



COMPARISON OF MAIN PULMONARY ARTERY DIAMETER BETWEEN PATIENTS WITH PULMONARY ARTERY HYPERTENSION AND ASYMPTOMATIC ADULTS USING COMPUTED TOMOGRAPHY

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ABSTRACT

Right cardiac catheterization is considered to be the gold standard for measuring pulmonary artery pressure but this is an invasive procedure. An increase in the diameter of the pulmonary artery is a strong indication for the presence of pulmonary hypertension. Some investigators have found reasonable correlations with pulmonary arterial size and **Pulmonary artery pressure** PAP in studies with chest radiography. However measurement of the pulmonary artery diameter by chest radiography is poorly reliable as a method for the examination of pulmonary artery pressure. The objectives of this study were to estimate the main pulmonary artery diameter and compare main pulmonary artery diameter between patients with pulmonary artery hypertension and asymptomatic adults using computed tomography. Total of 46 subjects were included in the study which includes 23 pulmonary hypertensive cases and 23 non-pulmonary hypertensive subjects. The mean diameter in pulmonary hypertensive group was 31.79 ± 4.3 mm and for the non – hypertensive group mean diameter was 25.94 ± 2.4 mm. Independent test was used for data analysis and the difference mean pulmonary artery diameter between two groups was found to be statistically significant with the confidence interval of 95%. Cut-off value of main pulmonary artery diameter was found to be 29.0 mm and had 82.60% sensitivity and 91.30% specificity for the detection of pulmonary hypertension.

KEYWORDS: Pulmonary artery hypertension-PAH, Main Pulmonary artery diameter-MPAD, Computed Tomography, Helical CT, Pulmonary artery pressure (PAP).



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INTRODUCTION

Right cardiac catheterization is considered to be the gold standard for measuring pulmonary artery pressure^{7,8}. However this is an invasive procedure and carries a risk of mortality and morbidity. An increase in the diameter of the pulmonary artery is a strong indication for the presence of pulmonary hypertension³. Some investigators have found reasonable correlations with pulmonary arterial pressure and pulmonary artery diameter in studies with chest radiography². It has also been reported that measurement of the pulmonary artery diameter by chest radiography is a poorly reliable method for the examination of pulmonary artery pressure. Several factors contribute to the problem such as superposition of the mediastinum and hilar structures; concurrent parenchymal diseases; architectural distortion and magnification differences⁹. The improvements in technology of computed tomography have made it more efficient, patient and user friendly. Also its cross sectional and multi planner reconstruction with improved image quality has made it an excellent non-invasive measurement tool. CT can be used to measure main pulmonary artery diameter accurately without using any interventional techniques. The objectives of this study were to estimate the main pulmonary artery diameter and compare main pulmonary artery diameter between patients with pulmonary artery hypertension and asymptomatic adults using computed tomography.

MATERIALS AND METHODS

Approval was acquired from ethical committee, Kasturba Hospital, Manipal and Institutional research committee, School of Allied Health Sciences, Manipal for this hospital based

observational study. Total sample collected was 46 which included 23 pulmonary hypertensive patients and 23 non-hypertensive subjects, who were referred for CECT thorax by treating doctor. Among pulmonary hypertensive group 15 were female and 8 were male subjects and in non- pulmonary hypertensive groups 13 were female and 10 were male subjects. All subjects chosen were age range of 20 years to 80 years. Consent for contrast injection was taken before the study as per routine procedure. Contrast enhanced CT for thorax was performed from the apex to the lungs to the diaphragm using routine protocol in Brilliance 64 slice Phillips MDCT scanner in our department. The scans were acquired with slice thickness of 5 mm and pitch 0.938 with a rotation time of 1.0 sec and collimation of 64×0.625 mm along with a standard filter. During the scan, the patient was instructed to breathe at full inspiration and hold his /her breath for a few sec during scanning time in-order to reduce motion artifacts. The original series of CECT thorax scan were then sent to a dedicated workstation Philips Extended Brilliance workstation: V4 .5.2.403 with Philips CT viewer software. An electronic cursor was used to measure the widest diameter perpendicular to the long axis of the main pulmonary artery at the pulmonary artery bifurcation level. Student T – Test was used for statistical analysis.

