Journal of the American College of Cardiology
© 2014 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 63, No. 16, 2014
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2013.11.017

Gross and Histological Features of Excised Portions of Posterior Mitral Leaflet in Patients Having Operative Repair of Mitral Valve Prolapse and Comments on the Concept of Missing (= Ruptured) Chordae Tendineae

William C. Roberts, MD,*†‡ Travis J. Vowels, BBA,* Jong M. Ko, BA,* Robert F. Hebeler, Jr, MD§
Dallas, Texas

Objectives The aim of the study is to describe gross and histological features of operatively excised portions of mitral valves in patients with mitral valve prolapse (MVP).

Background Although numerous articles on MVP (myxomatous or myxoid degeneration, billowing or floppy mitral valve) have appeared, 2 virtually constant histological features have been underemphasized or overlooked: 1) the presence of superimposed fibrous tissue on both surfaces of the leaflets and surrounding many chordae tendineae; and 2) the absence of many chordae tendineae on the ventricular surfaces of the leaflets as the result of their being hidden (i.e., covered up) by the superimposed fibrous tissue.

Methods We examined operatively excised portions of prolapsed posterior mitral leaflets in 37 patients having operative repair.

Results Histological study of elastic-tissue stained sections disclosed that the leaflet thickening was primarily due to the superimposed fibrous tissue. All leaflets had variable increases in the spongiosa element within the leaflet itself with some disruption and/or loss of the fibrosa element and occasionally complete separation of it from the spongiosa element. Both the leaflet and chordae were separated from the superimposed fibrous tissue by their black-staining elastic membranes.

Conclusions These findings demonstrate that the posterior leaflet thickening in MVP is mainly due to the superimposed fibrous tissue rather than to an increased volume of the spongiosa element of the leaflet itself. The superimposed fibrous tissue on both leaflet and chordae is likely the result of subsequent abnormal contact of the leaflets and chordae with one another. Chordal rupture (i.e., missing chordae) occurred in all 37 patients, but finding individual ruptured chords was rare. (J Am Coll Cardiol 2014;63:1667–74) © 2014 by the American College of Cardiology Foundation

Although numerous publications have appeared describing auscultory, angiographic, echocardiographic, and morphological features of mitral valve prolapse (MVP) (myxomatous or myxoid degeneration), surprisingly, none have reproduced the various histological features of the operatively excised mitral valves or parts thereof in color after staining for elastic fibers, an absolute necessity for proper evaluation, because a black-staining elastic membrane separates the leaflet and chordae from the superimposed fibrous tissue, a constant feature of MVP. In this report, we focus on the contribution of the superimposed fibrous tissue to the leaflet and chordal thickening, and second, we introduce the concept that missing or hidden chords (those lying beneath the superimposed fibrous tissue) are equivalent to ruptured chords.

Methods

Since March 1993, all specimens excised at operation by cardiac surgeons at Baylor University Medical Center at

From the *Baylor Heart and Vascular Institute, Baylor University Medical Center, Dallas, Texas; †Department of Internal Medicine (Division of Cardiology), Baylor University Medical Center, Dallas, Texas; ‡Department of Pathology, Baylor University Medical Center, Dallas, Texas; and the §Department of Cardiothoracic Surgery, Baylor University Medical Center, Dallas, Texas. The study was funded by the Baylor Health Care System Foundation, Dallas, Texas. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received August 31, 2013; revised manuscript received November 7, 2013, accepted November 12, 2013.

Abbreviations and Acronyms

MR = mitral regurgitation

MVP = mitral valve prolapse

Dallas have been submitted to the surgical pathology division of the pathology department, and all such specimens have been described by one of us (W.C.R.) who submitted the pathology report. Most gross specimens were photographed. After describing the submitted specimen, clinical, echocardiographic, and hemodynamic data were retrieved online via the Baylor University Medical Center at the Dallas Electronic Medical Records and the Apollo Cardiovascular Database. A total of 500 mitral valves or portions thereof were received from January 2005 through June 2013 (Fig. 1). Of this number, 140 patients underwent mitral valve repair or replacement for severe mitral regurgitation (MR) secondary to MVP. After excluding those patients where preoperative echocardiograms (n = 71) were not available to us or histological sections of the excised valves were not prepared or retrievable (n = 14) or the patients had chronic renal failure (n = 4), 51 patients were available for study: 14 had mitral valve replacement and were then excluded from the present study; 37 had mitral valve repair, and in each, portions of the posterior leaflet were studied. Sections of the posterior leaflets were cut from the margin of attachment to the free margin and submitted for histological preparation. After processing in alcohol and xylene, 2 sections were cut from each paraffin block: one was stained by hematoxylin/eosin, and the other, by elastic van Geison.

