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# The Pulmonary Artery Diameter Variation among Smokers and Non-Smokers.

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***Abstract: -*** Purpose: The primary goal of this study is to determine if a noticeable disparity in pulmonary artery diameter exists between individuals who smoke and those who do not. To accomplish this, we will conduct a thorough examination utilizing advanced imaging techniques

Method: This was an observational prospective study of 31 patients aged 18 to 65 years, who complained of chest pain and were assessed by an CT scan.

Result: In this study, 31 patients were included, of which 24 were males and 7 were females. Mean main pulmonary artery in nonsmokers were 23.68 and in smokers were 26.84. Mean main pulmonary artery were found statistically higher in smokers as the P- value <0.005. Mean right pulmonary artery was found statistically higher in smokers as the P< 0.021. Mean left pulmonary arteries were found higher in smokers but the difference in groups were not statistically significant as the P-value is 0.052.

Conclusion: The present study focused in assessing the diameter of pulmonary artery among smokers and non-smokers using MDCT. Also, the mean of Pulmonary artery diameter among smokers and non-smokers was evaluated and compared with respect to gender. CECT findings can help in the assessment of disease activity and reversibility: e.g. the presence of ground glass opacities indicates active and potentially reversible disease whereas the presence of septal thickening and pulmonary artery disorder indicates irreversible disease.

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

## 1. Introduction

In contemporary society, the prevalence of smoking remains a pressing global health concern, with significant ramifications for cardiovascular health. The intricate interplay between smoking and cardiovascular diseases has been a subject of extensive research, and one key facet of this relationship is the impact of smoking on the pulmonary vasculature. The pulmonary artery, a vital component of the circulatory system, plays a pivotal role in transporting deoxygenated blood from the heart to the lungs for oxygenation. Consequently, alterations in the diameter of the pulmonary artery can serve as a crucial indicator of vascular health.

This study delves into the nuanced realm of pulmonary artery diameter variation among smokers and non-smokers, seeking to unravel the intricate associations between smoking habits and pulmonary vascular morphology. The rationale for investigating this specific aspect lies in the potential implications for early detection of cardiovascular abnormalities and the development of targeted interventions to mitigate the adverse effects of smoking on pulmonary circulation.

Smoking, a major modifiable risk factor for cardiovascular diseases, has been unequivocally linked to the progression of atherosclerosis, endothelial dysfunction, and systemic inflammation. While the detrimental effects of smoking on large vessels such as the coronary arteries are well-documented, the impact on the pulmonary vasculature is still a subject of ongoing exploration. The pulmonary arteries, branching from the right ventricle of the heart, exhibit unique physiological characteristics, and alterations in their diameter may serve as early indicators of vascular dysfunction in response to chronic exposure to cigarette smoke.

The overarching objective of this research is to ascertain whether there exists a discernible difference in pulmonary artery diameter between smokers and non-smokers. To achieve this, a comprehensive examination will be conducted using state-of-the-art imaging

## 2. Methods

### Study area

The study was carried out at the Teerthanker Mahaveer Hospital. It is an approximately 750 bedded tertiary medical facility located in Moradabad, U.P.

### Study designs and search strategy:

A Prospective observational study was carried out in the Department of Radio diagnosis, between September 2019 to jan 2020 Teerthanker Mahaveer Hospital TMU, Moradabad U.P. Clinical and Pathological data were retrieved from the CT Console room.

### Patient Selection:

The source of data for this study are 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 case file which was used to confirm information from other data sources. 31 patients match are inclusion criteria 24 males and 7 female patients. examined ranged in age from 18 to 65.

***Inclusion Criteria***

All the patients with clinically suspected Pulmonary Artery Diameter diseases.

***Exclusion Criteria***

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. All post-operative cases as illustrated in Fig 1.

