The ventilation-perfusion (V/Q) scan is one of the frequently employed diagnostic tools for the diagnosis and follow-up of pulmonary embolism (PE), which, to date, remains the main indication for its use in a clinical setting. However, it has also been used to obtain valuable information about many other pathological entities (1). One particular area which has been the subject of interest, particularly among researchers, is the variation in regional ventilation and perfusion in patients with chronic obstructive pulmonary disease (COPD). Though initial papers on the utility of the V/Q scan in COPD were published way back in mid 70’s (2,3), research interest on this subject has waxed and waned over the years (4-7).

In this issue of The Crucible, a brief summary of the utility of the V/Q scan in COPD, with particular emphasis on the ventilation component of the study, is presented.

On a ventilation scan, five patterns of ventilation, each bearing a well defined pathophysiological meaning, have been described (4, 6).

a) Normal distribution (ND) pattern: Characterised by normal distribution of radioactivity in both lung fields with clearly defined peripheral lung edges and a physiological apex-to-base gradient.

b) Inhomogeneous deposition (ID) pattern: Characterised by patchy areas in the peripheral regions of the lungs due to altered deposition of the particles with the peripheral pulmonary edges being irregular or incomplete.

c) Central deposition (CD) pattern: Characterised by dominance of radioactivity in the hilar and para-hilar regions together with a background ID pattern.

d) Spotty deposition (SD) pattern: Characterised focal depositions (spots) of radioactivity within low radioactivity count areas.

e) Mixed deposition (MD) pattern: Characterised by intermediate features in the distribution of ventilation.

In COPD a mixture of ID, CD and SD patterns have been reported to be present (4, 6). These changes are thought to be secondary to the combination of airway obstruction and parenchymal damage resulting from associated emphysema (4, 6). It has also been reported that in earlier / milder stages of COPD, the ventilation scan usually exhibits increased central deposition with normal peripheral ventilation while in more severe stages, areas of little or even absent aerosol transportation to the periphery of the lung are seen (8).

In patients with early or mild COPD, the perfusion scan can be normal or near normal. However, with increasing severity of the disease and progressive destruction of the lung parenchyma, multiple non-segmental perfusion defects are seen (8). These defects can be relatively focal and discrete or diffusely scattered throughout the lungs. Perfusion defects can also be caused by regional hypoxia producing reflex vasoconstriction and by bullae themselves or their compression of adjacent lung (8).

Characteristic findings of COPD on the V/Q scan are matched ventilation and perfusion defects. A phenomenon
Technegas - Other Uses

named “reverse mismatch” is encountered when a given perfusion defect is less prominent than the ventilation defect (low ventilation – perfusion ratio) (8,9).

Recently, Cuki et al. (10) published an interesting paper on this subject. They studied 20 patients who were known to have COPD during an episode of acute exacerbation of the illness. All patients underwent lung function tests, body plethysmography and V/Q scan using Technegas and 99mTc MAA as ventilation and perfusion agents respectively. All the patients were found to have the ID pattern of lung ventilation alone or in combination with CD or with CD and SD patterns. This was thought to be suggestive of different degrees of airflow obstruction in different parts of lungs. The study, however, was limited by small numbers of subjects and no follow-up. Further studies with larger patient numbers with emphasis on follow-up after treatment will be needed to determine the clinical relevance of these findings.

Another interesting recently published paper on this topic is that of Norberg P et al. (11). (see also, ‘Crucible’ vol 8 #3, August 2015) Using a previously reported quantitative approach, authors studied regional heterogeneity in the lung ventilation using Technegas in 14 healthy subjects none of whom had documented lung disease or respiratory symptoms and had normal lung function test, and 2 patients with documented airway disease and abnormal lung function test. Variation in activity uptake between subjects was compensated for in resulting coefficient of variation (CV) values. The area under the compensated CV density curve (AUC), for CV values greater than a threshold value CVT, AUC(CV > CVT), was used as the measure of ventilation heterogeneity. Overall, patients with airway disease had higher AUC (CV > 20%) values compared to healthy subjects (p = 0.006). Interestingly, the authors noted deviating density curves i.e.

increased AUC (CV > 20%) in 4 healthy subjects compared to other normal subjects and, given that all these subjects had a normal lung function test, postulated that their technique has the capacity to identify minor lung function abnormalities earlier in a disease process than the conventional lung function test. Given the experimental nature of the study and small number of subjects studied, the findings need to be in larger studies to determine the value of the V/Q scan in the early diagnosis of COPD.

