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# SURGERY OF RHEUMATIC TRICUSPID VALVE DISEASE

THESIS SUBMITTED IN PARTIAL FULLFILLMENT  
OF MASTER DEGREE IN GENERAL SURGERY

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# ***F O R W O R D***

## FOREWORD

Acquired tricuspid valve disease, which is generally of rheumatic origin is not uncommon condition. It should always be considered in patients with rheumatic valve disease and its presence will certainly modify the surgical approach to these patients.

Surgical management of acquired tricuspid valve disease has been always controversial, and during the relatively short history of modern cardiac surgery, many surgical approaches to acquired tricuspid valve disease have been described. In addition, a more precise diagnosis of this valvular disease has been made possible with the aid of modern methods of investigations.

However, what has been written in literature about tricuspid valve surgery is relatively little. This work aims at discussing surgery of acquired tricuspid valve disease from different points of view. Anatomical, pathological, pathophysiological and diagnostic background of rheumatic tricuspid valve disease is also discussed as a basis for a more meaningful approach to the problem.

***ANATOMY OF***  
***THE TRICUSPID VALVE***

# ANATOMY

## OF THE TRICUSPID VALVE

The tricuspid orifice is oriented in a semivertical plane, it directs right atrial blood anteriorly, inferiorly and to the left (Silver *et al.*, 1971). The orifice is roughly oval with the main axis transversal (Carpentier *et al.*, 1974). Of the four cardiac valves, the tricuspid valve has the largest valve orifice, its circumference measuring 11 to 13 cm and the orifice area about  $10 \text{ cm}^2$  or more (Yang *et al.*, 1978). The flow of blood across the mitral and tricuspid orifice is regulated by interaction between the atrium, the annulus fibrosus, the valvular tissue, the chordae tendineae, the papillary muscles and the ventricular wall. These six components, constituting the mitral and tricuspid "complex", should be considered as a unit. The tricuspid valve differs from the mitral valve in having a larger orifice. The tricuspid leaflets differ from those of the mitral valve in being thinner, more translucent, and less easily separated into well-defined leaflets (Silverman and Schlant, 1978).

Despite wide variations affecting valve morphology, the tricuspid valve has three leaflets (anterior, posterior or inferior and septal). The terminology is based on their position in the heart *in situ*. The leaflets are separated by three commissures (anteroseptal, posteroseptal and anteroposterior). The largest is the anterior leaflet which is roughly quadrangular in shape, stretching from the infundibular area downward to the inferolateral wall of the ventricle. The anterior leaflet sometimes has a notch which may be as deep as a commissure. This cleft must be considered as a normal anatomic variation. The septal leaflet is semicircular in shape and attaches to both membranous and muscular portions of the interventricular septum. The posterior leaflet is usually the smallest and attaches to the tricuspid ring along its posteroinferior border. The bases of the cusps are attached to the fibrous ring surrounding the orifice (annulus fibrosus), and are also joined to each other at their basal attachment so as to form a continuous annular membrane. The free margins of the cusps are irregularly indented and their apices project into the ventricular cavity. In the normal heart, the cusps are white, glistening, tendinous,

curtain-like flaps that are perfectly smooth on their atrial surfaces but are ridged by the insertions of the chordae tendineae on their ventricular surfaces (Johnston *et al.*, 1958, Silver *et al.*, 1971, Carpentier *et al.*, 1974, Walmsley *et al.*, 1978).

When viewed from the atrial side, the cusps appear to be continuous with the atrial wall. When viewed from the ventricular side of the annulus there is an obvious perivalvular space between the ventricular walls and the three cusps of the tricuspid valve (Walmsley *et al.*, 1978). Carpentier *et al.*, (1974) described the fibrous ring as being unimpressive. They also pointed out that the attachment of the septal leaflet is not as well delineated as that of the two other leaflets. They further explained that the antero-septal half of the septal leaflet, which corresponds to the membranous interventricular septum, merges with the membranous septum so that the limit of the leaflet is indistinct. Close to the posteroseptal commissure, the base of the leaflet becomes slightly better delineated. They also pointed out that the exact point where the bundle of His crosses the attachment of the septal leaflet is 5 mm from the antero-septal commissure and hence the close relationship between the base of the septal leaflet and the bundle of His during surgery of the tricuspid valve (Fig. 1).

