WILDERNESS & ENVIRONMENTAL MEDICINE, **23,** 300–306 (2012)

ORIGINAL RESEARCH

Prevalence of Mitral Valve Prolapse in Residents Living at Moderately High Altitude

Tolga Sinan Güvenç, MD; Yiğit Çanga, MD; Yavuz Karabağ, MD; Kaya Özen, MD; Bahattin Balcı, MD, FESC

From the Department of Cardiology, Kafkas University School of Medicine, Kars, Turkey (Drs Güvenç, Karabağ, Özen, and Balcı); and the Department of Cardiology, Kartal Yavuz Selim Hospital, İstanbul, Turkey (Dr Çanga).

Objective.—Prolapse of mitral valve leaflets is a frequent disorder and the most common cause of severe mitral regurgitation in western countries. However, little is known about the effects of altitude on mitral valve prolapse. We studied the prevalence and echocardiographic characteristics of mitral valve prolapse at moderately high altitude and sea level.

Methods.—A total of 936 consecutive subjects who were admitted to 2 study institutions at Kars, Turkey (1750 m) and Istanbul, Turkey (7 m) were enrolled in this study to determine prevalence of mitral valve prolapse. Demographic and 2-dimensional echocardiographic characteristics of participants were recorded.

Results.—Prevalance of mitral valve prolapse was found to be significantly higher in people living at moderate altitude compared with those living at sea level (6.2% vs 2.0%; $P = .007$). Overall echocardiographic features regarding valve thickness (4.1 ± 0.80 mm vs 3.6 ± 0.66 mm; $P = 0.169$), maximal valve prolapse (4.6 ± 2.08 mm vs 3.9 ± 0.91 mm; $P = .093$), and frequency of mitral regurgitation (89% vs 73%; $P = .65$) were similar between groups, although anterior valve prolapse was seen more frequently at moderate altitude (50% vs 11%; $P = .056$) and posterior leaflet prolapse was significantly more frequent at sea level (66% vs 10%; $P = .002$).

Conclusions.—Mitral valve prolapse is more frequently observed at moderately high altitudes. Further studies are needed to determine clinical importance of our findings.

Key words: high altitude, mitral valve prolapse, echocardiography

Introduction

Mitral valve prolapse (MVP) is the most common nonischemic cause of severe regurgitation that necessitates surgical intervention in developed countries.[1] An increased propensity for arrhythmias, sudden death, and infective endocarditis is observed with this condition. Mitral valve prolapse is a valvular abnormality that can be caused by histologic abnormalities of valvular and subvalvular tissue, including chordae tendinea and mitral annuli, a disproportion between the left ventricle and mitral valve, or various collagen vascular disorders.[2] Echocardiographically, MVP is defined as an abnormal protrusion of one or both mitral leaflets beneath the annular plane.[2] Primary MVP is a result of progressive myxomatous degeneration, in which redundancy and thickness of leaflets are increased and excess leaflet tissue is present along with a dilated mitral annulus and elongated chords (Figure 1). Mitral valve prolapse is linked to congenital connective tissue disorders such as Marfan or Ehlers-Danlos syndromes, and sporadic forms are found to be associated with genes regulating connective tissue strength or remodeling.[3] Secondary MVP is caused by a wide variety of conditions, including rheumatoid heart disease, ischemic heart disease, or aortic regurgitation with jet impingement on the mitral valve.[2,3]

Little is known about environmental effects that may cause or increase progression of MVP. A study conducted on Kyrgyz highlanders in the mid-1980s found an association between living at high altitude and occurrence of MVP,[4] although this association has not been validated with further studies.

Presented at the 8th International Congress of Update in Cardiology and Cardiovascular Surgery, March 1–4, 2012, Antalya/Turkey.

Disclaimer: No conflicts of interest to disclose.

Corresponding author: Tolga Sinan Güvenç, School of Medicine, Kafkas University Campus, Paşaçayırı, Kars, Turkey (e-mail: TSGuvenc@gmail.com).

