Introduction
Imaging for suspected acute pulmonary embolus (PE) is one of the most frequently requested investigations in the radiology department. PE remains an important cause of mortality and its non-specific signs and symptoms often make it difficult for a definitive diagnosis to be made on clinical grounds alone. The safe and accurate diagnosis of PE remains a challenge; this article seeks to illustrate the role of ventilation perfusion single photon emission computed tomography (V/Q SPECT) in this domain.

What is V/Q SPECT?
SPECT imaging is a 3D technique allowing functional data to be viewed in the three orthogonal planes – transverse, coronal and sagittal. It is not a new technique, being frequently used in cerebral, bone and myocardial imaging and to image infection and characterise tumours. The acquisition for V/Q SPECT is very similar to that for planar scintigraphy; perfusion and ventilation data are acquired following administration of intravenous and inhaled radioisotopes using a gamma camera with SPECT capability. This information is then converted into a 3D data set using a computer tomographic algorithm. An example of a normal V/Q SPECT study is shown in figure 1. PE is diagnosed when there is a ventilation/perfusion mismatch (ie disruption to vascularity without a corresponding ventilatory abnormality). An example of multiple pulmonary emboli on V/Q SPECT is shown in figure 2.

History of imaging for PE
Planar V/Q imaging for PE has been available since the 1970s and was the only test for diagnosing PE other than an invasive catheter pulmonary angiogram until computed tomography (CT) became widely accessible in the 1990s. Traditionally the scan was reported in a probabilistic style in accordance with the Prospective Investigation of Pulmonary Embolism Diagnosis Study (PIOPED). Unfortunately, an unacceptably high proportion of scans being reported as “indeterminate” resulted in a decline in popularity among referrers. Planar V/Q scintigraphy has evolved little over the last three decades.

Since its introduction, computed tomography pulmonary angiography (CTPA) has been popular with both general radiologists and physicians. The anatomical nature of the scan, the potential for an alternative cause for symptoms to be demonstrated and 24 hour availability led to it rapidly becoming the investigation of choice for diagnosis of PE.

So why should we use V/Q SPECT?
Despite both CTPA and planar V/Q being regarded as good techniques for diagnosing acute PE, they both have limitations. The main drawback of planar V/Q imaging is the compromise in image quality due to its 2D nature. Areas of lung overlap and “shine through” can occur between different segments, both of which can mask perfusion defects. It is also unable to provide useful information on other potential causes for symptoms such as aortic dissection, oesophageal rupture, pneumonia and malignancy.

The advantages of SPECT V/Q over planar are not in doubt; contrast and 3D resolution are superior without the problems created by overlapping structures. All segments of all lobes of the lungs are clearly visualised, including the medial basal segment of the right lower lobe which is a particular problem in planar imaging. The result is an increased sensitivity for perfusion defects and a reduction in the indeterminate scan report rate (as little as 3% of cases). Intraobserver and interobserver reproducibility are better for V/Q SPECT than for planar (94% and 91%, 88% and 79% respectively), thought to be due to more definitive patterns for PE or other pathology being demonstrated by SPECT. The European Association of Nuclear Medicine states that, wherever possible, V/Q SPECT should be performed. There are virtually no contraindications to V/Q SPECT, it is feasible in 99% of patients. Technical failure and adverse events are very uncommon.
Using V/Q SPECT

To improve the usefulness of scintigraphy a prior chest x-ray should be always be performed to exclude pneumothorax or diagnose infection. A V/Q SPECT examination can be performed and reported in an hour, thus providing the rapid diagnostic service required in today’s busy emergency departments. Most UK radiology departments at present provide radiouclide imaging during working hours only. It may, therefore, be necessary to anticoagulate some patients for a short time before performing a SPECT study.

V/Q SPECT has limited ability to provide alternate diagnoses for the cause of symptoms. The flip side to this is incidental findings (eg lung nodules) that generate multiple follow-up studies and patient concern are not a feature of V/Q SPECT.

Conclusion

V/Q SPECT is a safe and accurate test for diagnosing acute PE. It should supersede planar V/Q scanning for the following reasons:

- it is more sensitive and specific for clot detection
- it is more reproducible
- it produces fewer ‘indeterminate’ results
- it takes no longer to acquire.

References