### Imaging protocols:

All patients are screened before entry into the CT scanner room for metallic objects of the interest of part. Patients were examined in the supine position on the patient table, proper positioning, and proper interaction for breath holding, and immobilization of the chest was obtained. Set the CECT protocol, initial topogram of the chest has obtained and planned according to the lungs field, CECT protocol at 128 slice includes the entire chest from apex to diaphragm, set the protocol (KVp, mA, slice thickness, Inter slice gap etc.), protocol also include axial plain with 3-5mm slice thickness, there by reconstruction, post processing and reformatting images into multiple planes

### Data Analysis

The statistical analysis was carried out using version 20 of SPSS. The mean (SD) for quantitative variable was calculated while the frequencies and percentages for qualitative variable were calculated. Shapiro Wilk test was used to determine normality of the quantitative variable and also normal Q-Q plot was used to visualize the structure of data. Two independent t-tests were used to compare the Pulmonary. Artery among gender & smoking status. Statistical significance was considered as less than 5%.

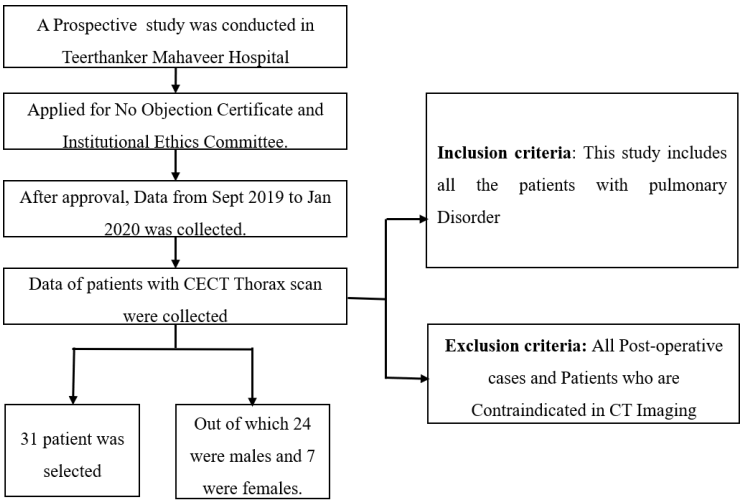



**Fig 1: Study of flow chart**

## 3. Results

The 31 participants who had acute or chronic chest pain at the time of the presentation age ranged from 18 to 65 years. 24 patients (77.4 %) were males and 7 patients (22.6 %) were females the proportion of male was higher than female represented in Table 1.

**Table 1:** Demonstration of Patient according to gender

| | Frequency | Percent |
|---|---|---|
| **Female** | 7 | 22.6 |
| **Male** | 24 | 77.4 |
| **Total** | 31 | 100.0 |

**Fig 1: Showing the distribution of smoking status, 17 (54.8%) were smoker and 14 (45.2%) were nonsmoker.**

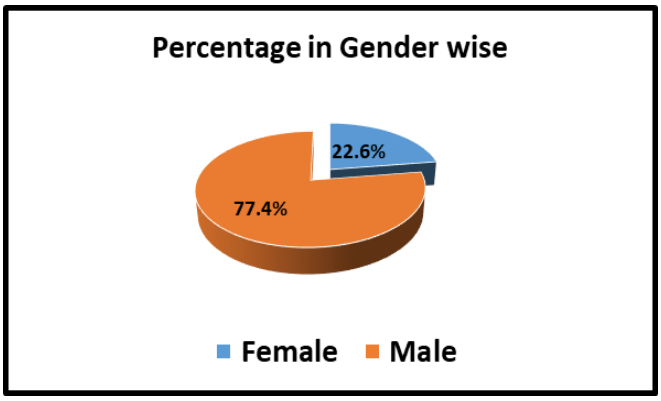
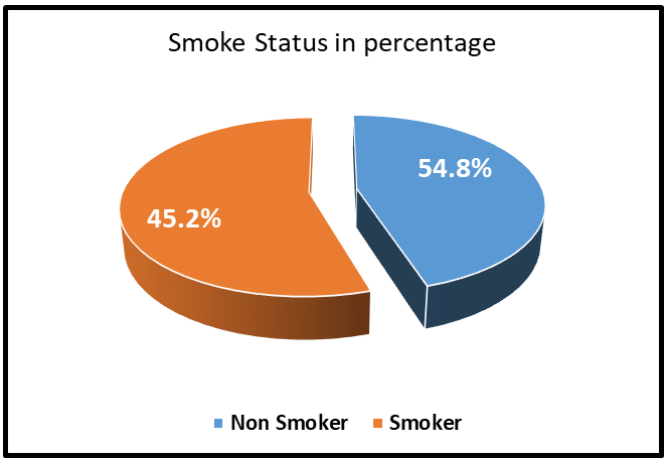



