MULTISLICE COMPUTED TOMOGRAPHY EVALUATION OF PULMONARY HYPERTENSION SECONDARY TO LUNG DISEASES

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ABSTRACT

Aim: to evaluate the role of multislice computed tomography in diagnosis of pulmonary hypertension secondary to lung diseases.

Patients and Methods: This study was done during the period from March 2014 to August 2014. Patients were subjected to radiological examinations including plain X-ray, echocardiography and multislice computed tomography (MSCT)

Results: 30 patients 18 male and 12 female with age ranged from 30 to 72 years. The size of the main pulmonary artery (PA) was the first radiological sign to be assessed. The main PA diameter to be measured at point of bifurcation at right angle to its long axis and just lateral to the ascending aorta. Among our 30 cases, 27 patients have a ratio between the main pulmonary artery size and the ascending aorta size (PA / AO ratio) more than (1: 1).

Conclusion: MSCT has a main role in evaluation of pulmonary hypertension secondary to lung diseases.

Keywords: MSCT; pulmonary, hypertension

NTRODUCTION

Pulmonary hypertension is a life-threatening chronic disorder of the pulmonary circulation. It is defined by a mean pulmonary arterial pressure over 25 mm Hg at rest or over 30 mm Hg during activity (1).

Pulmonary hypertension is characterized by progressive involvement of the pulmonary vessels that leads to increased vascular resistance and consequently to right ventricular failure (2).

According to the recent WHO classification pulmonary hypertension can be categorized as: pulmonary arterial hypertension, pulmonary venous hypertension, Pulmonary hypertension associated with lung diseases and / or hypoxemia ,chronic thrombo-embolic pulmonary hypertension and pulmonary hypertension from other causes (3).

Pulmonary hypertension associated with lung diseases (hypoxic) is common with chronic obstructive pulmonary disease (COPD), interstitial lung disease (ILD) , sleep disordered breathing , alveolar hypoventilation, chronic exposure to high altitude and developmental lung abnormalities (4) .

In cases of suspected pulmonary hypertension, imaging methods can confirm the diagnosis, suggest a cause, help choose the most appropriate treatment, and monitor the response to treatment (2).

The development of multi - detector CT has opened a wide range of recent applications. It has allowed the development of imaging technique for vascular imaging (5).

MDCT technique allows increase in gantry speed and acquisition of contiguous sections with a section thickness of (1 mm) or less throughout the thorax, with an enhancement on all acquired sections, and the narrow collimation increases spatial resolution and reduces partial volume averaging (6).

The size of the PA was the first radiological sign to be assessed. The ain PA diameter to be measured at point of bifurcation at right angle to its long axis and just lateral to the ascending aorta , it is preferable to compare the main PA diameter and the ascending aorta and calculate the ratio between them PA/ Ao ratio (2)

An enlargement of the main pulmonary artery greater than 29 mm may be seen on the CT scan . This finding has a sensitivity of 87% and a specificity of 89% for the diagnosis of PH. The specificity up to 100% when in addition to a diameter equal to or greater than 29 mm, is a segmental artery –bronchus ratio greater than 1:1 in most lung lobes (7)

PATIENTS AND METHODS

This study was done during the period from March 2014 to August 2014 at a private radio-diagnosis center. Our cases of chest diseases were selected from the internal ward of zagazig university hospital. This study included 30 patients 18 male and 12 female with age ranged from 30 to 72 years.

Methods of examinations included:

Clinical assessment

All patients were subjected to careful examination including:

-Full history taking including age and sex.

-General examination including pulse, temperature, blood pressure for all patients.

-Local examination of the chest including : Inspection, palpation, percussion and auscultation

-Electrocardiogram(ECG) All patients were examined by ECG.

-Radiological examination and imaging:

A-Plain X-ray:

All patients were examined by plain x-ray to the chest of in postro-anterior position. X-rays were performed using SIEMENS Multix Swing 500 mm at zagazig chest hospital.

B-ECHO:

Some of patients were examined by echocardiography at Al-Ahrar hospital, Al-Mabarh hospital and other private centers.

C-Computed Tomography

CT studies were performed using TOSHIBA ACTIVION 16 multislice CT system and GE BRIGHTSPEED 4 multislice device .