References:

Rashid Hashmi (Retired)
Nuclear Medicine Physician and Radiologist currently working at UNSW as Associate Professor.

‘EANM Congress 2015’

The EANM annual congress in Hamburg, Germany, October 10-14 this year had very little material on V/Q SPECT and pulmonary embolism. Only two presentations, both from Spain, were listed. The first, was really just a reinforcement of the value of our recommended procedure over planar imaging. [Ventilation/Perfusion SPECT feasibility and inter-observer concordance in patients with suspected pulmonary embolism D. Balaguér, L. Marbello, H. Rodríguez et al.]. Sixty three consecutive patients were planned to have both planar and SPECT studies, but 38 of these could not complete the prolonged procedure. But from the remaining 25 studies they were able to conclude: The main advantage of the V/P SPECT over the V/P PLANAR was the reduction of non-diagnostic explorations (0% versus 8%). Given that V/P SPECT has a high degree of interobserver concordance and fewer non-diagnostic cases than V/P PLANAR, we propose V/P SPECT as the standard technique, and the option of not performing the V/P PLANAR.

The second report was a poster (PW080), [Lung V/Q scintigraphy and perfusion SPECT in the diagnosis of Chronic Thrombo-embolic Pulmonary Hypertension (CTEPH)]. Marroquin Gálvez J. A., Sanchez Fuentes D, Saviato A, et al. This was a retrospective analysis of 32 patients. ‘The V/Q scan and perfusion SPECT for the diagnosis of CTEPH had a sensitivity of 100%, specificity of 81.82%, positive predictive value of 91.30%, negative predictive value of 100%, and an accuracy of 93.75%. Conclusion: In our study, lung V/Q scan and perfusion SPECT had a high sensitivity and negative predictive value for CTEPH diagnosis with an accuracy value around 95%, demonstrating their strong efficacy in the initial screening of CTEPH’.

Bill Burch - August 2015

Bill Burch: who ‘discovered’ what he named Technegas in 1984 and developed it through the John Curtin School of Medical Research (JCSMR) of the Australian National University (ANU) where he was a Visiting Fellow from 1976-2008.
Dr Rashid Hashmi’s article this issue focuses on other potential applications for the diagnostic use of Technegas. Many papers have been published over the years looking at the potential use of Technegas in such respiratory conditions as Asthma, C.O.P.D., Emphysema, Left Heart Failure. In many instances Planar imaging only was used leading to poor image quality and equivocal scan interpretation. Even when V/P SPECT was performed, lack of appropriate software for image analysis has contributed to restricting the expansion of Technegas V/P scanning into other respiratory co-morbidities.

A great of interest is now being displayed in the use of Technegas in these ailments. Three papers have recently been accepted for presentation at the Asia Pacific Society of Respiratory meeting in Kuala Lumpur. Chronic Obstructive Pulmonary Disease (C.O.P.D.) is a serious health issue throughout Asia. Pollution, smoking, burning of bio-fuels for cooking, etc. has resulted in an epidemic of chronic lung morbidities. While C.O.P.D. is an irreversible condition, early detection, effective treatments and accurate on-going measurement of disease progression, will result in fewer exacerbations and, hopefully, longer active, disease-free periods.

We are still interested in populating our lung teaching library, found at www.spectlung.com with reference cases that nuclear medicine physicians around the world can access and perhaps gain some insights into a difficult case they have come across in their department. Please keep us in mind and contact Bill at the websites on this page.

