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Original article

Gross anatomical variations in the veins draining into the coronary sinus – a case study

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ABSTRACT:

BACKGROUND AND OBJECTIVES: Most of the veins draining the heart commonly accompany the coronary arteries and its branches lying parallel to it in the interventricular and coronary sulci. This venous system is gaining importance nowadays, as they provide an alternate way to bypass coronary artery stenosis. It also helps in delivering the stem cells to the infarcted myocardium. The coronary venous system has more variations than the coronary arterial system. Hence this present study aims to evaluate the variations present in the Veins draining into the Coronary Sinus (CS).

MATERIALS & METHODS: The present study was conducted in randomly selected 100 human cadaveric hearts from the Department of Anatomy and autopsied bodies of Department of Forensic Medicine, Thanjavur Medical College. The presence or absence of the veins draining into CS, their number and its draining pattern were noted.

RESULTS: The Great Cardiac Vein (GCV) was present in all specimens. The Middle Cardiac Vein (MCV) was present in all specimens and it drained directly into the CS in 83% and in 16% it formed a common trunk with Small Cardiac Vein (SCV) and drained into CS and in 1%, the MCV drained directly into the right atrium. The SCV was present in 97% of the specimens and was absent in 3%. In one specimen, there were two SCV which drained into MCV which was unusual. The SCV drained directly into the CS in 61%, formed a common trunk with MCV and drained into CS in 16% and in 23% of specimens, SCV drained into MCV. The posterior vein of left ventricle was present in all the specimens and it was one in number in 58% , two in number in 30% and three in number in 12% of specimens. The posterior vein of left ventricle drained into the CS in 96% of specimens, into GCV in 1% of specimen, when the veins were more than one in number, it drained both into CS and GCV in 3% of specimens. The marginal vein of left ventricle was present in all the specimens and it was one in number in 97% and two in number in 3% and it drained into GCV in 86% and into CS in 14% of specimens

CONCLUSION: This study showed that there are variations in the presence or absence of the tributaries of CS, variations in their number and its draining pattern which may be helpful in retrograde drug administration for ischaemic myocardium, easy accessibility to perform percutaneous epicardial mapping and pacing of ventricles and for the ablation of arrhythmogenic foci in the subepicardial region. Of the veins draining into the CS, the SCV has the greatest course and opening variability.

KEY WORDS: Coronary Sinus, Coronary sulcus, Interventricular sulci, Cardiac Veins

INTRODUCTION:

The cardiac veins mostly accompany the arteries and tend to lie superficial to it [(1).] Nearly 75% of arterial blood flow of heart is drained by CS and its tributaries and the remaining is drained via non-Coronary Sinus route (the anterior cardiac veins) 15% or through Thebesian system 10%. Widespread anastomoses occurs at all levels of cardiac venous circulation resulting in the formation of venous plexus. This communication not only exists between the tributaries of CS, but also between its tributaries and anterior cardiac veins [(2)]

GCV, the main tributary of CS lies in the anterior interventricular sulcus and in the coronary sulcus in the left side of heart along with the anterior interventricular branch and the circumflex branch of Left Coronary Artery (LCA) respectively. The CS begins at the confluence of the GCV and the Oblique vein of Marshall in the left end of the posterior aspect of the coronary sulcus guarded by Vieussen's valve, which can obstruct catheter and lead placement. CS is a short and wide venous channel of about 2.5cms in length, running downwards and to the right of coronary sulcus opening into the right atrium through the CS ostium guarded frequently by the Thebesian valve.[(3,6,7,8)] Middle Cardiac Vein (MCV) lies in the posterior interventricular sulcus accompanying the posterior interventricular branch of RCA and drains into the right end of CS or rarely it opens directly into the right atrium. The SCV usually lies in the posterior atrioventricular groove between the rt atrium and ventricle along with the RCA. It may follow the entire course of RCA in the coronary sulcus or it may accompany the Right Marginal Artery and the RCA in the posterior aspect.[(6,7,8)] The SCV drains frequently into the right end of CS. Otherwise it either drains into the MCV or forms a Common Trunk (CT) with MCV and drain into the CS. Very rarely, it may drain into the right atrium. [(3,6,7,8)] The SCV receives the tributaries from the right auricle, right atrium and right ventricle. [(3,5)] Oblique vein of left atrium descends on the posterior surface of left atrium and drains into the left end of CS. The Posterior Vein of Left Ventricle runs upwards on its posterior surface and it drains into the CS commonly, sometimes into GCV draining the posterior surface of the Left Ventricle [(3,6,7,8,)].Marginal vein of LV ascends along the left margin of heart draining into the CS.

