Role of VQ in Acute PE
Outdated or underestimated?

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Assessment & Diagnosis of PE

• Symptoms
• Clinical Examination
  • Clinical scoring
    • Modified Geneva
    • Wells
• D-dimer
• Imaging
Imaging options

• CTPA
  • Direct visualisation of occlusive thrombosis in contrast opacified vessels

• VQ
  • Indirect visualisation by assessing subsequent perfusion abnormality
VQ

- Ventilation
  - Kr81m
  - Tc99m

- Perfusion
  - Tc99m MAA

- PE represented by VQ mismatch
  - Reduced perfusion with preserved Ventilation
Issues with VQ imaging

• Low resolution 2D planar acquisition

• Superimposition

• Antigenic probabilistic reporting style

• Performs poorly in presence of other pathology
Single Photon Emission Computed Tomography
SPECT VQ

• Multiple 2D acquisitions from multiple angles around patient

• “3D” Reconstruction in coronal, sagittal and axial plans

• Requires significant computing power
SPECT VQ vs Planar

- Same isotopes
- Same radiation dose
- Same acquisition time

- Different acquisition
- Different reconstruction
- Different reporting structure
Benefit of SPECT VQ

- Increased sensitivity 96-99%
- Increased specificity 91-98%
- Less inconclusive/nondiagnostic results 1-3%
- NPV 97-99%
- Binary negative reporting system

EANM guidelines for ventilation/perfusion scintigraphy; European Journal of Nuclear Medicine and Molecular Imaging. 36 (8) (pp 1356-1370), 2009
EANM reporting guidelines

• Positive
  • Single segmental or two subsegmental defects

• Negative
  • Normal perfusion pattern conforming to the anatomic boundaries of the lungs
  • Matched or reversed mismatch V/Q defects of any size, shape or number in the absence of mismatch
  • Mismatch that does not have a lobar, segmental or subsegmental pattern

• Inconclusive
  • Multiple V/Q abnormalities not typical of specific diseases
Limitations of SPECT VQ

• Radiation dose

• Underlying or alternative pathology

• Availability
Audit

• Retrospective review of SPECT VQ reports Oct 2014- June 2016

• Reviewed the reports and categorised as Positive, negative or inconclusive

• Clinical follow up from portal & ECS including any further imaging such as subsequent CTPA, repeat VQ or doppler
Audit data

• 387 referrals
• 384 scan performed
• 2 patients refused, one unable to comply
• 79% women
• 34.5% pregnant
Audit results

Non pregnant
• N=250
• Age range 17-97    median 58
• Pos 60 (24%)
• Neg 179 (71.6%)
• Inconclusive 11 (4.4%)
• One false positive, one false negative

Pregnant
• N= 134
• Age range 17-45    median 30
• Pos 9 (6.7%)
• Neg 112 (83.6%)
• Inconclusive 13 (9.7%)
• One false negative?
Audit results

- Sensitivity 97%
- Specificity 99%
- PPV 98%
- NPV 99%
- Inconclusive rate 6.25%

- Improved inconclusive rate from previous data
- Consistent with data from other centres
Audit results

• 18 deaths

• All in non pregnant group

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>N</th>
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<tbody>
<tr>
<td>Malignancy</td>
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<tr>
<td>Cardiac</td>
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SPECT VQ vs CTPA

• Higher sensitivity
  • CTPA sensitivity 83-100%
  • PIOPED II Sensitivity 83% excluding nondiagnostic studies

• Potentially lower inconclusive/non-diagnostic rate
  • CTPA nondiagnostic rate 5-11%

• Lower radiation dose

• No significant contraindications
  • 10-20% of patients unsuitable for CTPA
SPECT VQ vs CTPA

- Slightly lower specificity
- SPECT VQ not available out of hours or at all centres
- Alternative pathology
  - Higher inconclusive rates with VQ in context of abnormal CXR
  - CTPA able to identify alternative pathology
CTPA audit

• CTPA requests GRI Jan to March 2019

• Report reviewed for significant other findings or mention of suboptimal imaging

• 442 scans performed

• 51 under the age of 40 years
• 31% reported other findings
• Majority – consolidative/inflammatory change also seen on CXR and consistent with clinical impression

• 3 true incidentals
  • 2 rib #
  • 1 pulmonary nodule

• 5 not performed & 12 (24%) suboptimal scans
Radiation exposure

• Effective dose
  • CTPA 8-20mSv   VQ 0.6-3mSv

• Breast dose
  • CTPA 10-70mSv   VQ <1.5mSv

• Concern regarding increased risk of Breast cancer
Pregnancy

• Pregnancy and postpartum increase risk of PE

• Patients are young with low prevalence of lung disease

• Radiation Dose
  • Mother and foetus to consider
  • Foetal doses slightly lower with CTPA 1\textsuperscript{st} trimester

• Failure rate of CTPA up to 33%
  • Hyperdynamic circulation, increased plasma volume and raised IVC pressure
## Probability of bearing healthy children as a function of radiation dose

<table>
<thead>
<tr>
<th>Dose to conceptus (mGy) above natural background</th>
<th>Probability of no malformation</th>
<th>Probability of no cancer (0-19 years)</th>
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<tbody>
<tr>
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<td>&gt;100</td>
<td>Possible, see text</td>
<td>Higher</td>
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Summary

• When used properly
  
  • SPECT VQ is very useful accurate tool for imaging low risk patients
  
  • SPECT VQ & CTPA should be complimentary not competitive

• Both have a role in investigation of acute pulmonary embolism
When to use

• Young low risk patients
• No lung pathology
• Normal CXR
• Negative troponin
• Low suspicion of alternative pathology
• Pregnancy
• Anyone unsuitable for CTPA