

Influence of subclinical inflammatory airway disease on equine respiratory function evaluated by impulse oscillometry

E. A. RICHARD^{†*}, G. D. FORTIER[‡], J-M DENOIX, T. ART[†], P. M. LEKEUX[†] and E. VAN ERCK[†]

CIRALE-ENVA, RD 675, 14430 Goustranville, France; [†]Department of Physiology, Faculty of Veterinary Medicine, Bat. B42, University of Liège, 20 Boulevard de Colonster, 4000 Liège, Belgium; and [‡]Frank Duncombe Laboratory, 1 Route de Rosel, 14053 Caen Cedex 4, France.

Keywords: horse; respiratory function; forced oscillations; inflammatory airway disease; bronchoalveolar lavage

Description of the IOS procedure

The impulse oscillometry system (Fig o1) is composed of a loudspeaker that produces the impulses, a flexible tube (Fig o2), and a measuring head (Fig o3) with both pneumotachograph and pressure transducers, which can be tightly connected to a face mask placed on the horse's head.

Sedation is not required and should be avoided as it alters respiratory mechanics.

Application

A video in WMV format illustrating the set up and use of the system can be accessed via www.evj.co.uk/glossary.

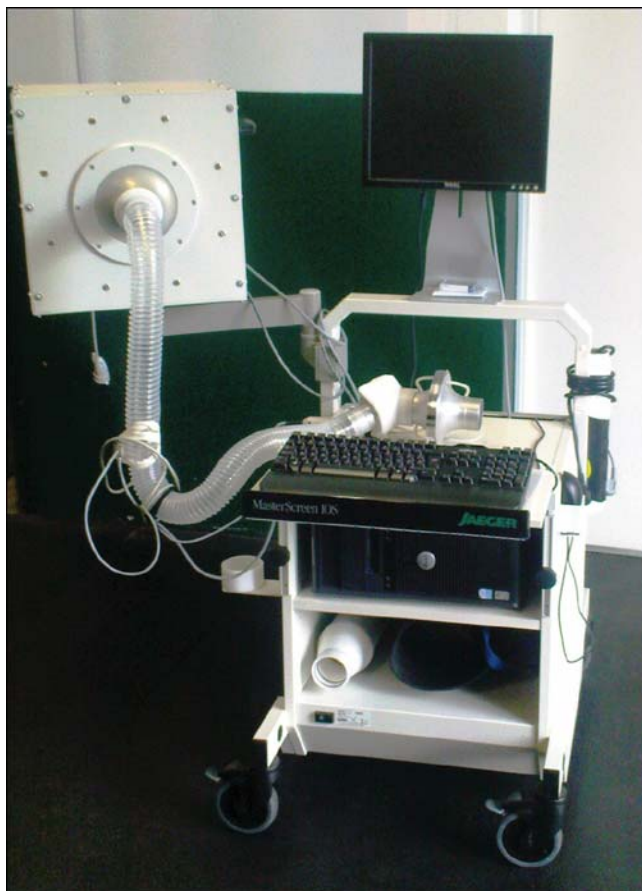


Fig o1: General view of the IOS.

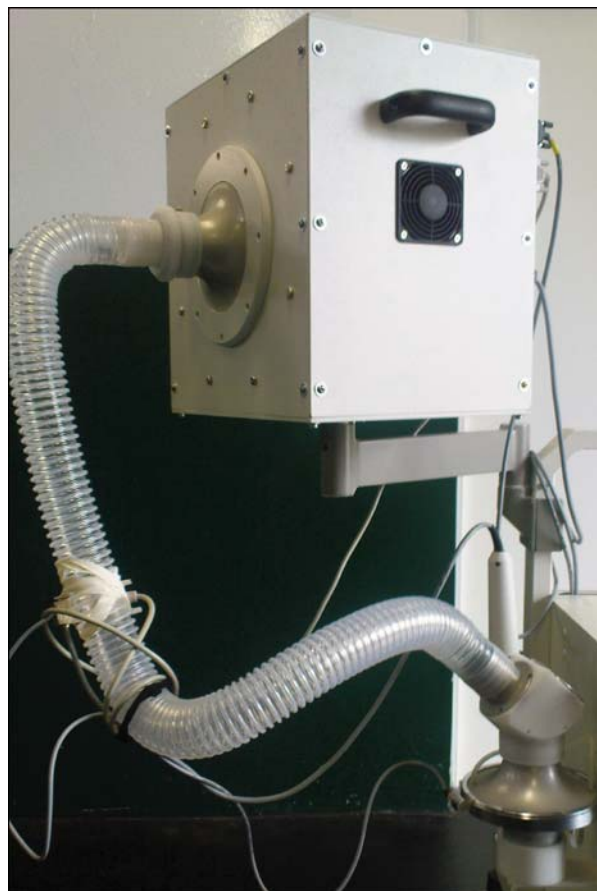


Fig o2: Loudspeaker and flexing tube.

*Author to whom correspondence should be addressed.

[Paper received for publication 20.06.08; Accepted 08.08.08]



Fig 03: Measuring head with both pneumotachograph and pressure transducers.

1. Calibration of the device.
 - a. Impedance (using a reference mesh screen impedance).
 - b. Flow volume (forcing 2 litres of air through the pneumotachograph).
 - c. Temperature and humidity of the room.
2. Air tight placement of the mask on the horse, with a minimal dead space (air leaks will significantly modify test results).
3. Data acquisition (over 30 s and automatically processed by the computer). The position of the head should be kept stable; compression of the nostrils by the mask should be avoided.
4. Analysis of the data and calculation of the parameters by the software.
5. Interpretation of the obtained values of resistance and reactance (to be done by the practitioner).

Glossary of terms

Dynamic compliance (C_{dyn}): Parameter characterising the distension capacity of the pulmonary structures during spontaneous breathing. C_{dyn} is the volume change per unit of intrapleural pressure change measured between 2 points of zero flow.

Fast Fourier transformation: Mathematical model enabling the analysis of the frequency components of a signal, decomposing a time-domain signal into its frequency components.

Impedance (Z): With the IOS, Z characterises the global opposition of the respiratory system to changes imposed by the oscillatory signal. The higher impedance, the higher pressure required in order to maintain a determined flow. The Cartesian complex notation of the mechanical impedance of a respiratory system is: $Z(t) = R + j.X$ (R = resistance; X = reactance; j = unity of the imaginary numbers, defined as $j^2 = -1$).

Oscillatory respiratory reactance (X_{rs}): Being dependent on both dynamic compliance and inertance (negligible in horses), X_{rs} reflects mainly elastic proprieties of the respiratory system. It represents the imaginary component of Z in its Cartesian complex notation.

Oscillatory respiratory resistance (R_{rs}): Characterises the permeability of the respiratory tract to airflow. It represents the real component of Z in its Cartesian complex notation.