Pattern of connection between papillary muscle and chordae tendineae of left ventricle

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SUMMARY
Mitral homograft replacement requires a good knowledge about anatomy of the papillary muscles. In 60 (38 male, 22 female) cardiac preparations of various age (16-44 ages), branch distribution of the chordae tendineae and level of their fixation to the ventricular surface of the right and left cusps of mitral valves have been studied. Papillary muscles and chordae tendineae were examined and their geometrical arrangement was determined. Three groups of the left ventricular papillary muscle were defined. In group I (43.3%, 52/120) the basal part and the apex of the muscle were undivided. In group II (30%, 36/120) there were two heads; in subgroup II/A (20%, 36/120) the base of the papillary muscle was undivided and in II/B (10%, 12/120) it was divided into two separate parts. In group III (26.7%, 32/120) the papillary muscle had three heads. It was also observed that 2 to 15 chordae tendineae can originate from the apex of papillary muscle and 9 to 60 chordae tendineae can ended into the corresponding half of the valve insertions. Thus these definitions and morphologic types may be of great value during endoscopic and conventional mitral valve replacement or reconstruction of the chordae tendineae in mitral valve homograft implantations.

Key words: Papillary muscle, chordae tendineae, mitral valve, left ventricular subvalvular apparatus, homograft implantation

ÖZET
Sol ventrikül’ün musculus papillaris ve chordae tendineae’lari arasındaki bağlanımlarını yapış
Mitral homograft nakiller için musculus papillaris’lerin anatomisinin yanı bir önemine gerekir. Desenli yaşlarda altı kopta (38 erkek, 22 kadın) chorda tendine’leri dağılımı ve mitral kapağın sağ ve sol kısımının tutunma seviyeleri incelendi. Papiller kaslar ve chorda tendine’leri incelendi ve geometrik özellikleri ortaya konuldu.


Anahtar kelimeler: Papiller kas, chordae tendineae, mitral kapak, sol ventriküler subvalvüler aparaj, homograft implantasyon
evaluate the morphology of papillary muscles and to
describe the geometrical pattern of the chordae ten-
dineae in the left ventricle of the human heart.

Material and Methods

120 papillary muscles were studied in 60 human autopsy hearts collected randomly. This study was
performed with permission from National Forensic Institute on specimens harvested by the classical
autopsies was performed in Morgue Specialization Department, Ankara Institute of Forensic Medicine.
In 60 (38 male, 22 female) cardiac preparations of various ages (16-44 ages) branch distribution of the
chordae tendineae and level of their fixation to the ventricular surface of the right and left cusps of mitral
valves have been studied. Papillary muscles and chordae tendineae were examined. Then their geo-
metrical arrangement was determined.

Results

Three groups of the left ventricular papillary muscle
were defined. In group I (43.3%, 52/120) the basal
part and the apex of the muscle were undivided (Fig.
1). In group II (30%, 36/120) there were two heads;
in subgroup II/A (20%, 36/120) the base of the papil-
lary muscle was undivided and in II/B (10%, 12/120)
it was divided into two separate parts (Fig. 2, 3). In
group III (26.7%, 32/120) the papillary muscle had
three heads. In subgroup III/A (16.7%, 20/120) the
base was undivided, while in III/B (10%, 12/120) it
was made up of two parts (Fig. 4, 5).

Additionally it was observed that 2 to 15 chordae
tendineae can originate from the apex of papillary
muscle and 9 to 60 chordae tendineae can ended into
the corresponding half of the valve insertions.

Discussion

Early authors dealt mainly surgical descrip-
tions of papillary muscle morphology in the litera-
ture(9,12,13,14). Later, with the advantage of open
heart surgery, more knowledge of the mitral valve
was gathered by numerous authors(15,16,17). In
a previous study classification of the left ventricu-
lar subvalvular apparatus based on the macroscopic
and endoscopic investigations was proposed(18).
Kervancioglu et al. described false tendons as single
or multiple, thin, fibrous or fibromuscular structures
that traverse the cavity of the left ventricle and have
no connections with the valvular cusps(19). Then re-
searchers mentioned that there is no direct attach-
ment of the mitral valve to the ventricular septum,
although the papillary muscles are frequently con-
nected to the septum or to the right fibrous trigone
by false cords(20). In previous study the authors
classified and named the papillary muscle(21). The single papillary muscles were conical, mammillated, flat topped, grooved, stepped, wavy, arched, sloped or saucerized. When there were two bellies they presented a two tiered, interlinked, parallel, arched, V, Y, or H configuration(21). Ramsheyi et al.(22) reported that based on presentation of the left ventricular subvalvular apparatus four groups can be established. But basal parts of the papillary muscles were not defined. In our study contributions of basal parts were also used during classification.

Ranaganthan and Lam produced a simplified description of the papillary muscle and chordae tendineae and introduced the nomenclature which has been used widely(17).

Four to 22 chordae originated from the anterolateral papillary group, ending in 14 to 72 chordal insertions into the corresponding half of the valve. Likewise, 2 to 18 chordae arose from the posteromedial papillary group and ended in 12 to 80 leaflet insertions. The chordae in each group are best considered totally as a fan. The configuration of the fan is unique in each heart(21).

A recent study was undertaken to understand the spatial configuration of the papillary muscles and chordae tendineae and to assess the extent to which this configuration may influence the reconstruction of the subvalvular apparatus and homograft implantation. The relevance of chordopapillary variations in rheumatic heart disease, reparative procedures, papillary muscle dysfunction, mitral valve prolapse, mitral valve replacement, and use of mitral valve homograft for mitral/tricuspid replacement have also been discussed(21). Morphology of the left ventricular subvalvular apparatus becomes popular in recent years with homograft implantation and the introduction of endoscopic procedures in mitral valve surgery(23,24).

Thus these results may be of great value in endoscopic and conventional mitral valve replacement or reconstruction of the chordae tendineae and in mitral valve homograft implantation. Because implantation of the papillary muscle to the left ventricular wall is important, types of the muscles will be important during these procedures.

This study differs from previous studies by presenting images of all types of papillary muscle patterns. These data will be helpful for relevant cardiac surgeons performing mitral valve homograft implantation.

References


