capillary barrier. Because tight intercellular junctions of the alveolar cells are tighter than those of the capillary endothelium,² speed of disappearance of tracer from the lungs depends mainly on the alveolar epithelium. If an infectious or noninfectious disease affects the alveolar epithelium, clearance of radiolabeled DTPA from the alveoli to the perfusing blood will be accelerated.³

Using this technique, the authors reported that horses with chronic obstructive pulmonary disease (COPD) in acute crisis had significantly faster ^{99m}Tc-DTPA clearance rates than did healthy horses.¹ Acute expression of the disease is a hypersensitive response⁴ of the respiratory system to spores inhaled from moldy hay and straw.^{5,7} Bronchospasm, excess mucus secretion, and inflammation of the airway characterize this disease.⁸ Furthermore, the airways are nonspecifically hyperresponsive, as evaluated by histamine^{6,9} or methacholine (MCh)¹⁰ challenge tests. The inflammatory process is accompanied by increased numbers of neutrophils in bronchoalveolar lavage (BAL) fluid,^{1,7,11-16} which may potentially cause structural alterations in tight intercellular junctions of alveolar cells because of proteases, reactive oxygen species, and inflammatory mediator release.¹⁷⁻¹⁹ Damages to tight intercellular junctions are believed to cause enhanced permeability.

Remission of clinical signs of COPD with restoration of normal pulmonary function test (PFT; eg, mechanics of breathing and blood gas analysis) results and disappearance of airway hyperresponsiveness are observed after a period at pasture^{6,9,20-24} (ie, an allergen-free environment). Thus, stabled horses with COPD require particular care regarding forage and bedding to remain in clinical remission. Feeding of grass silage and use of wood shavings as bedding are often recommended^{25,26} as replacements for hay and straw. While they are in this controlled environment,^{24,27} horses with COPD are maintained free of signs of the disease and have normal PFT results; however, nonspecific airway hyperresponsiveness exists, and the reactive state of the bronchi is intermediate between values obtained at pasture and during acute crisis.¹⁰

Analysis of ^{99m}Tc-DTPA lung clearance is believed to be a sensitive test for studying early changes in alveolar epithelial permeability.^{3,28,29} The study reported here was designed to determine whether this technique enables detection of a subclinical inflammatory process, confirmed by results of MCh challenge tests, by assessing ^{99m}Tc-DTPA clearance rate of horses with COPD after 2 consecutive 60-day periods (at pasture and stabled in a controlled environment²⁴ [low in

A scintigraphic method has been described to noninvasively measure pulmonary epithelial permeability as an index of alveolar epithelium damage in horses.¹ This method relies on the hypothesis that hydrophilic low molecular weight ^{99m}Tc-labeled diethylene triamine penta-acetate (^{99m}Tc-DTPA) chelate, deposited in alveolar regions by nebulization, slowly

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