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**INTERNATIONAL JOURNAL OF  
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/7817  
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/7817>



### RESEARCH ARTICLE

#### VARIOUS PATTERNS OF PULMONARY VEINS OPENING IN THE LEFT ATRIUM OF HEART: A CLINICAL INSIGHT.

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#### Manuscript Info

##### Manuscript History

Received: 6 August 2018

Final Accepted: 8 September 2018

Published: October 2018

##### Keywords:

Pulmonary Vein, Left Atrium,.

#### Abstract

Pulmonary veins carry oxygenated blood from lungs to the left atrium of heart. The four pulmonary veins open into the superior posterolateral surfaces of the left atrium, two on each side. This typical arrangement is present in 20–60% of the population. The present study was conducted on thirty hearts taken from embalmed male cadavers which were kept for dissection purpose in Government Medical College Jammu. 11(36.66%) hearts showed variations in the pattern of pulmonary veins opening into left atrium out of total hearts studied. The variations in both right and left pulmonary veins were observed in ten hearts (33.33%). Variations in right pulmonary vein were seen in 10(33.33%) whereas left sided pulmonary veins it was in 11(36.6%) hearts. Variations in the pulmonary veins can be explained on the embryological basis, as these veins develop as a common outgrowth from dorsal atrial wall. As the atria grows, these pulmonary veins get incorporated into the wall of atrium. Thus four separate openings are seen; two on each side of left atrium. Thoracic surgeons should be aware of these variations and meticulous intraoperative confirmation of pulmonary vein anatomy is required while using endoscopic devices.

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#### Introduction:-

Pulmonary veins carry oxygenated blood from lungs to the left atrium of heart. The four pulmonary veins open into the superior posterolateral surfaces of the left atrium, two on each side. This typical arrangement is present in 20–60% of the population. A common variation includes the presence of a short or long left common venous trunk and multiple pulmonary veins on the right. The right pulmonary veins travel posterior to their respective venae cavae. Their orifices are smooth and oval, the left pair frequently opening via a common channel (Gray H, 2000)

The knowledge about this variation is useful while performing surgeries on left atrium. These variations gain significance in isolation for radiofrequency ablation as a treatment for atrial fibrillation, interventional radiologists and thoracic surgeons before performing procedures which directly or indirectly involve pulmonary veins (Archana goel, et al, 2017). Preprocedural imaging of left atrium and pulmonary veins can offer safety during interventional procedures (Z. Asli et al, 2014). Earlier, it was considered that the variations in the number and course of pulmonary veins were rare and they were confined only to few case reports (Alfke H et al, 1995). Recently, however, it has been found that variations in pulmonary venous anatomy were seen in 36% of patients (Marom EM et al, 2004). It was also observed that it is one of the aetiologies for ectopic heart beats (Tsao HM et al, 2001). The major sources

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of these ectopic beats appear to be the myocardial sleeves of the distal pulmonary veins which are simple extensions of the left atrial myocardium over the outer surface of pulmonary veins (Tsao HM et al 2000 and Woznaik-Skowerska I et al, 2011). This is the reason why they became a target of interventional cardiology procedures such as catheter radiofrequency pulmonary vein isolation (Chen SA et al, 2000 and Gill JS 2004). Knowledge of number of pulmonary veins and their ostia locations is important to ensure that all ostia are ablated, as ectopic foci may go untreated in variant veins. The knowledge of pulmonary vein anomaly could also play a role in new balloon based ablation technology research and development (Kour et al, 2017).

### **Aims and Objectives**

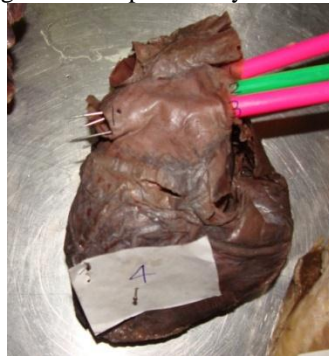
The purpose of this study was to evaluate the occurrence of anatomical anomalies of right and left pulmonary veins opening into left atrium on the cadavers and applying this knowledge by cardiothoracic surgeons, who should be aware of these variations while performing intraoperative surgeries and when using endoscopic devices.

