



Morphological study of coronary sinus and coronary Sinus ostium in human cadaveric hearts

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ABSTRACT

Background: The coronary sinus collects majority of venous blood from the heart & return it to the right atrium of the heart. Few studies were reported on coronary venous system till now. The present study is planned to study the formation, tributaries, length & shape of coronary sinus, and shape, length and breadth of coronary sinus ostium (Thebesian valve).

Materials and Methods: Thirty eight formalin fixed cadaveric hearts were used for the study. The formation, tributaries, length and shape of coronary sinus (CS) was noted. The length of CS in millimetres was measured from the union of great cardiac vein and left marginal vein up to the opening of the coronary sinus in the right atrium with vernier calliper. The shape of the coronary sinus ostium was noted & the measurements (length and breadth) of it were taken in millimetres with vernier calliper.

Results: In 89.47% (34) specimens the coronary sinus was formed by the union of great cardiac vein and left marginal vein. The left marginal vein was absent in 4 specimens and small cardiac vein was absent in 2 specimen. The mean length of coronary sinus was 53.80 ± 10.2 millimetre (mm). The mean width of coronary sinus ostium was 11.89 mm. The shape of coronary sinus was cylindrical. The Thebesian valve was semilunar in shape in 37 specimens and remnant in 1 specimen.

Conclusion: Coronary sinus was formed by great cardiac vein with left marginal vein in 89.47% specimens. Shape of CSO was semilunar in 37 specimens and remnant in 1. Average length of CSO was 9.11 mm and width was 11.89 mm. Knowledge of the morphology of CS and CSO is helpful while doing electrophysiological procedures.

KEYWORDS : Cardiac veins, Coronary sinus, Coronary sinus ostium, Thebesian valve

Introduction:

The majority of cardiac veins drain into the wide coronary sinus (CS). It is 2 or 3 cm long and lies in the posterior part of the atrio-ventricular groove. It opens into the right atrium between the opening of IVC and the right atrio-ventricular orifice. The opening is guarded by an endo-cardial fold- semilunar valve of coronary sinus. The tributaries of it are great, small and middle cardiac veins, posterior vein of left ventricle and oblique vein of left atrium.^[1] According to R. Manoranjitham et al, there are anatomic variations of the orifice of the human coronary sinus. It has practical significance since the advent of catheterization of the coronary sinus.^[2] The difficulties encountered in the catheterization of coronary sinus are probably due to obstruction offered by large membranes, bars and networks.^[3] Hence, the present study is planned to study formation, tributaries, length & shape of coronary sinus, and shape, length and breadth of coronary sinus ostium (CSO) (Thebesian valve).

Materials and methods

This study was conducted on 38 formalin fixed human cadaveric hearts available in the department of Anatomy, Government Medical College and Hospital, Akola, Maharashtra, India. The length of CS was measured with vernier calliper from the point where the great cardiac vein and left marginal vein opened into the CS in the left posterior atrio-ventricular groove up to the opening of it in right atrium in millimetres. All the tributaries of CS were traced by dissection. The veins forming the CS were noted. Any variations in the formation and tributaries of CS were noted. The right atrium was opened by dissection to study the opening of the CS. The width of the CS orifice in right atrium was measured using Vernier Calliper in millimetres. The presence and shape of TV were noted. The CSO was examined for the presence of any ridges, networks or membranes. All the parameters were tabulated, and mean with standard deviation (SD) and percentage were calculated.

Observations & results

A. Coronary Sinus (CS)

1) Formation of CS: In 34 specimens (89.47%) the CS was formed by the union of great cardiac vein with left marginal vein. In 3 specimen (7.89%) it was formed by the union of great cardiac vein and posterior vein of left ventricle and in 1 specimen (2.63%), it was formed by union of great cardiac vein and oblique vein of left atrium (Table 1).

