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Rubidium-82 PET/CT in COVID-19 ☆

Alina van de Burgt, MSc[a,*], *Frits Smit, MD*[a], *Sander Anten, MD*[b]

[a] *Department of Nuclear Medicine, Alrijne Hospital, Simon Smitweg 1, Leiderdorp 2353 GA, the Netherlands*
[b] *Department of Internal Medicine, Alrijne Hospital, Leiderdorp, the Netherlands*

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ABSTRACT

A 56-year-old man presented to the emergency department with shortness of breath during the COVID-19 pandemic. Chest computed tomography angiography (CTa) showed bilateral peripheral ground-glass opacifications classified as CO-RADS 5, but no pulmonary embolism. To analyze the possibility of CTa-undetectable pulmonary microthrombi and to rule out cardiac perfusion abnormalities, we decided to perform a rubidium-82 (^{82}Rb) PET/CT. ^{82}Rb PET/CT imaging in this patient yielded uptake in the pulmonary areas of ground-glass opacification and showed corresponding findings between ^{82}Rb PET/CT and CTa imaging without any signs of microthrombi despite the elevated d-dimer. Even in the areas of profound groundglass opacifications, the increased ^{82}Rb uptake indicates that perfusion is adequate to acquire ^{82}Rb uptake in the pulmonary cells. ^{82}Rb PET/CT is a promising imaging technique and might extend the diagnostic potential of conventional nuclear and radiological imaging in detecting pulmonary microthrombi or other minor perfusion defects.

Introduction

Since first emerging in China in late 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread worldwide, overwhelming healthcare systems and resulting in more than 150 million people getting infected and over 3.5 million deaths globally [1]. Severe coronavirus disease 2019 (COVID-19) typically starts 1 week to 10 days after the onset of symptoms and presents with fever, dyspnea, and hypoxia. Respiratory failure is the most common cause of death in COVID-19. Major complications are pneumonia, multisystem organ failure, acute respiratory distress syndrome (ARDS) and venous or arterial thromboembolic complications [2,3]. A hypercoagulable state associated with hyperinflammation is the most likely cause of these coagulation abnormalities which are distinctive from disseminated intravascular coagulation. This particular hypercoagulable state has been referred to as COVID-19-associated coagulopathy [4,5].

Pulmonary embolism (PE) can worsen pneumonia or ARDS associated respiratory failure. Autopsy studies have also shown widespread microthrombi in alveolar capillaries both in patients with and patients without segmental or subsegmental PE [6,7]. However, assessing patients for the occurrence of microthrombi using conventional imaging is difficult due to the small size of alveolar capillaries (5–10 μm) [8]. This may

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* *Corresponding author.*
E-mail address: avandeburgt@alrijne.nl (A. van de Burgt).

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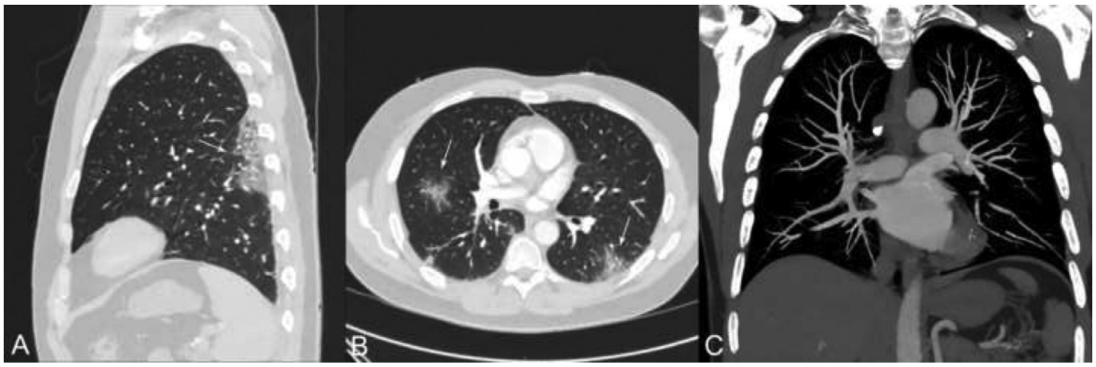

Fig. 1 – (A) Sagittal chest computed tomography angiography (CTa) with ground-glass opacifications (GGO) primary in the left lower lobe (arrow) and (B) axial chest CTa showing bilateral peripheral GGO in the right upper lobe and left lower lobe (arrows) classified as CO-RADS 5. C, coronal chest CTa.

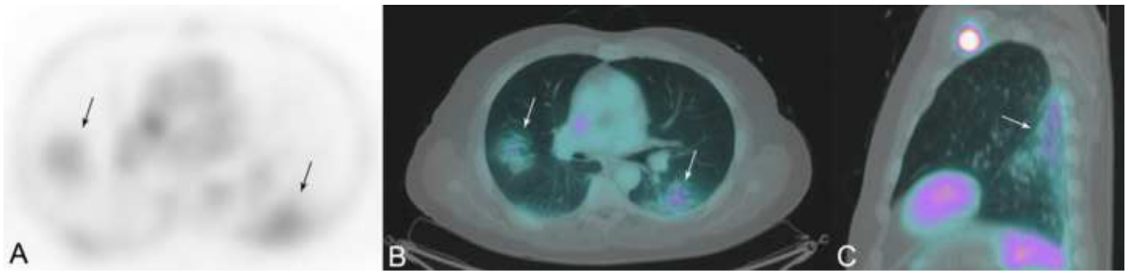

Fig. 2 – Axial images (A, PET; B, PET/CT fusion) with increased ^{82}Rb uptake in the pulmonary areas of ground-glass opacification (GGO) primary in the right upper lobe and the left lower lobe (arrows). (C) Coronal fused PET/CT image with increased ^{82}Rb uptake in the pulmonary areas of GGO primary in the left lower lobe (arrow) and physiological ^{82}Rb uptake in the left ventricle, stomach, and left subclavian vein.

lead to underdetection of pulmonary thrombosis and might keep the patient from potential beneficial treatment with anticoagulation therapy.

