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Letter From the Guest Editors

Many consider that the initial use of radioactive tracers in pulmonary studies was for the evaluation of pulmonary embolism (PE), as described in the seminal publication by Henry Wagner *Jr* in 1964.[1] However, more fundamental studies of gas exchange in the lungs were performed prior to this in 1960 by J.B West and C.T. (later Sir Colin) Dollery, using scintillation probes and positron emitting gases produced at the Medical Research Council's Cyclotron Unit at Hammersmith Hospital in London.[2] West was a respiratory physician and physiologist from Australia who made the trek to the Hammersmith Hospital to pursue post-graduate studies like many of his compatriots have done (guest editor DLB included), as, indeed did Henry N Wagner *Jr*. The Hammersmith group went on in the 1970s to use their cyclotron to produce the first rubidium-krypton generator for imaging the lungs using the inert gas ^{81m}Kr and a gamma camera[3] and SPECT V/Q in the mid-1980s,[4] further cementing this group's important contributions to investigating lung function with radiotracers.

While ventilation/perfusion (V/Q) scanning has been one of the most commonly performed nuclear medicine studies worldwide since the 1960s, its role as the primary test to evaluate PE has declined in many countries in recent years. Most notably in the United States, the V/Q scan has largely been supplanted by contrast-enhanced X-ray CT pulmonary angiography for the evaluation of PE, largely due to easier accessibility, faster acquisition, and perceived superior accuracy compared to planar scintigraphy, which is still used in some nuclear medicine centers. In other countries (particularly in Europe, Canada, and Australia), where better radioaerosol ventilation agents are available (such as ^{99m}Tc-labelled nanoparticles or ^{81m}Kr) and SPECT (or more recently SPECT/CT) imaging is the norm, V/Q scintigraphy remains an option as the primary imaging test in many patients with known, or suspected, PE.

Even though the clinical use of V/Q scanning has centered on the evaluation of PE for over 50 years, it is important to remember that scintigraphy using ventilation and perfusion agents provides important physiological information which can be of great benefit in the evaluation of other clinical conditions. In this issue, we turn our focus from PE diagnosis to alternate emerging areas of application of the V/Q lung scan. The widespread adoption of SPECT, and now SPECT/CT, would appear to be the impetus for many of these new applications, providing three-dimensional structure-function imaging of pulmonary physiology combined with lung morphology. Most notably, in our experience many of these uses are driven by requests from referrers, such as cardiothoracic surgeons looking for pre-surgical *regional* information about the impact that their lung reductive surgery might have on respiratory function; for example, in an individual with compromised lung function, removing a diseased lung lobe might have virtually no impact on the individual's respiratory status as the lobe had ceased contributing long before to the lungs' most vital function, gas exchange.

The topics that are covered in this issue of *Seminars* include the use of lung scanning in the investigation of the regional heterogeneity of asthma, studies in chronic obstructive pulmonary disease, clearance of inhaled particulate material from the lungs, radiotherapy treatment planning, insights into pulmonary manifestations of cardiopulmonary conditions, presurgical evaluation of regional lung function, and the use of PET for imaging the lungs.

The V/Q SPECT/CT (or PET/CT) lung scan will continue to find application in the future for two primary reasons: firstly, because it is a functionally-based study, and, secondly, because it provides regional spatial information which cannot be obtained from standard respiratory function testing which is, by definition, global. As quantitative SPECT/CT becomes more routinely available, and while we continue to witness the introduction of new, often expensive therapies for lung diseases, the need for a functional, three-dimensional imaging biomarker to evaluate pre- and post-treatment performance will continue.

As the role of the lung scan continues to evolve and new clinical applications emerge, we anticipate that V/Q scintigraphy is likely to still be around in another 50 years' time. As this issue of *Seminars* demonstrates, there are many important clinical and research uses for which pulmonary scintigraphy is well suited apart from the diagnosis of pulmonary embolism, and we foresee that several of these applications

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are likely to become important indications for V/Q scintigraphy in the future.

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