**Table 2: Shows the Smoking Status of Smoker and Non-Smoker**

| | Frequency | Percent |
|---|---|---|
| Non-Smoker | 14 | 45.2 |
| Smoker | 17 | 54.8 |
| Total | 31 | 100.0 |

**Fig 2: Showing the distribution of smoking status in Percentage of smoke and nonsmoker.**

**Table 3: Descriptive Statistics of Quantitative Variable**




| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| **Variable Name** | **N** | **Range** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Age | 31 | 59 | 17 | 76 | 52.23 | 15.68 |
| Main Pulmonary Artery | 31 | 12.90 | 20.10 | 33.00 | 25.41 | 3.26 |
| Right Pulmonary Artery | 31 | 16.20 | 10.90 | 27.10 | 18.37 | 3.78 |
| Left Pulmonary Artery | 31 | 14.00 | 11.60 | 25.60 | 18.33 | 3.40 |

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

**Table 4: Descriptive Statistics of Male and Female**

| Descriptive Statistics for Female | | | | | | |
|---|---|---|---|---|---|---|
| **Variable Name** | **N** | **Range** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Age | 7 | 38 | 18 | 56 | 39.14 | 12.14 |
| Main Pulmonary Artery | 7 | 6.20 | 22.30 | 28.50 | 24.41 | 1.96 |
| Right Pulmonary Artery | 7 | 5.30 | 12.40 | 17.70 | 15.77 | 1.84 |
| Left Pulmonary Artery | 7 | 8.60 | 14.00 | 22.60 | 17.96 | 2.62 |
| **Descriptive Statistics for Male** | | | | | | |

| Variable Name | N | Range | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| Age | 24 | 59 | 17 | 76 | 56.04 | 14.65 |
| Main Pulmonary Artery | 24 | 12.90 | 20.10 | 33.00 | 25.70 | 3.53 |
| Right Pulmonary Artery | 24 | 16.20 | 10.90 | 27.10 | 19.13 | 3.89 |
| Left Pulmonary Artery | 24 | 14.00 | 11.60 | 25.60 | 18.44 | 3.64 |

The above tables are showing descriptive statistics according to gender, mean age of female were 39.14±12.14 whereas mean age of male was 56.04±14.65. Mean age of males were found higher than females show in table 4. Mean main pulmonary artery of females were 24.41±1.96 whereas in males were 25.70±3.53. Mean main pulmonary arteries were found approximately equal in both groups. Mean right pulmonary artery of females were 15.77±1.84 whereas in males were 19.13±3.89. Mean right pulmonary arteries were found higher in males. Mean left pulmonary artery of females were 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**

| Descriptive Statistics for Non-Smoker | | | | | | |
|---|---|---|---|---|---|---|
| **Variable Name** | **N** | **Range** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Age | 14 | 51 | 17 | 68 | 46.21 | 17.69 |
| Main Pulmonary Artery | 14 | 9.70 | 20.10 | 29.80 | 23.68 | 2.33 |
| Right Pulmonary Artery | 14 | 10.50 | 12.40 | 22.90 | 16.67 | 3.02 |
| Left Pulmonary Artery | 14 | 11.70 | 11.60 | 23.30 | 17.04 | 3.19 |
| **Descriptive Statistics for Smoker** | | | | | | |
| | **N** | **Range** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Age | 17 | 46 | 30 | 76 | 57.18 | 12.20 |
| Main Pulmonary Artery | 17 | 12 | 21.00 | 33 | 26.84 | 3.28 |
| Right Pulmonary Artery | 17 | 16.20 | 10.90 | 27.10 | 19.76 | 3.84 |
| Left Pulmonary Artery | 17 | 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 were 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 were 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 |

