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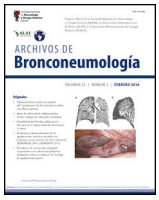

Editorial

Future Diagnostic Techniques in Pulmonology. A Change in Mindset☆

Las futuras técnicas diagnósticas en neumología, cambiar el chip

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Unfortunaltely as pulmonologists, we not always have had at our fingertips all the information we need to confidently diagnose respiratory diseases. Despite all the advances, the combination of clinical and complementary criteria required for the diagnosis of many respiratory diseases still today present a margin of error that needs to be reduced. What can we expect in the reasonably immediate future?

Mobile technologies: devices that patients can wear on their chest, waist, or wrist, or even upload to their cell phone, that can monitor physical activity, respiratory rate, temperature, blood oxygenation, wheezing, lung function, and the use of inhalers.[1] It is clear that this technology will facilitate the monitoring of chronic diseases, treatment adherence, and early detection of exacerbations of chronic processes.[1] The disadvantage of mobile monitoring, whether remote or not, is the information overload that will occur if it is used in large numbers of patients, and the legal responsibility for the data that may become available in the absence of sufficient capacity for analysis and response.

Miniaturization: mini-pulse oximeters already belong in the pulmonologist's toolkit, but now we also have spirometers connected to cell phones,[2] pocket ultrasound devices, manual chromatographs for volatile compounds in the breath, miniaturized labs-on-a-chip (LOC) that, in the near future, will provide us with on-the-spot diagnostic information for many diseases. This technology has already made strong inroads into the screening/diagnosis of sleep apnea.[3]

Diagnostic aid software: the analytical capacity of computers will be used in clinical practice for the interpretation of radiological, endoscopic, and histological images of all kinds. The improved analysis of 3-dimensional computed tomography in, for example, the evaluation of tumor volume, fibrosis and emphysema promises to become more affordable, and might perhaps change the definition of disease.[4] This software will also foreseeably be implemented in our practice as diagnostic assistants and we must prepare ourselves for patients also having access to their responses.

Imaging: confocal microscopy enables the analysis of vasoactivity phenomena during hypoxia, ischemia reperfusion events, or migrating ("homing") cells in disease processes, such as tumors or inflammatory diseases.[4] Positron emission tomography (PET) is limited by the rapid decay of radioactive isotopes.[5] The development of more sensitive detectors will extend the life of the isotope and reduce exposure to radiation. Different, more selective fluorescent molecules will be used, and the use of PET will expand to the evaluation of inflammatory diseases.[5] This technology will still be costly in the immediate future, and, as such, use will be restricted. Magnetic resonance imaging (MRI) with hyperpolarized noble gases permits the study of the movement of the tissues and gas flow in the lung in real time, although the high cost of this technique will restrict its use in the clinic.[6] Real-time MRI may be useful for the pathophysiological evaluation of pulmonary hypertension.

Lung function devices: we will see the expansion of spirometers using ultrasound, which do not require calibration.[7] These devices will be used in bi-directional flow measurements and more compact and portable diffusion devices[2] that can measure NO diffusion, and, in combination with CO analyzers, will provide a simple determination of the membrane and capillary components, factors of interest in certain lung and heart diseases.[2] New technology based on the effect of brief interruptions in flow in a known volume will perhaps make it possible to measure lung volumes quickly, without the need for a body box or gases.[8]

Biomarkers: the identification of precise, easy-to-determine biomarkers is perhaps the major issue pending in respiratory medicine.[4] Innovations are already emerging from different cell sources and "omics" (genomics, proteomics, metabolomics, etc.).[1,4] A technical revolution is also approaching, with automated polymerase chain reaction (PCR) systems, and electric field-induced release and measurement (EFIRM).[9] All this technology will allow us to determine the predisposition of patients to certain diseases. We will be able to make a prompt, precise diagnosis and an accurate prognosis, in a simple and economic manner,[4] as is already being with liquid biopsies in lung cancer.[9]

Diagnosis based on polymerase chain reaction in pulmonary infections: this technique will revolutionize the clinical practice of infectious diseases. The technology, though costly, is already

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available and can identify the potentially causative pathogens in pneumonia in a few hours, even if the patient is already receiving antibiotic treatment. Its introduction will be immediate in severe pneumonia, particularly in immunocompromised individuals and in intensive care, where quick and timely treatment decisions will improve prognosis, reduce the development of resistance, and lower costs.[10] This technique will also have other clinical applications, including the rapid detection of antimicrobial resistance in patients with tuberculosis and chronic respiratory infection, the evaluation of emerging infections, and surveillance and early detection of agents that might potentially cause epidemics or outbreaks.[10] PCR identification of the microbiome may also help us understand the behavior of certain diseases or even their etiology.[11]

Pulmonologists of the future will use these tools to monitor patients and predict how they will respond to certain therapeutic approaches tailored to their individual physiology, instead of relying on the mean response of large groups of individuals who participate in clinical trials. The availability of more accurate tests will possibly lead to the differentiation of known diseases in other new or in several subtypes. Diagnostic aids will make the practice of respiratory medicine more scientific, and will reduce the value of our ability to make diagnostic decisions in situations of uncertainty (the so-called art). Our inexorable progress toward accuracy will force us to work in a very standardized fashion, similarly to that already observed in other specialties, such as cardiology and oncology, specialties that already almost always practice in an environment of accurate diagnoses. Respiratory medicine specialists will need therefore adapt and place more emphasis on skill and knowledge in order to use sophisticated diagnostic techniques and to manage our patients using precision medicine.

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