Results

Pertinent data from the 37 patients are summarized in Table 1. (Data on the 14 patients having mitral valve replacement for MVP are shown in the table simply for comparison.) The operative report in all 37 patients indicated "prolapse" of a portion of posterior mitral leaflet and that the prolapsed segment was the one almost always excised. None of the 37 had calcific deposits in the operatively excised specimens. All 37 patients also had an annular ring inserted.

Examination of the posterior mitral leaflet in the 37 patients disclosed several consistent features (Figs. 2 to 9, Table 2). All 37 operatively excised portions of posterior mitral leaflet had "missing" (i.e., ruptured) chordae tendineae on gross examination. Histologically, the leaflet itself and the chordae tendineae were clearly demarcated by an elastic membrane (elastic van Geison stain). Both atrial and ventricular aspects of the leaflet in all 37 patients contained superimposed fibrous tissue, thicker on the atrial side than on the ventricular side. Additionally, numerous elastic fibers were present in the superimposed fibrous tissue on the atrial aspect, whereas few if any were present in the superimposed fibrous tissue on the

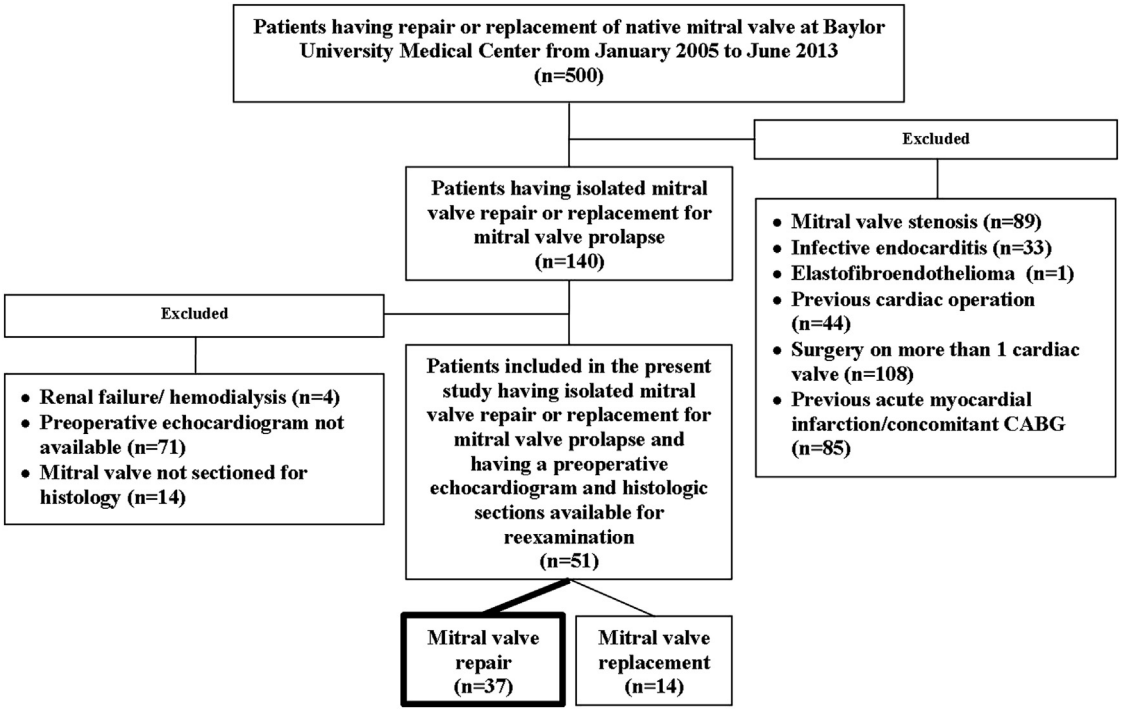

Figure 1 Flow Chart

Chart showing the origin of the 37 patients included in the present study. CABG = coronary artery bypass grafting.