This present study aims to analyse the variations present in the tributaries of CS.

MATERIALS & METHODS:

The hearts were removed en bloc from 100 adult cadavers in the Department of Anatomy and at autopsy in the Department of Forensic Medicine, Thanjavur Medical College, during the study period 2009-2011. These hearts were washed thoroughly in running water and were preserved in 10% formalin and thymol solution and the specimens were studied by gross anatomical dissection. After stripping off the visceral pericardium, by scrapping the fat, the CS was identified in the coronary sulcus. The tributaries of the CS namely the GCV, MCV, SCV, Oblique vein of Marshall and Posterior vein of LV were also identified. Presence or absence of these veins , their number and draining pattern were noted.

RESULTS:

The tributaries of CS were present in all specimens except SCV which was present in 97% and absent in 3% SCV .

1.Middle Cardiac Vein:

In 83% of specimens, the MCV drained directly into the CS (Picture1). In 16% it formed a common trunk with SCV and drained into CS (Picture 2) and in 1%, it drained directly into the right atrium. (Picture 3)

2.Small Cardiac Vein:

a) Number of SCV

In this study, in 99 % of specimens ,the SCV was one in number , but in 1 % a rare variation of two SCV were present. (Picture 4)

b) **Draining pattern of SCV**

Usually the SCV drained directly into the right end of the CS. Otherwise, it either formed a common trunk with MCV , which in turn drains into CS, or the SCV drained directly into MCV.

In this study, in 61 % of specimens, it drained directly into the CS. In 16 % , it formed a common trunk and drained into CS and in the remaining 23 % of specimens, it drained into the MCV. An unusual variation of two SCV was present in one specimen both of which drained into the MCV. (Chart1)

3. Oblique vein of left atrium:

It was present in all specimens and it was one in number.(Picture6)

4. Posterior vein of left ventricle:

a) Number of posterior vein of left ventricle

The posterior vein of left ventricle is usually one in number, sometimes it may be two to three in number which drained commonly into the CS, but sometimes into GCV. The number of veins and its percentage are given in (Table1)

b) **Draining pattern of** posterior vein of left ventricle

The posterior vein of left ventricle drained into the CS in 96% of specimens, into GCV in 1% . In 3% of specimens, when the veins were more than one in number, the veins drained both into CS and GCV (Picture5).

5. Marginal vein of left ventricle:

The Marginal vein of left ventricle was one in number in 97% of specimens (Picture6) and two in number in 3% of specimens. The marginal vein of left ventricle drained into GCV in 86% of specimens and into CS in 14% of specimens.

Table:1 Number of Posterior vein of left ventricle.

S. No	No. of Posterior vein of Lt. ventricle.	No. of Specimens	Frequency
1	1	58	58%
2	2	30	30%
3	3	12	12%

Table: 2 Comparison of presence/absence of Small Cardiac Vein

between different studies.

S.no.	Name of study	SCV-present (%)	SCV- absent (%)
1.	Adachi	46	54
2.	Ratajczyk – Pakalska	94	6
3.	Present Study	97	3

