



Pulmonary Vein Variation in Routine Dissection: A Cadaver Study

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Abstract: The heart, functionally consists of four cavities; right atrium, right ventricle, left atrium and left ventricle. The blood vessels associated with the systemic and pulmonary circulation open into these heart cavities or take the blood out from the heart through these cavities. The oxygen-poor venous blood that comes to the lungs returns to the left atrium of the heart with four pulmonary veins which located two on the rightside and two on the leftside, after being oxygenated. During the routine dissection studies performed in the anatomy practice laboratory, it was observed that there were five pulmonary vein opening into the left atrium of the heart in the male cadaver. It was observed that two of these vessels opened to the left atrium from the right side and three of them opened to the left atrium from the left side. The course and localizations of other anatomical structures of the heart and anatomical structures adjacent to the heart were normal. In this rare case, the importance of the anatomy of the region in terms of clinical evaluations and surgical approaches was emphasized. As in our study, we believe that knowing such anatomical variations is important especially for interventional operations in the thorax region.

Keywords: Pulmonary Vein, Anatomy, Variation, Heart Morphology

1. Introduction

Heart, is located in the middle mediastinum of the thorax cavity, in a sac called pericardium [1].

It is a cone-shaped organ with its base above and its apex below. The heart, which is 2/3 to the left and 1/3 to the right of the midline, is located between the level of 5-9 thoracic vertebrae [1].

It weighs 230-280 gr in females and 280-340 gr in males and has an average volume of 500-700 cc. The distance between the apex and the base of the heart is approximately 12 cm, the transverse axis is 9 cm, and the anterior-posterior length is 6 cm. In the cross section of the heart, there are four cavities: right atrium, left atrium, right ventricle and left ventricle. Functionally, the right atrium and ventricle are called the right heart, the left atrium and ventricle are called the left heart. Systemic (large) and pulmonary (small) circulatory vessels open into these cardiac chambers or take

blood out of the heart from these spaces [2].

Aorta, the main vein of the circulatory system, starts from the left ventricle and distributes oxygen-rich blood throughout the body. The superior vena cava, which is formed by the union of the right and left brachiocephalic veins, collects the venous blood of the upper half of the body and empties it into the right atrium. The inferior vena cava, formed by the union of the common iliac veins of the both sides, carries the venous blood of most of the structures under the diaphragma to the heart. Pulmonary trunk, which carries venous blood from the right ventricle to the lungs, carries venous blood despite being an artery. The blood coming to the lungs is enriched with oxygen and returns to the left atrium of the heart with pulmonary veins. In addition to these vessels, there is also coronary sinus, which drains the venous blood of the heart into the right atrium [3, 4].

2. Case Presentation



Figure 1. The posterior aspect of the heart. AA: Arch of Aorta, RCCA: Right Common Carotid Artery, LCCA: Left Common Carotid Artery, RSA: Right Subclavian Artery, LSA: Left Subclavian Artery, BT: Brachiocephalic Trunk, LBV: Left Brachiocephalic Vein, RBV: Right Brachiocephalic Vein, SVC: Superior Vena Cava, AV: Azygos Vein, LPA: Left Pulmonary Artery, RPA: Right Pulmonary Artery, LSPV: Left Superior Pulmonary Vein, LMPV: Left Middle Pulmonary Vein, LIPV: Left Inferior Pulmonary Vein, LA: Left Atrium, RSPV: Right Superior Pulmonary Vein, RIPV: Right Inferior Pulmonary Vein, LV: Left Ventricle, Pericardium.

