Case Report

Artifactual Hot Spots on Technetium-99m Macroaggregated Albumin Perfusion Lung Scan

Abstract

A 40-year-old male patient with pulmonary tuberculosis was subjected to a perfusion lung scan to rule out pulmonary embolism. Administration of technetium-99m macroaggregated albumin through preexisting venous access resulted in multiple round hot spots in both pulmonary fields. This finding was interpreted as an artifact caused by injection through preexisting venous access.

Keywords: *Artifact, pulmonary hot spots, technetium-99m macroaggregated albumin lung scan*

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Introduction

Technetium-99m macroaggregated albumin (^{99m}Tc–MAA) lung perfusion scan is an important diagnostic tool in the evaluation of pulmonary embolism. Macroaggregates of albumin are microspheres of human serum albumin; in perfusion lung scans, they are radiolabeled with ^{99m}Tc and administered intravenously to assess the presence of emboli or other abnormalities in the pulmonary blood flow.[1] ^{99m}Tc–MAA is trapped in the lung capillary bed and is thus employed to study the perfusion of the pulmonary tissue.[1] It had been demonstrated, both *in vivo* and *in vitro*, that MAA accelerates blood clotting.[2,3] Moreover, they are highly trapped inside blood clots due to mechanical factors.[2-4] This could explain the phenomenon of hot spots in lung perfusion scans which was described since the introduction of this technique.[1] We present a case of a patient referred to our department for lung perfusion scan for evaluation of pulmonary embolism. Lung images show multiple hot spots in both pulmonary fields.

Description of the Case

A 40-year-old man with pulmonary tuberculosis was addressed to the nuclear medicine department for a lung perfusion scan to rule out pulmonary embolism at the source of his symptoms. A dose of 148 MBq (4 mCi) of ^{99m}Tc–MAA was administered through a preexisting antecubital venous access in the left arm after checking the flow with an injection of serum saline. Scintigraphic images were obtained using a high-resolution parallel collimator. Planar images are shown in Figure 1. Both lungs showed a heterogeneous distribution of ^{99m}Tc–MAA with multiple defects and multiple hot spots. Figure 2 is the single-photon emission computed tomography–computed tomography images. The patient was treated with low-molecular-weight heparin. The patient refused any further examinations, thus we could not obtain a lung scan to assess the efficacy of treatment and to confirm the artifactual origin of the hot spot pattern.

Discussion

Hot spots in lung perfusion scans are abnormal areas of increased uptake. Generally, round and intense, hot spots had been documented in ^{99m}Tc–MAA lung perfusion scans since the 1960s.[2] They are thought to be microemboli in small pulmonary capillaries and can be either technical or nontechnical. Hot spots which are due to technical factors are called artifactual hot spots and are a result of a faulty technique. The first cases of artifactual hot spots were thought to be caused by the patient blood drawn back in the syringe containing the radiopharmaceutical, especially in cases of difficult venipuncture, which will result in clotting of the blood and accumulation of labeled MAA in the clots.[2,5] In the same way, injection from preexisting venous access may cause small clots to accumulate

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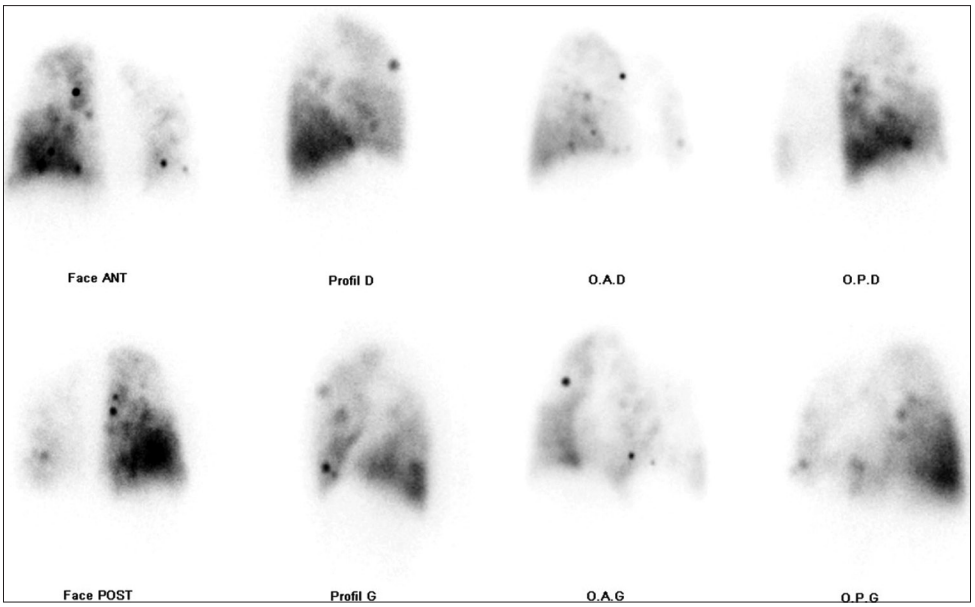