chart1- Draining Pattern of SCV

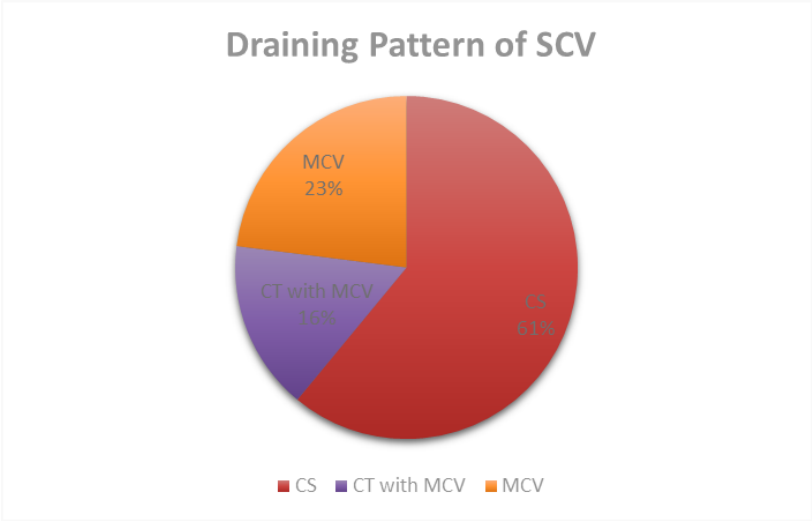
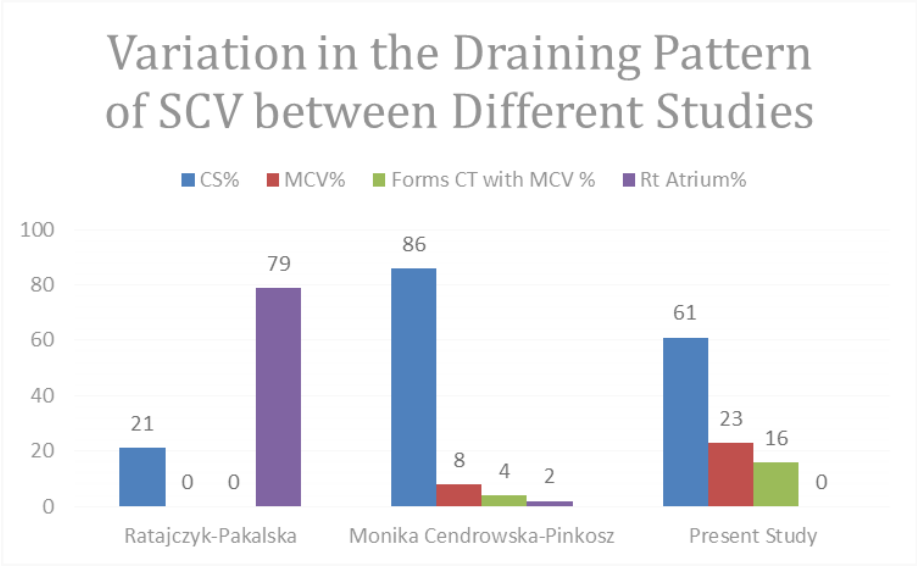


Chart 2: Comparison of draining pattern of Small Cardiac Vein between different studies