**Maintaining a reliable power supply**

Users of Technegas generators should be aware of a potential problem with 20 amp power outlets. Some power supply outlets are mounted higher up the wall. The drag from the weight of the power lead can result in damage to the connecting pins in the outlet.

This in turn can lead to a problem with the burn temperature within the Technegas generator.

It is suggested that a hook be installed in the wall near the outlet to support the weight of the lead. This will ensure that a proper connection to the power supply is maintained and there is some risk of a wasteful incomplete burn within the unit.

Richard F Gotch  
Global Service Manager  
Cyclomedica Australia P/L  
Mobile +61 (0) 418 203 629

**www.spectlung.com**

The information source for all aspects of lung imaging including Case Study examples of PE detection, Literature, Imaging Issues, Diagnostic Options, GP Info and Links to other sites.

**Submit Case Studies**

To make spectlung.com a truly useful reference library we are seeking interesting, unusual Case Studies.

**Help us build this resource.**  
Send your files and images or inquiries to -  
casestudies@spectlung.com

**TECH TIP**

**TEACHING AIDS AND REFERENCE MATERIAL**

Call us for your copy.

1) Pulmonary Embolism  
This 32 page booklet provides a great deal of information on effective diagnosis of P.E.

2) Algorithm card  
A fully referenced, pocket size algorithm for diagnosing P.E.

3) SPECT Lung Map Kit  
Comes with Lung template film to aid diagnosis.

4) Wall Chart  
Diagnosing P.E. and reconstructing planar images from SPECT.

**Medical Information and Adverse Reaction Reporting**

Cyclomedica provide distributor and customer support with medical information queries on the products. Customers are advised to initially contact their local distributor, or they may contact Cyclomedica Australia direct using the contact details below.  
If you wish to report an adverse reaction to the product this can be done using the same contacts details.

Telephone +61 (0)2 9541 0411  
Facsimile +61 (0)2 9543 0960 or  
Email: vigilance@cyclomedica.com.au
Best agent for V/Q SPECT

- Proven diagnostic accuracy - even in the presence of COPD
- Almost 4 million studies performed in 53 countries
- No exclusion criteria; neonates to frail-aged
- 1-3 breaths for full dose
- Non-invasive
- Low radiation burden compared with CTPA

About 1/7th of breast tissue exposure

Posijet

Total control - the power, convenience and precision of bulk dose operations

Load one bulk FDG dose - Minimal exposure to patient or operator

Completely manoeuvrable - move to the patient

Internal power - no need for power points

Draws up patient dose for injection - exact dosage

Connects to patient records - Completely current files

Patient dosage printout - Stays with patient for confirmation

Step by step touch screen - Added safety in operation

Manual injection - Added assurance of cannula placement

Ask About Posijet

Contact your nearest office -

ASIA / PACIFIC / STH AFRICA - Cyclomedica Australia - sales@cyclomedica.com.au Ph: +61 2 9541 0411 Fx: +61 2 9543 0960
Contact - Charles Buttigieg Ph: +61 2 9541 0411 M: +61 (0)418 285 048 E: cbuttigieg@cyclomedica.com.au
EUROPE / MIDDLE EAST / NTH AFRICA - Contact Mr Bjorn Altmann - info@technegas.de Ph: +49 (0) 5341 550802 Fx: +49 (0) 5341 55803
CANADA - Cyclomedica Canada - lynn.mclauchlin@cyclomedica.ca Ph: +1 905 319 9610 Fx: +1 905 319 0497
Contact - Lynn McLauchlin Ph: +1905 690 0345 Fx: +1905 690 0553
LATIN AMERICA - Cyclomedica Latin America - mlema@cyclomedica.com.ar Ph: +54 11 4585 9172 Fx: +54 11 4586 0251
Contact - Martin Lema Ph: +54 911 5174 1639
GERMANY - Cyclomedica Germany - info@technegas.de Ph: +49 (0) 5341 550802 Fx: +49 (0) 5341 55803 Contact - Bjorn Altmann