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Editorial

Use of the Electronic Nose for Diagnosing Respiratory Diseases[☆]

Utilidad de la nariz electrónica para el diagnóstico de enfermedades de la vía respiratoria

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The continuous search for non-invasive respiratory disease markers has led to the development of new techniques that can distinguish disease that affect the airway or pulmonary parenchyma. Thus, the analysis of exhaled air has gained importance in research, and in particular pathologies it has already been transferred to clinical practice. The evolution in new technologies has spurred the development of new devices, and with these the analysis of exhaled air has become an important non-invasive diagnostic method that may be used in the evaluation of pulmonary diseases. An example is the measurement of exhaled nitric oxide, now used in daily clinical practice for the diagnosis and follow-up of asthma.

Since the age of classical medicine, the sense of smell has been used to classify certain diseases. Some examples are the putrid smell of infections due to anaerobes or the fruity scent of ketone in patients with diabetic ketoacidosis. In this new era of technological advances, devices are being developed that will be able to quantify and differentiate such smells in a more precise manner. One of these new devices is the electronic nose (E-nose), which could be described as a tool that is made up of a matrix of chemical sensors with overlapping sensitivities that, when exposed to volatile particles, experience specific changes in their electric resistance. An advanced system of pattern recognition that is able to recognize simple or complex aromas can, based on the integrated signal obtained from each of the sensors, create a *smellprint*.[1]

In order to understand how the E-nose works, it is necessary to clarify that the chemical sensors that make up the sensory matrix are not specific, meaning that they are not selective for a given compound, but instead for a groups of compounds. In fact, the E-nose technique in medicine is based on the detection of volatile organic compounds (VOC) that are present in the gaseous phase of human breathing.[2] This response generates a signal whose pattern or *smellprint* can be recognized by comparing it with previously recorded patterns. In this context, the technology of the electronic nose is intended to be used for the identification of bacterial pathogens, either *in vitro* or *in vivo*[3–5] or as a potential tool for the identification of patients with lung cancer,[6–9] COPD[8,11] and asthma.[10,11]

Humphreys et al.[12] have studied the potential use of the electronic nose in the diagnosis of pneumonia associated with invasive mechanical ventilation, comparing the results obtained with the E-nose with those obtained from bronchoalveolar lavage cultures. With 44 patients and with a model of 4 clinically different groups (gram-positive, gram-negative, fungi and no biological growth), the E-nose correctly classified 83% of the samples.

An initial study by Machado et al.[9] in lung cancer compared the VOC in the exhaled air from 14 patients with lung cancer *versus* 54 control patients. They found a sensitivity of 71% and a specificity of 91% for detecting patients with lung cancer.

Another paper written by Dragonieri et al.[8] compared the VOC present in 10 patients with lung cancer with those obtained from 10 healthy controls and 10 COPD patients, and significant differences were found. Similar results were obtained by Fens et al.[11] when they compared the VOC of the exhaled gas from 20 asthma patients, 30 COPD patients, 20 non-smoker controls and 20 smoker controls.

In this direction, a preliminary study by our group,[13] following the same methodology, analyzed the exhaled air from 18 COPD patients and 10 controls. All the COPD patients were correctly recognized, as well as 8 of the 10 controls. This represents a sensitivity of 100% and a specificity of 92% for the diagnosis of the disease.

All these findings spark great expectations for the potential use of the electronic nose in the diagnosis of respiratory tract diseases. It is a simple, non-invasive technique that is easy to use, transportable and easy to apply in daily practice. Other positive features of this technique are that results are obtained quickly and they are apparently reproducible, even with different devices and on different days.[11]

For the definitive implementation of this new tool, studies are necessary with sufficiently large case volumes in order to determine the more specific VOC patterns of each disease. New tools also need to be exploited for processing and analyzing the results, such as neuronal networks, which are able to quickly and precisely recognize the most characteristic patterns of each disease.

In conclusion, it seems that in the near future pulmonology with have a new tool in its arsenal. This new instrument will study

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patients simply, quickly, safely and effectively and will aid in the diagnosis and follow-up of different lung pathologies.

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