

Role of VQ in Acute PE

Outdated or underestimated?

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Assessment & Diagnosis of PE

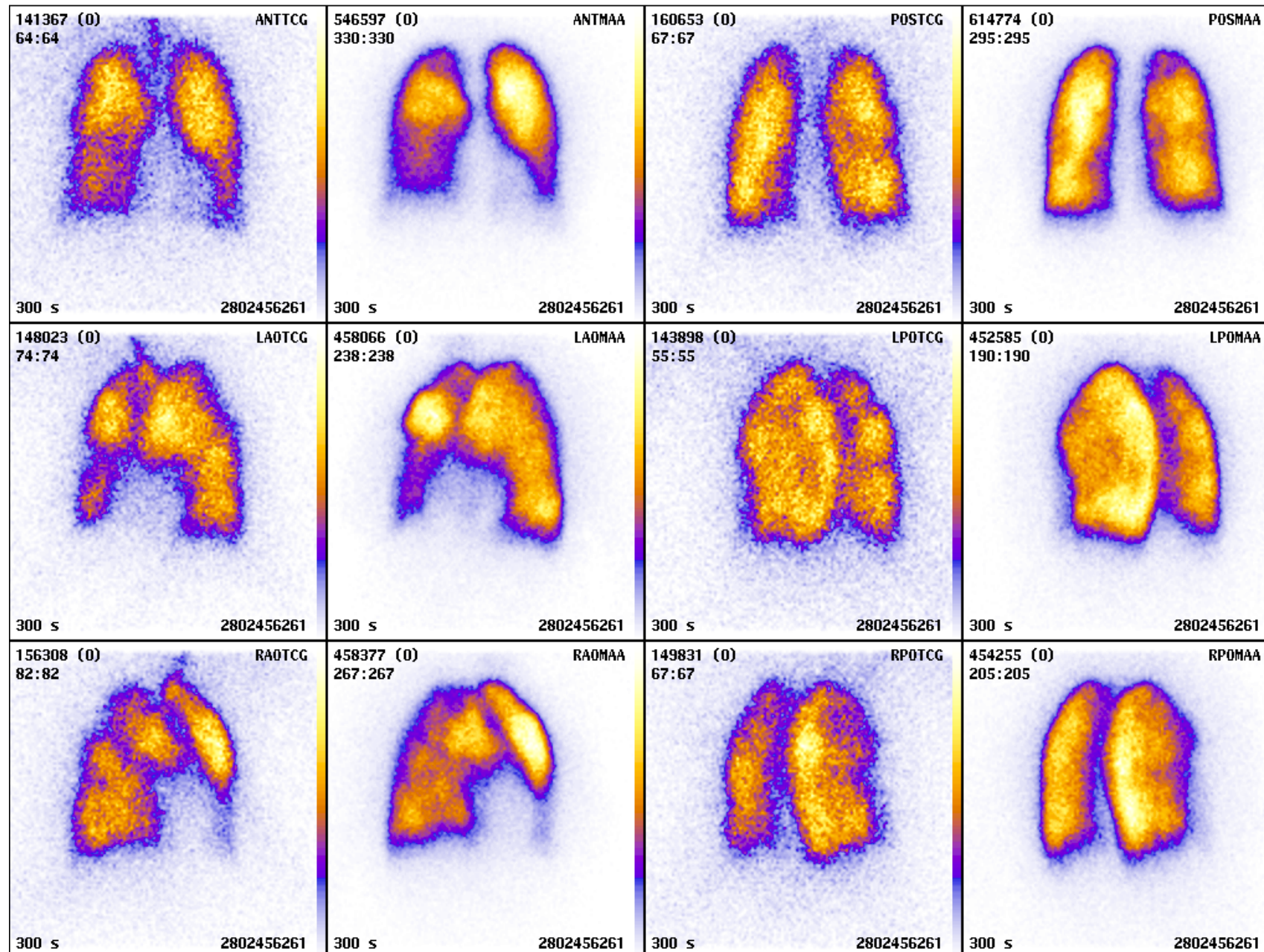
- Symptoms
- Clinical Examination
- Clinical scoring
 - Modified Geneva
 - Wells
- D-dimer
- Imaging