### **Material and Methods:-**

The present study was conducted on thirty hearts taken from embalmed male cadavers which were kept for dissection purpose in Government Medical College Jammu. The hearts having severe anatomical defects, hearts on which surgery had been done were not included. The hearts with grafts, heart trauma and were also not included. The number of the pulmonary veins on right side as well as on left side were observed from external aspect and noted down. Percentage of variations found on right and left side was calculated. Percentage of most common variation on both the sides was also calculated.

### **Results and Observations:-**

**Figure 1:-**The variations in both right and left pulmonary veins were observed in 10(33.33%) hearts.



11(36.66%) hearts showed variations in the pattern of pulmonary veins opening into left atrium out of total 30 hearts studied.. Variations in right was seen in 10(33.33%) and in left pulmonary veins variations were seen in 11(36.6%) hearts.

On right side single pattern of pulmonary veins was seen in 6 (20%) hearts, double pattern observed in 20(66.6%) hearts and triple pattern was seen in 4(13.3%) hearts(Figure:2).

Figure :2



On left side single pattern of pulmonary vein in 11 (36.6%) hearts ( Figure: 1) whereas double pattern was seen in 19(63.6%) hearts and none showed triple venous pattern.

The normal pattern of two pulmonary veins was reported in 66.6% on right side and 63.3% on left sided hearts. Most common variation on both sides was single venous pattern of 20% on right side and 36.4% on left side.

**Figure 3:-**Pattern with single pulmonary vein on both right and left side was seen in 4 (13.3%) out of total 30 hearts.



**Table 1:-**Number of hearts showing variations in the pulmonary veins and their percentage

No. of pulmonary veins	RIGHT			LEFT		
	1	2	3	1	2	3
No. of hearts	6	20	4	11	19	0
Percentage	20%	66.6%	13.3%	36.6%	63.3%	0%

**Discussion:-**

Thoracic surgeons should be aware of the variations and meticulous intraoperative confirmation of pulmonary vein anatomy which is required while using endoscopic devices. The variations in pulmonary venous anatomy were reported in 36% of patients (Mangrum JM et al, 2002). Taso et al stated that ectopic beats could arise from these anomalies. It was observed that this is greater than expected variability in pulmonary venous anatomy could alter the success of procedures like radiofrequency ablation of arrhythmias / fibrillation, as ectopic foci may go untreated in variant veins (Marom EM et al, 2004).

Parsana et al reported variable pulmonary venous pattern as 28% and 6% on right and left sided pulmonary veins. It was noted that present study was not comparable with earlier studies as these were 33.3% variations in the right side and 36.6% on left side.

There are very few studies on the cadaveric hearts for pulmonary venous pattern. Ho et al reported a single ostium for pulmonary veins in six out of 26 hearts in cadaveric study. Similarly in a cadaveric study conducted by Parsana et al there were 14% specimens with single pulmonary vein on right side and 6% specimens had single pulmonary vein. A case of one pulmonary vein on left side and three pulmonary veins was reported by Shamoun et al. In our study 20% hearts with single pulmonary vein on right side and 36.6% on left side were observed which does not concide with the previous studies.

Marrom et al and Ho et al observed double venous pattern as most common pattern which is consistent with our study. Ho et al demonstrated 69% out of 35 hearts as double venous pattern of pulmonary veins opening on each side of left atrium.

The present study showed triple pulmonary venous pattern in 4 (13.3%) out of 30 hearts. Wannasopha et al (2012) stated that the presence of middle pulmonary vein has been found to produce increased frequency of cardiac arrhythmias; atrial fibrillation being the most common. This arrhythmia is a cause of significant morbidity and mortality, with the highest risk being sudden cardiac death through heart failure (Taso et al).

The anomalous veins can give rise to thrombo-emboli and embolic stroke because of the ectopic beats arising from these veins. Furthermore, atrial fibrillation has been shown to result in atrial remodeling by impacting atrial size (Calkins H et al).

### **Conclusion:-**

Precise knowledge about the variation in number and drainage pattern of pul vns is important for cardiothoracic surgeons and for certain procedures involving radiofrequency ablation, lobectomies, valve replacements, pul vein cathetrization and others.

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