Abbreviations

MCV - Middle Cardiac Vein

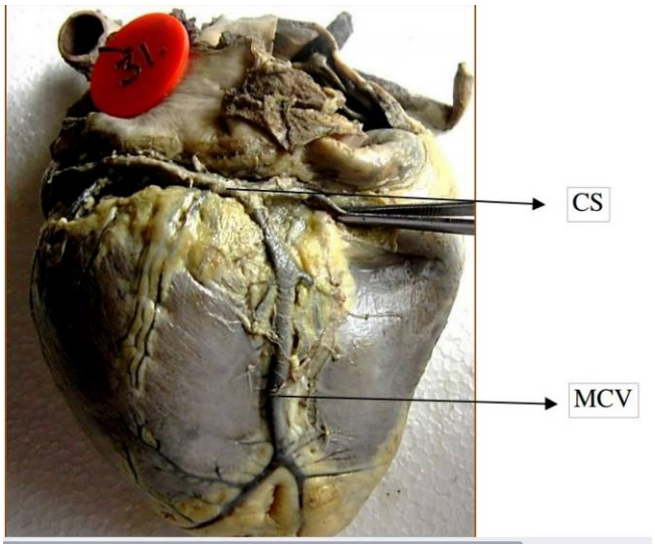
SCV - Small Cardiac Vein

CT – Common Trunk

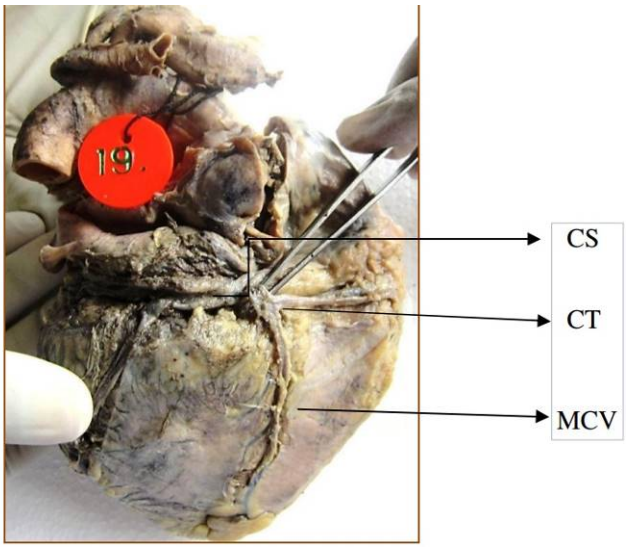
CS- Coronary Sinus

PICTURES

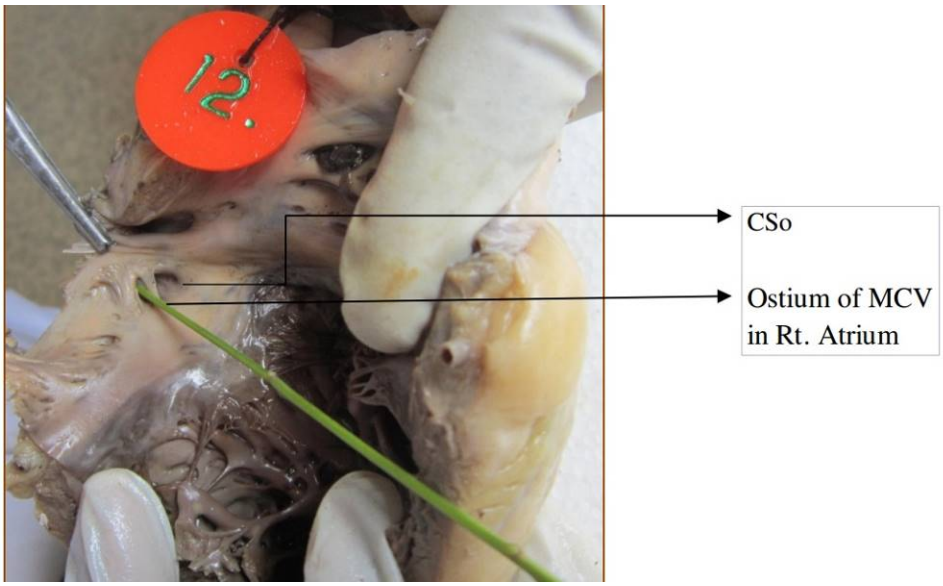
PICTURE1 – MCV opening into CS



PICTURE 2- MCV forming CT with SCV and drains into CS