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

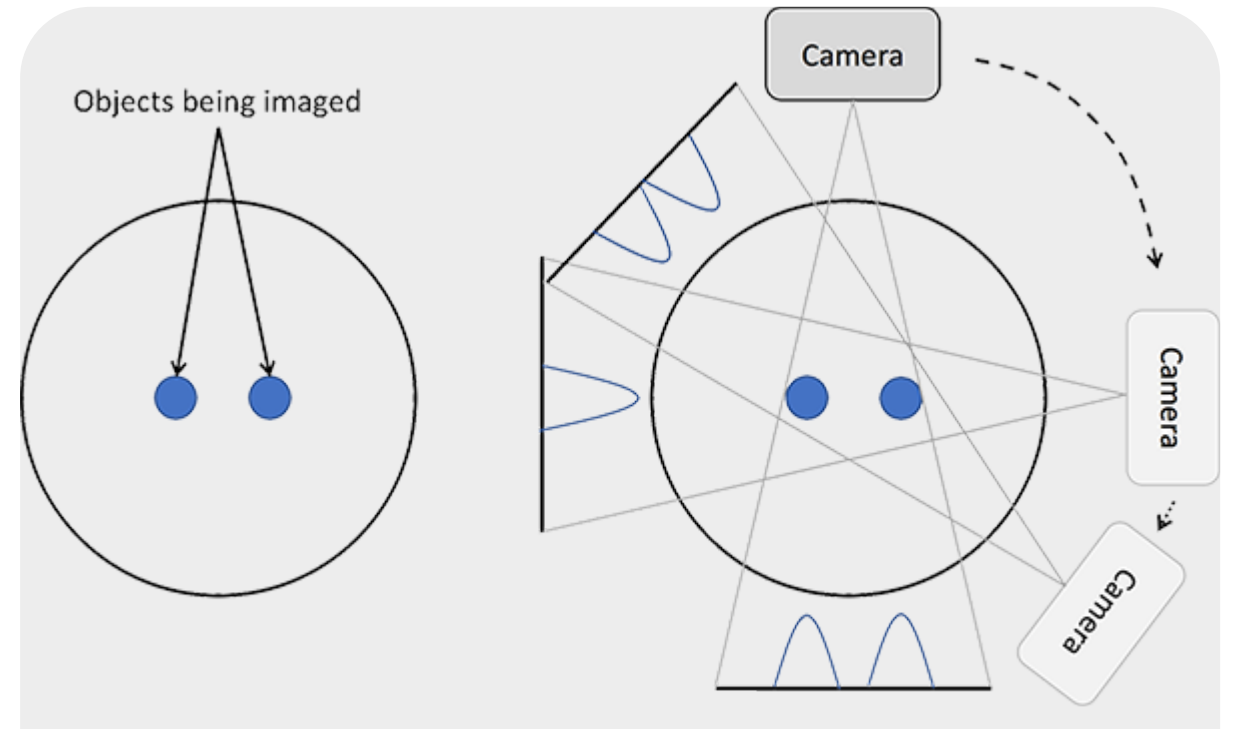
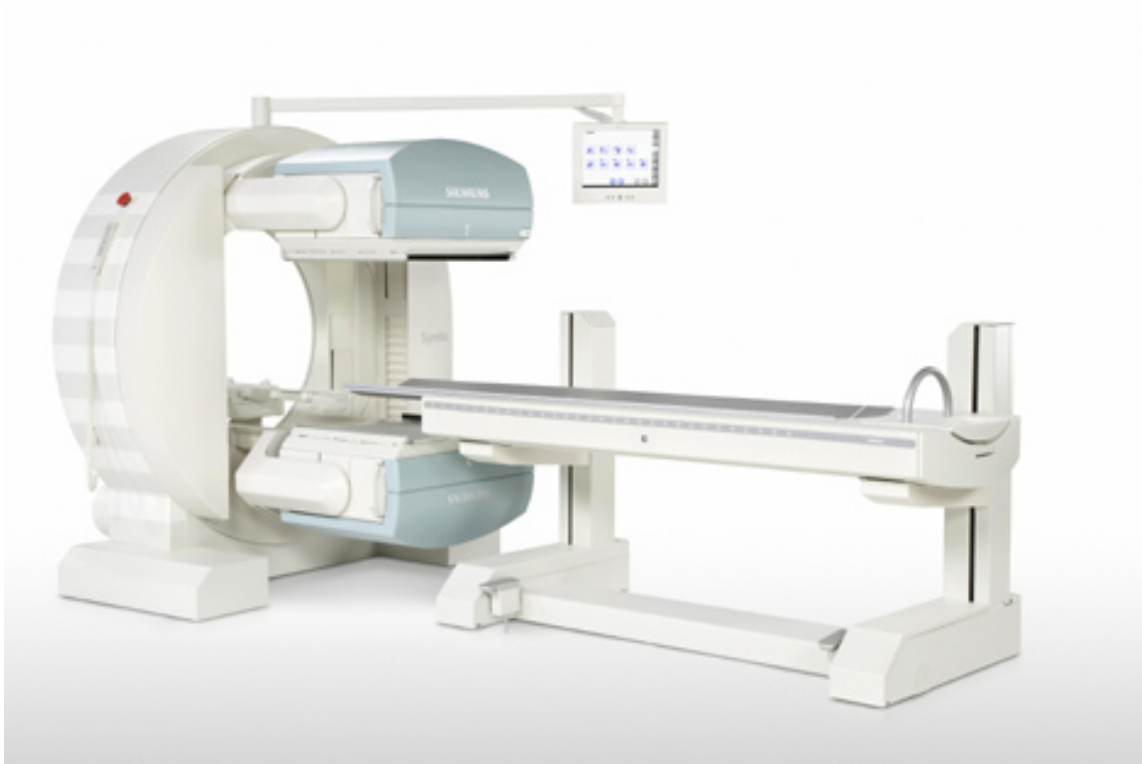