Axial CT cuts were performed on all 30 cases from the level of the manubrium sterni to the level of the diaphragm in both lung and mediastinal window ; 5 mm slice thickness with exposure factors of 120 kV and 150-200 mAs. , CT scan with or without contrast injection was done . The used contrast media was (urografin 76%) in a dose of 40-80 ml, administered as a bolus injection.

Patient preparation:

No special preparation was needed except fasting for about 4-6 hours before examination.

Patient position

All patients were examined supine and immobilized in a comfortable position.

RESULTS

Our study included 30 patients, 18 males and 12 females, with male: female ratio 1.5:1. The patients ages ranged from 30 to 72 years, with mean an age of 43 years. It was observed that the most frequently affected age group was [45-<60] which represents 60% of the cases (table 1).

The incidence of pulmonary hypertension according to the type of chest disease was in COPD (7 cases), bronchiectasis (5 cases), interstitial pulmonary fibrosis {IPF} (5 cases), bronchial asthma (4 cases), obesity hypoventilation syndrome {OHS} (3 cases), connective tissue disease related {CTR} (2 cases), sarcoidosis (2 cases), and sleep disordered breathing {SDB} (2 cases) which are represented in (table 2).

The most frequent symptoms and signs were dyspnea, cough, fatigue, heamoptysis , day time sleepiness ,loss of appetite, fever , lower limb edema and clubbing is demonstrated in (table 3).

The size of the main pulmonary artery (PA) was the first radiological sign to be assessed. The main PA diameter to be measured at point of bifurcation at right angle to its long axis and just lateral to the ascending aorta, represented in (table 4).

Among our 30 cases, 27 patients have a ratio between the main pulmonary artery size and the ascending aorta size (PA / AO ratio) more than (1: 1), which is represented in (table 5).

Table (1): Shows the age groups, sex and percentage of each group.

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
0-<15	0	0%	0	0%	0	0%
15-<30	0	0%	0	0%	0	0%
30-<45	5	27.8%	3	25%	8	26.7%
45-<60	11	61.1%	7	58.3%	18	60%
60-<75	2	11.1%	2	16.7%	4	13.3%
>75	0	0%	0	0%	0	0%
Total	18	100%	12	100%	30	100%

Table (2): Shows the number and the percentage of chest diseases associated with PH:

Chest disease	No.	%
COPD	7	23.3%
Bronchiectasis	5	16.7%
IPF	5	16.7%
Bronchial asthma	4	13.2%
Obesity hypoventilation syndrome	3	10 %
Sarcoidosis	2	6.7%
Connective tissue disease related	2	6.7%
Sleep disordered breathing	2	6.7%
Total	30	100%

Table (3): Shows the number and the percentage of most frequent symptoms and signs.

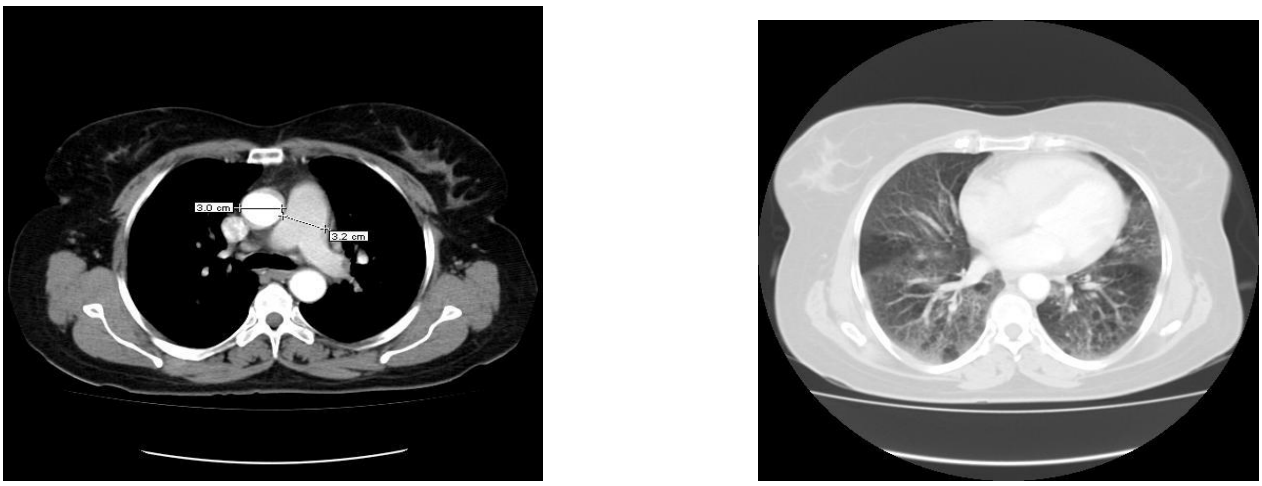
Symptoms and Signs	No.	%
Dyspnea	30	100%
Cough	21	70%
Fatigue	21	70%
Lower limb edema	15	50%
Clubbing	11	36.7%
Heomoptysis	4	13.3%
Day time sleepiness	3	10 %
Loss of appetite	2	6.7%
Fever	2	6.7%