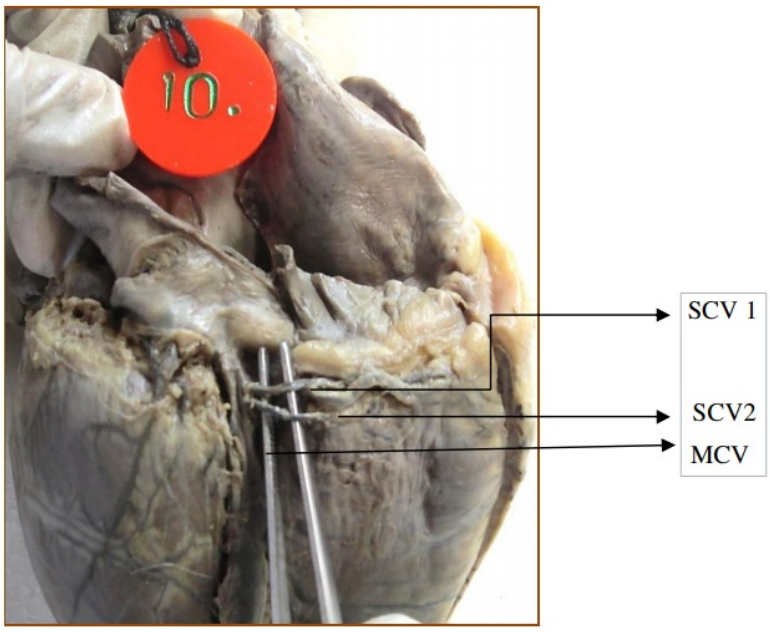


PICTURE 3 - MCV opening into Right Atrium

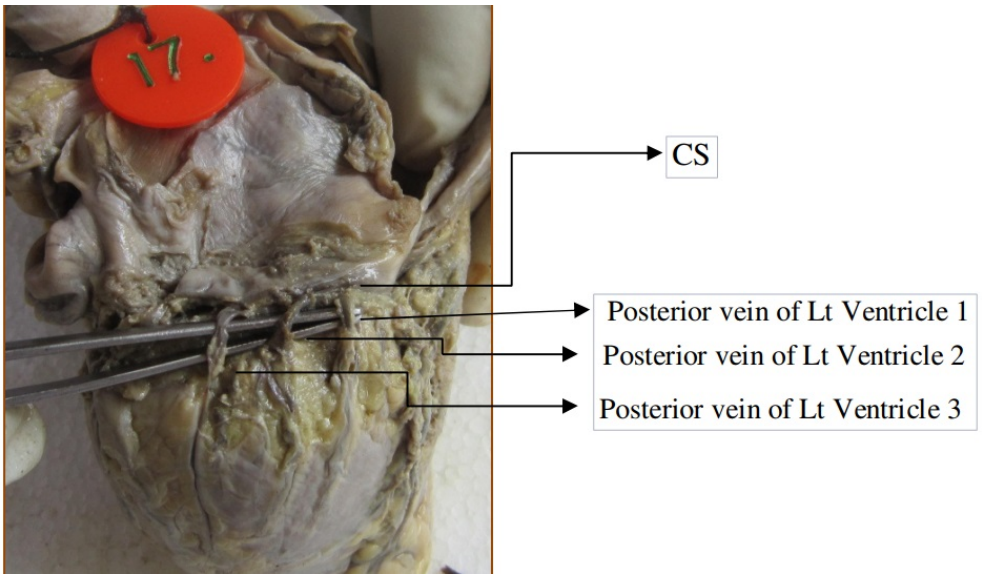


PICTURE 4

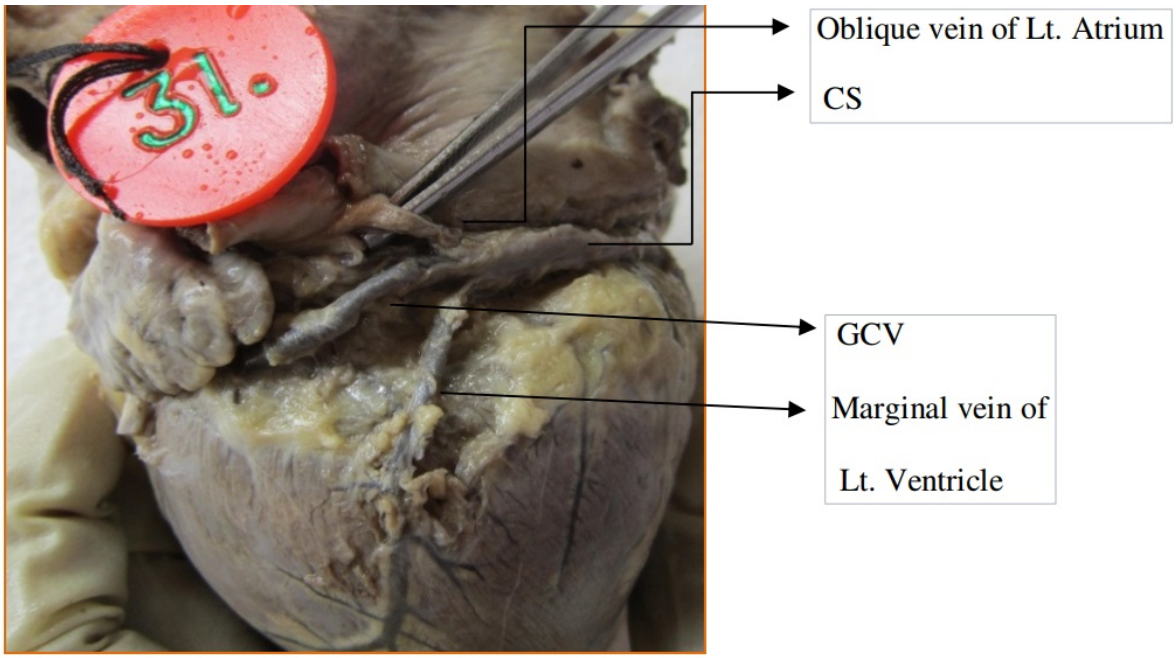
Two SCV draining into MCV



Picture5 - Posterior vein of Left ventricle -3Nos



Picture6 - Marginal vein of Left ventricle draining into CS



DISCUSSION:

