DUAL SOURCE MULTISLICE COMPUTED TOMOGRAPHY FOR PULMONARY EMBOLISM: INITIAL EXPERIENCE AT AFIC/NIHD RAWALPINDI

Abstract

Objective: Observation of different computed tomography findings in patients suffering from pulmonary embolism.

Study Design: All patients who underwent computed tomography for pulmonary embolism and had positive findings of pulmonary embolism, were included in the study.

Place and Duration of study: Armed Forces Institute of Cardiology/National Institute of Heart Diseases, between April 2009 and October 2010.

Data Analysis: Total number of patients included in the study were 34 with mean age 50 years. The mean of Score by Miller was 10±5.532 and the mean percentage obstruction by method of Miller was 62.5%. The mean of Score by Qanadli was 19.62±12.32 and the mean percentage obstruction by method of Qanadli was 49.04%. The mean of Score by Mastora was 54.53±33.27 and the mean percentage obstruction by method of Mastora was 35.18%. Calculated mean and SD of right ventricular (RV) diameters was 44±7.75mm, left ventricular (LV) diameter was 32±8.06mm, RV/LV ratio was 1.508±0.58mm, main pulmonary artery (PA) luminal diameter was 29±4.16mm, ascending aorta size was 32.46±5.14mm, PA/Aorta ratio was 0.913±0.188mm, Azygos Vein diameter was 11.14±1.88mm and superior vena cava (SVC) diameter (at azygos arch) was 18.93±3.73mm. Correlation between methods was generally significant. Reflux of contrast injection was noted in 24 out of 34 patients, leftward bowing of inter-ventricular septum was observed in 21 patients, pleural effusion was noted in 10 patients and pericardial effusion was seen in only 3 patients.

Conclusion: CT pulmonary angiography has emerged as a reliable non invasive tool for not only confirmation of diagnosis of pulmonary embolism in short time but also gives valuable information about prognosis of these critically ill patients. Further it can provide accurate follow up of thrombolytic therapy and can help plan an interventional strategy.

Article

INTRODUCTION

Pulmonary embolism (PE) is a relatively common cardiovascular emergency and by occluding the pulmonary arterial bed it may lead to right ventricular failure.1 Venous thromboembolism remains a major health problem, with an incidence of around 1.5 per 1,000 person years.2 In two large multicentric studies, a high mortality rate of 50–55% was found in patients presenting with hemodynamic instability and a 8–15% mortality rate was still reported in hemodynamically stable patients.3,4 As death may occur within a few hours after admission, an accurate rapid and specific diagnosis is required and many reports have proven the usefulness of CT angiography.5 CT pulmonary angiography has become a first-line diagnostic modality in patients suspected of having PE.6 Magnitude of pulmonary embolism or clot load can be calculated by applying angiographic scores adapted for CT (Miller and Walsh scores) or dedicated CT scores (Qanadli and Mastora).7,8,9 Acute right-sided heart failure, which is critical for risk stratification can be assessed at CT pulmonary angiography by measuring the dimensions of right-sided heart cavities or upstream venous structures, such as the SVC or azygos vein.10 Quantitative cardiac CT measurements obtained on axial CT images, namely the RV short axis, LV short axis, and particularly the RV/LV short axis ratio, have shown a significant positive (RV short axis, RV/LV diameter ratio) or negative (LV short axis) correlation with the severity of PE or with fatal outcome.11,12 Identification of low-risk patients based on the lack of RV dilatation is possible.13

MATERIALS AND METHODS

The study was conducted at Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD). All patients who underwent computed angiography for PE between April 2009 to Oct 2010 and had findings of PE were included. CT pulmonary angiographic scans were obtained with 64 slice dual source computed tomography (DSCT) machine (Somatom definition) from Siemens. Patients were trained to hold their breath in full inspiration for 10–15 seconds. A craniocaudal helical acquisition was obtained with a collimation of 64 x 0.6 mm and a pitch of 1.2–1.4.

Conclusion: CT pulmonary angiography has emerged as a reliable non invasive tool for not only confirmation of diagnosis of pulmonary embolism in short time but also gives valuable information about prognosis of these critically ill patients. Further it can provide accurate follow up of thrombolytic therapy and can help plan an interventional strategy.
arterial clots and the degree of arterial obstruction were scored by using the systems proposed by Miller et al,7 Walsh et al,8 Qanadli et al,5 and Mastora et al.9 For comparison, each score was expressed as the percentage of the PA that was obstructed. Percentages were calculated by dividing the value obtained with each system by the maximum possible value for that particular system and then multiplying by 100. Measurements for the RV and LV short axis were obtained on axial images RV at the level of the tricuspid valve tips and LV at the level of the mitral valve tips and RV/LV ratio calculated. Measurements of the main PA lumen, ascending aorta, azygos vein, and SVC, were obtained. The ratio of the main PA diameter to the aorta diameter was calculated. Vascular measurements were obtained in multiplanar reformatted images. Reflux of contrast medium into the inferior vena cava, convex leftward bowing of the interventricular septum, pleural and/or pericardial effusion, and pulmonary findings, including pulmonary consolidation, infarct, platelike atelectasis etc were recorded.11

RESULTS
Total number of patients included in the study was 34.

