Case Report

Mechanical Hemolysis after Mitral Valve Repair: Report of a Case

Shigeaki Aoyagi*, Takeshi Oda, Ryo Kanamoto, Eiji Nakamura, Tomokazu Kosuga and Hiroshi Yasunaga
Department of Cardiovascular Surgery, St. Mary’s Hospital, Japan

Abstract

A 60-year-old man underwent aortic valve replacement with a bileaflet mechanical valve for aortic regurgitation and mitral valve repair using a prosthetic ring for mitral regurgitation (MR). Intraoperative transesophageal echocardiography (TEE) confirmed no residual MR and a normally functioning aortic prosthetic valve without a para-valvular leak. One week after the operation, transthoracic echocardiography showed trivial MR. Two weeks later, in addition to elevation of a lactate dehydrogenase value and schistocytosis, TEE revealed mild MR with a high velocity jet that collided with the prosthetic ring. However, structural and non-structural abnormalities of the aortic mechanical valve such as para-valvular leakage were not detected on TEE. Subsequent to failed medical treatment for hemolysis, reoperation for the mitral valve was performed. At reoperation, the mitral valve repair was intact, and the cause of failed valve repair was thought to be residual MR. Mitral valve replacement with a mechanical valve led to immediate cessation of hemolysis.

ABBREVIATIONS

MR: Mitral Regurgitation; TEE: Transesophageal Echocardiography; LV: Left Ventricle; TTE: Transthoracic Echocardiography; Hb: Hemoglobin; Ht: Hematocrit; AST: Aspartate Aminotransferase; LDH: Lactate Dehydrogenase; BUN: Blood Urea Nitrogen; Cr: Creatinine; eGFR: estimated Glomerular Filtration Rate; MVR: Mitral Valve Replacement

INTRODUCTION

Mitral valve repair is preferred over valve replacement for severe mitral regurgitation (MR) because of its superior operative results, better preservation of left ventricular (LV) function, and fewer valve-related complications [1-3]. However, mechanical hemolysis has been reported as one of the complications of mitral valve repair, although less frequent [3-6]. In this paper, we report a case of mechanical hemolysis after mitral valve repair caused by residual MR, and discuss the strategies for reoperation after an initial mitral valve repair is unsuccessful. This study was approved by our Institutional Research Ethics Board at the St. Mary’s Hospital, and patient consent was waived.

CASE PRESENTATION

A 60-year-old man was admitted for treatment of a valvular disease with impaired renal function. On admission, ECG revealed normal sinus rhythm and left ventricular hypertrophy but no ischemic changes of ST-segments were found. Transthoracic echocardiography (TTE) showed severe dilatation of the left ventricle (LV) with poor contraction (ejection fraction; 0.26). Doppler study demonstrated severe aortic regurgitation and MR due to tethering of the leaflets with coaptation depth of 11 mm and annular dilatation (Figure 1). Coronary arteriography delineated normal arteries. Laboratory data revealed a red blood cell count of 345 x10^4, hemoglobin (Hb) of 9.9 g/dl, hematocrit (Ht) of 30.7%, aspartate aminotransferase (AST) of 11 IU/L.
Central

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function to the preoperative level (BUN; 35.2 mg/dl, Cr; 3.62 mg/dl, Ht; 35.4%, LDH; 310 IU/L) and the improvement of renal function (Cr; 6.06 mg/dl, eGFR; 8.3 ml/min/m²) was observed. On postoperative day 26, laboratory data showed progressive worsening of these signs (Hb; 10.3 g/dl, reticulocyte; 14.7‰, AST; 61 IU/L, LDH; 1650 IU/L, haptoglobin; <15 mg/dl), and fragmentation of the red blood cells was microscopically confirmed. TEE revealed mild MR with a high velocity jet along the leaflet, which came into collision with the prosthetic ring and sharply altered its trajectory toward the center of the LA after the collision (Figure 2), but dehiscence of the prosthetic ring was not observed. Abnormal transvalvular back flow and significant para-valvular leakage were not detected in the aortic bileaflet valve. Medical treatment with a beta-blocker and tocopherol nicotinate for mechanical hemolytic anemia for the following 10 days was not effective, and gradual aggravation of renal function (Cr; 6.06 mg/dl, eGFR; 8.3 ml/min/m²) was observed. At redo surgery 37 days after the valve repair, the initial repair was intact, and no newly developed valve lesions were found. The cause of hemolysis was judged to be residual MR after mitral valve repair, considering his impaired renal function and poor LV function, mitral valve replacement (MVR) with preservation of the posterior leaflet and subvalvular tissue was achieved using a bileaflet mechanical valve. Postoperatively, the patient recovered uneventfully with resolution of mechanical hemolysis (Hb; 11.0 g/dl, Ht; 35.4%, LDH; 310 IU/L) and the improvement of renal function to the preoperative level (BUN; 35.2 mg/dl, Cr; 3.62 mg/dl).

