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Coronary Sinus

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Abstract: *Aim:* To study the anatomy of the coronary venous system in cadaveric hearts, to ascertain various morphological features of the coronary sinus in order to compare male and female coronary sinus.In addition to provide anatomical basis for the cannulation of coronary sinus and its tributaries. Methods; The study was performed on 40 hearts from embalmed cadavers in different age group varies from 20-70 years in the department of anatomy,madaras medical college,Chennai.Morphological parameters like length and width of coronary sinus at the site of opening into right atrium and shape of coronary sinus were examined. All measurements were taken with the help of thread, scale and precise digital vernier Calipers. Results: a. Length of coronary sinus (CS) ranged from 2cm to 3.8cm, the mean being 2.8cm. b. Relation of coronary sinus to the left coronary artery (LCA) andmitral valve annulus was above and parallel in 100% cases. c. The number of Atrial tributaries ranged from 1-2 and ventricular from 1-6. d.The most frequent shape of coronary sinus is cylindrical.. e. The average length and width of coronary ostium was 9mm and13mm respectively. F.The length of coronary sinus is having positive significant relation with weight of heart in males.The width of coronary sinus at the site opening into right atrium showed significant positive correlation with age and weight of cadaver.. Conclusion: For invasive cardiologists, knowledge about CVS anatomy could add value before and during electrophysiology procedures.

Key words: Coronary Ostium · Sinus · Cannula

INTRODUCTION

Cardiac venous system was a neglected field however it has now begun to attract more attention with development of new interventional techniques such as coronary catheterization and selective catheterization of the cardiac veins.

The coronary sinus is a short vein, varying in size from about 15 to 65 millimeters, located along the heart's posterior surface between the left ventricle and left atrium. The circumference of the vein is larger than average and is big enough to allow blood to be deposited by most veins that enter the heart including the great cardiac vein, oblique vein and other arterial veins, the left marginal vein and the posterior veins of the interventricular and left ventricle. The coronary sinus orifice guarded by thebesian valve. The course of anterior interventricular vein is similar to the adjacent left anterior descending artery in the interventricular groove. Great cardiac vein is the main tributary of the coronarysinus.

Its first part, the anterior interventricular vein, begins near the apex of the heart and ascends with the anterior interventricular branch of the LCA. At the coronary sulcus it turns left and its second part runs around the left side of the heart with the circumflex branch of the left coronary artery to reach the coronary sinus.

The coronary sinus collects the majority of the cardiac venous blood. It receives the blood from the myocardium and facilitates the movement of the blood into the right atrium. The coronary sinus often serves as a marker for surgeons who are performing cardiac surgery. It also plays an important role in many surgical procedures. Balloon catheters can safely be placed here to introduce contrasting agents, cardioplegia buffers and other therapeutics. For patients suffering from coronary artery disease, it is an effective place to deliver cardioplegia to afford myocardial protection.

Material and Methods; The study was performed on 40 hearts from embalmed cadavers in different age group varies from 20-70 years in the department of

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anatomy, madaras medical college,Chennai.morphological parameters like length and width of coronary sinus at the site of opening into right atrium and shape of coronary sinus were examined. All measurements were taken with the help of thread, scale and precise digital vernier Calipers

Observations: Length of coronary sinus (CS) ranged from 2cm to 3.8cm, the mean being 2.8cm. b. Relation of coronary sinus to the left coronary artery (LCA) andmitral valve annulus was above and parallel in 100% cases. c. The number of Atrial tributaries ranged from 1-2 and ventricular from 1-6. d.The most frequent shape of coronary sinus is cylindrical.. e. The average length and width of coronary ostium was 9mm and13mm respectively. F.The length of coronary sinus is having positive significant relation with weight of heart in males.The width of coronary sinus at the site opening into right atrium showed significant positive correlation with age and weight of cadaver.

DISCUSSION

In patients in whom coronary sinus recordings have been clinically indicated, our practice has been to cannulate the coronary sinus by means of a catheter advanced from the femoral vein. We had noted that it was considerably easier to successfully place the electrode in patients whose subsequent diagnosis was AVJRT, particularly if a steerable catheter was used. This study was designed to determine whether there was a structural or anatomic reason for this clinical observation. Additionally, we sought to determine whether there might be a morphological mechanism by which AVJRT patients are prone to their arrhythmia.

