Morphological and Clinical Significance of Thebesian Valve Guarding Ostium of Coronary Sinus

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Background  The advent of novel therapeutic techniques require cannulation of coronary sinus. The Thebesian valve guarding the ostium of coronary sinus can pose practical difficulties during such procedures.

Aim  With this background we undertook a detailed study of the morphological features of Thebesian valve, so that we can substantially evaluate the clinicoanatomical importance of it.

Materials and Methods  Fifty human dissected cadaveric heart specimens were selected from the department of anatomy, SDM College of Medical Sciences and Hospital, Dharwad. The location of ostium of coronary sinus and the occurrence of the Thebesian valve and its shape, composition, and extent of occlusion of the ostium were carefully observed and noted.

Results  Our observations revealed that 90% of specimens had the Thebesian valve guarding the opening of coronary sinus. It was semilunar in shape in 74% of specimens. The valve was membranous in composition in 46% of specimens. Among these, in 26% of specimens the valve almost covered more than 50% of the ostium of coronary sinus indicating moderate to severe occlusion.

Keywords
► coronary sinus ostium
► thebesian valve
► cannulation
► occlusion

Introduction
Coronary sinus, the largest venous sinus that receives most of the veins of the heart opens into the right atrium. The ostium of coronary sinus is guarded by the Thebesian valve. It was first described by Adam Christian Thebesius in 1708.1 Embryologically it is a caudal remnant of sinuatrial valve. Coronary sinus ostium is situated in the posteroinferior surface of the heart between inferior venacaval opening and tricuspid orifice.

Coronary sinus is a frequently cannulated structure in patients undergoing cardiac resynchronization therapy, catheter ablation of cardiac arrhythmias, defibrillation, perfusion therapy, mitral valve anuloplasty, and targeted drug delivery. But the Thebesian valve has been known to display significant variation and for many years, researchers have speculated on the potential of the valve to cause hinderance during cannulation of the coronary venous system.2,3 So, the success of cannulation depends on the anatomy of the Thebesian valve as it might pose difficulty during such procedures.

Keeping these facts in view we undertook a detailed study of the morphology of the Thebesian valve as it has potential clinicoanatomical implications.

Materials and Methods
The study was conducted in the department of anatomy of SDM College of Medical Sciences and Hospital, Dharwad, Karnataka. Fifty formalin fixed heart specimens from dissection room cadavers of adults of both sexes were selected for the study.

The interior of right atrium was examined in these hearts by making a vertical incision from inferior vena cava to superior vena cava and reflecting the flap made by the lateral incision in the right atrium. Coronary sinus ostium was identified and the Thebesian valve covering it was carefully

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examined and its morphological features studied in detail. This included occurrence of the valve, its shape, composition (nature), and extent of occlusion (coverage) of coronary sinus ostium in each of the specimens.

**Results**

The following observations were interpreted. Among the 50 heart specimens, ostium of coronary sinus was present in all the specimens. The location of ostium was constant in all the specimens. It was situated between inferior venacaval opening and tricuspid annulus (►Fig. 1).

The specimens were then examined for the occurrence of the Thebesian valve. 90% of the specimens had Thebesian valve guarding the opening while it was absent in 10% of the heart specimens. We observed the shape of the Thebesian valve and it was observed that it was semilunar in shape in majority of specimens (►Fig. 2), and linear as well as circular in few (►Table 1).

Composition of each valve was observed carefully which revealed that it was membranous in 23 specimens, fibrous in 17 specimens, partly membranous and partly fibrous in

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<tr>
<th>Composition of Thebesian Valve</th>
<th>No. of heart specimens</th>
<th>In percentage</th>
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<tbody>
<tr>
<td>Membranous</td>
<td>23</td>
<td>46%</td>
</tr>
<tr>
<td>Fibrous</td>
<td>17</td>
<td>34%</td>
</tr>
<tr>
<td>Partly membranous and partly fibrous</td>
<td>05</td>
<td>10%</td>
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Thebesian valve was absent in 5 (10%) of the heart specimens.