RESULTS

The mean main pulmonary artery diameter (MPAD) in the pulmonary hypertensive group was 31.79 ± 4.3 mm and for the non – pulmonary hypertensive group mean diameter was 25.94 ± 2.4 mm (Table.1).

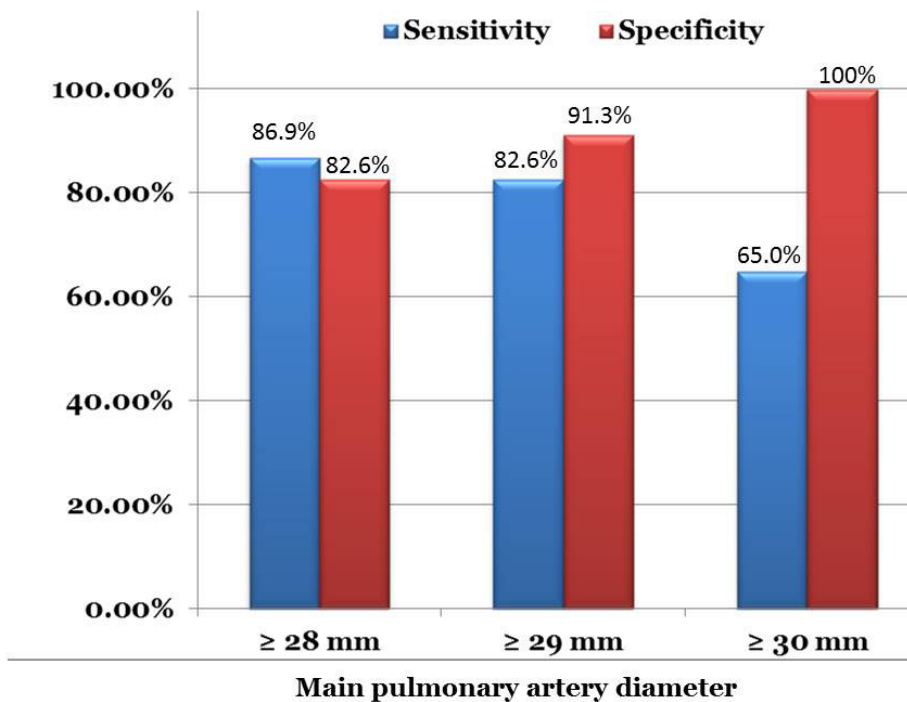
Table 1
Table showing mean main pulmonary artery diameter in pulmonary hypertensive and non-pulmonary hypertensive groups

GROUP	MEAN	SD
Pulmonary Hypertensive	31.79 mm	4.320 mm
Non-Pulmonary Hypertensive	25.94 mm	2.433 mm

The difference in mean pulmonary artery diameter between hypertensive and non hypertensive patients were found to be statistically significant ($P < 0.001$) using an independent t test with the confidence interval of 95%. Various cut-off values for MPAD were used in calculating the sensitivity and specificity in detecting pulmonary artery

hypertension (Figure1). It can be seen that 29 mm can be selected as a reliable cut-off in predicting pulmonary arterial hypertension. Cut-off value of pulmonary artery diameter ≥ 29 .mm had 82.60% sensitivity and 91.30% specificity for the detection of pulmonary hypertension.

Figure 1
Bar diagram showing sensitivity and specificity for various main pulmonary artery diameter in detecting Pulmonary artery hypertension



DISCUSSION

The main pulmonary artery diameter (MPAD) is one of the measurements which is clinically relevant for the diagnosis of main pulmonary artery hypertension and other cardiopulmonary disease. Although right cardiac catheterization is considered as gold standard for measurement of pulmonary artery pressure, researches have been carried out using other non invasive techniques specially using chest radiograph and CECT of thorax. According to the study conducted by Pd Edward et.al⁴ in Germany the MPAD in normal subject MPAD was 27.2 ± 0.3 mm where as in hypertensive patients they found a significant increase in diameter which is 34.7 ± 0.33 mm. A similar result for normal MPAD was reported by Sinemkarzincir et.al⁵ in Japan which was 26.6 ± 2.8 mm. We found almost similar result, closer to report by Sinemkarzincir et.al which is 25.94mm in normal subjects. Quynh A.Truong et.al⁶ also reported almost similar result from their cohort study at Milwaukee USA in which the mean MPAD in the overall cohort was 25.1 ± 2.8 mm. Tobias J Lange et.al¹ conducted a retrospective study in Germany and study shows MPAD were significantly larger in 26 patients with borderline Pulmonary hypertension(PH) which was 31.6 ± 0.53 mm compared with 52 patients without Pulmonary

