

VARIATIONS OF THE THEBESIAN AND EUSTACHIAN VALVES

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Summary

The study was performed in order to determine possible variations and frequency of the valves of inferior vena cava and coronary sinus.

Rezumat

Studiul a fost efectuat cu scopul de a determina variantele posibile și frecvența ale valvei venei cave inferioare și ale sinusului coronar.

News Theme

The valve of the coronary sinus is clinically important, it is a commonly cannulated structure in patients undergoing electrophysiology studies, and, more recently, percutaneous mitral valve repair.

Aim

To improve our understanding of structure of the heart, we studied the valves that guard ostia of its tributaries. The aim of this study was to describe morphological variability of Thebesian and Eustachian valves visualized directly

Materials and methods

The valves of the coronary sinus and of the inferior vena cava were studied in 47 hearts from dissection room cadavers. In 47 randomly selected autopsied human hearts, we prepared for examination with macroscopical techniques. Images of the coronary sinus ostia were obtained using a digital camera.

Discussions and results

The valve of the inferior vena cava (eustachian valve) lies at the junction of the inferior vena cava and right atrium. In fetal life, the Eustachian valve helps to direct the flow of oxygen-rich blood through the right atrium into the left atrium via the foramen ovale (preventing blood flowing into the right ventricle). Before birth, oxygen rich blood returning from the placenta mixes with blood from the hepatic veins in the inferior vena cava. Streaming this blood across the atrial septum via the foramen ovale increases the oxygen content of blood in the left atrium. This in turn increases the oxygen concentration of blood in the left ventricle, the aorta, the coronary circulation and the circulation of the developing brain. Following birth and separation from the placenta, the oxygen content in the inferior vena cava falls. With the onset of breathing, the left atrium receives oxygen-rich blood from the lungs via the pulmonary veins. As blood flow to the lungs increases, the amount of blood flow entering the left atrium increases. When the pressure in the left atrium exceeds the pressure in the right atrium, the foramen ovale begins to close and limits the blood flow between the left and right atrium. While the Eustachian valve persists in adult life, it is essentially vestigial.

The eustachian valve is the valve at the distal end of the inferior vena cava, which passes blood from the lower extremities into the Right Atrium of the heart. Eustachian Valve (EV), also called *valvulae venae cavae inferioris*, was described for the first time by the Italian anatomist: Bartolomeo Eustachi (born between 1500 and 1513, died 1574).

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mixes with blood from the hepatic veins in the inferior vena cava. Streaming this blood across the atrial septum via the foramen ovale increases the oxygen content of blood in the left atrium. This in turn increases the oxygen concentration of blood in the left ventricle, the aorta, the coronary circulation and the circulation of the developing brain.

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A persisting eustachian valve in the absence of other structural heart diseases is believed to have no pathological importance / McMohan CJ, Pignatelli RH, Rutledge JM, et al. (2000) /.

There is a large variability in size, shape, thickness, and texture of the persistent eustachian valve, and in the extent to which it



Fig.1. Photograph showing the Eustachian valve. 1- ostium of the superior vena cava; 2- ostium of the coronary sinus; 3- ostium of the inferior vena cava; 4- Eustachian valve.

encroaches on neighboring structures such as the atrial septum. At one end of the spectrum, the embryonic eustachian valve disappears completely or is represented only by a thin ridge. Most commonly, it is a crescentic fold of endocardium arising from the anterior rim of the inferior vena cava (IVC) orifice. The lateral horn of the crescent tends to meet the lower end of the crista terminalis, while the medial horn joins the thebesian valve, a semicircular valvular fold at the orifice of the coronary sinus. At the other extreme, it persists as a mobile, elongated structure projecting several centimeters into the right atrial cavity. In this case, it may demonstrate an undulating motion in real time echocardiography; and when it is quite large, it may be confused with right

atrial tumors, thrombi, or vegetations. Occasionally, the eustachian valve crosses the floor of the right atrium from the orifice of the IVC and inserts into the lower portion of the interatrial septum adjacent to the atrioventricular valves.

The large eustachian valves have been reported to increase right-to-left shunting in patients with atrial septal defects by directing inferior vena caval flow through the defect into the left atrium. This abnormality may cause cyanosis during early infancy and should be corrected surgically.

The eustachian valve may be prominent in some individuals. Occasionally, this valve is large enough to produce obstruction to flow entering from the IVC. The IVC may be dilated, which suggests that the eustachian valve may be impeding blood flow from the IVC to the right atrium. One prior study



Fig. 2. Persisting Eustachian valve of 46-year-old-male.

reported a rate of approximately 60% (in a group of 120 consecutive necropsies) of a persisting eustachian valve in adults / Yater WM, 1929/.

