European Journal of Nuclear Medicine and Molecular Imaging (2019) 46:2427–2428
https://doi.org/10.1007/s00259-019-04464-8

EDITORIAL

A guide for a brave future for lung ventilation/perfusion tomography: the most important pulmonary nuclear medicine technique

Marika Bajc[1] · Björn Jonson[1] · Roberto C. Delgado Bolton[2]

Received: 19 July 2019 / Accepted: 25 July 2019 / Published online: 7 August 2019

Until this century, planar imaging was the primary non-invasive method for the diagnosis of pulmonary embolism (PE). This historical technique combined with so-called probabilistic interpretation suffered disrepute since the PIOPED I study showed that 65% of scans were non-diagnostic [1]. The European Association of Nuclear Medicine (EANM) guideline written by Bajc et al. [2] is a state-of-the-art guideline of the most important pulmonary nuclear medicine technique. This seminal work updates the EANM's previous and first guideline for ventilation/perfusion scintigraphy (V/P) published in 2009 [3, 4]. A decade ago, in 2009, the EANM guideline had already determined that the principle of probabilistic diagnosis was obsolete based on the overwhelming superiority of V/P single-photon emission computed tomography (SPECT) combined with a holistic interpretation [3, 4]. The improved technique reduced the number of non-diagnostic findings to 4% or less, while sensitivity and specificity were excellent [5]. Recent V/P_{SPECT} studies have shown that interpretation of all patterns representing ventilation, together with perfusion, achieves conclusive reports in 97 to 99% of cases [6, 7]. The ability to quantify the regional ventilation and perfusion gives pulmonary V/P_{SPECT} the paramount role of nuclear imaging techniques when leveraging the knowledge of lung physiology together with pathophysiology. Ventilation imaging maps regional ventilation and helps define lung borders, thereby facilitating the recognition of peripheral perfusion defects. Furthermore, the ventilation scan is essential in providing additional information about cardiopulmonary disorders beyond PE such as chronic obstructive pulmonary disease (COPD), asthma, pneumonia, and left heart failure and in clinically challenging situations such as chronic pulmonary embolism and chronic thromboembolic pulmonary hypertension (CTEPH). A combined 1-day V/P study is recommended as it increases the specificity for PE diagnosis and allows the detection of additional pathology [2]. In this respect, ventilation imaging has an invaluable role as part of the lung V/P scintigraphy. V/P_{SPECT} has a key role in diagnosing PE in pregnant women.

Follow-up of PE using imaging is essential to (a) assess the effect of therapy, (b) differentiate between new and old PE when there is a suspicion of PE recurrence, and (c) explain physical incapacity after PE. V/P_{SPECT} seems ideally suited for the follow-up of PE because small and large emboli are recognised so that regression or progression of thrombotic disease can be studied in detail applying a reasonable radiation exposure [8–11].

Since the 2009 EANM guidelines, the technique for V/P_{SPECT} remains largely stable. However, it has become more available as companies producing cameras and software have adopted the principles behind V/P_{SPECT}. Ventilation studies are in general based on inhalation of radiolabelled aerosols. The preferred aerosol, ^{99m}Tc-labelled Technegas®, has solid particles small enough to penetrate to the alveolar level, nearly as a gas. This is advantageous, particularly in patients with obstructive lung disease [12]. The diagnosis of PE in patients with COPD became possible by using Technegas®. The distribution of ventilation allows even grading of COPD [13].

V/P_{SPECT} combined with low-dose computed tomography (CT) is an evolving technique that according to the 2019 guidelines is not recommended as the first-line procedure in patients with suspected PE although the dual modality V/P_{SPECT}/CT will have impact in some patients, particularly

This article is part of the Topical Collection on Editorial

This Editorial Commentary refers to the article https://doi.org/10.1007/s00259-019-04450-0.

✉ Marika Bajc
marika.bajc@med.lu.se

[1] Department of Clinical Sciences, Clinical Physiology and Nuclear Medicine, University of Lund, Lund, Sweden

[2] Department of Diagnostic Imaging (Radiology) and Nuclear Medicine, University Hospital San Pedro and Centre for Biomedical Research of La Rioja (CIBIR), Logroño, La Rioja, Spain

when malignancy may be suspected. Further studies to assess the benefits and risks are needed [2].

The EANM 2019 guideline comprehensively analyses the advantages and limitations of V/P_{SPECT} and computed tomography of the pulmonary arteries (CTPA) and presents an improved algorithm for diagnosing PE. Applying the interpretation criteria described in the 2019 guideline is essential in interpreting V/P_{SPECT} images and reaching an accurate diagnosis, as well as allowing quantification of functional parenchyma. The 2019 guideline emphasises that V/P_{SPECT}, in contrast to CT, can be performed in all patients, with renal or thyroid disease, and with or without chest X-ray changes. Patients seeking advice leading to suspicion of acute PE have non-specific symptoms like dyspnoea and chest pain. The new guideline analyses how diseases like COPD, left heart failure, and pneumonia can be diagnosed by V/P_{SPECT}. The rate of such diagnoses explaining the presenting symptoms is even more frequent than the rate of confirmed PE. V/P_{SPECT} provides a diagnosis and an explanation for the symptoms more frequently than CT; it has no contraindication and gives a much lower radiation burden than CT particularly to the female breast. Its limitation is a lower availability than CT [2].

V/P_{SPECT} interpreted with a holistic interpretation is the cornerstone of the new paradigm as re-emphasised in the 2019 guidelines, expanded with a broader group of authors, including representatives of angiology, cardiology, and radiology [2–4]. With respect to some traditionalists arguing for the planar technique, one may cite Max Planck: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it." V/P_{SPECT} is recommended as the first-hand method for diagnosis of PE by the EANM and endorsed by the Canadian Association of Nuclear Medicine [2].

The EANM guideline has an important role for education. It should promote methodological harmonisation and homogeneity in our discipline. By pointing out the limitations of our knowledge, it might stimulate further research. Recent studies show that V/P_{SPECT} allows the diagnosis of heart and lung diseases which otherwise often would remain undiagnosed. This motivates us into challenging intra- and interdisciplinary co-operation that has potential for improved healthcare in wide fields. Intra- and interdisciplinary co-operation must be enhanced in research as well as in the clinical field. Methodological homogeneity should pave the way to co-operation in terms of interpretation via remote telenuclear medicine and artificial intelligence in such a way that we may increase the availability of V/P_{SPECT} at the highest international standard. If nuclear medicine does not want to be left on the platform when the train leaves, we must be ready.

Compliance with ethical standards The authors declare that they have no conflict of interest.

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