



SPECTRUM
DYNAMICS MEDICAL

Serial Ventilation/Perfusion SPECT/CT Lung Scan in a COVID-19 Patient

Lung ventilation/perfusion SPECT/CT scan acquired
on the VERITON-CT® digital SPECT/CT

June, 2021



Patient Information

54-year-old woman with no previous history of any significant health disease, recently affected by COVID-19. Presented with a dry cough and shortness of breath requiring oxygen supply. CT images were normal with no abnormality shown.

A series of Ventilation/Perfusion (V/P) SPECT/CT investigations were conducted. The 1st scan showed no evidence of pulmonary embolism but demonstrated a COVID-related severe tracheobronchitis; the 2nd scan, conducted one month later due to a recurrence of dyspnea, showed an extended pulmonary embolism; and a third scan, which is not presented here, was strictly normal after the patient had undergone 4 months of an anticoagulant treatment.

Indication for Scan

Suspected pulmonary embolism in a COVID-19 patient.

Clinical Scan

Lung ventilation/perfusion SPECT, with Technegas® for the ventilation scans, acquired on the VERITON-CT® hybrid system comprising a high-sensitivity 360° CZT-camera and 64-row detector CT. Other images from this patient have already been published (Eur J Nucl Med Mol Imaging. 2021:1–6).

Dose

NM Dose: approximately 4.7 mSv per investigation.

CT Dose: approximately 2.7 mSv per investigation.

Investigation protocol

1. Patient placement on the VERITON-CT camera bed and when necessary, provided with oxygen supply.
2. 99mTc-Technegas® inhalation ~40 MBq during two to three deep inspirations.
3. Lung CT acquired first, with the following parameters: 120 kV, 80 mAs, pitch of 1.0, slice thickness of 2.5 mm.
4. Lung SPECT acquired using a single-bed position encompassing the lungs and upper airways, and with consecutive acquisitions of ventilation scans (V) over a 10-min period, and perfusion scans (P) over a 3-min period, just after the injection of ~ 370 MBq of 99mTc-labeled albumin macroaggregates (MAA).
5. Reconstruction of V/P SPECT images with a dedicated OSEM iterative reconstruction algorithm and image display through cubic 2.46 mm³ voxels.

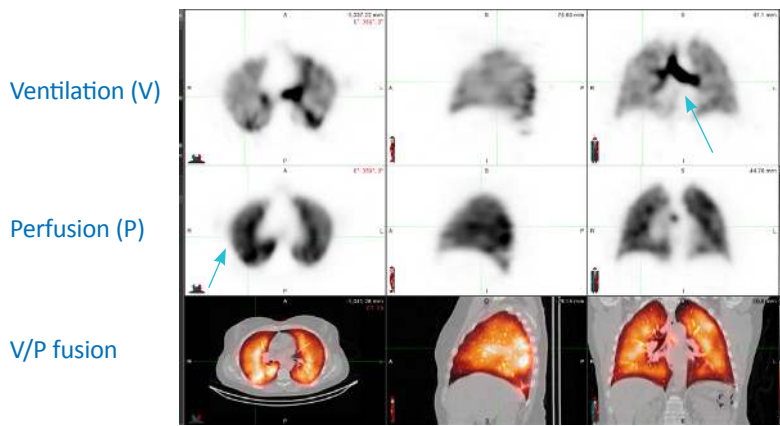
The total duration of each investigation, including Technegas® inhalation, with the subsequent disinfection of the camera, and the handling of this patient who was admitted on a stretcher and with oxygen supply for the first investigation, was always less than 30 min.

Findings

Signs of pulmonary embolism were obvious on the 2nd scan with a large V/P mismatch of the right inferior lobe (see arrows on axial slices) and following anticoagulant treatment this was no longer present on the last scan. The CT images were also highly demonstrative on the 2nd scan, showing a small atelectasis and pulmonary infarct area in contact with the pleura surrounding the right inferior lobe. No pulmonary embolism was reported at the time of the 1st scan, but on retrospective analysis, a very small V/P mismatch could be detected within the right inferior lobe.

