Platinum
ELITE SERIES™ PLETHYSMOGRAPH

Pulmonary Function

Airways Resistance

One of the most valuable measurements provided by a body plethysmograph is airways resistance or R_{aw}. It is particularly useful in the detection, diagnosis and evaluation of airways disease such as asthma, bronchitis and emphysema. The clinician cannot rely on spirometry alone to accurately determine the presence or absence of obstructions. Compared to spirometry, airways resistance:

- Is more sensitive in the diagnosis of airways disease
- Provides earlier detection of airways disease
- Is more accurate for evaluation of airway reactivity (bronchodilation and broncho-provocation)
- Assists in the differential diagnosis of obstructive disease (central vs. peripheral obstruction)
- Offers enhanced evaluation of upper airway lesions

What is Airways Resistance?

R_{aw} is essentially a measure of how much pressure it takes to push a certain flow of air through an airway. Since airway resistance and airway diameter are inversely related (Poiseuille's Formula), a larger airway has a decreased resistance to flow (Figure1) whereas a smaller diameter airway (Figure 2) has a *significantly* greater resistance and reduced flow. For example, if the diameter of an airway is halved, the resistance to flow increases by a factor of sixteen. In addition to airways resistance, airways conductance (G_{aw}), the reciprocal of R_{aw} ($G_{aw} = 1/R_{aw}$), is reported.

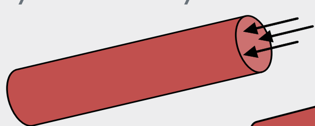
Fig. 1

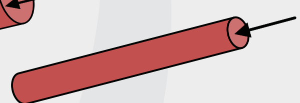
Fig. 2

Test Procedure

Airways resistance is an effort independent assessment of the airway diameter and a determinant of the resistance to airway flow. During testing, the patient is asked to breathe with an open shutter and then against a closed shutter. The efforts can be performed using panting or non-panting ("quiet breathing") maneuvers. Mouth pressure changes and gas flow measurements are taken at the mouth and concurrently, pressure changes inside the cabinet are recorded. While the shutter is open, the patient's gas flow and cabinet pressure changes are plotted. The resulting graphic shows flow in the vertical axis and cabinet pressure on the horizontal axis (Figure 3). This graphic is overlaid with the graphic from closed shutter breathing and the combined effort appears as in Figure 4.

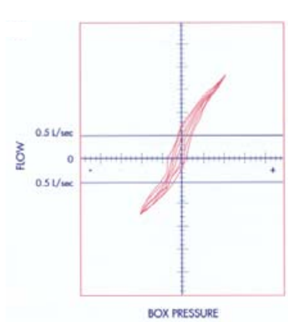

Fig. 3

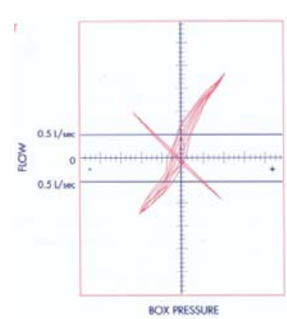

Fig. 4

Specific Resistance (sR_{aw}) and Specific Conductance (sG_{aw})

R_{aw} and G_{aw} can also be expressed per liter of lung volume; sR_{aw} and sG_{aw} respectively. sR_{aw} and sG_{aw} are particularly helpful in differentiating disease states. Some patients overinflate their lungs to distend the airways, increasing lung volumes and thereby lowering resistance. This is a common compensatory mechanism and explains why obstructed patients may present a normal airway resistance value. However, if R_{aw} is compared to the volume at which it was measured, sR_{aw} may be significantly increased. While a normal Raw may be reported, an increased sR_{aw} or a decreased sG_{aw} would be more indicative of the disease process. This volume correction is very useful in pediatrics where normal patients have increased resistance, but smaller lungs. sR_{aw} and sG_{aw} provide age independent predicted values.

