Computer tomography pulmonary angiograms vs ventilation perfusion scans in pulmonary embolism diagnosis of pregnant and breastfeeding patients

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INTRODUCTION

The incidence of pulmonary embolism (PE) is greatly increased in pregnant patients (1 in 1600 pregnancies) and early post partum. PE is the leading cause of maternal death. The clinical diagnosis of PE is complicated by normal physiological changes during pregnancy. Ventilation perfusion lung scanning (V/Q) was the most commonly performed for diagnosis of PE until the newer technology of Computer Tomography Pulmonary Angiography (CTPA) was introduced in 1990’s. CTPA offers direct imaging of pulmonary arteries and is often favoured due to its greater availability for PE.

Tc-99 labelled MAA is used in VQ scan to assess lung tissue. Patient is imaged on a gamma camera with Single Photon Emission Computer Tomography (SPECT) or planar imaging. Doctors compare perfusion and ventilation images for diagnosis of either normal or positive PE. Positive PE will show mismatch between perfusion and ventilation images (Picture 2). Cold defect with no activity on a perfusion image indicates occlusion of a branch of an artery when no defect on ventilation image of the corresponding perfusion part of the image is detected.

Aim and Method

Clinical audit of the CTPA estimated effective radiation dose in pregnant and recent post-partum patients and associated CTPA diagnostic yield at a single institution.

Retrospective review of CTPA patient data for PE between June 2012 and December 2016 was performed. 13 female patients were available for reviews including 7 pregnant and 6 breastfeeding patients within a few weeks from giving birth. One patient had 3 scans: CTPA, abdomen and pelvic CT. Only the CTPA dose data of this patient was entered to study. The diagnostic outcome of each CTPA study was reviewed as positive or negative.

CTPA effective chest dose (ED) was calculated by formula: $E = DLP \times K$

where DLP is dose length product and $K$ is coefficient of region specified normalised effective dose of chest using tissue-weighting factors of ICRP 110 table.

13 pregnant or post-partum patients, who had lung scans, were randomly selected as a controlled group.

RESULTS

All CTPA studies were negative for the diagnosis of PE. Two patients had both CTPA and V/Q scans. Both of them had negative CTPA results and positive V/Q results.

There were 2 positive PE from randomly selected 13 patients with V/Q scans only. Positive VQ images are presented on Picture 2. There is a picture of a blood clot in pulmonary artery presented on picture 3.

Average estimated EF of CTPA was 11.4 mSv with max 20.5mSv, min 6.9 mSv. Effective doses of CTPA are presented on Picture 1. In comparison half dose perfusion lung scan dose (110MBq of Tc-99MAA) is 1.2 mSv in total that contributes to fetal radiation dose of about 0.25 mSv, background radiation is about 2mSv per year in Sydney.

Furthermore there is an estimated at least 30 fold greater in CTPA breast dose with CTPA than with low dose perfusion scintigraphy.

CONCLUSION

CTPA exposes patients to much higher whole body and breast radiation doses compared with lung scanning. Breast tissue of pregnant and breastfeeding patients is very sensitive to radiation. Given the zero positive diagnostic yield of CTPA and high radiation exposure in this audited group of patients it is important to use CTPA more judiciously in pregnant and post-partum women and to consider using low dose lung scanning instead. Low dose lung scans are more sensitive and involve a significantly low radiation dose to the woman and her breasts. Radiation dose to the fetus is only slightly higher (about 15%) than background radiation during pregnancy.