hypertension which was 27.8 ± 0.43 mm. Tobias J Lange et.al¹ reported highest MPAD for normal subjects compared to other studies, however this is also well within cut off value which was 29 mm. All reported MPAD for pulmonary artery hypertension are above this cut off value. A reasonable explanation for small discrepancies in pulmonary artery diameter in normal subjects may be due to interracial differences. Sinemkarzincir et al⁵ patients were predominately of Japanese origin whereas in Pd Edward et al⁴ study the subjects were predominately of Anglo- Saxon origin. In our study all the subjects were of Caucasoid origin.

CONCLUSION

1. The upper limit of normal main pulmonary artery in South Indian population can be considered as 29.0 mm. This upper limit can be useful for identification of patients with borderline pulmonary hypertension for further study and to prompt further diagnostic work-up of possible underlying diseases.
2. There may be small difference in diameter of main pulmonary artery among different racial and geographic groups.

REFERENCES

1. Tobias J. Lange, Christian Dornia, Jaroslava Stiefel, Christian Stroszczyński, Michael Arzt, Michael Pfeifer, and Okka W. Hamer. Increased pulmonary artery diameter on chest computed tomography can predict borderline pulmonary hypertension. *Pulmonary Circulation*, 3(2): 363 -368, 2013.
2. Kanemoto N, Furuya H, Etoh T, Sasamoto H, Matsuyama S. Chest roentgenograms in primary pulmonary hypertension. *Chest*, 76(1): 45–49, (1979).
3. Kuriyama K, Gamsu G, Stern RG, Cann CE, Herfkens RJ, Brundage BH. CT-determined pulmonary artery diameters in predicting pulmonary hypertension. *Investigative Radiology*, 19(1):16–22 (1984).
4. PD Edward, RK Bull, R Coulden. CT Measurement of Main Pulmonary Artery Diameter. *The British Journal of Radiology*, 71(850): 1018-1020, (1998).
5. Sinem Karazincir, Ali Balcı, Ergün Seyfeli, Sebahat Akoğlu, Cenk Babayiğit, Ferit Akgül, Fatih Yalçın, Ertuğrul Eğilmez. CT assessment of main pulmonary artery diameter. *Diagnostic and Interventional Radiology*, 14(2): 72-74, (2008).
6. Truong QA, Massaro JM, Rogers IS, Mahabadi AA, Kriegel MF, Fox

- CS, O'Donnell CJ, Hoffmann U. Reference Values for Normal Pulmonary Artery Dimensions by Noncontrast Cardiac Computed Tomography: The Framingham Heart Study. *Circulation Cardiovascular Imaging*, 5(1):147-154, (2012).
7. Paul D. Stein, Christos Athanasoulis, Abass Alavi, Richard H. Greenspan, Charles A. Hales, Herbert A. Saltzman, Carol E. Vreim, Michael L. Terrin, John G. Weg. Complications and validity of pulmonary angiography in acute pulmonary embolism. *Circulation*, 85(2):462-468, (1992).
8. Van Erkel AR, Van Rossum AB, Bloem JL, Kievit J, Pattynama PM. Spiral CT Angiography for Suspected Pulmonary Embolism: A Cost-Effectiveness Analysis. *Radiology*, 201(1):29-36, (1996).
9. Jeanne B. Ackman Haimovici, Beatrice Trotman-Dickenson, Elkan F. Halpern, G. William Dec, Leo C. Ginns, Jo-Anne O. Shepard, Theresa C. McLoud. Relationship between pulmonary artery diameter at computed tomography and pulmonary artery pressures at right-sided heart catheterization. *Academic Radiology*, 4(5): 327-334, (1997)