MEDGRAPHICS®
Cardiorespiratory Diagnostics

Clinical Significance

Airways resistance helps differentiate between restrictive and obstructive disease and the cause or site of obstruction. The presence of obstructive disease does not necessarily mean increased resistance. Obstruction is possible with normal resistance and increased resistance may be present without airflow obstruction. Airways resistance can be used to determine whether or not the cause of obstruction is airway dysfunction. The differential role of airway mechanics in determining the cause or site of obstruction is summarized in Figure 5:

Airway Dysfunction	*Raw*	*sRaw*
Central Airways Disease (e.g., bronchitis, asthma)	High	High
Peripheral Dysfunction (e.g., emphysema, bronchiolitis)	Normal	High
Extrapulmonary Causes (e.g., neuromuscular)	Normal	Normal

NOTE: if Gaw and/or sGaw are used, low rather than high values would be abnormal.

Fig. 5

The effect of brochodilation can be assessed more accurately by airways resistance when compared to forced maneuvers such as in spirometry. During a forced maneuver, because the airways are relaxed from the bronchodilator, the airways may collapse more easily from this somewhat unnatural maneuver. Even though the airways are dilated, expiratory flows may not increase. Because of the sensitivity of airways resistance, the effect of the bronchodilator can be easily quantified. A patient may state that they feel better after given a bronchodilator; however, forced expiratory flow measurements may not show objective proof of the bronchodilator response. Airways resistance measurements, on the other hand, may show a significant response to the medication.

Additional Diagnostic Capability

An additional utility of airways resistance testing is the use of the loops obtained. The shape of the curves from R_{aw} testing can be as diagnostic as the shape of the flow/volume loops obtained during forced vital capacity testing. The loops can give information on the dynamic characteristics of the airways themeselves. The numbers alone from a forced vital capacity may not tell the complete story about a patient so the clinician may rely on the shape of the loops for further diagnostic help. Figure 6 displays various loops from R_{aw} testing and corresponding flow/volume loop that matches the disease state.

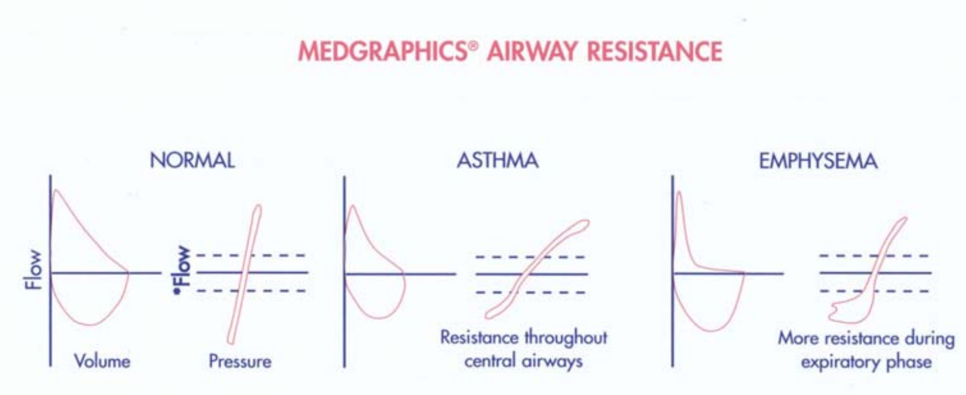

Fig. 6

Medical Graphics Corporation
350 Oak Grove Parkway
St. Paul, MN 55127-8599
Toll Free: 800.950.5597
International: +1.651.484.4874
Fax: +1.651.484.8941
www.medgraphics.com
info@medgraphics.com

Part #060046-001 Rev A

Medical Graphics Corporation, Europe
(Customer support only. For sales,
contact Medical Graphics, USA)
Via Simone d'Orsenigo n.21
20125 Milano, Italy
Phone: +39 346-857-5928
Fax: +39 025-412-0233
www.medgraphics.com
info@medgraphics.com