



Is there a role for lung perfusion [^{99m}Tc]-MAA SPECT/CT to rule out pulmonary embolism in COVID-19 patients with contraindications for iodine contrast?

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Published online: 30 April 2020

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The recent pandemic of the 2019 novel coronavirus disease (COVID-19) is challenging medical institutions around the world. Management of severe acute respiratory symptoms (SARS) caused by the novel coronavirus often includes intensive care and invasive ventilation. One important complication associated with COVID-19 disease and a potential differential diagnosis in sudden respiratory distress is pulmonary embolism (PE). A retrospective cohort study by Zhou et al. demonstrated respiratory failure to be the most common complication with 54% of the patients leading transfers to the Intensive Care Unit and death. Severe coagulopathy was present in 19%, but rates differed significantly between survivors (7%) and non-survivors (50%) [1]. This phenomenon is already well known in interalia influenza-associated pneumonia and leads to a predisposition for ischemic events and thrombosis [2]. On this basis, recent data open the discussion of anticoagulation in severe cases of COVID-19 as treatment with low-molecular-weight heparin (LMWH) appeared to be

associated with reduced mortality [3]. Therefore, the International Society of Thrombosis and Hemostasis (ISTH) recently published the recommendation that all patients hospitalized for COVID-19 should receive a prophylactic dose of LMWH during hospitalization, in the absence of any contraindications such as active bleeding or platelet counts of less than $25 \times 10^9/l$ [4].

The current gold standard to rule out significant PE in patients with COVID-19 pneumonia is a contrast-enhanced CT-scan (ceCT). Several case reports have been published that could confirm PE in patients with typical COVID-19-associated pulmonary changes [5, 6].

However, in patients with contraindications for iodinated contrast media, ceCT cannot be used to rule out PE. A potential alternative to ceCT for this indication is perfusion single-photon emission tomography (SPECT) using [^{99m}Tc]-labeled macroaggregated albumin (MAA). Due to the high risk of aerosol production associated with ventilation ([^{99m}Tc]-labeled aerosols) scans, the Society of Nuclear Medicine of Northern America discouraged the use of classic imaging combination of ventilation-perfusion in patients with COVID-19 in a recent communication by Zuckier et al. [7]. Ventilation scans should be omitted in any patient with known or suspected COVID-19 infection; therefore, a chest X-ray based algorithm was proposed, with perfusion only SPECT scans in patients without pulmonary opacities. This excludes all patients with pulmonary infiltrates and therefore the majority of patients with critical illness associated with COVID-19.

As presented in the image of the month of the current issue, we believe that the combination of low-dose CT and [^{99m}Tc]-MAA SPECT can be used to rule out significant PE with careful analysis of the CT component to rule out infiltrates of emphysema in areas of reduced perfusion. In fact, patients with pulmonary infiltrates show stronger perfusion in the non-affected lung areas. As a result, clots should be expected in vessels of non-affected pulmonary segments. This can be observed in

This article is part of the Topical Collection on Infection and Inflammation

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recently published cases of pulmonary emboli on ceCT in COVID-19 patients [6].

Of course, pulmonary embolism by itself can lead to pulmonary infiltrates, and therefore, the argument that within areas with pulmonary infiltrates embolism cannot be ruled out is correct. In patients with multiple repeated embolisms, wedge-shaped subpleural opacities without air bronchograms (Hampton hump) are indeed a key finding for pulmonary hemorrhage or infarction. But usually, hemorrhage and infarction are found only in few affected areas, while areas with fresh PE did not have the time to develop changes due to the reduced perfusion.

For a differentiation between progressive pneumonia and PE in patients with sudden decrease of respiratory capacity, perfusion SPECT/CT using [^{99m}Tc]-MAA is a safe procedure without increased risk of contagious aerosols. With the combination of SPECT and CT, significant PE can be ruled out and may therefore be used in patients with contraindications for ceCT.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval Not applicable.

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