Issues with VQ imaging

- Low resolution 2D planar acquisition
- Superimposition
- Antigenic probabilistic reporting style
- Performs poorly in presence of other pathology

SPECT VQ

Single Photon Emission Computed Tomography

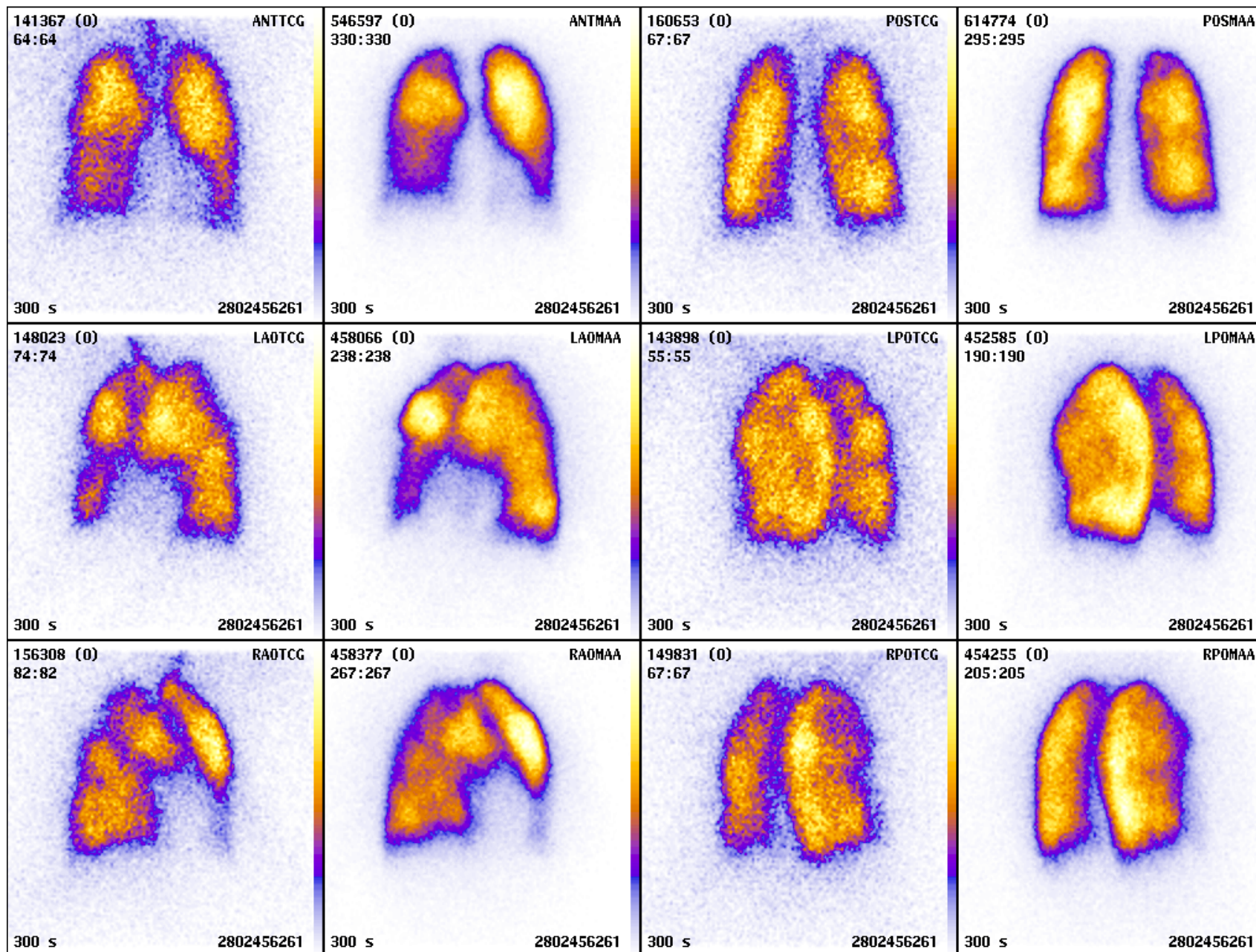


SPECT VQ

- 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



NM - NM

T C S ALL MIP

Layout 6 x 2



References Overlay Thickness 3



Zoom: 155.13%
T: 29 / 56
C: 59 / 128
S: 72 / 128
Absolute: 0 / 1226
Min: 0
Max: 1226
Current: 1



Zoom: 155.13%
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C: 59 / 128
S: 72 / 128
Absolute: 0 / 1941
Min: 0
Max: 1941
Current: 10



Lung
Subtraction / Ratio
Histogram
v-splash
Statics

NM - NM

T C S ALL MIP Layout 4 x 2 References Overlay Thickness 3

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NM - NM

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Max: 1226
Current: 488



Anterior



Anterior

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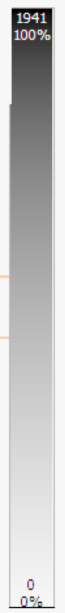
Lung
Subtraction / Ratio
Histogram
v-splash
Statics

