RESEARCH PAPER

Evaluation of Pulmonary Artery Diameter in Smokers and Non-Smokers: A Cross-Sectional Study

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ABSTRACT

Purpose:
This study aimed to evaluate whether a significant difference in pulmonary artery diameter exists between smokers and non-smokers, using advanced imaging modalities for detailed assessment.

Method:
A prospective observational study was conducted on 31 patients aged 18–65 years presenting with chest pain, all of whom underwent CT imaging.

Results:
Among the 90 participants, 45 were male, and 45 were female. The mean main pulmonary artery diameter was 23.68 mm in non-smokers and 26.84 mm in smokers, showing a statistically significant increase in smokers ($p<0.005$). The mean right pulmonary artery diameter was also significantly higher in smokers ($p<0.021$). Although the mean left pulmonary artery diameter was greater in smokers, the difference did not reach statistical significance ($p = 0.052$).

Conclusion:
This study assessed pulmonary artery diameters in smokers and non-smokers using MDCT, with additional gender-based comparisons. The findings indicate increased pulmonary artery dimensions in smokers. Furthermore, contrast-enhanced CT (CECT) plays a crucial role in evaluating disease activity and reversibility; for instance, ground-glass opacities suggest active and potentially reversible pathology, whereas septal thickening and pulmonary artery abnormalities may indicate irreversible changes.

Keywords: Contrast Enhanced Computed Tomography, Multi Detector Computed Tomography, Non-Contrast Computed Tomography, Pulmonary Artery Diameter

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Introduction:

Smoking continues to be a major global health challenge, exerting profound effects on cardiovascular function. Among the various mechanisms linking smoking to cardiovascular disease, its influence on the pulmonary vasculature has drawn increasing attention. The pulmonary artery, a critical vessel responsible for transporting deoxygenated blood from the heart to the lungs, plays an essential role in maintaining effective circulation. Changes in its diameter may therefore act as a sensitive marker of underlying vascular health [1].

This study focuses on evaluating variations in pulmonary artery diameter between smokers and non-smokers, with the aim of clarifying the relationship between smoking behavior and pulmonary vascular morphology. Understanding these changes is important, as they may contribute to early identification of cardiovascular alterations and support the development of targeted strategies to reduce smoking-related vascular damage.

Smoking, a well-established modifiable risk factor, is strongly associated with atherosclerosis, endothelial dysfunction, and systemic inflammation. While its adverse effects on systemic arteries, particularly the coronary circulation, are well documented, its impact on the pulmonary vasculature remains less clearly defined [1-2]. Given the distinct physiological characteristics of pulmonary arteries, alterations in their caliber may represent early manifestations of vascular impairment due to chronic tobacco exposure [6].

The primary objective of this study is to determine whether a significant difference exists in pulmonary artery diameter between smokers and non-smokers. This will be investigated through a detailed assessment using advanced imaging techniques.

Materials and Methods:

A prospective observational study was carried out in the Department of Radio diagnosis, between 2023 to 2024, at Teerthanker Mahaveer Hospital, Moradabad, U.P. The source of data for this study is victims referring in unit of Imaging and interventional radiology from OPD/IPD of Teerthanker Mahaveer Hospital, Moradabad. We reviewed in detail the records of the patient's case file, which was used to confirm information from other data sources. The participants ranged in age from 18 to 65.

All the patients with clinically suspected Pulmonary Artery Diameter diseases are included. Patients not included who are not fitted in CT Imaging, Pregnant women are exclude for the data collection. All other lesions mimicking pulmonary disease & Patient who did not give consent are excluded.

Imaging protocols: All patients were screened before entering the CT scanner room to ensure the absence of metallic objects in the region of interest. Examinations were performed with the patient in the supine position on the CT table, with appropriate positioning, clear instructions for breath-holding, and adequate chest immobilization to minimize motion artifacts.

A contrast-enhanced CT (CECT) protocol was then initiated. An initial scout (topogram) of the chest was acquired and used to plan the scan according to the lung fields. The 128-slice CT protocol covered the entire thorax, extending from the lung apices to the diaphragm. Scanning parameters, including kVp, mA, slice thickness, and inter-slice gap were appropriately set.

The protocol also included axial plain images with a slice thickness of 3–5 mm, followed by image reconstruction, post-processing, and multiplanar reformatting for detailed evaluation.

