Original research article

Study of Gross Anatomy and Metrical Analysis of Coronary Sinus in Human Heart

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Abstract

Background: The gross anatomy and metrical analysis was carried out in 60 human hearts taken from the cadavers (irrespective of sex and age). The morphological features of coronary sinus were investigated along with study of its metrical analysis. The formation, course, variation in its tributaries and termination to the right atrium were investigated and recorded.

Material and Methods: This is morphological study was conducted by utilizing 60 human cadaveric hearts available in the Department of Anatomy, at PMCH Patna. Study duration of Two and half years.

Conclusion: The study of Coronary sinus utilizing 60 human hearts (irrespective of age and sex) preserved in formalin showed variations in its formation. The orifice of the Coronary sinus in the right atrium appeared mostly oval in shape and is guarded by semi lunar shaped valve in 59 of specimens and semicircular in one specimen.

Keywords: metrical analysis, Coronary Sinus, vasa vasorum.

Introduction

The coronary sinus (Latin- Sinus coronaries) is a dilated venous channel that drains the blood from most of the part of the heart. It lies in the posterior coronary sulcus and opens into the right atrium. The sinus name is derived because of its short length and width. The coronary sinus is known since the antiquity. The earlier anatomists such as Eristratos (280 BC) and Galeno (129 AD) for centuries have considered it as a vein that returns the blood to the heart. It receives usually 5 major tributaries and opens into the right atrium between tricuspid orifice and opening of inferior vena cava[1]. Coronary sinus is a wide venous channel measuring about 2 or 3cm long and lies in posterior coronary sulcus (atrioventricular groove) between the base of the heart and ventricles. It begins usually near the left end of the posterior coronary sulcus by the union of great cardiac vein with either left marginal vein or veins from the left ventricle and runs towards the right to end in the right atrium. The opening is guarded by a valve (Thebasian valve) which is a remnant of right venous valve of sinus venosus. The normal named tributaries are great cardiac vein, left marginal vein, veins from left ventricle, oblique vein of left atrium, middle cardiac vein, and small cardiac vein. It is sometimes concealed partly by fibers of myocardium in the posterior coronary sulcus and is deep to epicardium.[2, 3]. The anterior cardiac veins drain the anterior part of the right ventricle. Usually two or three, sometimes even five in number(Baroldi and Scomazzoni - 1967)[4] , they ascends in subepicardial tissue to cross the right part of theanterioratrioventricular sulcus, passing deep or superficial to the right coronary artery. They end in the anterior wall of right atrium, near the sulcus, separately or in variable combinations. A subendocardial collecting

channel, into which all may open, has been described(James, 1961)[5] . The right marginal vein courses along the inferior(‘acute’) cardiac margin, draining adjacent parts of the right ventricle, and usually opens separately into the right atrium but may join the anterior cardiac veins or, less often, the coronary sinus. Because it is commonly independent it is often grouped with the venae cordisminimae but, since it is larger in caliber, it iscomparable with the anterior cardiac veins or even wider. It is perhaps better considered one of the latter, which also sometimes drain with it into the coronary sinus. Mechanik(1934)6 described all cardiac veins as draining into the coronary sinus in the early fetal period[1], [2]. The existence of Venae cordisminimae, opening into all cardiac cavities, has been confirmed by many subsequent authors to their first recording by Thebasius(1708)[6] ; they are more difficult to demonstrate than larger cardiac vessels. Their numbers and size are highly variable. Aho(1950)[7] demonstrated ‘minimal’ veins of up to 2mm in diameter opening into the right atrium and about 0.5mm into the right ventricle. The coronary sinus has become a clinically important structure through its role in providing access for different cardiac procedures. Historically, cardiac vascular studies have focused mainly on the circulation of coronary artery. The coronary venous system has become important in many electrophysiological procedures, viz. biventricular pacing, arrhythmia ablation and for deployment of an array of cardiac devices.[8].

Objectives

1. To study the formation, course, variations and termination of coronary sinus in the posterior coronary sulcus.
2. To measure the length of coronary sinus and width of the coronary sinus at three different locations- -At its beginning, (Union of GCV with immediate named tributaries) -At its terminations and -At the point of entry of middle cardiac vein into the coronary sinus.

Material and Methods

This is morphological study was conducted by utilizing 60 human cadaveric hearts available in the Department of Anatomy, at Patna Medical College and Hospital Patna. Study duration of Two and half years. Dissection method –Right atrium was opened as per Cunningham’s manual second volume(15th edition) to study the opening of CS, then the coloring agents was injected through the orifice of CS in the RAto make the tributaries of coronary sinus clearly visible and then tributaries were cleanedand photographed. · By using Digital Vernier caliper(Fig.1), the length, and width of the coronary sinus were measured at the site of its formation (GCV joins with the immediate named tributary) , at its middle(where the MCV joins the CS), and near its termination into the RA(fig.2). · The variations in the tributaries were recorded and photographed. · The orifice of CS was measured by using DigitalVernier caliper and the shape of valve of CS was noted and photographed. · Sixty human cadaveric hearts preserved in formalin, irrespective of age and sex were used in the present study.