NM - NM

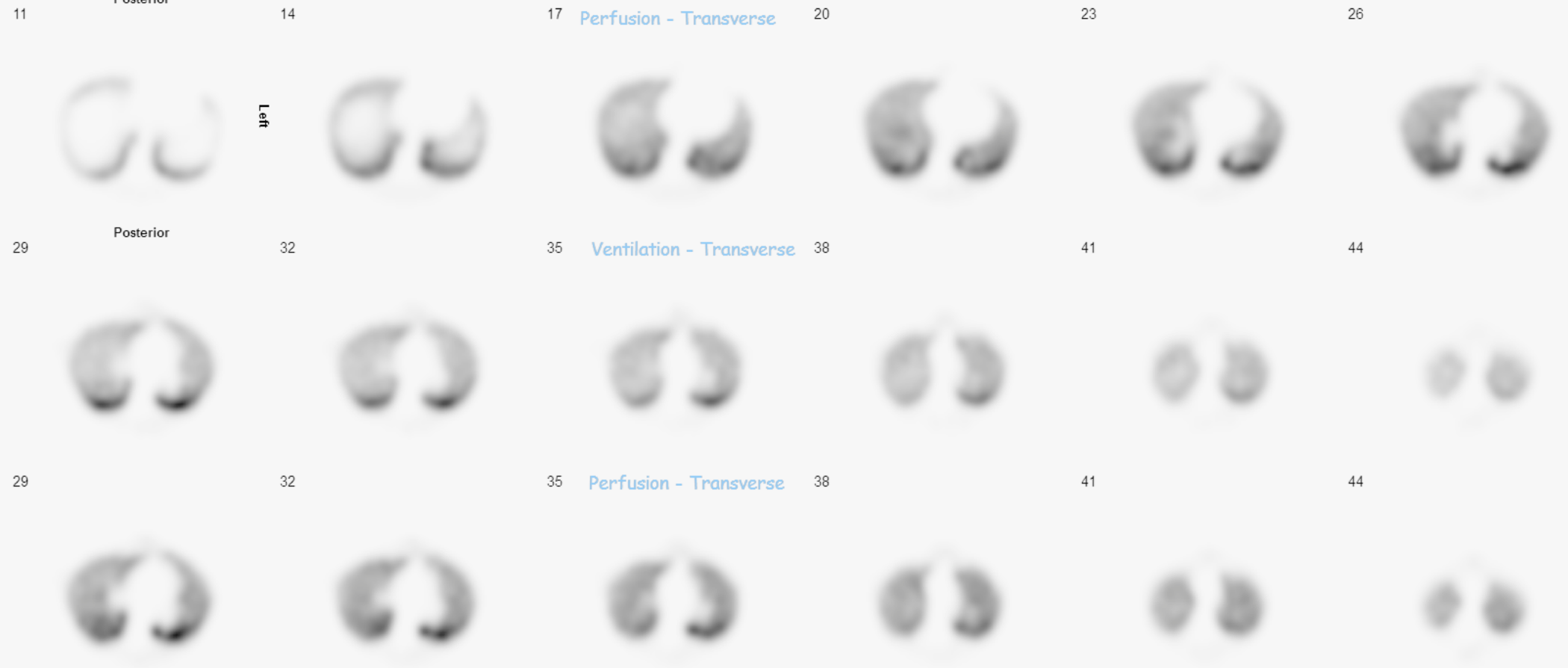
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S: 72 / 128
Absolute: 0 / 1941
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Max: 1941
Current: 105