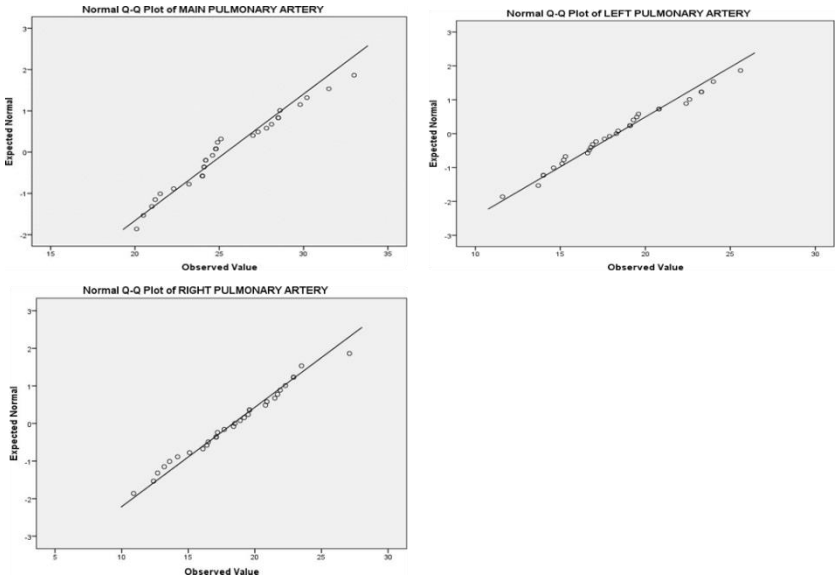



**Fig 3: Shows the normality of data.**

We found 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) greater than level of significance 0.05. Hence, we used parametric t-test to compare two independent groups as shown in table 6 and fig 3.

**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 |

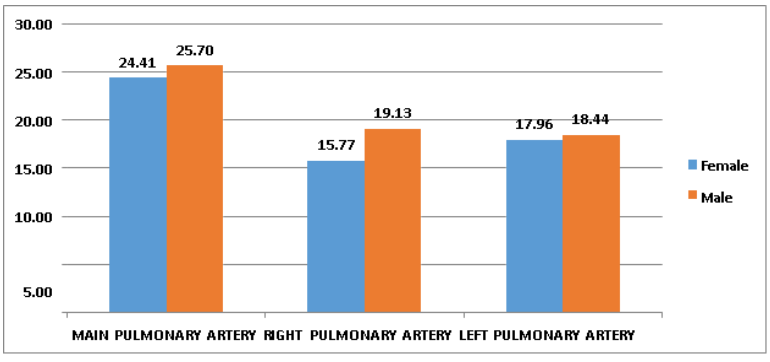



**Fig 4: Showing the comparison of Pulmonary Artery according to gender**

The comparison of pulmonary artery according to gender, mean main pulmonary artery in females were 24.41 and in males were 25.70. Mean major pulmonary artery was found to be marginally higher in male differential

between the sex was not statistically important as the meaning-value is higher than meaning point i.e. 0.368 as shown in table 7.

Mean right pulmonary artery in females were 15.77 and in males were 19.13. Mean right pulmonary artery were found statistically higher in males as the P-value is less than the level of significance i.e. 0.037. Mean left pulmonary artery were in females were 17.96 and in males were 18.44. 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 as shown in fig 4.

