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Letter

Spectral dual-energy CT: A new tool to monitor lung perfusion recovery in acute pulmonary embolism after mechanical thrombectomy

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To the Editor,—Pulmonary embolism (PE) is characterized by the obstruction of a pulmonary artery that leads to impaired perfusion of pulmonary parenchyma, resulting in hypoxemia and increased pulmonary artery pressure (PAP) [1]. Although mechanical thrombectomy can be used to relieve right ventricular overload by reducing the thrombotic burden, the impact on global and lobar pulmonary perfusion restoration immediately after mechanical thrombectomy is still poorly understood. Spectral dual-energy computed tomography (DECT) offers new capabilities compared to conventional CT by allowing specific quantitative iodine content imaging within the lungs [2]. Iodine images serve as a surrogate marker for pulmonary perfusion, enabling analysis of pulmonary blood volume (PBV) [3,4]. Consequently, PBV offers a qualitative and quantitative functional analysis in patients with PE [5]. Moreover, with the recent development of post-processing solutions, lobar PBV can be quantified, providing a tool for understanding the impact of thrombectomy on pulmonary perfusion. In this letter, we report two patients who successfully underwent pulmonary thrombectomy for PE to illustrate the potential of spectral DECT in the assessment of lung perfusion recovery after mechanical thrombectomy in patients with acute PE.

Both patients underwent lung angiography imaging using spectral DECT (CT7500, Philips Healthcare) before and after mechanical thrombectomy with a retrieval/aspiration system (FlowTriever®, Inari Medical). The first patient was a 64-year-old man with intermediate-risk PE. Spectral DECT imaging obtained after mechanical thrombectomy showed a decrease in thrombotic burden, particularly in the right lung, where the large proximal thrombus was removed, resulting in an overall decrease of the Qanaldi score by 29% (28/40 *vs.* 20/40). Right to-left-ventricle ratio decreased by 31% (1.1 *vs.* 1.6) and systolic PAP by 47% (49 mmHg *vs.* 26 mmHg). Quantitative PBV showed an overall improvement by 3.6% within the lungs. The analysis per lobe revealed an improvement of PBV by 83% in the right lower lobe. However, PBV decreased by 63%, 46% and 26% in the middle, right upper and left upper lobes, respectively (Fig. 1). The second patient was a 60-year-old man with intermediate-risk PE. After mechanical thrombectomy, spectral DECT showed a decreased thrombotic burden in all pulmonary arteries, resulting in an overall decrease of the Qanaldi score by 42% (19/40 *vs.* 11/40). Right to-left-ventricle ratio decreased by 40% (0.9 *vs.* 1.5) and systolic PAP by 51% (64 mmHg *vs.* 33 mmHg). Quantitative PBV showed an overall improvement by 99%. The analysis per lobe revealed an improvement of PBV by 100% and 68% in the right lower and upper lobes, respectively, and by 87% and 59% in the left upper and lower lobes, respectively. However, it also revealed a sub-segmental perfusion defect in the left Fowler lobe (Fig. 1).

These two observations illustrate the variable efficacy of pulmonary mechanical thrombectomy on lung perfusion in patients with intermediate risk PE, with more marked recovery observed in the right lobes and less effective recovery in left lobes. This variability in efficacy per lobe may be related to the anatomy of the pulmonary arteries, device angulation, or even clot position. The angulation of the right upper lobe makes the passage of the thrombectomy device easier, while the angulation of the left lower lobe makes access to the target area more challenging. This observation may be important in predicting the success of mechanical thrombectomy. In addition, despite a favorable decrease in thrombotic burden, the impaired perfusion in the middle and left upper lobes may indicate an uncorrelated relationship between macro and microcirculatory status, possibly explained by distal migration of clots associated with mechanical thrombectomy. This raises an important question to further investigate. In particular, it is not clear if distal clot migration during mechanical thrombectomy increases the risk of post-embolic pulmonary hypertension. These two observations suggest that spectral DECT can be used to quantify the degree of decreased lung perfusion due to distal clot migration and, assumably, monitor lung perfusion over time after PE. In conclusion, spectral DECT before and after mechanical thrombectomy allows for the evaluation of

Abbreviations: DECT, Dual-energy computed tomography; PAP, Pulmonary artery pressure; PBV, Pulmonary blood volume; PE, Pulmonary embolism

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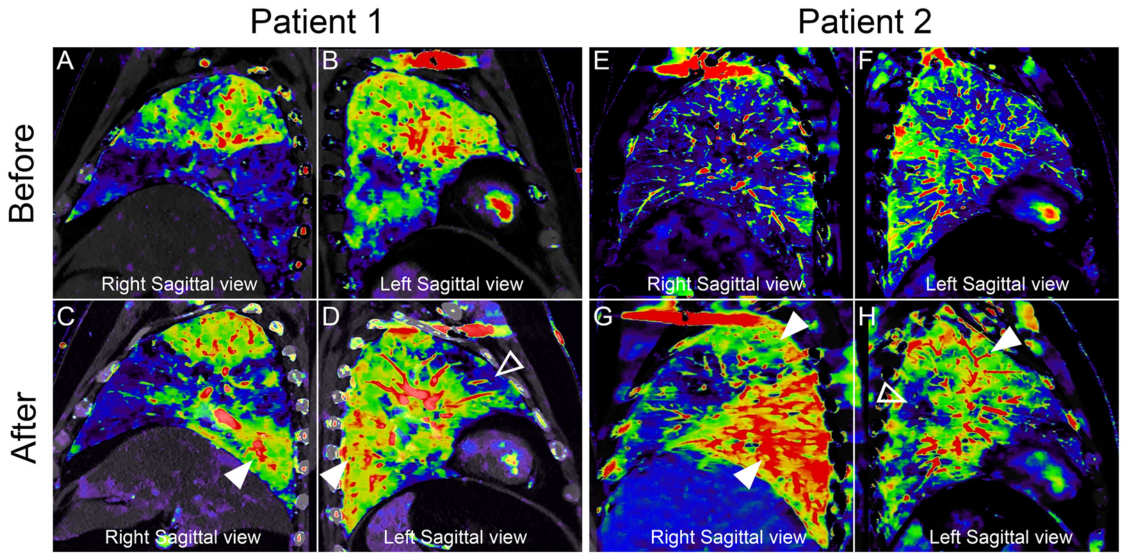

Fig. 1. Lung perfusion imaging using spectral dual-energy computed tomography (DECT) angiography in two patients with pulmonary embolism before and after mechanical thrombectomy.
(A—D), 64-year-old man with pulmonary embolism. After mechanical thrombectomy, spectral DECT images show perfusion recovery by 83% and 55% in the right and left lower lobes (arrowheads) while a reduction by 25% was noticed after the procedure in the anterior part of the left upper lobe (hollow arrowhead). (E—H), 60-year-old man with pulmonary embolism. After mechanical thrombectomy, spectral DECT images show perfusion recovery by 100% and 87% in the right and left lower lobes and by 59% in the left upper lobe (arrowheads) despite a perfusion defect after the procedure in the left Fowler lobe (hollow arrowhead).

pulmonary perfusion recovery in patients with PE. However, further study should be made to determine the clinical benefit of such approach.

Human rights

The authors declare that the work described has been performed in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans.

Informed consent and patient details

The authors declare that this report does not contain any personal information that could lead to the identification of the patients.

Author contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

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