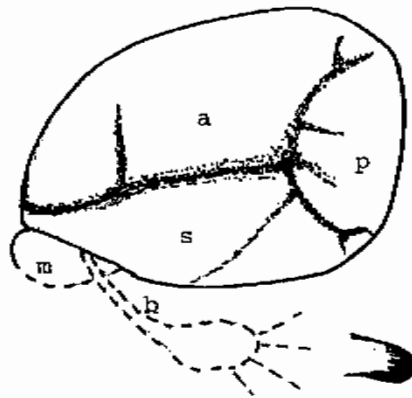


Fig. 1: Normal Tricuspid valve, (a) anterior leaflet. (p) Posterior leaflet. (s) Septal leaflet. (b) Bundle of His (m) Membranous Septum. <Reproduced from Carpentier *et al*,, Surgical management of acquired tricuspid valve disease, J.Thorac. Cardiovasc. Surg. 67:53, 1974.>

In addition to the main cusps of the tricuspid valve it is not uncommon to find accessory or supernumerary cusps. They are situated at the junctional or commissural zones of the main cusps, and they may affect closure of the valve (Walmsley *et al*,, 1978).

The essential histological feature of each cusp is a central core of fibrous tissue which has a basal attachment to the annulus fibrosus and is continuous on its ventricular side with the chordae tendineae. Each cusp is covered on both its atrial and ventricular surfaces with a layer of endocardium. The two layers of endocardium are continuous with each other at the free edge of the cusp and are also continued onto the contiguous chordae. There are many observations, often controversial, on the presence of muscle fibres and blood vessels in the cusps. Cardiac muscle fibres may be present in the basal region of the cusps, and there are considerable differences in the amount of muscle fibres, not only from cusp to cusp, but in the same cusp in different hearts. In health, blood vessels are restricted to those basal regions of the cusps that contain muscle fibres. Otherwise, normal cusps appear to be avascular, although under certain circumstances the blood vessels from the basal regions of the cusps may extend a greater or lesser distance towards the free margins of the cusps (Johnston *et al.*, 1958, Walmsley *et al.*, 1978).

In the right ventricle, there are usually three papillary muscles. The anterior papillary muscle is the largest and originates from the anterolateral ventricular wall, at the insertion of the moderator band. It is attached by chordae tendineae to the anterior and septal leaflets. The posterior papillary muscle originates from the inferior wall of the right ventricle and is attached to the posterior and septal leaflets. A small septal (conus) papillary muscle originates from the wall of the infundibulum and is attached to the anterior and septal leaflets. The conus papillary muscle is not constantly present, and chordae tendineae may spring directly from the ventricular septum or from small septal papillary muscles (Silver *et al.*, 1971, Johnston *et al.*, 1958 Silverman and Schlant 1978).

The chordae tendineae are strong cords of fibrous tissue covered by a closely adherent layer of endocardium. They spring from the apices of the papillary muscles. Although they are mainly avascular, occasional vessels are present in their parts adjacent to the papillary muscles. Each papillary muscle gives origin to a variable number (usually 4 to 10) of the main

chordae. During their course towards the valves, they divide into finer cords and these may divide yet again into slender strands that are attached to the cusps. The chordae tendineae have been classified into three groups or orders according to the manner of the insertion of these terminal strands.

The first order are chordae that are inserted into the free edge of the cusp. They are numerous fine anastomosing threads.

The second order are chordae that pass over the free edge of the cusp and are inserted at intervals on its ventricular surface. Within the substance of the cusp, they ascend to blend with the lamina fibrosa. This gives the middle part of the cusp thickness and causes the roughness on its ventricular surface. Two features of these second order chordae are especially noteworthy. First, they are relatively thick and strong, and the thicker they are the higher they are inserted onto the valve cusps. Secondly, those from any one papillary muscle are inserted onto the ipsilateral parts of two cusps.