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EDITORIAL

The monitoring of bronchial inflammation by bioimpedance

Ever since inflammation was recognised as the fundamental pathogenic process of asthma[1], different techniques have been investigated which seek to measure the degree of bronchial inflammation in patients suffering from this disease. Without doubt the bronchial biopsy and the study of cellularity and concentration of the different mediators in the bronchoalveolar lavage by fibrobronchoscopy have enabled us to better understand the asthmatic process[2]. However, the aggressiveness of the technique does not allow for its routine use in daily practice. Other less aggressive methods, but which are still troublesome, include the study of induced sputum[3] or of biomarkers in condensed expired air[4]. Use has also been made of systems like the measuring, in serum or urine, of cellular mediators such as the eosinophilic cationic protein,[5] among others. All these methods have a clear usefulness in research but they are of limited use in daily practice. The most commonly used procedure nowadays in medical practice is to measure the expired fraction of nitric oxide[6]. The appearance of portable systems and which have a moderate cost has permitted their more widespread use[7]. Despite having been extensively studied, many doubts still remain as to how useful they are in deciding on changes in the treatment and in inproving the degree of asthma control in patients[8].

None of these methods is ideal. The majority of these are indicators of eosinophilic inflammation, but in the case of asthma, there is not only eosinophilic inflammation but also inflammation mediated by other cells: neutrophils, lymphocytes etc[9]. For all of the above, we must welcome research into new methods which permit the measuring of inflammation in the airway in a straightforward manner.

The study by Peroni et al[10] published in this issue of Allergologia et Inmumopathologia analyses the usefulness of the measurement of bioimpedance for the monitoring of inflammation in children with allergic asthma. Impedance is an abstract physical variable which describes the resistive characteristics (or the opposite, the conductivity) of an electrical circuit. Mathematically it is a complex number which consists of a real part and of an imaginary one (resistance and reactance)[11]. Bioimpedance measures the conductive and resistive properties of the tissues upon the application of a low voltage electrical current. When a low frequency current is employed (< 10 Hz), the impedance measured gives an idea of the composition of the extra-cellular space; a current with a greater frequency would report on the composition of both the extra-cellular as well as the intra-cellular space. The technique consists in generating a difference in power between two electrodes and with a micro-amperometer connected in series, measure the resistance of the tissues to the passage of the current. The greater or lower conductivity of the tissue will depend on the hydroelectrolytic composition of the extra-cellular space of the tissue.

In the bronchial inflammatory process, the arteriolar muscle relaxes and there is an increase in the blood flow (active hyperaemia) and an increase in the capillary and venal permeability with an extravasation of plasma. The combination of these two processes increases the concentration of electrolytes in the extra-cellular compartment, which in turn increases the electrical conductivity. The system employed by the authors seeks to evaluate this increase in conductivity and thus infer the degree of inflammation of the patient's airway.

The system utilised by the authors: Allergo-Midax (Eurospital, Trieste, Italy. http://www.eurospital.it/midaxsystem/index-AllergoMidax.htm) is a device which carries out a tomographical analysis of the extra-cellular bioimpedance by means of several electrodes placed on the patient's head, lumbar region, wrists and ankles. The interpretation of the data is carried out in an analysis centre which uses a system of neural networks by telematics. In the scientific literature there is nothing published which supports the idea that the changes in impedance registered by this system are related with the degree of bronchial inflammation. There is but one study, by Di Rienzo et al[12] in which bioimpedance; maximum expiratory flow; a symptom score; and eosinophil cationic protein (ECP) before and 21 days after treatment, are measured in a group of 87 adults with mild persistent asthma. They found that a good degree of agreement existed between the symptom score and the bioimpedance. However,

they do not refer that there was a correlation between the bioimpedance and the levels of ECP or peripheral eosinophilia which would be more related with the degree of eosinophilic inflammation. The study by Peroni et al[10] does not refer to the existence of a relation between the fall in conductivity and the fall in nitric oxide either. They do refer that they did not find a correlation with the changes in lung function.

Bioimpedance depends directly on the concentration of electrolytes in the extra-cellular space which is in great part mediated by the degree of hydration of the patient. The systems which regulate the composition of the extra-cellular medium are complex and may be altered due to diverse mechanisms. The changes in bioimpedance found by Peroni et al. from the moment in which the patients arrive at the Instituto de Misurina at 1756 metres above sea-level, coming from locations at sea-level, and those changes after one or four months living at that altitude could also be related to, for example, changes in the composition of the extra-cellular space in the lung, which are secondary to the changes in atmospheric pressure and are not necessarily related with the reduction in bronchial inflammation brought about by a lack of contact with allergens.

Although researches such as the one published in this issue are very promising, many basic studies are necessary before one can affirm that the changes in bioimpedance are secondary to changes in the bronchial inflammation and that their determination may be useful in the control of asthma patients.

José Ramón Villa Asensi
Sección de Neumología.
Hospital Infantil Universitario Niño Jesús.
Madrid.
jrvilla@gmail.com

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