Table (4): Shows the number and the percentage of main pulmonary artery size in all 30 cases.

Size of Main pulmonary artery	No.	%
<2.9 cm	1	3.3%
2.9-< 3.9 cm	20	66.7%
3.9-< 4.9 cm	6	20%
4.9-< 5.9 cm	3	10%
>5.9 cm	0	0%
Total	30	100%

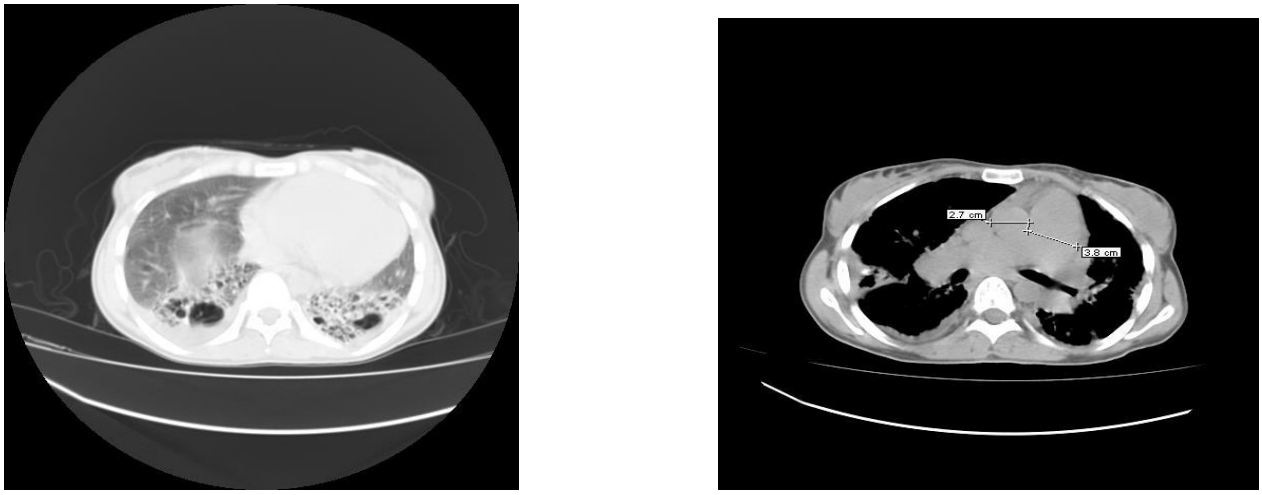
Table (5): Shows the percentage of (PA / AO ratio).

PA / AO ratio	No.	%
> 1 : 1	27	90%
= 1 : 1	3	10%
< 1: 1	0	0%
Total	30	100%



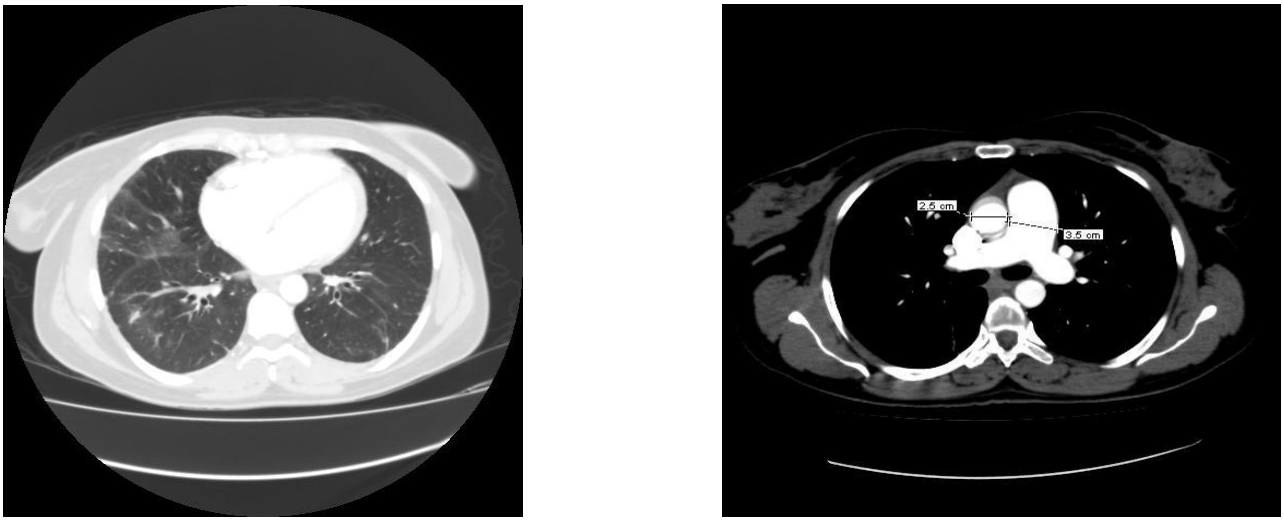
(A) (B)