<table>
<thead>
<tr>
<th>Thebesian Valve</th>
<th>No. of heart specimens</th>
<th>In percentage</th>
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</thead>
<tbody>
<tr>
<td>1. Semilunar</td>
<td>37</td>
<td>74%</td>
</tr>
<tr>
<td>2. Linear</td>
<td>06</td>
<td>12%</td>
</tr>
<tr>
<td>3. Circular</td>
<td>02</td>
<td>04%</td>
</tr>
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Thebesian valve was absent in 5 (10%) of the heart specimens.

**Table 1 Types and percentage occurrence of Thebesian valve based on its shape**

**Table 2 Types and percentage occurrence of Thebesian valve based on its composition**

Fig. 1 Location of coronary sinus ostium. Black arrow: circular Thebesian valve. Yellow arrow: fossa ovalis. Red arrow: tricuspid orifice.

Fig. 2 Semilunar Thebesian valve.

Fig. 3 Semilunar and membranous Thebesian valve with a threadlike structure in the center of ostium of coronary sinus.

Fig. 4 Linear Thebesian valve with fibrous edges.
Discussion

Coronary sinus is a wide venous channel that has an opening in the right atrium which is guarded by a fold of endocardial tissue called the Thebesian valve. Pacing of coronary sinus and right atrium is performed in the course of radiofrequency ablation in the treatment of atrial and ventricular arrhythmias and during certain cardiosurgical procedures; cardioplegia is performed by retrograde perfusion of myocardium through coronary sinus. These procedures may not be always successful due to numerous morphological variants of the Thebesian valve and it has been reported in literature through various studies (Table 4).

Randhawa et al studied the coronary venous anatomy in 50 adult cadaveric hearts. In their study Thebesian valve was seen covering more than 75% of coronary sinus ostium in 25% of cases. Mlynarski et al visualized coronary sinus and Thebesian valve by cardiac magnetic resonance. Thebesian valve was found in 56 cases (45.9%) and in 21 cases (17.2%) the valve almost totally covered the coronary sinus ostium which can potentially create problems during coronary sinus cannulation.

Scholten et al reported a case study in which they visualized the Thebesian valve using intracardiac echocardiography that can cause problematic cannulation. They tried to demonstrate the usefulness of advanced imaging techniques such as intra cardiac echocardiography (ICE) in identification of anatomical variants like Thebesian valve and how this may result in successful procedure. Seventy-five autopsied human hearts were examined to find variations in Thebesian valve anatomy and coronary sinus ostium and their implications for invasive electrophysiology procedures by Gary S Mak in 2009. They concluded stating that in more than 70% of hearts Thebesian valve was present with various composition like fibrous, muscular, and fibromuscular, thus making it a potentially complicating structure interfering with cannulation of coronary sinus.

A study conducted by Katti and Patil suggested that Thebesian valve was noticed in many (88%) cases. Its appearance varied widely, few valves were made of small strands of tissue, while others were composed of membrane covering more than half of the coronary sinus ostium. Around 20% of valves occluded more than 65% of the ostium, making them “potential complicating factors” during cannulation of the coronary sinus. Ghosh et al conducted a study and reported that semilunar type of Thebesian valve was most commonly seen.

Variations of Thebesian valve anatomy has been studied in detail by Paget et al wherein they have emphasized the fact that an echocardiographer should be aware of factors hindering the passage of cannula during coronary sinus cannulation procedures.

Few authors opine that 2-dimensional (2D) transesophageal echocardiography (TEE) is helpful to identify a larger Thebesian valve which can cause difficulty during coronary sinus cannulation. While other authors debate the fact that 3D TEE would be clinically more advantageous than 2D TEE.

Thus, clinicoanatomical research in relation to Thebesian valve is being carried out and reported in literature. To our knowledge, hardly any such studies have been undertaken in the recent past.

The present study is an effort to emphasize the unrecognized problem of coronary sinus cannulation by a prominent Thebesian valve. It can pose significant challenge to clinicians during cardiac therapeutic procedures. Knowledge of morphological features of this structure will considerably reduce potential clinical complications and provide better outcome during such procedures.

Conclusion

Knowing the fact that coronary sinus is a frequently cannulated structure in various cardiac therapeutic procedures
and the Thebesian valve is invariably present in many, we cannot overlook the possibilities of unsuccessful cannulation. Thus, a thorough anatomical knowledge of the Thebesian valve may prevent any untoward event during coronary sinus cannulation and hence has potential practical implications.

Conflict of Interest
None.

References
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