Figure 1: Digital Vernier Caliper

Figure 2: Measuring the length of CS with the help of Digital Vernier Caliper.

Inclusion Criteria:
Formalin preserved human cadaveric hearts from the department of Anatomy, PMCH, Patna

Exclusion Criteria:
Priorly dissected/damaged/crushed heart specimens.
Hearts with developmental anomalies and with pathological changes.

Results
The formation of CS was observed taking GCV joining with the first named tributaries of CS such as LMV, PVLV, OVLA and MCV in the present study. In 44 specimens studied the GCV joined the LMV, at the left end of posterior coronary sulcus(73.4%).In all the specimen studied the GCV was terminating only in the CS.

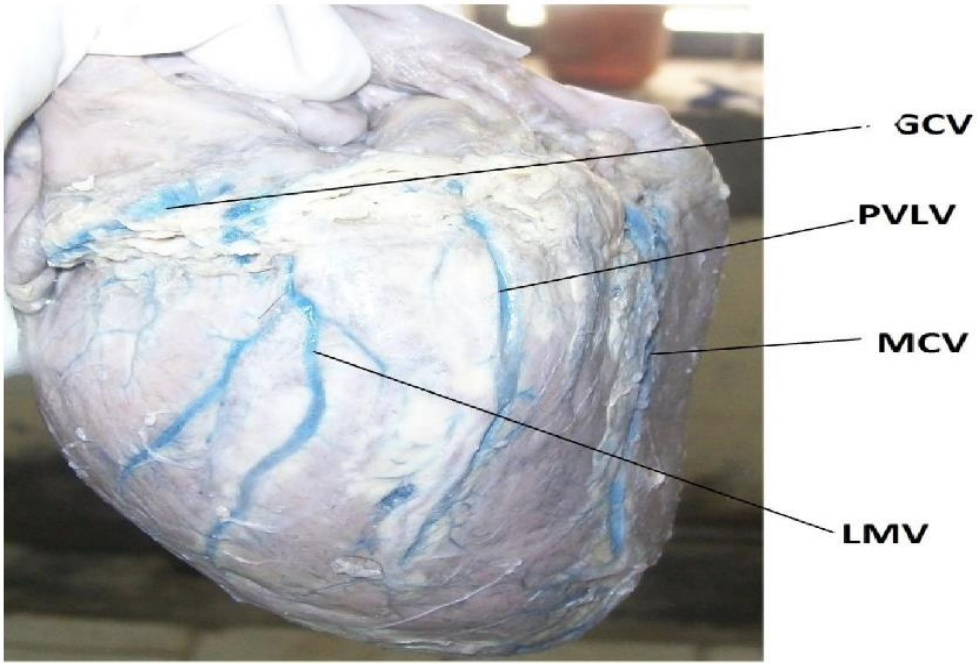

Figure 3: Formation of CS-GCV WITH LMVIn 15 specimens examined the GCV joins with the PVLV . to form the CS near the left end of posterior coronary sulcus (25%). The LMV was absent in the remaining 16 specimen. In the remaining 44 specimen the PVLV terminated directly in the GCV.