Figure (1) : MSCT of a 56 years old female complaining of dyspnea, (A): Bilateral sub pleural reticulations and ground glass opacities most pronounced in lung bases (B) The ratio between segmental artery and bronchus was greater than 1:1. Mild dilated main pulmonary artery (3.2 cm) and ascending aorta of (3 cm) with a ratio > (1 : 1)



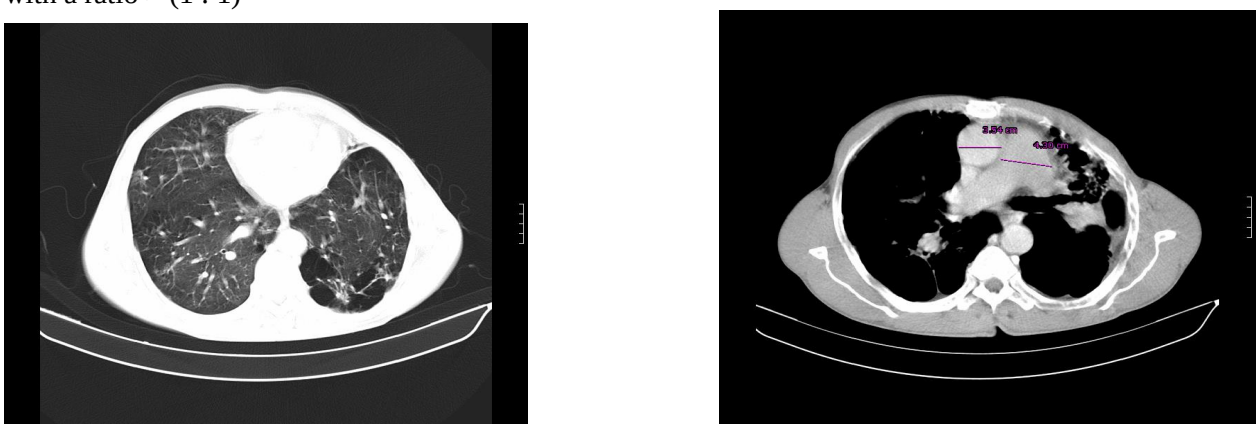
(A) (B)

Figure (2) : MSCT of a 49 years old male presented with hemoptysis (A): Bilateral bronchiectasis is demonstrated more pronounced at lung bases, in addition, multiple linear fibrotic strands are noted with costal pleural thickening. Findings consistent with sequela of old tuberculosis (B) Dilated main pulmonary artery (3.9cm) and ascending aorta of (2.7cm) with a ratio > (1: 1)



(A) (B)

Figure (1) : MSCT of a 38 years old female complaining of progressive dyspnea, (A) Patchy bilateral ground-glass density lesions (B) Dilated main pulmonary artery (3.5cm) and Ascending aorta of (2.5cm) with a ratio > (1 : 1)



(A) (B)

Figure (1) : MSCT of a 62 years old male patient presented with sever dyspnea, (A): multiple fibrotic strands, nodularity and air filled cavities (B) Dilated main pulmonary rtery (4.3 cm) and Ascending aorta of (3.5 cm) with a ratio > (1: 1)

DISCUSSION

Pulmonary hypertension (PH) is defined as a group of diseases characterized by a progressive increase in pulmonary vascular resistance leading to right ventricular failure and death. Idiopathic PH is a rare disease and PH most frequently associated with other diseases. (8).