Therefore, PET/CT imaging with the perfusion tracer rubidium-82 (^{82}Rb) may provide functional information regarding the alveolar perfusion in COVID-19 patients with suspected pulmonary microthrombi and hence might guide treatment decision-making.

Case report

A 56-year-old man presented to the emergency department with shortness of breath during the COVID-19 pandemic. He had been in his usual unremarkable state of health until 1 week earlier when he developed a cough, fatigue, and progressive dyspnea. He also experienced a syncope twice. Oropharyngeal polymerase chain reaction was positive for the SARS-CoV-2 virus. Work up revealed a C-reactief proteïne of 9 mg/L, an increased Alveolar-arterial gradient of 4.5 kPa and an elevated d-dimer of 4309 μg/L. Chest computed tomography angiography (CTa) showed bilateral peripheral ground-glass opacifications classified as CO-RADS 5 (Fig. 1), but no pulmonary embolism. The patient was admitted for oxygenation support.

To analyze the possibility of CTa-undetectable pulmonary microthrombi that could explain the syncope and to rule out cardiac perfusion and function abnormalities, we decided to perform ^{82}Rb PET/CT, as depicted in Fig. 2. ^{82}Rb is the most commonly used PET perfusion tracer for myocardial perfusion imaging [9]. It is a potassium analog that is extracted rapidly from the blood and is taken up by the cardio myocytes which are dependent on coronary blood flow [10]. ^{82}Rb PET/CT imaging in this patient yielded uptake in the pulmonary areas of ground-glass opacification. Moreover, the left pulmonary upper lobe showed higher ^{82}Rb uptake compared to the remainder of the lung, which corresponded with the increased density in that lobe on CTa. The ejection fraction (EF) was normal (56%) and no PE or other defects were detected.

Discussion

To our knowledge, this is the first time ^{82}Rb PET/CT was performed for suspected pulmonary microthrombi in a COVID-19 patient. This case report shows corresponding findings between ^{82}Rb PET/CT and CTa imaging and does not show any signs of microthrombi despite the elevated d-dimer. Even in the areas of profound ground-glass opacifications the increased ^{82}Rb uptake indicates that perfusion is ade-

quate to acquire ^{82}Rb uptake in the pulmonary cells. These findings therefore do not support the theory of pulmonary hypoperfusion in patients with COVID-19.

^{82}Rb PET/CT is a promising imaging technique and might extend the diagnostic potential of conventional nuclear and radiological imaging in detecting pulmonary microthrombi or other minor perfusion defects. To demonstrate sufficient evidence for the use of ^{82}Rb PET/CT in clinical practice for COVID-19, validation should take place in a prospective clinical trial, which studies a large cohort of patients.

Patient consent

A written consent was obtained from the patient for publication.

REFERENCES

[1] Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis 2020;20(5):533–4. doi:10.1016/S1473-3099(20)30120-1.

[2] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323(11):1061–9. doi:10.1001/jama.2020.1585.

[3] Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(18):1708–20. doi:10.1056/NEJMoa2002032.

[4] Leentjens J, van Haaps TF, Wessels PF, Schutgens REG, Middeldorp S. COVID-19-associated coagulopathy and antithrombotic agents-lessons after 1 year. Lancet Haematol 2021. doi:10.1016/S2352-3026(21)00105-8.

[5] Iba T, Warkentin TE, Thachil J, Levi M, Levy JH. Proposal of the definition for COVID-19-associated coagulopathy. J Clin Med 2021;10(2):191. doi:10.3390/jcm10020191.

[6] Ackermann M, Verleden SE, Kuehnel M, Haverich A, Welte T, Laenger F, et al. Pulmonary vascular endothelialitis, thrombosis, and angiogenesis in COVID-19. N Engl J Med 2020;383(2):120–8. doi:10.1056/NEJMoa2015432.

[7] Menter T, Haslbauer JD, Nienhold R, Savic S, Hopfer H, Deigendesch N, et al. Postmortem examination of COVID-19 patients reveals diffuse alveolar damage with severe capillary congestion and variegated findings in lungs and other organs suggesting vascular dysfunction. Histopathology 2020;77(2):198–209. doi:10.1111/his.14134.

[8] Guyton AC, Hall JE. Adjustments of the infant to extrauterine life. In: Textbook of medical physiology; 2006. p. 1021. Ch. 83.

[9] Murthy VL, Bateman TM, Beanlands RS, Berman DS, Borges-Neto S, Chareonthaitawee P, et al. Clinical quantification of myocardial blood flow using PET: joint position paper of the SNMMI cardiovascular council and the ASNC. J Nucl Cardiol 2018;25(1):269–97. doi:10.1007/s12350-017-1110-x.

[10] Yoshinaga K, Klein R, Tamaki N. Generator-produced rubidium-82 positron emission tomography myocardial perfusion imaging-From basic aspects to clinical applications. J Cardiol 2010;55(2):163–73. doi:10.1016/j.jjcc.2010.01.001.