Table 1: Age and Gender of Patients

<table>
<thead>
<tr>
<th>Age of Patient</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
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<td></td>
<td>50.79</td>
<td>17.352</td>
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<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Male</td>
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<td>52.9</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>47.1</td>
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</tbody>
</table>

Table 1 shows the mean age of patients. The youngest was 19 and oldest 85 years of age.

Table 2: Clot Scores

<table>
<thead>
<tr>
<th>Score (By Miller)</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Obstruction by Miller</td>
<td>62.5000%</td>
<td>34.57672</td>
<td>0.00</td>
<td>100.00</td>
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<tr>
<td>Score (By Qanadli)</td>
<td>19.62</td>
<td>12.319</td>
<td>1</td>
<td>40</td>
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<td>Percentage Obstruction by Qanadli</td>
<td>49.0411</td>
<td>30.79757</td>
<td>2.50</td>
<td>100.00</td>
</tr>
<tr>
<td>Score (By Mastora)</td>
<td>54.53</td>
<td>30.724</td>
<td>2</td>
<td>108</td>
</tr>
<tr>
<td>Percentage Obstruction by Mastora</td>
<td>35.1808</td>
<td>21.46716</td>
<td>1.29</td>
<td>69.68</td>
</tr>
</tbody>
</table>

Table 2 gives detail of calculated clot scores according to different methods and corresponding percentage of obstruction. The mean of Score by Miller was 10±5.532, minimum being 0 and maximum 16. The mean percentage obstruction by method of Miller was 62.5%. The mean of Score by Qanadli was 19.62±12.32, minimum being 1 and maximum 40. The mean percentage obstruction by method of Qanadli was 49.04%. The mean of Score by Mastora was 54.53±33.27, minimum being 2 and maximum 108. The mean percentage obstruction by method of Mastora was 35.18%.

Table 3 displays various cardiovascular quantitative findings. Calculated mean and SD of RV diameters was 44 ± 7.75mm, LV diameter was 32.48±0.66mm, RV/LV ratio was 1.508±0.58 mm, main pulmonary artery (PA) luminal diameter was 29 ± 4.16 mm, ascending aorta size was 32.46 ± 5.14mm, PA/Aorta ratio was 0.913 ± 0.188 mm, azygos vein diameter was 11.14 ± 1.88mm and SVC diameter (at azygos arch) was 18.93 ± 3.37mm. Correlation coefficient between pulmonary clot load scores and cardiovascular quantitative measurements was calculated by using Pearson correlation coefficient as shown in table four.
DISCUSSION
The diagnosis confirmation in most of the patients was easy due to obvious findings. A compromise of the central pulmonary arteries or of two or more lobar arteries by nuclear magnetic resonance or CT pulmonary angiography and confirmed by conventional pulmonary angiography has been defined as massive PE14. By defining indices of obstruction specifically, an objective and reproducible method can be used for communication. Importantly it is a noninvasive approach for monitoring the effect of therapies in follow-up studies5,6,7,10. Our study shows that PA clot loads scores indicate the extent of the clot and further different methods of scoring are comparable. A CT obstruction index of less than 40% would be unlikely in the presence of a pulmonary embolism with acute right ventricular dysfunction5. Generally obstruction of more than 30% of the pulmonary circulation causes sufficient elevation of the pulmonary vascular resistance to produce significant pulmonary hypertension, resulting in RV afterload increase and dilatation10,11. In massive PE, RV/LV ratio and azygos vein diameter are the best predictors of survival, enabling correct prediction of survival in 89% of patients. A diagnosis of RV failure is a better determinant of mortality than PA clot load alone. In acute PE with severe arterial pulmonary hypertension, RV dilation results in an increased RV/LV ratio and an RV/LV ratio of 1 or less is associated with a 5% likelihood of death, which is close to the mortality rate in all patients with treated PE11,12,16.
V failure occurs if thin RV walls do not succeed in compensating for the sudden elevation in PA pressure 11. In two studies of 25 patients with PE and 14 patients with massive PE, Contractor et al and Lim et al found that signs of RV strain at CT pulmonary angiography (RV/LV diameter ratio>1, leftward septal bowing) had a sensitivity of 78%–92%, specificity of 100%, and positive predictive value of 100% when compared to echocardiographic findings for the detection of RV dysfunction similarly other studies have estimated that an RV/LV diameter ratio superior to 1.5 indicates severe PE 11,12,13,16. CT findings can be used to plan interventional procedures to open a partially occluded pulmonary trunk or major pulmonary arteries which may have a life-saving effect. Fragmentation and dispersion can be done by using catheters and devices17,18,19. Hemodynamic improvement can be dramatic following successful thrombus fragmentation from what appears to be only a modest angiographic change. Fragmentation of proximal pulmonary arterial clots may be considered as an alternative to surgical treatment in high-risk PE patients when thrombolysis is absolutely contraindicated or has failed 1,17,18,19.
We acknowledge several limitations of our study. In particular, the study is relatively small and entirely observational and 'non-interventional'. In addition, data was not complete for other variables such as D-dimer levels which was essentially dependent on treating physicians.

CONCLUSION
CT pulmonary angiography shows typical findings when carefully analyzed and has emerged as a reliable non invasive tool not only for confirmation of diagnosis of pulmonary embolism in short time but also for rendering valuable information about prognosis of these critically ill patients. Further more, it can provide accurate follow up of thrombolytic therapy and can help plan an interventional strategy.

ACKNOWLEDGEMENT
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Reference