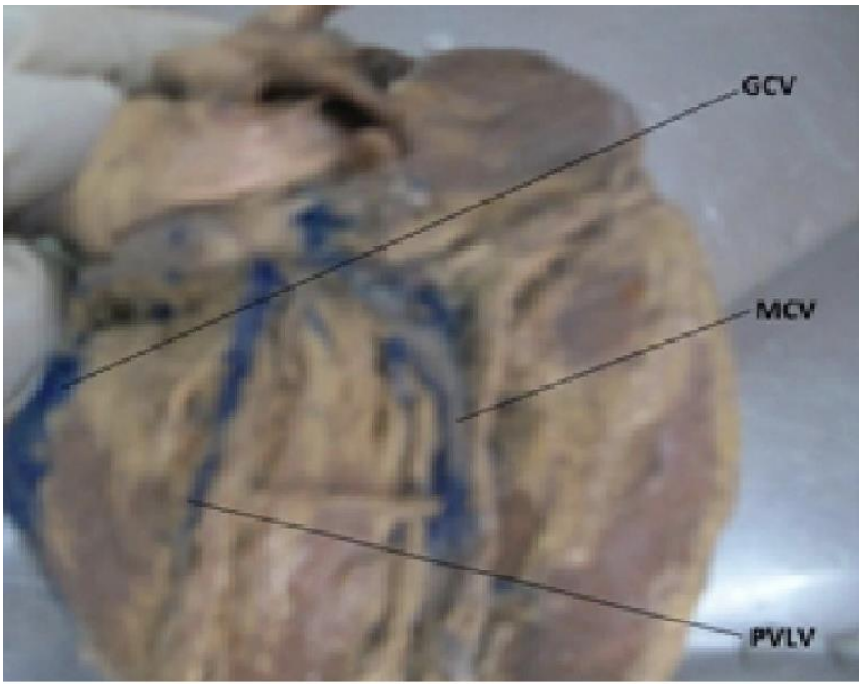

Fig 4. Formation of CS-GCV WITH PVLV

In the lone specimen no 19 the GCV joins with the OVLA, to form the CS near the crux of the heart(1.6%)

The MCV was large and terminated in the CS. In this specimen except few small veins are present that joins the GCV from the left ventricular wall. LMV, PVLV were not observed in this specimen.

Table 1: Formation of Coronary sinus in a sample of 60 specimens

S.NO		PRESENT	ABSENT
(1)	GCV WITH LMV	44	16
(2)	GCV WITH PVLV	15	-
(3)	GCV WITH OVLA	1	-
(4)	OTHERS	0	-

Table 2: Length of Coronary sinus in a sample of 60 specimens(average lengthin mm)

S.No	Formation of CS	Length of CS (mm)
(1)	GCV WITH LMV (44 Specimen)	57.61 ± 13.2 SD
(2)	GCV WITH PVLV (15 Specimen)	56.8±10.5 SD
(3)	GCV WITH OVLA (1 Specimen)	20
(4)	OTHERS	0

Table 3: Valve of coronary sinus in a sample of 60 specimens

	Present	Absent
Valve of CS	47 (78.4%)	13 (21.6%)

Discussion

The CS is described as formed by OVLA joining with GCV by most of the authors[3,9]. According to some authors the GCV itself continues as CS at the left end of posterior coronary sulcus[9]. These authors did not consider the LMV and PVLV as tributaries of coronary sinus, therefore ambiguity arises regarding the formation of CS. In the present study we have noted the formation of CS under the following types:-

Type-I. When the GCV joins with the LMV to form CS.

Type-II. When the GCV joins with the PVLV to form CS

Type-III. When the GCV joins with the OVLA to form CS

Type-IV. When GCV does not end in the CS and ends directly into the RA or into the anterior cardiac vein[10]. In the present study we have seen the first three types of formation of CS. In majority of cases examined by us are of type-I (73.4%). Venous variations of the heart have recently been summarized by Loukas et al.[11]. Seven cases were reported in which the great cardiac vein (GCV) did not drain into the coronary sinus: two GCVs followed an aberrant course anterior to the arterial conus and the root of the pulmonary trunk and joined the anterior cardiac veins five passed posterior to the great arteries to drain into either the right atrium [45]or to the superior vena cava[15,16,17],[12]. These authors felt that the rarity of these variations and the potential problems may cause during clinical interventions. In the present study the GCV formed a tributary to the CS after joining with LMV, PVLV and OVLA. According to majority of the authors the Coronary sinus begins in the left part of atrioventricular groove where it receives the GCV and then passes downwards and to the right along the posterior part of atrioventricular groove accompanied by anastomosis of right and left coronary arteries. Finally the sinus ends in the sinus venarum of right atrium between the opening of the inferior venacava and right atrioventricular orifice [2,3,13].

In all the specimen studied the GCV drains into the CS as one of its tributaries without

directly opening into the RA. The opening of CS is guarded by a valve in 78.4% specimens. The shape of the valve is semilunar in 59 specimens and in one specimen it is semicircular. we observed a band like structure connecting the valve to the margin of the orifice . The mean diameter of the orifice of the coronary sinus was 9.6 mm, with the standard deviation 2.2 mm. The anatomical variations of the coronary sinus orifice were considered to be important for the purpose of catheterization, mixing of coronary venous blood, and from the point of benefit during the Beck operation (aorta-coronary sinus anastomosis)[14]. The available literature mentions coronary sinus as a wide venous channel and describes the width of the coronary sinus at the terminationasmeasuring9.6mm[14]. In the present study the coronary ostium measured 9.35 mm ± SD 3.54 mm and it is in conformity with available literature. The other measurements of width of Coronary sinus explained in the present study are not available in the literature for comparison.

Conclusion

The study of Coronary sinus utilizing 60 human hearts (irrespective of age and sex) preserved in formalin showed variations in its formation. The orifice of the Coronary sinus in the right atrium appeared mostly oval in shape and is guarded by semi lunar shaped valve in 59 of specimens and semicircular in one specimen.

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