Table 1: Formation of Coronary Sinus (CS)

Sr. no.	Veins forming CS	Veins forming CS (n)	Percentage (%)
1	Great cardiac vein with left marginal vein	34	89.47%
2	Great cardiac vein with posterior vein of left ventricle	3	7.89%
3	Great cardiac vein with oblique vein of left atrium	1	2.63%

2) Tributaries of coronary sinus: Great cardiac vein & Middle Cardiac Vein were present in 38 hearts. Posterior vein of left ventricle & oblique vein of left atrium were present in 37 hearts, absent in 1 heart. Small cardiac vein was present in 36 hearts, absent in 2 hearts & left marginal vein was present in 34 hearts, absent in 4 hearts (Table 2).

Table 2: Tributaries of coronary sinus

Sr. no.	Tributaries of coronary sinus	Present (n)	Absent (n)
1	Great Cardiac Vein	38	0
2	Left Marginal Vein	34	4
3	Posterior Vein of Left Ventricle	37	1
4	Oblique Vein of Left Atrium	37	1

5	Middle Cardiac Vein	38	0
6	Small Cardiac Vein	36	2

3) Length of CS in mm: Length of CS formed by Great cardiac vein with left marginal vein was 53.8 ± 10.2 mm, length of CS formed by Great cardiac vein with posterior vein of left ventricle was 51.06mm & length of CS formed by Great cardiac vein with oblique vein of left atrium was 31.50 mm (Table 3).

Table 3: Length of CS in millimetres

Sr. no.	Formation of CS	Length of CS in millimetres Mean ± standard deviation
1	Great cardiac vein with left marginal vein	53.80 ± 10.2mm
2	Great cardiac vein with posterior vein of left ventricle	51.06mm (3)
3	Great cardiac vein with oblique vein of left atrium	31.50mm

4) Shape of CS was cylindrical in all specimens.

B. Coronary sinus ostium (CSO)

1) Shape of CSO & its valve: The shape of CSO was oval in all specimens. Coronary sinus ostium (Thebesian valve) was semilunar in shape in 37 specimens & it was remnant in 1 specimen (Table 4).

Table 4: Shape of Coronary sinus ostium (CSO) & its valve

Sr. No	Coronary sinus ostium (CSO)	No. Of specimen
1	Shape of CSO –oval	38
2	Valve of CSO(thebesian valve) –semilunar	37
3	Valve of CSO(thebesian valve) –remnant	1

2) Length & width of CSO in mm : In the present study, the average length of CSO was 9.11 mm & the average width of it was 11.89 mm.

Figure 1: Heart specimen showing coronary sinus



Fig. 1. showing Coronary Sinus

Figure 2: Heart specimen showing Remnant & semilunar Thebesian valve

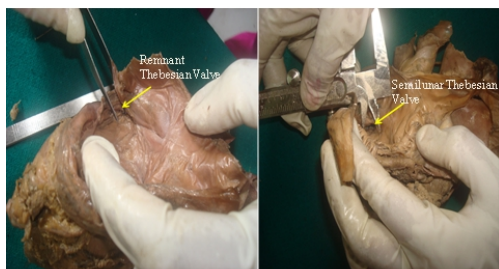


Fig. 2. showing Remnant & Semilunar Thebesian Valve

Discussion

A) Coronary Sinus (CS)

1) Formation of CS: According to R. Manoranjitham et al^[2] and Ortale JR et al^[4], CS is formed by oblique vein of left atrium joining with great cardiac vein. However, according to Iyer PB,^[5] the great cardiac

vein itself continues as coronary sinus at the left end of the posterior coronary sulcus. These authors did not consider the left marginal vein and posterior vein of left ventricle as tributaries of CS, therefore the ambiguity arises regarding the formation of CS. In the present study, we have noted the formation of coronary sinus under the following types: Type I- when the great cardiac vein joins with left marginal vein to form coronary sinus (present in 89.47% of our specimens) Type II- when the great cardiac vein joins with posterior vein of left ventricle to form the coronary sinus (present in 7.89% of our specimens) Type III- when the great cardiac vein joins with oblique vein of left atrium to form coronary sinus (present in 2.63% of our specimens). (Table 1) Other variety Type IV- when the great cardiac vein does not end in the CS and ends directly into right atrium or into anterior cardiac vein^[5,6], however this was not found in our study.