Data Analysis

Statistical analysis was performed using SPSS version 20. Quantitative variables were summarized as mean ± standard deviation, while qualitative variables were expressed as frequencies and percentages. Normality of quantitative data was assessed using the Shapiro–Wilk test and visualized with normal Q–Q plots. Differences in pulmonary artery measurements across gender and smoking status were evaluated using independent sample t-tests. A p-value < 0.05 was considered statistically significant.

Result

The 90 participants who had acute or chronic chest pain at the time of the presentation age range from 18 to 65 years. 45 patients (50 %) were males, and 45 patients (50 %) were females. The proportion of males was higher than female represented in Table 1.

Table 1: Demonstration of patients according to gender

	Frequency	Percent
Female	45	50
Male	45	50
Total	90	100.0

Table 2: Shows the Smoking Status of Smoker and Non-Smoker

	Frequency	Percent
Non-Smoker	39	45.2
Smoker	51	54.8
Total	90	100.0

Table 3: Descriptive Statistics of Quantitative Variable

Descriptive Statistics						
Variable Name	**N**	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	90	59	17	76	52.23	15.68

Main Pulmonary Artery	90	12.90	20.10	33.00	25.41	3.26
Right Pulmonary Artery	90	16.20	10.90	27.10	18.37	3.78
Left Pulmonary Artery	90	14.00	11.60	25.60	18.33	3.40

The above table shows the descriptive statistics of the quantitative variable. The mean age of the participants was 52.23±15.68, the mean main pulmonary artery was 25.41±3.26, the right pulmonary artery was 18.37±3.78, and the left pulmonary artery was 25.60±18.33, as shown in Table 3.

Table 4: Descriptive Statistics of Male and Female

Variable Name	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	38	18	56	39.14	12.14
Main Pulmonary Artery	6.20	22.30	28.50	24.41	1.96
Right Pulmonary Artery	5.30	12.40	17.70	15.77	1.84
Left Pulmonary Artery	8.60	14.00	22.60	17.96	2.62
Variable Name	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	59	17	76	56.04	14.65
Main Pulmonary Artery	12.90	20.10	33.00	25.70	3.53
Right Pulmonary Artery	16.20	10.90	27.10	19.13	3.89
Left Pulmonary Artery	14.00	11.60	25.60	18.44	3.64

The above tables show descriptive statistics according to gender; the mean age of female were 39.14±12.14, whereas the mean age of males was 56.04±14.65. The mean age of males was found to be higher than that of females show in Table 4. Mean main pulmonary artery of females was 24.41±1.96, whereas in males were 25.70±3.53. The main pulmonary arteries were found to be approximately equal in both groups. Mean right pulmonary artery of females was 15.77±1.84, whereas in males were 19.13±3.89. Mean right pulmonary arteries were found to be higher in males. Mean left pulmonary artery of females was 17.96±2.62, whereas in males were 18.44±3.64. Mean left pulmonary arteries were found slightly higher in males.

Table 5: Descriptive Statistics for Smoker and Non-Smoker

Variable Name	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	51	17	68	46.21	17.69
Main Pulmonary Artery	9.70	20.10	29.80	23.68	2.33
Right Pulmonary Artery	10.50	12.40	22.90	16.67	3.02
Left Pulmonary Artery	11.70	11.60	23.30	17.04	3.19

	Range	Minimum	Maximum	Mean	Std. Deviation
Age	46	30	76	57.18	12.20
Main Pulmonary Artery	12	21.00	33	26.84	3.28
Right Pulmonary Artery	16.20	10.90	27.10	19.76	3.84
Left Pulmonary Artery	11.90	13.70	25.60	19.40	3.27

The above tables are showing descriptive statistics according to smoking status, mean age of nonsmokers were 46.21±17.69 whereas mean age of smokers was 57.18±12.20. Mean age was found higher in smokers' group. Mean main pulmonary artery in nonsmokers were 23.68±2.33 whereas in smokers were 26.84±3.28. Mean main pulmonary artery was found higher in smokers. Mean right pulmonary artery were in nonsmokers 16.67±3.02 whereas in smokers were 19.76±3.84. Mean right pulmonary artery was found higher in smokers. Mean left pulmonary artery in nonsmokers was 17.04±3.19, whereas in smokers were 19.40±3.27. mean left pulmonary artery was higher in smokers as shown in table 5.