DISCUSSION

Generally, mechanical hemolysis is one of the potentially serious complications following cardiac valve replacement, and it is also reported as a mode of failure of mitral valve repair [1-3]. In valve replacement, mechanical hemolysis is usually associated with either structural deterioration or para-valvular leakage [7]. Although these prosthetic abnormalities usually visualized by TTE, the abnormalities were not detected in the aortic mechanical valve even by TEE in this patient. This fact suggests that the residual MR jet colliding with the prosthetic ring should have been the major cause of the hemolysis, rather than turbulent blood flow through the prosthetic valve [7,8].

Mitral valve repair is the surgical treatment of choice for MR of all etiologies, particularly degenerative disease, because of several significant advantages over MVR [1-3]. Deloche and colleagues [1] have stated that mitral valve repair is feasible in 95% of patients with degenerative valvular disease, 70% with rheumatic valvular disease, and 75% with ischemic valvular disease. However, mitral valve repair is followed by a high initial instantaneous risk of valve failure and a subsequent low constant risk of late valve failure [9]. Reoperation after mitral valve repair has been reported to occur at a linearized rate of 0.5% to 1.5% per year [10].

The mechanisms of failed mitral repair are categorized as procedure-related, valve-related, or unknown causes [6]. Procedure-related causes, which include incomplete initial repair, suture dehiscence, systolic anterior motion causing left ventricular obstruction, rupture of previously shortened chordae, or hemolysis, are the most common mechanisms of failed mitral repair requiring reoperation [6]. Among these factors, hemolysis was the second most common indication for reoperation, following suture dehiscence, and it accounted for 21 (22%) of 96 patients requiring reoperation for failed mitral valve repair [6]. Although hemolysis can occur in a variety of settings after mitral valve repair, residual or recurrent MR is found in all cases on echocardiography [4]. Generally, clinically significant hemolysis is observed in patients with moderate or severe recurrent MR, however, it also occurs even in patients with mild MR [4,6]. The effects of shear stress causing hemolysis have been well known, and experimentally, significant hemolysis occurred at shear stress forces >3,000 dynes/cm² [11]. According to the results of clinical and experimental studies [5,12] hemolysis mostly occurred in patients with the echocardiographic MR flow patterns of fragmentation, collision, and rapid acceleration, which associated with high shear stresses >4,500 dynes/cm², whereas it was rarely observed in patients with the patterns of slow acceleration and free jet, in which shear stresses were low (<925 dynes/cm²). The collision of the high velocity regurgitant jet with the prosthetic ring may have led to the severe hemolysis in our patient, although the severity of MR was mild.

Conservative treatment for mechanical hemolysis after mitral valve operation has been successful in rare cases [13,14], and in most cases MVR has been performed for residual or recurrent MR, particularly for MR causing mechanical hemolysis, after valve repair [4,5]. However, mitral valve re-repair has occurred with increasing frequency in recent years [4,6]. Suri and colleagues [5] achieved mitral valve re-repair in 64 (44%) of 145 patients

Figure 2 A postoperative TTE performed on postoperative day 26. A high velocity mitral regurgitant jet collided with the semi-rigid ring (a white arrow) and abruptly changed its trajectory.
who underwent mitral reoperations for recurrent MR, including 20 (74.1%) of 27 patients with hemolysis, and mentioned that hemolysis was a factor favoring re-repair without increasing a risk for a third mitral operation. Furthermore, they also demonstrated that mitral valve re-repair was an independent predictor of improved survival and better recovery of LV function and size, compared with MVR [6,12]. However, in our patient, MVR was chosen because of his impaired LV and renal function, in addition to the more predictable outcome of MVR.

In conclusion, we report a case of severe mechanical hemolysis after mitral valve repair caused by collision of a residual MR jet with the prosthetic ring. If anemia and/or hemolysis is severe enough to require repeat transfusion or continued symptoms despite medical treatment, reoperation should be performed without delay.

REFERENCES