Lung
Subtraction / Ratio
Histogram
v-splash
Statics

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

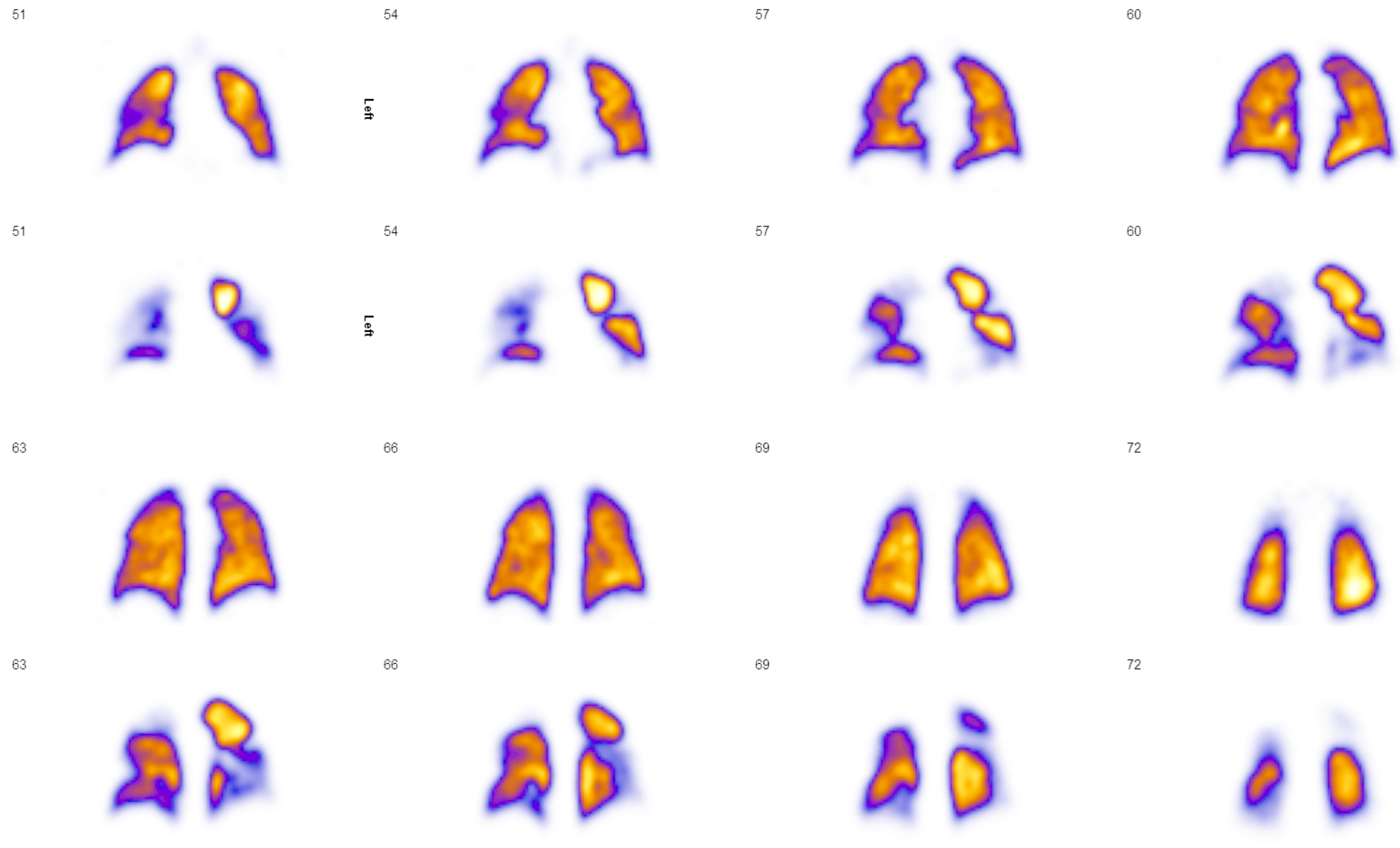
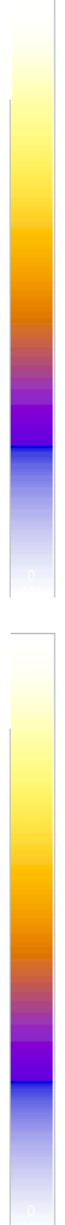
- Positive
 - Single segmental or two subsegmental defects
- Negative
 - Normal perfusion pattern conforming to the anatomic boundaries of the lungs
 - Matched or reversed mismatch V/Q defects of any size, shape or number in the absence of mismatch
 - Mismatch that does not have a lobar, segmental or subsegmental pattern
- Inconclusive
 - Multiple V/Q abnormalities not typical of specific diseases

NM - NM

T C S ALL MIP Layout 4 x 2 References Overlay Thickness 3

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S: 80 / 128
Absolute: 0 / 585
Min: 0
Max: 585
Current: 260