The relation between the weight of cadaver & breadth of heart was found insignificant in either sex & this was proven statistically.

The statistical analysis shows the positive relationship between age and length of the heart as correlation coefficient & p value was found 0.42 and 0.178. the length of the heart compared with the weight of cadaver it was observed that relation between length of heart & weight of cadaver is highly significant (r=0.61, p value=0.0004).In males this relation is highly significant(r=0.947, p value=0.0001) & in females also significant(r=0.809,p value=0.015).

It also shows clear relationship between weight of cadaver and weight of heart that higher weight of a cadaver had the higher weight of a heart. (Correlation coefficient-0.67,pvalue-0.0001).

Weight of the heart when compared with weight of cadaver it was observed that weight of the heart directly proportional to weight of the cadaver. It was also highly significant in male (r= -0.776, p value=0.0002) & significant in female (r=0.859,pvalue=0.006)statistically.

All measurements were taken with the help of thread, scale and precise digital vernier Calipers. High-resolution pictures were taken with a digital camera.

Diameters of tributaries of coronary sinus close to their(mm) opening in the coronarysinus- Great cardiac vein, Middle cardiac vein,Small cardiac vein.

Relation of anterior interventricular vein with anterior interventricular artery- left/right

Brocq and Mouchet arterio-venous triangle- was specifically evaluated. The Brocq and Mouchet arterio-venous triangle was a well known topographic region that was composed by the intersection of the great cardiac vein (GCV), the circumflex artery (CA) and the anterior interventricular artery (AIA) of the left coronary artery. These structures were located between conus arteriosus and left auricle, on the left side of anterior surface of the heart. Great cardiac vein, circumflex artery and anterior interventricular artery were analyzed without dissecting them from the adjacent adipose tissue so that their original anatomy was not disturbed. They were analyzed regarding to their disposition in the triangle and the relations between them.

The coronary sinus of each heart was examined under following heads and the findings were properly documented-Length of coronary sinus(Point where oblique vein of left atrium and left marginal vein drains into coronary sinus up to coronary opening in right atrium) Shape of coronary sinus-cylindrical/conical/others Width of coronary sinus orifice Morphology of Thebesian valve (Semicircular, strands, band, remnant, membranous, fibrous, fibromuscular, muscular, fenestrated or absent) was recorded Presence of Vieussens valve Area of covering of ostium of valve Distance between coronary sinus ostium & inferior vena cavae ostium All the tributaries of coronary sinus and their–Occurrence Morphology (Tortuous, straight, kinking, twisting) Length All these findings were recorded. Oblique vein of Marshall- its occurrence and length Anterior cardiac vein- its occurrence and number Anastomoses occurring at apex of heart between anterior interventricular vein and middle cardiac vein-– present/absent

The difficulties encountered in catheterization of the human coronary sinus were possibly due to obstruction offered by large membranes, bars and networks and less frequently due to presence of a large Eustachian ridge.

More recently, since restoration of coronary blood flow prior to an acute myocardial infarction can significantly reduce infarct size and improve myocardial function, the administration of recombinant tissue-type plasminogen through the coronary venous system was shown to result in both shorter recovery times and significant reduction in infarct size when compared to intravenous administration. The coronary venous system also can be employed to deliver cell therapy directly to the myocardium as a potential treatment for heart failure.

The distribution of cardioplegia through the coronary sinus has been proven to be safe and effective in myocardial protection and even superior to the traditional method of antegrade cardioplegia, especially in patients with coronary artery disease.

Furthermore, from the coronary venous system, the coronary flow reserve can be determined and coronary perfusion during percutaneous transluminal angioplasty of coronary arteries can be monitored the coronary venous system is not prone to the effects of atherosclerotic disease, it is considered that it may also serve as an effective conduit for drug delivery or as a potential avenue for coronary artery bypass.

Cardiac venous anastomoses there are widespread anastomoses at all levels of cardiac venous circulation. Regions of abundant anastomoses are the apex and its anterior and posterior aspects about 85% of the venous drainage of the heart occurs through the great, middle and small cardiac veins through the coronary sinus to the right atrium anterior cardiac veins do not drain into the coronary sinus and enter the right atrium directly The right marginal vein passes right, along the inferior cardiac border and may join the small cardiac vein in the coronary sulcus but more often opens into the right atrium.

