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USE OF THE SPECTRAL IODINE MAP IN THE ASSESSMENT OF CHRONIC PULMONARY THROMBOEMBOLISM

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Abstract: Lung scintigraphy is considered the technique of choice in the evaluation of chronic pulmonary thromboembolism. Technical advances in computed tomography such as dual energy (spectral) have allowed high quality images to be obtained. As an example, a CT scan is shown as a dual-energy patient case, who underwent both scintigraphy and deep spectral learning, not only was a lower radiation dose observed on scintigraphy, but also provided anatomical data on perfusion defect, essential for surgical planning and also highlighted other areas of perfusion alteration that were not clearly identified on V/Q scintigraphy. Therefore, we bring this initial experience with the use of Spectral Deep Learning as a possibility to combine anatomical and perfusion assessment in the same acquisition, reducing dose and possible costs.
Keywords: tomography; thromboembolism; dual energy; scintigraphy

INTRODUCTION

Lung scintigraphy (V/Q scintigraphy) is considered a technique of choice in the evaluation of chronic pulmonary thromboembolism (CPTE) (1). Technological advances in computed tomography (CT), in the last decade, have allowed the obtaining of high-quality images with lower radiation levels, enabling the diagnosis of small thrombi in segmental and subsegmental regions (2). Although some studies have demonstrated greater sensitivity in V/Q scintigraphy, more recent studies have shown better sensitivity in CT (1).

The term dual-energy CT (DECT) or spectral CT, refers to tomographic acquisition that uses two energy spectrums providing both morphological and functional information on the lung parenchyma, which can assist in the process of understanding the pathology involved (2,3). There are several technologies related to TCDE, however, some have limitations in the use of FOV and others do not allow the use of automatic radiation exposure (AEC).

The TCDE present in the Aquilion ONE / PRISM Edition equipment - Canon Otawara, Japan, is a deep learning (DL) reconstruction algorithm that allows ultrafast kVp switching (80-135), with volumetric anatomical coverage, routine use of the AEC and 50 cm FOV at acquisition.

TCDE reconstruction by DL is based on the large amount of information contained in low kVp and high kVp data, which are compared iteratively generating high quality images.

Deep Learning Visualizations (VAPs) are generated by a trained neural network using measured components between opposite energy data. The use of VAPs results in highly accurate temporal and spatial alignment for improved material classification and minimal temporal artifact (4, 5).

TCDE has several clinical applications, including the iodine map that allows the visualization, analysis and quantification of iodine distribution. In the chest, the three most frequently analyzed materials are iodine, air and soft tissue. With TCDE, iodine attenuation is considerably greater at 80Kvp compared to 135Kvp. Therefore, it improves the detection of CPTE compared to conventional CT, in addition to enabling the assessment of lung perfusion (6).

As an example, we demonstrate a case of a patient with CPTE, who underwent both V/Q scintigraphy and DLCT (figure 1).

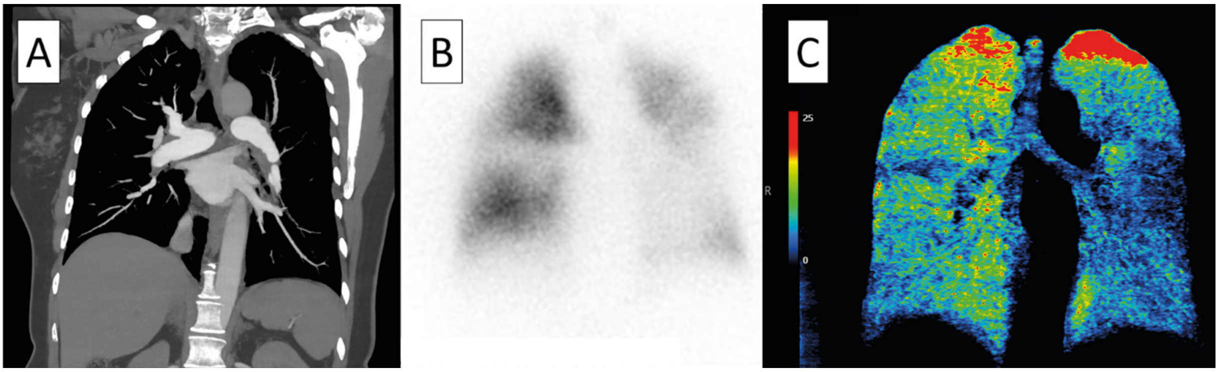

Figure 1: (A) Coronal MIP CT pulmonary angiography image demonstrating signs of CPET, including organized and eccentric chronic thrombus in both interlobar arteries, as well as abrupt narrowing of vessels and luminal bands in the left inferior lobar artery. There is also marked narrowing and occlusion of several distal branches in the middle and lower lobes and the lingula. (B) V/Q scan image (anterior projection), showing multisegmented perfusion defects. (C) Coronal image of the DL MIP iodine spectral map, which not only revealed the same different areas of multisegmented perfusion change, but also highlighted the involvement of basal segments in both the lower lobes and the inferior lingular segment, areas that also showed signs of CPET in angiographic images (Vitrea® Advanced Visualization - Canon Medical Informatics, INC).

Not only was a lower dose of radiation observed (V/Q scintigraphy: 7.55 mSv and TCDE by DL: 6.72 mSv), but also the TCDE by DL simultaneously provided anatomical data on filling defects, essential for surgical planning (2,3,6), and not only confirmed and showed excellent agreement with the perfusion failures seen on scintigraphy, but also highlighted other areas of perfusion alteration that were not clearly identified on scintigraphy but which demonstrated a correlation with areas of filling failure seen on tomographic angiography images.

CONCLUSION

Thus, we bring this initial experience with the use of TCDE by DL as a possibility of combining anatomical and perfusion assessment in the same acquisition, reducing dose and possible costs.

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