2) Tributaries of CS: The great cardiac vein and middle cardiac vein are the 2 most consistently present tributaries of CS.^[7] The great cardiac vein has been reported to vary considerably in its course.^[8,9] Studies by Mao et al. confirmed 100% presence of CS, great cardiac vein, middle cardiac vein, the posterior vein of left ventricle & also found left marginal vein in 81% of patients studied.^[10] It is mostly thought that implantation of electrode is most convenient along the margin of the heart, therefore big interest is put on the left marginal vein.^[11] In the present study, left marginal vein was absent in 4 specimens and posterior vein of left ventricle & oblique vein of left atrium were absent in 1 specimen, small cardiac vein was absent in 2 specimen.

3) Length of CS: In the study by Kavimani and Jebakani CF^[3], the length of CS ranged from 20 to 38 mm and the mean was 28 mm. In the present study, the mean length of CS in 34 specimens was 53.80 ± 10.2 mm where the CS was formed by the union of great cardiac vein and left marginal vein. In the specimen in which CS was formed by the union of great cardiac vein and posterior vein of left ventricle, the length was 51.06 mm in another specimen in which CS was formed by the union of great cardiac vein and oblique vein of left atrium – the length was 31.50mm.

According to Kavimani and Jebakani CF^[3], the most frequent shape of CS is cylindrical and we also found cylindrical shape in all specimens.

B) Coronary Sinus Ostium (CSO)

1) Shape of CSO & Thebesian valve (TV) - According to Hellerstein HK and Orbison JL,^[12] the orifice of CS appeared mostly oval in shape and was guarded by the Thebesian valve. Mainly 6 types of variations in the valve of coronary sinus reported by them were absent, small and crescent most common, large and covering the entire orifice of coronary sinus, bars and bands, threads and networks, common eustachian and TV. According to Mateusz k. Holda et al.^[13] semilunar Thebesian valve was most common. The biggest obstacles to communication between the right atrium and the CS is the valve, first described by Adam christian thebesius in 1708 in his monograph, De circulosanguinis in corde. In the present study, the thebesian valve was semilunar in shape in 37 specimens & it was remnant in 1specimen.

2) Length of CSO: According to Kavimani and Jebakani CF^[3] the average length & width of CSO was 9 mm & 13 mm respectively. In the present study the average length of CSO was 9.11mm.

3) Width of CSO: The width of CS at the termination, measuring 9.6 mm according to Cleland JG.^[14] In the study of R. Manoranjitham et al^[2] the coronary ostium measured 9.35 ± 3.24 mm and it is in conformity with available literature. In the present study the average width of CSO was 11.89mm.

Many studies have focused mainly on coronary arteries. With the advent of many invasive and interventional cardiac procedures for the management of cardiac ailments like heart failure, arrhythmias,

the understanding of coronary sinus anatomy is important.^[14,15] The coronary venous system is important in many electrophysiological procedures including arrhythmia ablation, biventricular pacing and for deployment of an array of cardiac devices like pacemakers.^[16,17,18]

According to Kavimani and Jebakani CF,^[3] CS has now begun to attract more attention because of the development of latest interventional techniques like cardiac catheterization, selective catheterization of cardiac veins.

Conclusion:

In 89.47% specimens, coronary sinus (CS) was formed by great cardiac vein with left marginal vein. Great cardiac vein was present in all specimens and left marginal vein was absent in 4 specimens. Shape of CS was cylindrical in all specimens. Length of CS was 53.80 ± 10.2 mm when it was formed by great cardiac vein with left marginal vein. Shape of CSO was semilunar in 37 specimens and remnant in 1. Average length of CSO was 9.11 mm and width was 11.89 mm. Knowledge of the morphology of CS and CSO is helpful while doing electrophysiological procedures.

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