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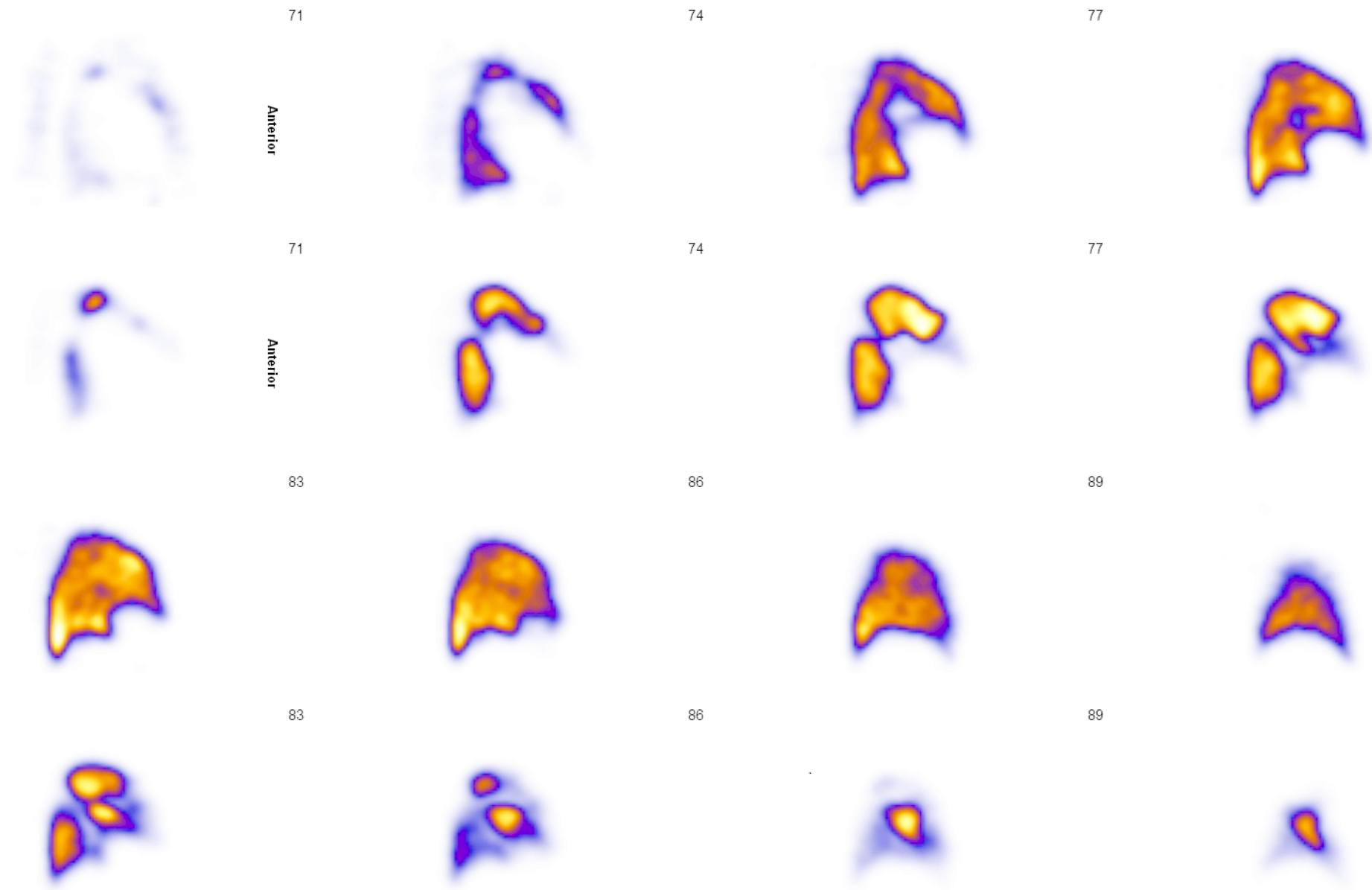
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Current: 260

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Min: 0
Max: 3667
Current: 806



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NM - NM

T C S ALL MIP Layout 4 x 2 References Overlay Thickness 3

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17



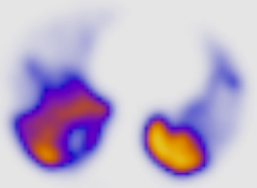
Posterior

Left

Left

Posterior

17



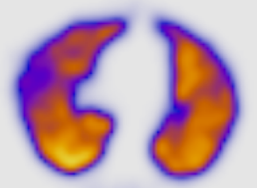
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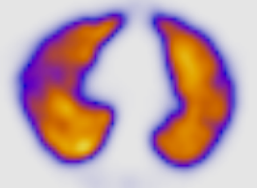
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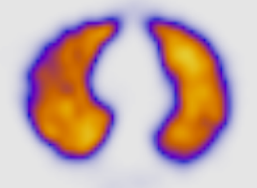
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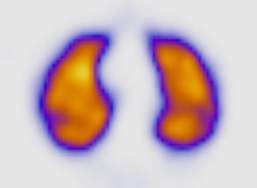
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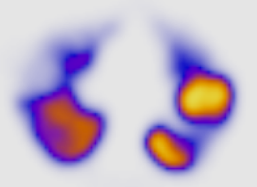
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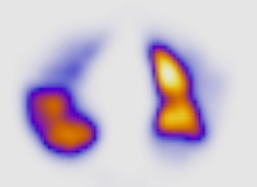
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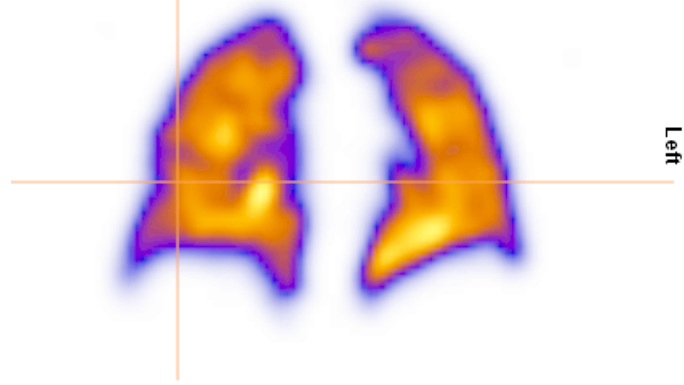


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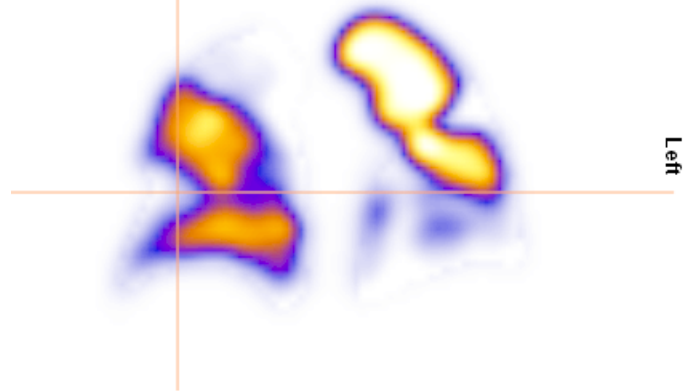


