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# Emerging Techniques in the World of Respiratory Imaging

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A physician's subject of study is necessarily the patient, and his first field for observation is the hospital. But if clinical observation teaches him to know the form and course of diseases, it cannot suffice to make him understand their nature; to this end he must penetrate into the body to find which of the internal parts are injured in their functions. ... – *Claude Bernard* [1]

The French physiologist Claude Bernard expressed in the above quote, in 1865, a burning wish to explore the internal body parts of the patient with a certain disease [1]. It was only 30 years later in 1895 that the first X-ray was made. Indeed, at the end of the 19th century, while studying the effects of passing an electrical current through gases at low pressure, the German physicist Wilhelm Röntgen accidentally discovered X-rays – highly energetic electromagnetic radiation capable of penetrating most solid objects. His discovery transformed medicine almost overnight [2]. Within a year, in 1896, Dr John McIntyre set up the world's first X-ray department in a hospital at Glasgow Royal Infirmary, and the department head produced the first pictures of a kidney stone and a penny lodged in a child's throat [3].

It is fascinating to note what a transformation and evolution medical imaging went through during 125 years:

from the clinical introduction of computed tomography (CT) in 1971 to the 10.5-T human MRI that was introduced last year [4].

As in many areas of clinical medicine, in respiratory medicine imaging is commonly the diagnostic cornerstone. Over time, the invention and further development of tools such as X-ray imaging, rigid bronchoscopy, flexible fiberoptic bronchoscopy, CT, flexible video bronchoscopy, nuclear imaging, thoracic ultrasound, MRI, and endoscopic ultrasound (EUS/EBUS) have significantly changed the way we practice medicine and approach science nowadays. The progressive developments have led to better diagnostic and treatment approaches and a better understanding of the pathogenesis in a wide variety of lung diseases, such as obstructive lung diseases, infectious diseases, interstitial lung disease to thoracic oncology. Today the practicing respiratory physician relies heavily on imaging tools.

In addition, in respiratory research both the development of new techniques, or new approaches for more pre-

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cise phenotyping, as well as the field of radiomics and pattern recognition using big data and machine learning are evolving. All of these are key to potential successful or new outcomes.

We are delighted to introduce a series of review articles in *Respiration* that will be published in the coming year, focusing on the further development of respiratory imaging in a series called “Emerging techniques in the world of respiratory imaging.” In this series we have invited world experts on four diverse progressive respiratory imaging topics.

*Radiomics* is an emerging translational field of research aiming to extract mineable high-dimensional data from clinical images. Radiomic features have the potential to uncover disease characteristics that fail to be appreciated by the naked eye. A review in this series by the team of professor Lambin from Maastricht University, The Netherlands, will focus on the increased understanding, value, and awareness of radiomics in lung cancer and COPD. Machine learning techniques have resulted in software that could reliably calculate and predict the severity and disease activity of emphysema, airway disease, and interstitial lung disease. Professor Jonathan Goldin from the University of California Los Angeles, USA, will

focus on the current status, clinical implementation, future developments, and possibilities of the *Quantification of respiratory imaging*. Over the past decades, the “hunt for the pulmonary nodule” has gained increasing attention with better CT imaging, chest CT lung cancer screening programs, the need for molecular diagnosis, and the introduction of endoscopic navigation. To cover this exciting and clinically relevant imaging topic, Professor Pallav Shah and his team from the Royal Brompton Hospital and Imperial College London, UK, will shed light on the emerging developments in *Navigational Bronchoscopy*. Doctor Bonta and his group from the Amsterdam University Medical Center, The Netherlands, will describe the options which advanced endoscopic imaging of airways and epithelium using progressive techniques such as *optical coherence tomography and confocal laser endomicroscopy*. With these techniques, in-depth knowledge can be gained in airway and parenchymal lung diseases both for scientific and clinical purposes.

With this “Emerging techniques in the world of respiratory imaging” series we hope to provide our readers with new insights, food for thought, and enthusiasm to together further advance the exciting field of respiratory medicine.

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