At the site where the coronary sinus joins the right atrium, a valve known as the Thebesian valve controls blood flow into the heart and prevents blood from backing up the coronary sinus. The valve of Thebesius is also sometimes known as the valve of the coronary sinus, and takes the form of a small fold of tissue which allows blood to go one way, but not the other. The heart relies on a series of such one way valves to keep pressure constant and prevent backflow within the circulatory system. Thebesian valve is a semicircular fold of the lining membrane of the atrium, at the **coronary sinus ostium (CSO)**. It prevents the regurgitation of blood into the sinus during the contraction of the atrium. A Thebesian valve was seen in 54% of these. Almost all Thebesian valves were positioned at the inferior (61 %) or posterior (33%) aspect of the CSO. Only 1,5% of hearts had Thebesian valves that covered more than 70% of the CSO.

Thebesian valve varied from a flap that covered up to 70% of the ostium of the coronary sinus, to a few small strands of tissue. In 3 cases no valve was present. In most cases (35 out of 50), the valve covered <50% of the ostium of the coronary sinus, so it is unlikely to play an important role in preventing reflux into the coronary sinus. Microscopically, the valve was found to contain layers of myocardium, most of which disappeared in the less well formed valves, but some myocardium was persistent even in the most rudimentary valves studied.

A wide range of coronary sinus morphologies was observed including remnant Thebesian valves covering approximately 50% of the coronary sinus ostium and a large fenestrated Thebesian valve covering greater than 50% of the coronary sinus ostium.

The valve may vary in size, or be completely absent. This valve may be double or it may be cribriform. Figure 3 shows still images of the coronary sinus ostia of 2 human hearts. The

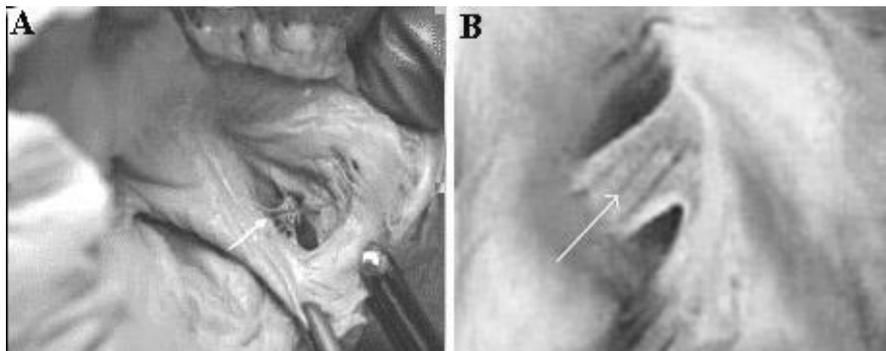


Fig. 3. Variants of the Thebesian valve. A- cribriform; B- bundle-shaped.

Thebesian valve image may be although large enough to cover the entire coronary sinus ostium, never actually completely covers the ostium. The orifice of the coronary sinus and its valve, the Thebesian valve occupy the most posteroinferior corner of the right atrium. A commissure is formed between the Thebesian valve and Eustachian valve

of the inferior vena cava, which extends as a fibrous strand known as the tendon of Todaro to insert into the central fibrous body.

Conclusions

1. Persistence of the Eustachian valve in adult life is a vestigial structure.
2. The valve of the coronary sinus (Thebesius) may be semilunar in shape (51%), cribriform (0,049%) or septal-shaped (0,07%) or it may be absent (0,37%) in one study of adults (0,72%), teenagers (0,22%), pre-teens (0,021%), and newborn (0,035%) hearts.
3. Thebesian valve is present in the majority of hearts (>70%).
4. A significant minority (16%) had a valve morphology (covering >75% of the ostium, a fibrous, fibromuscular, or muscular composition, and devoid of fenestrations) that makes them a 'potentially complicating' structure interfering with the cannulation of the CS.

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VARIATIONS IN MORPHOLOGY OF THE VEINS IN THE HUMAN HEART

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Summary

The study based on injection method was carried out on human hearts to identify several variants of the cardiac venous bed including the large-caliber and small-caliber veins. The variants of the atrial veins, ventricular veins, of the coronary sinus and peculiarities of blood supply of the heart were described.

Rezumat

A fost efectuat un studiu pe baza metodei de injectare prin care am depistat variabilitatea patului venos cardiac ce se referă atât la venele de calibru mare cât și la cele mici. Sunt descrise venele atriilor, ventricolelor, sinusul coronar și particularitățile vascularizației cordului.

News Theme

New methods of cardiological examination and treatment, such as catheterization of the coronary sinus, venous reperfusion and cardioplegia have made necessary an exact account of the distribution pattern and the mode of opening of the cardiac veins.

Aim

To study diversity of the venous bed of the heart.

Materials and methods

The variants of the veins of the heart were studied in 47 hearts from dissection room cadavers. Images of the coronary sinus ostia were obtained using a digital camera. 47 randomly selected autopsied human hearts were prepared for examination with macroscopical techniques. An injection study was carried out in human hearts to compare the anatomy and distribution of the main cardiac veins and Thebesian veins (venae cordis minimae). A colored jelatin was injected