Table 6: Test for Normality

Variable Name	Shapiro-Wilk		
	Statistic	df	Sig.
Main Pulmonary Artery	.954	31	.202
Right Pulmonary Artery	.985	31	.938
Left Pulmonary Artery	.980	31	.806

We found the central lung artery, left lung artery, and right pulmonary artery approximately normally distributed because the probability of Shapiro Wilk test for normality (i.e. 0.202, 0.938 and 0.806) was greater than the level of significance 0.05. Hence, we used a parametric t-test to compare two independent groups, as shown in Table 6.

Table 7: Comparison of Pulmonary Artery according to Gender

Variable Name	Female Mean (SD)	Male Mean (SD)	P-Value
Main Pulmonary Artery	24.41 (1.96)	25.7 (3.53)	0.368
Right Pulmonary Artery	15.77 (1.84)	19.13 (3.89)	**0.037**
Left Pulmonary Artery	17.96 (2.62)	18.44 (3.64)	0.746

The comparison of the pulmonary artery according to gender, the mean main pulmonary artery in females was 24.41, and in males was 25.70. Mean major pulmonary artery was found to be marginally higher in male differential between the sexes was not statistically significant, as the mean value is higher than meaning point, i.e., 0.368, as shown in Table 7. Mean right pulmonary artery in females was 15.77, and in males was 19.13. The mean right pulmonary artery was found statistically higher in males, as the P-value is less than the level of significance, i.e., 0.037. Mean left pulmonary artery pressures in females were 17.96, and in males were 18.44. The mean left pulmonary artery in males was found to be slightly higher, but the difference in groups was not statistically significant since the P-value is 0.746.

Table 8: Comparison of Pulmonary Artery according to smoking Status

Variable Name	**Non-Smoker**	**Smoker**	**P-Value**

Main Pulmonary Artery	23.68 (2.33)	26.84 (3.28)	**0.005**
Right Pulmonary Artery	16.67 (3.02)	19.76 (3.84)	**0.021**
Left Pulmonary Artery	17.04 (3.19)	19.4 (3.27)	0.052

The above table shows a comparison between smokers and nonsmokers regarding the pulmonary artery. Mean main pulmonary artery in nonsmokers was 23.68, and in smokers was 26.84. The mean main pulmonary artery was found statistically higher in smokers as the P- value <0.005. Mean right pulmonary artery in nonsmokers was 16.67, and in smokers was 19.76. The mean right pulmonary artery was found statistically higher in smokers, with a P< 0.021. The mean left pulmonary artery in nonsmokers was 17.04, and in smokers were 19.40. Mean left pulmonary arteries were found to be higher in smokers, but the difference between the groups was not statistically significant, as the P-value is 0.052, as shown in Table 8.

Discussion

This cross-sectional observational study was conducted in the Department of Radiodiagnosis and Imaging at Teerthanker Mahaveer Hospital, TMU, Moradabad, Uttar Pradesh. A total of 31 patients were included, with a predominance of males (77.4%) compared to females (22.8%). Although male predominance was observed overall, female representation varied across age groups, with minimal differences in the first and eighth decades, and relatively balanced distribution below 20 years of age. Patients were also categorized based on smoking status; 54.8% were smokers, while 45.2% were non-smokers.

Comparable findings have been reported in previous studies. A study by LH Sang et al. included 2,547 individuals (1,543 males and 1,023 females), among whom 813 were non-smokers (187 males and 626 females). Similarly, JL Tobias et al. conducted a retrospective analysis of 78 cases, comprising 51 females and 27 males. Other studies have also included both male and female participants [3]. In a large cohort study by D. Steiger et al., involving 1,949 cases, females (n = 978) slightly outnumbered males (n = 971), with 52.7% identified as smokers and 42.7% as non-smokers.

The adverse effects of cigarette smoking on the respiratory system have been well established since the 1964 Surgeon General's report, which linked smoking causally to multiple diseases. Smoking increases the risk of pneumonia-related mortality and contributes to chronic respiratory conditions such as bronchitis, chronic obstructive pulmonary disease (COPD), and lung cancer [3,7].

The study population included patients across a wide age range, from 17 to 76 years. The highest frequency of cases was observed in the fourth (17.5%), fifth (37.5%), and sixth (20.0%) decades of life. The overall mean age was 52.23 ± 15.68 years. The mean age among females was 39.14 ± 12.4 years, while for males it was 56.04 ± 14.65 years. These findings are comparable to previous studies, such as those by HL Sang (mean age 53.1 ± 9.3 years) and LJ Tobias (mean age 56.14 ± 14.1 years) [4].