Lung
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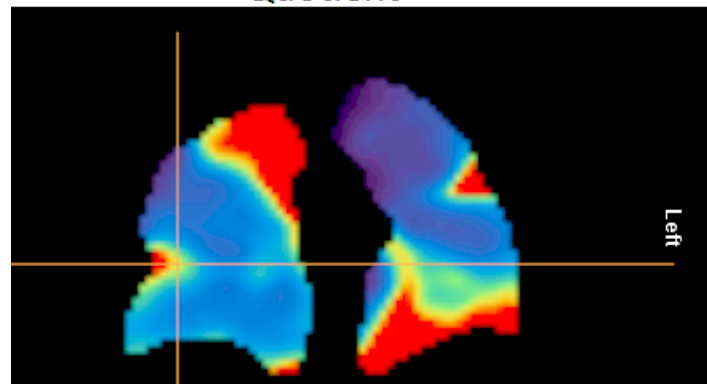
vent



perf



Quotient



Limitations of SPECT VQ

- Radiation dose
- Underlying or alternative pathology
- Availability

Left

58

Left

70

70

Vent

61

Perf

73

Vent

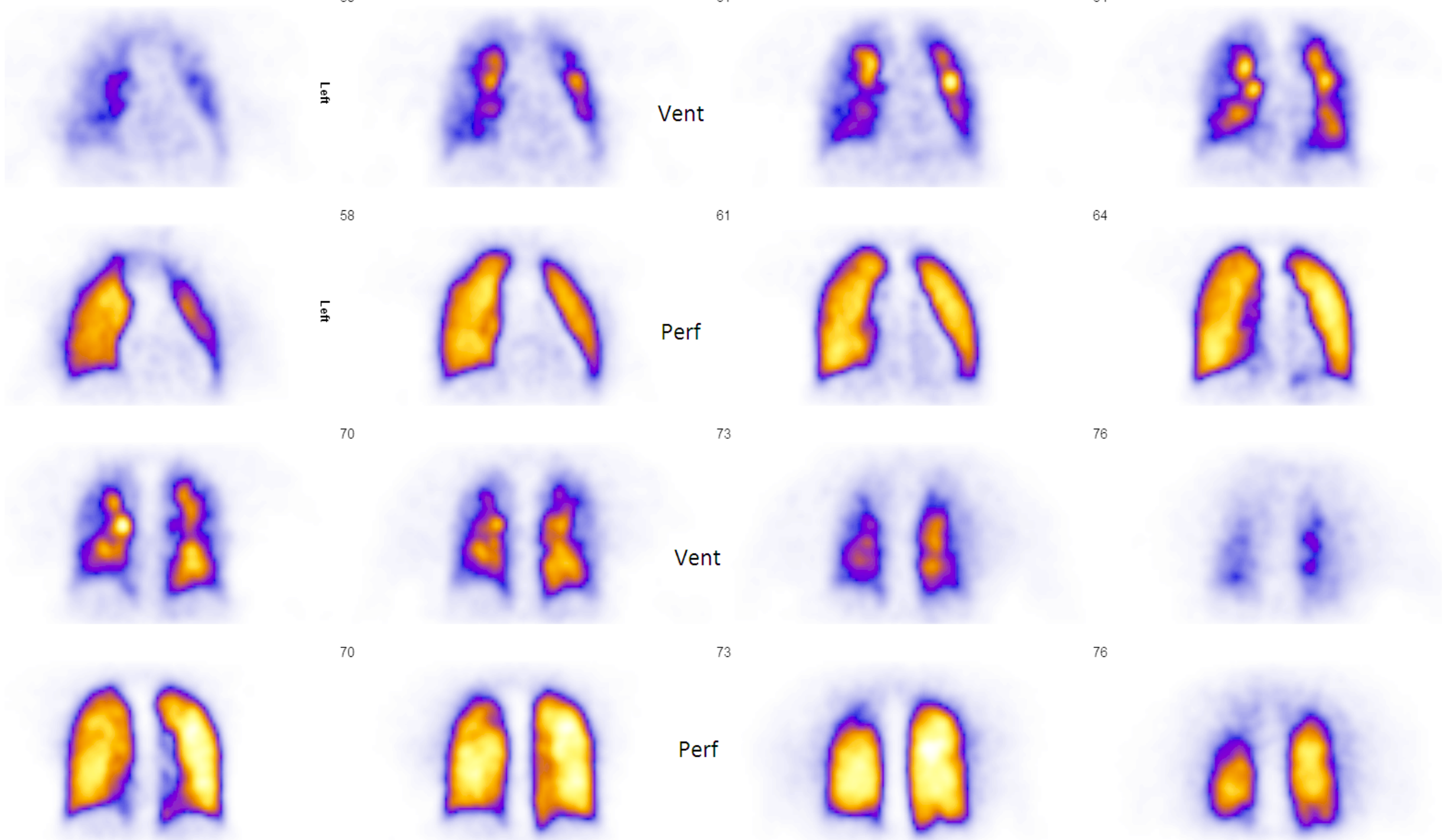
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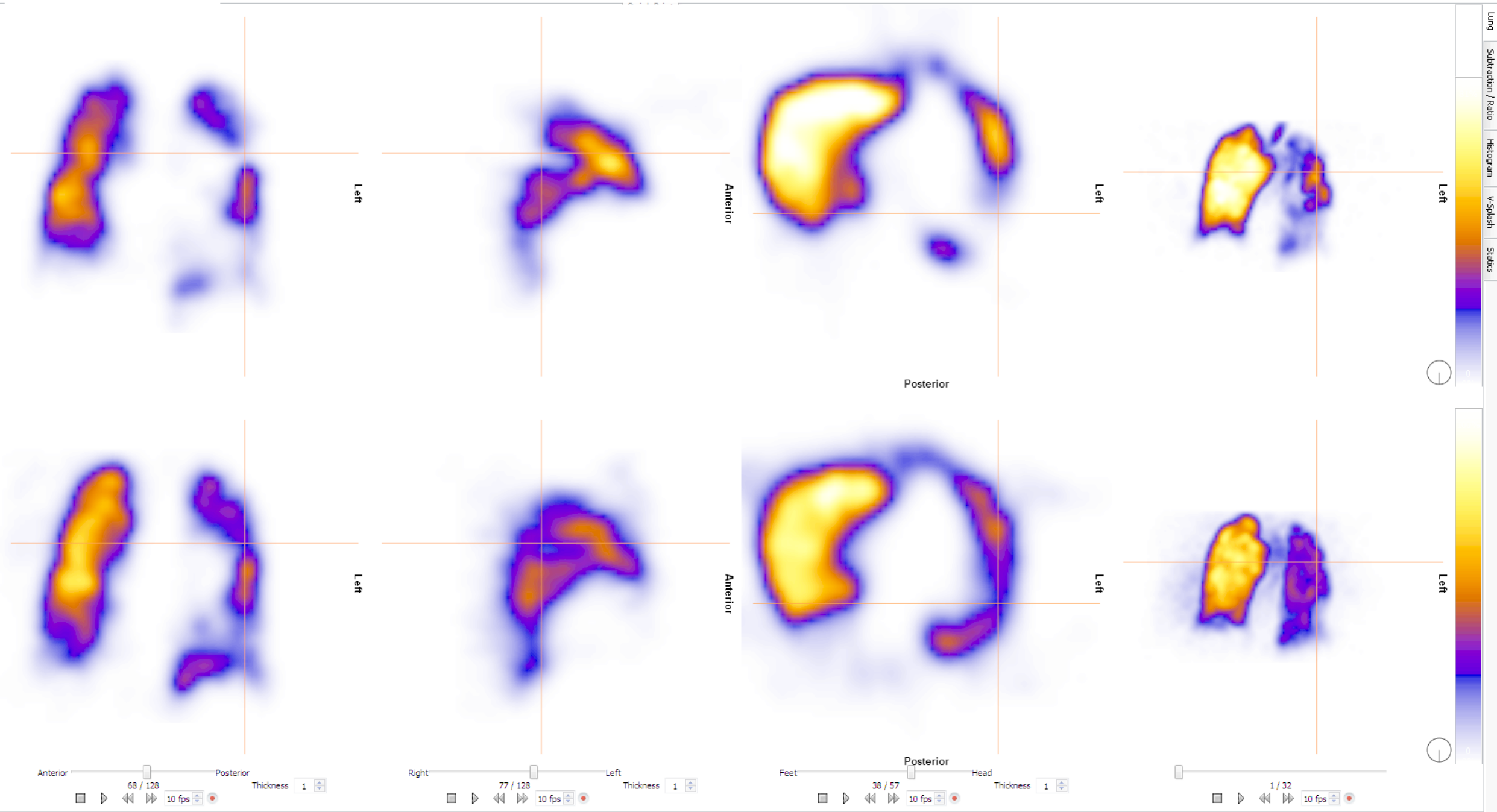
Perf

64

76

76





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

Ventilation/perfusion single-photon emission computed tomography: a service evaluation. Nuclear Medicine Communications: August 2017 - Volume 38 - Issue 8 - p 672–675

Audit results

- 18 deaths
- All in non pregnant group

<u>Cause of death</u>	<u>N</u>
Malignancy	8
Pneumonia	3
Cardiac	3
Scleroderma	1
Catastrophic intraabdominal event	1
Pulmonary Embolism	1
No data	1

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 40years

CTPA audit

- 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 1st 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

Dose to conceptus (mGy) above natural background	Probability of no malformation	Probability of no cancer (0-19 years)
0	97	99.7
1	97	99.7
5	97	99.7
10	97	99.6
50	97	99.4
100	97	99.1
>100	Possible, see text	Higher

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