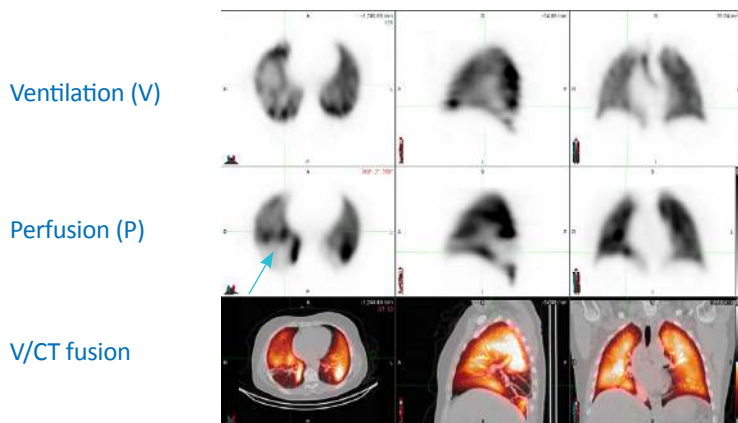
Signs of tracheobronchitis were clearly documented on the Technegas® ventilation images from the 1st scan (see arrows on coronal slices), however they were much less intense on the 2nd scan and had disappeared totally on the last scan. These signs of tracheobronchitis may constitute the main sign of respiratory involvement in COVID-patients with shortness of breath (Eur J Nucl Med Mol Imaging. 2021:1–6). They correspond to deposits of the Technegas® particles in the central airways. These deposits may also be documented in chronic pulmonary obstructive disease (COPD) as a function of the level of increased airway resistance. Such deposits may also be observed in a very few patients who have inadequate Technegas® inhalation, although in this case, they extend to the airways upper to the trachea (mouth, larynx and pharynx).

1st Scan



Signs of tracheobronchitis are clearly seen on the Technegas® ventilation images. These signs of tracheobronchitis may constitute the main sign of respiratory involvement in COVID patients with shortness of breath.

2nd Scan



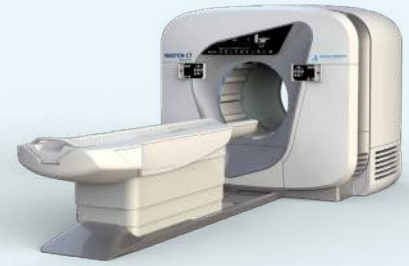
Signs of pulmonary embolism are clear on the second scan with a large V/P mismatch of the right inferior lobe.

Case Review and Learning Points

A complete lung V/P SPECT/CT protocol may be conducted with the high-speed VERITON-CT® hybrid system and Technegas® ventilation scans in less than 30 minutes, and with a high level of image quality.

This investigation protocol enables not only the identification of pulmonary embolism, but also of diseases affecting the tracheobronchial tract (tracheobronchitis, bronchitis, COPD...), together with the provision of precise anatomic information from the high-resolution 64 row-detector CT.

These properties may be particularly helpful for investigating patients with an unexplained shortness of breath, amongst whom include those with suspected pulmonary embolism and COVID-19 patients.



VERITON-CT® DIGITAL SPECT/CT

Technology

Spectrum Dynamics Medical built the VERITON-CT with a new generation imaging technology like no other, wrapping 360° around the body's contour for a personalized exam. The heart of the innovation is Spectrum's proprietary Broadview Technology: a set of 12 digital CZT detectors that automatically move within millimeters of the patient's body.

The scanner was designed with the patient's comfort in mind. The axial field of view, 32 cm, ensures organs such as lungs are imaged in one bed position scan. Its 80 cm bore, for both SPECT and CT, accommodates patients of all sizes. For patients worried about feeling a sense of claustrophobia, detectors will automatically pull back if they are accidentally or intentionally touched.

Clinicians can use the high-resolution, 16sl or 64sl, CT scan data, not only for attenuation correction and localization, but also to routinely reconstruct SPECT data with partial volume correction (PVC) for improved contrast and resolution. The 3D hybrid digital scanner gives clinicians comprehensive information to help diagnose with confidence and accuracy.



University Hospital of Nancy

Nancy is a moderate sized French city located to the east of Paris, approximately mid-way between Strasbourg and the German border, and the University Hospital of Nancy caters for patients from a significant part of eastern France. More than one hundred patients per day are investigated in the Department of Nuclear Medicine, with almost half of these having a PET procedure on one of the Department's 3 fully digital PET cameras. The other half are investigated utilizing 6 gamma cameras, two of which are CZT cameras from Spectrum Dynamic (one D-SPECT camera for cardiac investigations and one VERITON-CT camera for all purpose indications). The Department team is very actively involved in research and development the "Nancyclotep" clinical research and experimental imaging platform.

<https://nancyclotep.com/>



The VERITON-CT camera significantly eases the workflow for technologists compared to some conventional cameras – following the ventilation scan they can move the patient outside the gantry to inject with MAA, followed by automatic return of the table to acquire a perfusion scan at the same position as the ventilation scan.

– Nancy Team



Dr. Achraf Bahloul is a Nuclear Medicine physician with a specialist clinical interest in lung scintigraphy; Dr. Laetitia Imbert is a Radiophysicist specializing in both the clinical and research use of CZT cameras; and Prof. Pierre-Yves Marie is Head of the Department of Nuclear Medicine at the University Hospital of Nancy. All are widely published in the field of nuclear medicine imaging.