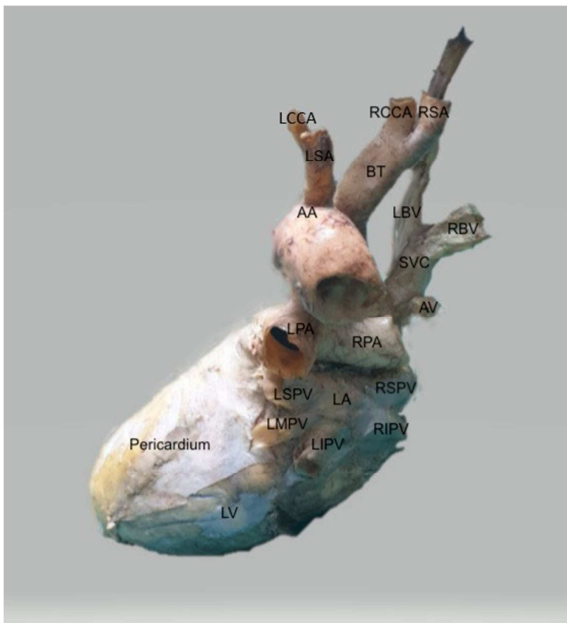


Figure 2. The lateral-posterior aspect of the heart. AA: Arch of Aorta, RCCA: Right Common Carotid Artery, LCCA: Left Common Carotid Artery, RSA: Right Subclavian Artery, LSA: Left Subclavian Artery, BT: Brachiocephalic Trunk, LBV: Left Brachiocephalic Vein, RBV: Right Brachiocephalic Vein, SVC: Superior Vena Cava, AV: Azygos Vein, LPA: Left Pulmonary Artery, RPA: Right Pulmonary Artery, LSPV: Left Superior Pulmonary Vein, LMPV: Left Middle Pulmonary Vein, LIPV: Left Inferior Pulmonary Vein, LA: Left Atrium, RSPV: Right Superior Pulmonary Vein, RIPV: Right Inferior Pulmonary Vein, LV: Left Ventricle, Pericardium.

The thoracic region dissection of the male cadaver, that fixed with the classical formaldehyde method was performed in the Dissection Laboratory of the Department of Anatomy, Faculty of Medicine, Adıyaman University. Variation in the left pulmonary veins (PVs) was found during routine dissection. In the case, there were three PVs on the left side (Figure 1, Figure 2). During our routine dissection study, the thoracic region was opened first. Afterwards, anatomical structures of the heart were carefully dissected. When PVs were examined, it was seen that there were two PVs on the right side and three on the left side. No variation was detected in the dissection of other anatomical structures of the heart.

3. Discussion

The heart, is a hollow organ made of muscle. The cone-shaped heart is located between the anterior-lower parts of the two lungs and on the diaphragm. It is the main organ of the circulatory system [1].

Cardiovascular system disorders are one of the most common diseases in the clinic due to the high risk of death [5]. It is important to know the normal structure and location of the heart during surgical procedures.

Numerous congenital anomalies caused by changes in heart anatomy have been mentioned in the literature. Hoffman et al. noted that ventricular septal defect was the most common one of these heart abnormalities [6]. Schultz et al. reported that Ebstein anomaly which caused by tricuspid valve variation accounted for approximately 1% of congenital heart diseases [7]. Matakas et al. in their studies, they stated that the risk of left-sided stroke was higher in patients with Bovine aortic arch than those with normal aortic arch [8].

During routine dissection, the heart was found to be of normal structure and size in the mediastinum medius [1]. The placement of the heart has been reported in the literature and our case report is consistent with these data.

84% of the amount of blood in adult individuals is found in systemic circulation. 64% of the blood in the systemic circulation is in the veins, 13% is in the arteries, while 7% is in the capillaries and arterioles. 16% of the amount of blood in the body is found in the heart and lungs. 9% of the blood in the heart and PVs is in the PVs, while 7% is in the heart. 5% of the blood pumped by the heart feeds the heart by passing into the coronary arteries [9].

Variations of these vessels opening to or feeding the heart have been mentioned quite frequently in the literature [10, 11]. Altin et al. in their study, which examined coronary artery variations, they noted that in 11% of cases they saw a middle artery in addition to the right and left coronary arteries. In the same study, they reported that there was no left coronary artery in 0.9% of the cases [11]. Wróbel et al., in their prepared case presentation, they identified double posterior interventricular artery separated from the right coronary artery in two cases [10].

Polaczek et al., studied the variations of PVs in their work with computed tomography angiography images and according to their observation, they divided the variations

into three categories: In the first category, they examined atypical placement of PVs, atypical flow to the left atrium in the second category, and atypical venous vascularization in the bronchopulmonary segment of the lung in the third category. Accordingly; the retrobronchial heading of the vein in the posterior segment of the right upper lobe was observed at 8.15%. The most frequently variation, however, was a direct PV separating from the middle lobe of the lung in 25.19% of cases, while in 11.11% of cases a distribution of PV separating from a common long body was observed [12]. When Akiba et al., examined computed tomography images of a patient with right lung cancer, they found a middle lobe PV that has an opening to the right atrium [13]. According to Altinkaynak et al.'s cohort study, typical anatomy of PV's was observed 43.5% of patients. The remaining had anatomic variations on the sides. They stated that the most common variation was left common PV (32.2%) [14]. Marom et al.'s studied the variations of PVs and their results showed that while most of the patients had an typical anatomic pattern (71%), about 14% of the patients had a single ostium at the atrium wall. They also indicated that, patients with a separate ostium for the right middle lobe PV are more prone to atrial arrhythmia [15].