Posterior vein of the left ventricle found on the diaphragmatic surface of the left ventricle a little left of the middle cardiac vein.

Oblique vein of the left atrium (vein of Marshall), a small vessel, descends obliquely on the back of the left atrium to join the coronary sinus near its left extremity; Middle cardiac vein commences at the apex of the heart and ascends along the posterior interventricular groove toward the coronary sinus. Small cardiac vein arises from the anterior/lateral/inferior portion of the right ventricle. It ascends and runs inferior to and roughly parallel with the marginal branch of the right coronary artery until it reaches the right AV sulcus The great cardiac vein commonly continues until the left inferior portion of the coronary sulcus and finally merges with the coronary sinus. The valve of Vieussens, which covers the ostium of the great cardiac vein as it enters the coronary sinus, typically delineates the beginning of the coronary sinus. The junction of the great cardiac vein and coronary sinus can also be defined by the existence of the vein of Marshall. The great cardiac vein in turn joins the main posterior lateral vein to form the coronary sinus.

The most common valve is the Thebesian valve (Adam C. Thebesius, German physician, 1686-1732) at the ostium of the coronary sinus.

The coronary sinus receives the great cardiac vein at its left end and the middle cardiac vein and small cardiac veins at its right end. Its main tributaries are the three cardiac veins the great, middle and small cardiac veins. The posterior vein of the left ventricle, left marginal vein and the oblique vein of the left atrium also open into the coronary sinus.

Most cardiac veins drain into the coronary sinus, the main vein of the heart is a wide venous channel about 2 or 3 cm long, lying posteriorly in the coronary sulcus (atrioventricular groove) between the left atrium and left ventricle on the diaphragmatic or posterior surface.

The coronary sinus empties directly into the right atrium through ostium located between the inferior vena cava and tricuspid valve.

Veins Draining the Heart May Be Grouped as:

- Coronary sinus and its tributaries
- Anterior cardiac veins (anterior right ventricular veins)
- Smallest cardiac venous system (Venae cordis minimae / Thebesian veins)

The anatomy of the AV nodal region and its electrophysiological characteristics have received much attention in recent years,[1 - 5] renewing previous debates about the presence of specialized AV conducting tracts[6, 7].Surgery of the AV node in a patient with {atrioventricular junctional reentry tachycardia] AVJRT resulted in symptomatic cure without causing complete heart block,[8] indicating that selective modification of AV nodal function was possible. Refinements of surgical techniques[9, 10]allowed a new therapeutic option for patients refractory to medical therapy. The anatomy of the AV junctional area is extremely complex and discussion of perinodal tissues must consider the entire area comprised by the triangle of Koch. It is now widely accepted that the antegrade input into the compact node occurs via two principal routes. Fibers of the first group are numerically more important in humans and run from the anterior limbus of the fossa ovalis to the AV node, well removed from the coronary sinus (The “fast pathway”). The

second, smaller input runs posteroinferiorly around the coronary sinus ostium (The slow pathway) [4, 5]. However, dual or multiple AV pathways may be electrophysiologically identified, without an associated anatomic substrate[3] not found. Major coronary sinus abnormalities were defined as one of the following morphological features, partly on the basis of historical details of congenital anomalies found at postmortem examination : coronary sinus hypoplasia due to drainage of some of the cardiac venous system directly into the right atrium rather than through the coronary sinus; angulation; localized narrowing; fistulas, eg, persistent left superior vena cava; or presence of diverticulum. The study reported an overall incidence of 3% in SVTs, 5% in patients with accessory pathways and 1% in AVJRT patients.

During the diagnostic electrophysiological study, it was noticeably easier to access the coronary sinus in patients whose subsequent diagnosis was AVJRT. Indeed, in many of these patients, when we explored the region of the tricuspid valve annulus with a steerable catheter, it was almost impossible to avoid entering the coronary sinus. On the tricuspid ring, anterior rotation of the catheter placed the electrode in the right ventricle and posterior rotation resulted in the catheter's entering the coronary sinus ostium.

CONCLUSION

Cardiac venous system was a neglected field however it has now begun to attract more attention with development of new interventional techniques such as coronary catheterization and selective catheterization of the cardiac veins. For invasive cardiologists, knowledge about CVS anatomy could add value before and during electrophysiology procedures.

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