PH is considered when the average value of pressure in the pulmonary artery (PA), measured by right heart catheterization is more than 25 mm Hg at rest or over 30 mm Hg during activity (1).

Pulmonary hypertension associated with lung diseases (hypoxic) is common with chronic obstructive pulmonary disease (COPD) , interstitial Lung disease (ILD) , sleep disordered breathing , alveolar hypoventilation, chronic exposure to high altitude and developmental lung abnormalities (4) .

In 90% of PAH patients, the chest radiograph is abnormal at the time of diagnosis, however a normal chest radiograph may also be seen (Rich et al., 1987). Chest radiographic findings of PH include main and hilar pulmonary arterial dilatation with attenuation of peripheral pulmonary vascular markings (pruning or loss). cardiomegaly (cardiothoracic ratio greater than 0.5)with predominant right ventricular (RV) enlargement may be present (9).

MDCT with contrast media administration is necessary to evaluate the pulmonary arteries as well as the heart and the vessels of the chest. the MDCT technique can also provide thin-section images of the lung parenchyma, evaluation of the lung windows helps in detection of abnormalities in most common cases of secondary pulmonary hypertension (10).

In our study, among the 30 cases subjected to examination, 18 patients were males and 12 patients were females and with male:

female ratio 1.5:1. These results were in agreement with **Joshi, 2000** (11) who stated that male are affected more often than female, at a ratio about 1.5:1.

Our study showed age range between 30 and 73 years and 60% of the patients aged between 45 and 60 years, 26.7% of the patients between 30 and 45 years old, and 13.3% of patients over the age of 60 years with mean age 43 years. These results were compatible with those of **Joshi, 2000** (11) who stated that most of patients are between the ages of 21 and 71 years at the time of presentation. And most of the cases are around fifties especially in COPD and ILD patients, he also mentioned that the mean age at diagnosis is 41.45 years.

Our findings showed that the most common chest diseases associated with pulmonary hypertension were COPD (23.3 %) , ILD , Bronchiectasis (16.7 %) each , Bronchial asthma (13.2 %) , Sarcoidosis , Connective tissue related and Sleep disordered breathing (6.7%) each. These results were similar to those of **Oswald, 1995** (12) who stated that COPD is by far the most common cause of PH, more common than interstitial lung disease and other chest diseases.

In our study dyspnea especially with exertion found to be the most common clinical finding in pulmonary hypertension secondary to chest disease ,all 30 cases suffered from dyspnea either at rest or with exertion, fatigue and cough were also very common found in 21 cases. These results were in agreement with **Trenton and Steven, 2001** (13) whom stated that the most common symptom of PH was exertional dyspnea, then fatigue witch reflect an inability to increase cardiac output during activity.

In our study, among the 30 cases, the main PA diameter in 29 cases measured at point of bifurcation at right angle to its long axis and just lateral to the ascending aorta is greater than or equal to 29 mm. Also our findings showed that the ratio between segmental artery and bronchus was greater than 1:1 in most lung lobes as shown by MDCT in most of the cases examined. These results were compatible with those of **Devaraj and Hansell, 2009** (7) and **Frazier et al., 2000** (14) whom stated that when main PA is greater than or equal to 29 mm has an indication of 87% sensitivity and 89% specificity for PH. The specificity up to 100% when in addition to a diameter equal to or greater than 29 mm, is a segmental artery –bronchus ratio greater than 1:1 in most lung lobes.

Our study revealed that 27 cases out of 30 have a ratio between the main pulmonary artery size and the ascending aorta size (PA / AO ratio) more than (1: 1), and in 3 cases (PA / AO ratio) equal (1:1). These results were compatible with those of **Ng et al., 1999** (15) who stated that if the ratio between main pulmonary artery and ascending aorta (PA / AO) is greater than (1:1), it is likely to be PH

CONCLUSION

As a noninvasive test, MDCT is routinely performed in patients being investigated for a possible diagnosis of PH. It also has the potential to provide the first pointer toward the diagnosis of the condition; MDCT offers anatomic information about the size of the pulmonary arterial tree and signs of right ventricular dysfunction beside its ability to provide thin-section images of the lung parenchyma. This study has shown that MDCT measurements are strongly correlates of mPAP in patients with a spectrum of underlying chest disorders.

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