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## Case report

# Hyperdense pulmonary artery sign - detection of pulmonary embolism in patients with suspected COVID-19 using non-contrast chest CT <sup>☆</sup>

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## ABSTRACT

The request for CT (computed tomography) diagnostic in patients with suspected COVID-19 pneumonia has become part of the daily clinical routine. We reported a case of a 61-year-old patient with flu-like symptoms and a suspected COVID-19 pneumonia. After a negative PCR-test (polymerase chain reaction), a non-contrast enhanced CT was performed which revealed a suspicious hyperdensity in the left pulmonary artery and a pneumonia in the left lower lobe. A contrast enhanced CT confirmed a pulmonary embolism. An acute pulmonary embolism is a major complication and a main differential diagnosis of COVID-19. A hyperdense pulmonary artery sign (PAS) is a sensitive sign for a pulmonary embolism. Non-enhanced chest CT scans should be checked for hyperdense PAS in suspected of COVID-19 patients.

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## Introduction

Over the last months, the request for computed tomography (CT) diagnostic in patients with suspected COVID-19 has steadily increased in our radiology department, similar to the increase of radiological diagnostic worldwide. As recently recommended by the Deutsche Röntgengesellschaft (german society of radiology), a CT scan in COVID-19 is subordinated to the patient's examination with a RT-PCR (Reverse transcription polymerase chain reaction) due to its unspecific nature.

Nevertheless, a CT scan can aid the clinician, especially in case of unequivocally respiratory symptoms as well as a suspected SARS-CoV-2 (Severe acute respiratory syndrome coronavirus 2) infection with a negative PCR [1,2]. If the differential diagnosis that comes into question does not indicate intravenous contrast agents, the CT scan must be performed using low dose technique. Worth mentioned, a negative CT scan does not exclude COVID-19 (Coronavirus disease 19) [3]. Sensitivity of chest CTs in the diagnosis of COVID-19 has been reported ranged between 61 and 99% while specificity was generally low (25–33%) [4].

<sup>☆</sup> Competing interest: The authors declare that they have no competing interest.

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Beside the potential of chest CT in leading to the diagnosis of COVID-19, it should be performed in ruling out differential diagnosis or in case of confirmed COVID-19 infection in the diagnosis of certain disease related complication [5]. A pulmonary embolism has shown to be a major complication in many COVID-19 patients but also a differential diagnosis in the context of COVID-19 [5,6].

## Case report

A 61-year-old male was referred to our clinic due to a newly occurred paraparesis. A cranial CT scan showed a new bilateral subdural bleeding with a small mass effect. Afterwards, the patient underwent a neurosurgical treatment. An earlier performed blood test showed an increased level of CRP and a leukocytosis. An X-ray of the chest detected a small amount of pleural effusion with minimal pulmonary consolidation in the left lower lobe of the lung, giving the rise to suspect a pneumonia. With regard to that, the treating physician initialized an antibiotic therapy with ceftriaxone. The patient presented more flu-like symptoms, for example, fever and non-productive cough under antibiotic therapy. Follow-up blood test showed increase of inflammatory parameters with a CRP over 200 mg/l (reference < 5 mg/l) and a leukocytosis of 24530/ $\mu$ l (reference 4600 - 9500/ $\mu$ l).

Due to the current SARS-CoV-2 pandemic a SARS-CoV2-RNA and SARS-CoV2 E-gene test was performed but showed a negative result. As the patient remained under high risk for COVID-19 a non-contrast CT-scan of his lung, as recommended by the AG Thoraxdiagnostik of the DRG (Deutsche Röntgengesellschaft) was ordered [3].

The CT revealed a consolidation and patchy ground glass opacity in the left lower lobe of the lung. In addition to that, there was a hyperdensity in the left pulmonary artery of the left upper and lower lobe (average HU: 74,7 in ROI (region of interest) measurement with  $8 \times 8$  pixels/30,43 mm<sup>2</sup>; min. 58 HU (Hounsfield-Units), max. 100 HU. HU of blood in right atrium: 36,8 HU in ROI measurement with  $22 \times 22$  pixels/251,59 mm<sup>2</sup>; min. 18 HU, max. 63 HU) (Figs. 1A,C,D), suggesting a pulmonary embolism. An additional contrast enhanced CT with 60 ml Imeron 350 (infused over right cubital vein, bolus tracking in the pulmonary trunk) confirmed a pulmonary embolism in the left pulmonary artery (Fig. 1B). A duplex ultrasound revealed a thrombosis of the popliteal and peroneal veins in his right leg.

The patient was in stable cardiopulmonary conditions. While still being on the intensive care unit, he was treated with heparin. Because of the bilateral subdural bleeding, the treating doctor renounced an anticoagulation therapy with phenprocoumon or non-vitamin-K-dependent oral anticoagulants (NOAC) after stable cerebral condition. The antibiotic therapy was escalated to piperacillin/tazobactam which led to decreasing inflammatory blood parameters and degenerating symptoms of the patient. After a few days, the patient was discharged with normalized inflammatory parameters and no flu-like symptoms left.