**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 |

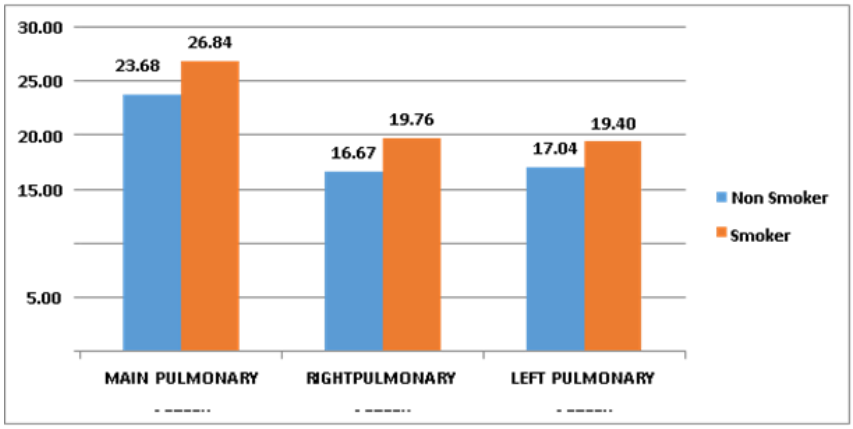



**Fig 5: Shows the comparison between smokers and nonsmokers of pulmonary artery.**

The above table and graphs are showing the comparison between smokers and nonsmokers of pulmonary artery as shown in fig 5.

Mean main pulmonary artery in nonsmokers were 23.68 and in smokers were 26.84. Mean main pulmonary artery were found statistically higher in smokers as the P- value <0.005. Mean right pulmonary artery in nonsmokers were 16.67 and in smokers were 19.76. Mean right pulmonary artery was found statistically higher in smokers as the P< 0.021. Mean left pulmonary artery in nonsmokers were 17.04 and in smokers were 19.40. Mean left pulmonary arteries were found higher in smokers but the difference in groups were not statistically significant as the P-value is 0.052 as shown in table 8.

## 4. Discussion

Pulmonary artery diseases can be difficult to a specific cause, both clinically and radio graphically. Pulmonary artery diseases in the setting of a normal-appearing radiography and a nonspecific history and clinical findings can be a difficult dilemma. The precise diagnosis of Pulmonary artery diseases can be elusive, since the signs and symptoms are frequently similar for the different diagnosis and conventional roentgenograms are non-specific for the diagnosis purpose.

The present cross sectional observational study was conducted at Department of Radio diagnosis, Imaging, Teerthanker Mahaveer Hospital, TMU, Moradabad UP. In this study, 31 patients were recruited and the majority of the patients (77. 4%) were males followed by the

females (22.8%). There was female predominance, the difference being nil in one and eight decades, being minimal third decade and seventh decade and equal predisposition under 20 years of age. Furthermore, the patients were categorised into a group of smokers and non-smokers. It was observed that 54.8% of the patients were smokers followed by the non-smokers (45.2%). A similar study was conducted by LH Sang et al. [1] in which 2547 individuals were examined consisting of 1543 males followed by 1023 female cases. Out of these individuals, a group of 813 cases (187 males and 626 females) were observed as a group of individuals with no smoking history. Another retrospective analysis was conducted by JL Tobias [2] which recruited a total of 78 cases consisting of 51 female cases and 27 male cases. Similar studies was conducted by several investigators which included both female as well as male cases [3,4,5]. Moreover, the study conducted by D Steiger et al., it consisted of 1949 cases out of which there were a majority of female cases (n= 978) followed by male cases (n=971). 52.7% of the total cases were smokers followed by 42.7% cases of non-smokers.

Moreover, in 1964 according to the first Surgeon General's report, it is reported that on the respiratory system, adverse effects have been caused due to cigarette smoking, causally linked to multiple diseases [6]. The risk of death from pneumonia is increased because of smoking and in addition to lung cancer and COPD, it causes bronchitis [7].

This study included patients across all age groups with pulmonary diseases. The youngest patient was male 17 years old and male 76 years oldest. The highest number of patients was found in fourth (17.5 percent), five decades (37.5 percent) and six decades (20.0 percent). The mean age of the patients in our sample was 52.23±15.68. The mean age of female cases was 39.14 ± 12.4 whereas the mean age of male cases was 56.04 ±14.65. In relevant to our study, HL Sang recruited the patients with mean age of 53.1 + 9.3 Similarly, the mean age of patients was observed to be 56.14 ± 14.1 according to the investigations done by LJ Tobias [3].