Figure 1: The planar images of ^{99m}Tc–MAA lung perfusion scan show multiple hot spots in both pulmonary fields. ^{99m}Tc–MAA: Technetium-99m macroaggregated albumin

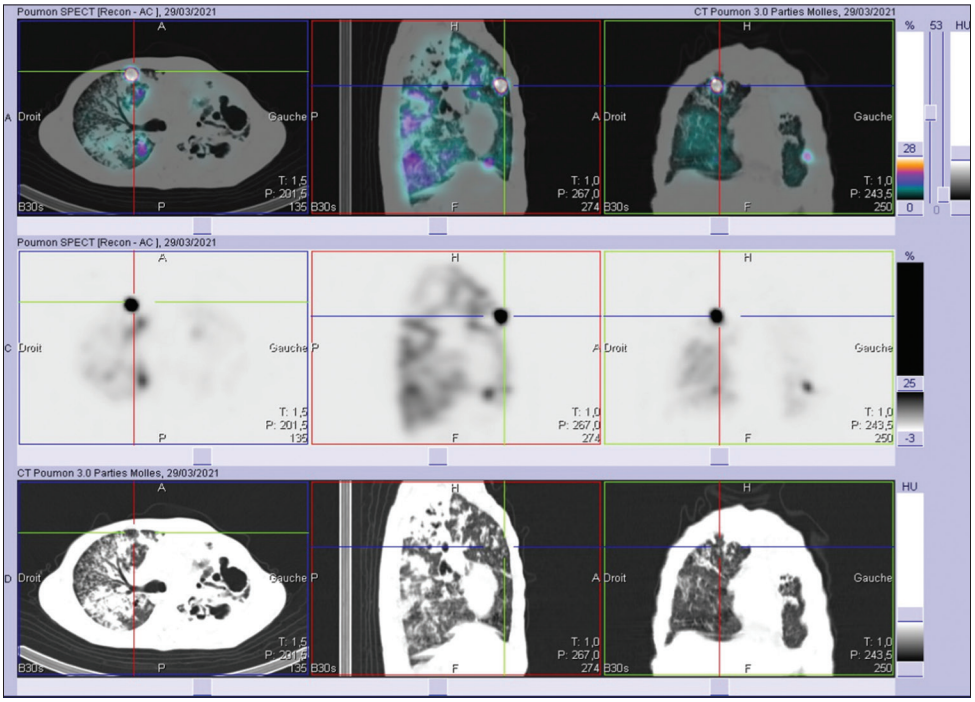

Figure 2: SPECT-CT images show a heterogeneous distribution of the radiotracer on both lung fields with a hot spot adjacent to a perfusion defect. SPECT-CT: Single-photon emission computed tomography–computed tomography

in the radiotracer and result in the pattern of hot spots in the scan images.[6] Another cause of artifactual hot spots is thought to be poor preparation and separation of macroaggregates;[5] Microspheres larger than 100 μm are more likely to clump in pulmonary arteries and result in focal hot spots on the lung image,[7] especially in zones of hypoxic vasoconstriction.[8]

On the other hand, nontechnical hot spots are caused by a particular clinical condition that the patient is suffering from. Reports had been made about hot spots as a result of thrombophlebitis,[3] especially that of the upper extremity.[9] Furthermore, it is thought that congestive heart failure is another condition that may result in the same pattern.[10]

Our patient was referred to our department with antecubital venous access in the left arm which was checked using normal saline. Although the injection was smooth with no noticeable flow resistance, there may be small amounts of thrombus *in situ* that can be dislodged with a relatively

large amount of tracer attached to it.[6] The patient did not have signs of upper extremity thrombosis nor congestive heart failure, thus it is most likely that our hot spot lung scan pattern was an artifactual one, due to injection from preexisting venous access. The possibility of embolization of MAA in the upper extremity venous blood cannot be ruled out though,[11] especially with the hypercoagulability state caused by tuberculosis.[12]

Conclusion

We assume that this artifact was caused by injection from preexisting venous access although the flow was checked beforehand. We thus recommend good radiopharmaceutical preparation and injection from new blood access to avoid this artifact.

We cannot rule out though the possibility of incorporation of the MAA into small blood clots in the upper extremity venous blood after injection, which cannot be prevented.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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