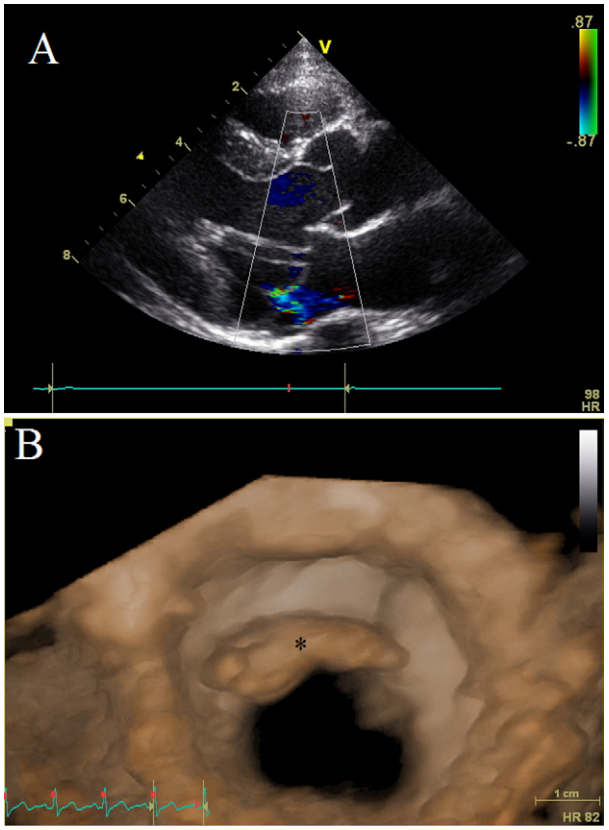

Figure 1. Echocardiographic images of mitral valve prolapse and myxomatous mitral valve. (A) Two-dimensional echocardiographic image of mitral valve prolapse with associated mitral regurgitation. (B) Three-dimensional echocardiographic image of myxomatous anterior mitral valve (shown with asterisk) as seen from left ventricle.

In this study, we aimed to determine the prevalence of MVP in subjects living at moderately high altitude. In addition, we compared echocardiographic characteristics of the mitral valve in MVP patients living at moderate altitude and sea level.

Materials and Methods

This study was approved by the ethics committee of Kafkas University School of Medicine, and all participants gave their informed consent before participating in the study. For this study, a total of 494 persons living at moderately high altitude (Kars, Turkey, mean altitude 1750 m) and 442 persons living at sea level (Kartal district of İstanbul, Turkey, 7 m) who were admitted to cardiology departments in the study institutions were consequently enrolled. In both study institutions, enrolled subjects were born at that altitude and had not lived in a different altitude except for brief periods. All enrolled participants were of Caucasian origin and older than 15 years of age. Patients who were previously operated on for mitral valve disease were not included, as the etiology of their underlying mitral pathology could not be determined. Likewise, patients with identifiable causes of MVP, such as rheumatoid valve disease, severe aortic regurgitation with jet impingement on mitral valve, and ischemic mitral prolapse, were excluded. Those subjects who had traveled to sea level (for the moderate altitude group) or to high altitude (for the sea level group) 6 months before the study were also excluded from study.

Age and gender of all participants were noted, and further demographic and laboratory data were collected only in patients with echocardiographic MVP including height and weight of subjects, body surface area, body mass index, and complete blood count.

ECHOCARDIOGRAPHIC EVALUATION

Echocardiography was performed on the day of admission by using a GE Vivid 3 (GE Healthcare Systems, Piscataway, NJ) system equipped with a 2.5-MHz phased-array transducer at both institutions (Figure 2). Echocardiographic evaluation was performed by one cardiologist at each institution (TSG and YÇ). Mitral valve prolapse was defined as more than or equal to 2 mm of displacement of 1 or 2 leaflets of the mitral valve superior to the mitral annular plane, without an obvious disorder that may cause prolapse. Additional echocardiographic information regarding the amount of prolapse, leaflet thickness, dimensions of the left ventricular cavity and left atrial cavity, and the presence and degree of mitral regurgitation were acquired from patients diagnosed with MVP. M-mode and 2-dimensional measurements for the left ventricular cavity were performed from

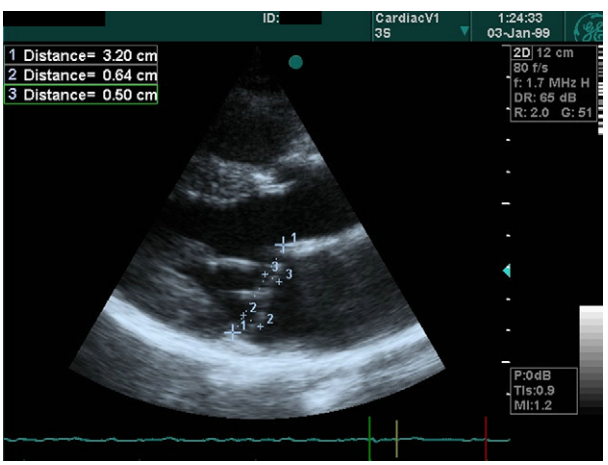

Figure 2. An example of nonclassical mitral valve prolapse that was included in the moderately high altitude group. In this example, maximal prolapse of both leaflets was recorded.