The etiological spectrum varies in the different age groups.However, in our study the overall mean of Main Pulmonary Artery, Right Pulmonary Artery and Left Pulmonary Artery was 25.41 ± 3.26, 18.37 ±3.78 and 18.33 ± 3.40 respectively. According to a study conducted by HL Sang et.al. observed to be 26.6 ± 3.4. The variation was observed to be slightly higher as compared with our study. Moreover, the mean of main pulmonary artery in female and male cases was 26.0±3.4 and 27.0±3.4 respectively [1] whereas in the present study the mean of main pulmonary artery in female and male cases was observed to be 24.41 ± 1.96 and 25.70 ± 3.53 respectively. However, for the healthy group of individuals with no smoking history, the findings by LH Sang et, al showed that the mean of main pulmonary artery was 25.9 ± 3.2 (for n=813).

The findings by D Steiger et al. revealed that for all the cases (n=1949) the mean was 26.6 ± 3.9 whereas for the male and female cases the mean of main pulmonary artery was found to be 27.2 ± 3.9 and 26.0 ± 3.9 respectively [4].However, the findings by LJ Tobias [3] showed that the mean of Left Pulmonary Artery and Right Pulmonary artery was 2.24±0.38 and 2.35±0.47 respectively whereas as per the present study the mean was 25.41 ± 3.26, 18.37 ± 3.78 and 18.33 ± 3.40 respectively. Recently, on unenhanced CT in 3,171 individuals was reported to be 2.51 ± 0.28 cm [8].

In case of non-smokers, the findings of the present study revealed that the mean of main pulmonary artery was 23.68 ± 2.33 whereas in case of smokers the mean main pulmonary artery was observed to be 25.70 ± 3.53. According to the findings by LH Sang et al., the mean of main pulmonary artery for non-smokers and smokers was 26.6 ± 3.4 and 26.9 ± 3.4 respectively.

Moreover, the present findings also showed the normality of the main pulmonary artery, left as well as right pulmonary artery. It was observed that it was normally distributed. Although, no such studies have been revealed yet. Further studies might help for better accuracy. Our study in children under 10 year of age no case of CECT was seen. Under 20 years of age three cases of CECT were seen. Under 40 years four cases and under 60 years only seventeen cases were seen. Above 60 years of age 11 cases were seen, and the maximum cases under 60 years and under 70 years of CECT were seen. Under 80 years of age no case of CECT were seen.

**Etiological profile with CECT protocol**

We studied the CECT of all the 31 cases. An attempt was made to arrive at the CECT protocol on basis of age, clinical history and examination and the radiographic findings. The parameters evaluated on CECT were collimation, exposer parameters (KVp, mAs etc.), slice thickness, scan mode, scan type, field of view, image reconstruction, patient position, and window setting. Filter or kernel, Reconstruction algorithm, Detector configuration for multi-detector systems, increment or Image reconstruction interval, ACE (longitudinal) Radiation dose report and Reformatted images (curvilinear, minimal IP, MIP and multiplanar (MPR)) and image plane (sagittal, coronal and axial) and 3-D surface or volume-rendered (VR), The image data should be available for a method for digitally transmitting.

## 5. Conclusion:

The present study was an attempt to measure the variation of Pulmonary Artery diameter among smokers and non-smokers. Moreover, the present study focused in assessing the diameter of pulmonary artery among smokers and non-smokers using MDCT. Also, the mean of Pulmonary artery diameter among smokers and non-smokers was evaluated and compared with respect to gender. This study suggests that regular checkups should be performed in case of smokers, especially in individuals with high risk of pulmonary disease. The present study also provides the reference values with clinical clues which might be helpful for the medical supervision.

However, as it can differentiate active from inactive pulmonary artery diameter diseases with greater sensitivity. This study concludes that CECT is a powerful and reliable investigation in the diagnosis of pulmonary artery diameter diseases. Our learning illustrates CECT in early recognition of pulmonary abnormalities on the CECT of patients with persistent pulmonary artery disorder. Changes suggestive of pulmonary artery disorder namely bronchial dilatation, frequently resolve spontaneously, artery involvement as alternative and differentiation active inflammatory process from pulmonary artery disorder. CECT findings can help in the assessment of disease activity and reversibility: e.g. the presence of ground glass opacities

indicates active and potentially reversible disease whereas the presence of septal thickening and pulmonary artery disorder indicates irreversible disease. This research also indicated that further analysis with greater groups of individuals is needed in order to obtain normative evidence in this defining imaging metric.

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