## Discussion

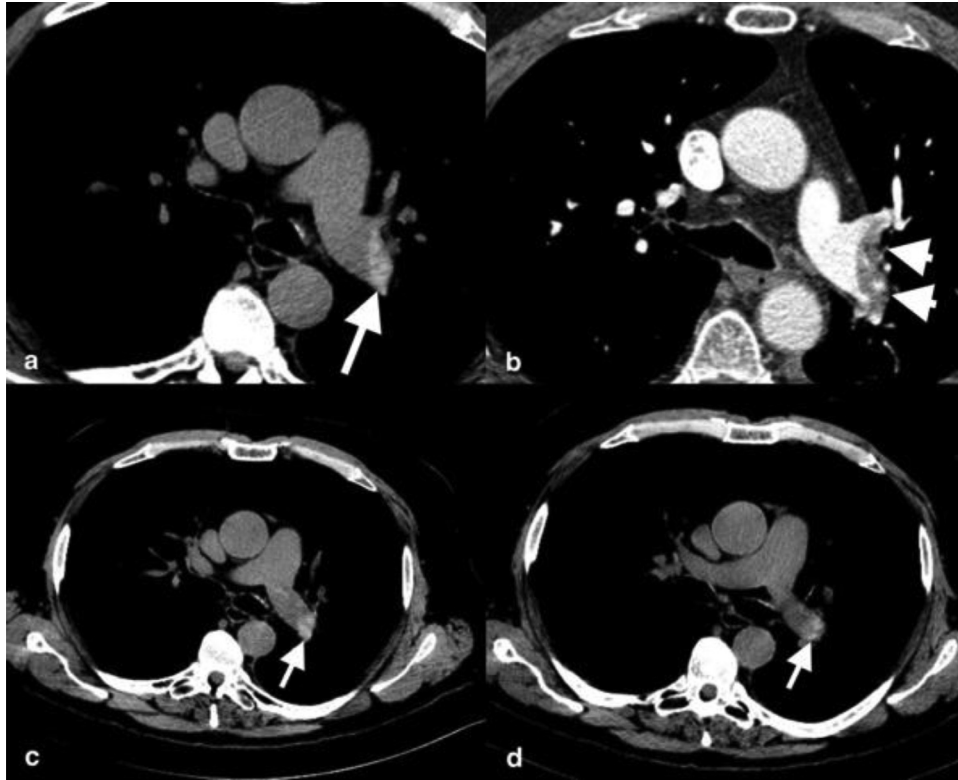
Over the last months, the request for CT diagnostic in patients with suspected COVID-19 has steadily increased in our radiology department, similar to the increase of radiological diagnostic worldwide. As recently recommended by the Deutsche Röntgengesellschaft (German society of radiology), a CT scan in COVID-19 is subordinated to the patient's examination with a RT-PCR due to its unspecific nature. Nevertheless, a CT scan can aid the clinician, especially in case of unequivocally respiratory symptoms as well as a suspected SARS-CoV-2 infection with a negative PCR [2,3]. If the differential diagnosis that comes into question does not indicate intravenous contrast agents, the CT scan must be performed using low dose technique. Worth mentioned, a negative CT scan does not exclude COVID-19 [1]. Sensitivity of chest CTs in the diagnosis of COVID-19 has been reported ranged between 61 and 99% while specificity was generally low (25-33%) [4].

Beside the potential of chest CT in leading to the diagnosis of COVID-19, it should be performed in ruling out differential diagnosis or in case of confirmed COVID-19 infection in the diagnosis of certain disease related complication [5]. A pulmonary embolism has shown to be a major complication in many COVID-19 patients but also a differential diagnosis in the context of COVID-19 [5,6].

In our case, the patient showed rising inflammatory parameters and flu-like symptoms under antibiotic therapy that urged us to request a non-contrast enhanced chest CT for further evaluation of suspicious COVID-19 infection. The unenhanced CT scan revealed a pneumonia in the left lower lobe as well as an intravascular hyperdensity in the left pulmonary artery of thrombotic origin. An additional contrast enhanced examination confirmed a pulmonary embolism. Similar to the hyperdense media sign in stroke vessel occlusion in other regions can present as hyperdense vessel sign. Cobelli et al. reported that the sensitivity in the diagnostic of a pulmonary embolism in non-contrast enhanced CTs by hyperdense pulmonary artery sign (PAS) reaches 41,2 % [7]. In addition, Chien et al. reported a sensitivity of 71,9 % and specificity of 100% in the detection of high-attenuation pulmonary embolism in non-enhanced chest CTs [8].

The density difference between embolus and blood depends on the hematocrit which plays a key role in the detection of the embolism. High-attenuated emboli can be seen better by low hematocrit [7]. In comparison to the density of blood, the clots appeared as a high-density embolism because of their higher level of hemoglobin [8]. In our case the hematocrit of the patient was 34,7 % (reference 43 - 49 %). Hounsfield units (HU) of the blood in the right atrium was lower than the HU of the suspected embolus (36 vs 76 HU).

Even though there was no evidence for an atypically pneumonia in the CT scan of the chest some studies have shown that there is a high risk for pulmonary embolism in patients with COVID-19. 22% up to 30% of the patients with COVID-19 have developed an acute pulmonary embolism [9,10,11].



**Fig. 1 – Intravascular hyperdensity in the left pulmonary artery (A,C,D, white arrows). Confirmed thromboembolism of the left pulmonary artery in a contrasted enhanced CT (B, white arrowheads).**

## Conclusion

In the pandemic of SARS-CoV-2 a non-contrast enhanced chest CT can help to support the diagnosis of COVID-19 under special conditions. However, even when suspecting COVID-19 radiologists should not only search for typical changes in the lung but also be aware to disregard unexpected findings such as hyperdense PAS. An acute pulmonary embolism might be an important differential diagnosis but can also occur as frequent complication in a high number of patients suffering from COVID-19. As such non-enhanced chest CT scans should be checked for hyperdense PAS in all patients suspected of COVID-19.

## Patient consent statement

All patient identifying information has been stripped from the images files. Additionally, no patient identifying information is used in the case report.

## Disclosures

Nothing to disclose.

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## Author contributions

All the authors have made substantial contributions to the work. Neither this work– which has been approved by all co-authors – nor any part of its essential substance, or figures have been published or submitted to another scientific journal during the submission and review process.

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