1.Variations in the Middle Cardiac Vein:

Draining pattern of middle cardiac vein:

i. According to Von Ludinghausen[9] (1987) and Maros et al [14](1995), the MCV and SCV joined together to form a common trunk in 6% of both of their studies , which drained into CS.

ii. According to Monica cendrowska [9](2004), the MCV and SCV joined together to form a common trunk in 4% of cases, which drained into CS.

iii. In the present study, in 83% of specimens, the MCV drained directly into the CS . MCV formed a common trunk with SCV and drained into the CS in 16% of specimens. the percentage was more when compared to the above three studies.

In our study in 1%, the MCV drained directly into the Right atrium, even though the CS was present which was contradicting to the study done by Bergman et al (1988) and Kawashima et al (2003) which stated that in the absence of CS, MCV converge into the Rt.atrium .

2.Variations in the Small Cardiac Vein:

i. Presence/ absence of Small Cardiac Vein

Comparison of the presence or absence of the SCV with different studies are given in the Table(2) . Our study correlated with Ratajczyk – Pakalska study[10]

ii. Number of SCV

An interesting variation of two small cardiac veins were present in one specimen which has not been reported by other authors in their study.

iii. Draining pattern of Small Cardiac Vein:

The comparison of the draining pattern of small cardiac vein with other authors is given in the chart 2 In our present study, the SCV predominantly drained into the CS in 61% of specimens, 23 % into MCV and in 16%, it formed a common trunk with MCV and drained into CS. The SCV did not drain directly into Rt.atrium in any of the specimens while in other studies like Ratajczyk – Pakalska,, where it drained predominantly into right atrium, and in Monika Cendrowska – Pinkosz study in only 2% of specimens SCV drained directly into the right atrium[9].

An unusual variation of two SCV were present in one specimen and both of which drained into the MCV which in turn drained into the CS.

3. Variations in the Oblique vein of left atrium:

In the present study, oblique vein was present in all the 100 specimens . According to Monika Cendrowska – Pinkosz (2000), by corrosion technique the oblique vein was present in only in 97%. In Oliveira et al (2007) study , the oblique vein was present in 87% of heart specimens and was absent in 13%[14].

4. Variations in the Posterior Veins of Left Ventricle

According to De Valle-Fernandez et al, **posterior vein of left ventricle** was one in number in 50% of cases ,two in number in 37.5% cases and in 10.5% of cases the veins were three in number[8]. This correlated with our study where this vein was one in number in 58% of specimens, two in number in 30% of specimens and three in number in 12% of specimens. Posterior vein of left ventricle drained into CS in 96%, GCV in 1 %, Both into CS and GCV in 3% in the present study.

5. Variations in the Marginal vein of left ventricle:

i) Comparison of Presence or absence of Marginal veins of left ventricle

According to De Valle-Fernandez et al , marginal vein was present in 93%. In our present study the marginal vein was present in all the specimens[14].

ii) Comparison of number of Marginal veins of left ventricle. According to De Valle-Fernandez et al, the marginal vein was one in number in 48%, two in number in 37% and three in number in 7%. It was absent in 7%[18]. In our present study, number of marginal vein were one in number in 97% of specimens and two in number in 3% of specimens. The variation may be due to number of specimen (390) and the technique(MDCTA) done by De Valle-Fernandez et al[15].

iii. Drainage pattern of Marginal vein of left ventricle :

According to De Valle-Fernandez et al. study, the left marginal vein drained into GCV in 81% of cases and into CS in 19% of cases which correlated with our present study where this vein drained into GCV in 86% of cases and into CS in 14% of cases[15].

CONCLUSION:

The cardiac veins are used as an alternate route to bypass coronary artery stenosis and in IHD patients with refractory angina, retrograde venous perfusion with arterial blood is used for surgical procedures. The coronary venous system also act as a potential route for administering drugs in IHD patients. These veins, via the Coronary Sinus, also provides access to procedures like percutaneous epicardial mapping and pacing of the ventricles and ablation of subepicardial arrhythmogenic foci. The CS and its tributaries still remain as a site of potential research and hence a thorough knowledge about the variations in the presence, their number and mode of draining pattern may be helpful in preventing inadvertant injuries during these surgical procedures.

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