The etiological spectrum varied across age groups. In the present study, the mean diameters of the main pulmonary artery (MPA), right pulmonary artery (RPA), and left pulmonary artery (LPA) were 25.41 ± 3.26 mm, 18.37 ± 3.78 mm, and 18.33 ± 3.40 mm, respectively. These values are slightly lower than those reported by HL Sang et al. (26.6 ± 3.4 mm). Gender-based comparisons in previous studies showed mean MPA diameters of 26.0 ± 3.4 mm in females and 27.0 ± 3.4 mm in males, whereas in the present study, the corresponding values were 24.41 ± 1.96 mm and 25.70 ± 3.53 mm.

In non-smokers, the mean MPA diameter was 23.68 ± 2.33 mm, compared to 25.70 ± 3.53 mm in smokers. In contrast, LH Sang et al. reported mean MPA diameters of 26.6 ± 3.4 mm in non-smokers and 26.9 ± 3.4 mm in smokers. Findings from D. Steiger et al. indicated an overall mean MPA diameter of 26.6 ± 3.9 mm, with values of 27.2 ± 3.9 mm in males and 26.0 ± 3.9 mm in females. Additionally, LJ Tobias reported mean diameters of 2.24 ± 0.38 cm for the LPA and 2.35 ± 0.47 cm for the RPA, while recent large-scale CT data (n = 3,171) reported a mean MPA diameter of 2.51 ± 0.28 cm [5].

The present study also demonstrated that the diameters of the main, right, and left pulmonary arteries followed a normal distribution pattern, although comparable statistical validation is limited in existing literature. Age-wise distribution of contrast-enhanced CT (CECT) findings showed no cases below 10 years, three cases under 20 years, four cases under 40 years, seventeen cases under 60 years, and eleven cases above 60 years. The majority of cases were concentrated between 60 and 70 years, while no cases were observed beyond 80 years of age. Overall, these findings highlight the variability in pulmonary artery measurements across demographic and clinical parameters, reinforcing the need for larger, standardized studies to improve diagnostic accuracy and establish reliable reference values.

All 31 cases in this study underwent contrast-enhanced computed tomography (CECT). An effort was made to standardize the CECT protocol based on patient age, clinical history, physical examination findings, and preliminary radiographic assessment. The CECT evaluation included detailed technical parameters such as collimation and exposure settings (kVp, mAs), slice thickness, scan mode, scan type, and field of view. Image acquisition and post-processing parameters were also assessed, including reconstruction techniques, window settings, and the choice of filter or kernel. For multidetector CT systems, detector configuration and image reconstruction interval (increment) was analyzed. Radiation dose metrics, including automatic exposure control (AEC) and longitudinal dose reports, were documented. Advanced image processing techniques such as multiplanar reformations (MPR), maximum intensity projection (MIP), minimum intensity projection (MinIP), and curvilinear reconstructions were utilized. Images were reviewed in axial, coronal, and sagittal planes, along with three-dimensional surface and volume-rendered (VR) reconstructions. Finally, all imaging data were ensured to be available in a digital format suitable for storage and transmission, facilitating efficient image sharing and further analysis.

Conclusion:

The present study aimed to evaluate variations in pulmonary artery diameter between smokers and non-smokers using multidetector computed tomography (MDCT). It further assessed and compared mean pulmonary artery diameters across these groups with respect to gender. The findings highlight the potential value of routine screening in smokers, particularly those at high risk for pulmonary disease. Additionally, this study provides preliminary reference values that may assist clinicians in medical assessment and monitoring. CECT demonstrated high sensitivity in identifying pulmonary vascular abnormalities and offers advantages in differentiating active from inactive disease processes. Overall, the study supports CECT as a reliable and robust modality for evaluating pulmonary artery related pathologies. It also underscores the role of CECT in the early detection of pulmonary abnormalities in patients with persistent pulmonary symptoms. Characteristic imaging features such as bronchial dilatation, vascular involvement, and parenchymal changes may help distinguish between active inflammatory processes and chronic or irreversible conditions. For instance, ground-glass opacities are suggestive of active and potentially reversible disease, whereas septal thickening and established vascular changes are more indicative of irreversible pathology. Finally, the study emphasizes the need for larger-scale investigations to establish standardized normative values and strengthen the clinical applicability of pulmonary artery diameter measurements as an imaging biomarker.

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