4. Conclusions

In literature surveys, there have been no studies of any variation with three PVs found in cadaver examinations. Especially it should be considered that these variations in PVs can affect hemodynamics and cause changes in blood flow to the left atrium and can lead to a clinical picture leading up to atrial fibrillation. Knowing such differences will be important in cases that require surgical treatment of the thorax as well as cardiovascular disorders. Knowing the normal structure from a clinical point of view, as well as knowing the variations that may be encountered, will provide a convenience during the planning and implementation of surgical procedures.

References

- [1] Standring S. Gray's Anatomy International Edition: The Anatomical Basis of Clinical Practice: Elsevier Health Sciences; 2015.
- [2] Bogart, Bruce Ian, and Victoria Ort. *Elsevier's Integrated Anatomy and Embryology E-Book*. Elsevier Health Sciences, 2007.
- [3] Wineski, Lawrence E. *Snell's clinical anatomy by regions*. Lippincott Williams & Wilkins, 2018.
- [4] Moore, Keith L., and Arthur F. Dalley. *Clinically oriented anatomy*. Wolters kluwer india Pvt Ltd, 2018.
- [5] Organization WH. World health statistics 2018: monitoring health for the SDGs, sustainable development goals. 2018.
- [6] Hoffman JI, Kaplan S. The incidence of congenital heart disease. *J Am Coll Cardiol* 2002; 39 (12): 1890-900. 2002/06/27. doi: 10.1016/s0735-1097(02)01886-7.
- [7] Schultz K, Haeffele C. Heart failure in the adult Ebstein patient. *Heart Failure Reviews* 2020; 25. doi: 10.1007/s10741-020-09930-2.
- [8] Matakas JD, Gold MM, Sterman J, Haramati LB, Allen MT, Labovitz D, et al. Bovine Arch and Stroke Laterality. *Journal of the American Heart Association*; 0 (0): e015390. doi: 10.1161/JAHA.119.015390.
- [9] Guyton A, Jhon HE. Text book of medical physiology. WB Saunders Company, A Division of H Brace Comp 1996: 629-42.
- [10] Wróbel G, Spalek M, Kuder T. Double Posterior Descending Artery Arising from a Right Coronary Artery A Post-Mortem Examination of Two Cases. *International Heart Journal* 2019; 60 (5): 1226-9. doi: 10.1536/ihj.19-018.
- [11] Altin C, Kanyilmaz S, Koc S, Gursay YC, Bal U, Aydinalp A, et al. Coronary anatomy, anatomic variations and anomalies: a retrospective coronary angiography study. *Singapore Med J* 2015; 56 (6): 339-45. 2014/12/17. doi: 10.11622/smedj.2014193.
- [12] Polaczek M, Szaro P, Jakubowska L, Zych J, Religioni J, Orłowski TM. Pulmonary veins variations with potential impact in thoracic surgery: a computed-tomography-based atlas. *J Thorac Dis* 2020; 12 (3): 383-93. 2020/04/11. doi: 10.21037/jtd.2020.01.34.
- [13] Akiba T, Tabei I, Kinoshita S, Yanagisawa S, Kobayashi S, Odaka M, et al. Three-dimensional computed tomography for lung cancer in a patient with three right vein ostia. *Gen Thorac Cardiovasc Surg* 2011; 59 (5): 376-9. 2011/05/07. doi: 10.1007/s11748-010-0675-y.
- [14] Altinkaynak, D., Kokter, A. Evaluation of pulmonary venous variations in a large cohort. *Wien Klin Wochenschr* 131, 475-484 (2019). <https://doi.org/10.1007/s00508-019-1517-21>
- [15] Marom EM, Herndon JE, Kim YH, McAdams HP. Variations in Pulmonary Venous Drainage to the Left Atrium: Implications for Radiofrequency Ablation. *Radiology*. 2004; 230 (3): 824-9.