



Mitral Valve Repair Using Glutaraldehyde Scrub Disinfection and Fixation for the Treatment of Active Infective Endocarditis on Mitral Annular Calcification: A Case Report

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Abstract

An 81-year-old female was admitted to our hospital with fever and arthralgia. Blood culture revealed *Streptococcus pyogenes*. Echocardiography showed Mitral Annular Calcification (MAC) and absence of vegetation. After two-weeks of antibiotic treatment, the patient suffered chest pain and returned to our hospital. An inferior ST-elevated myocardial infarction was diagnosed; echocardiography revealed vegetation and severe regurgitation. Multi-detector computed tomography showed occlusion of the posterior descending artery. An urgent surgery was performed and a MAC associated with an abscess was observed with vegetation protruding between Left Ventricle (LV) and Left Atrium (LA). The abscess was disinfected, and the fragile tissue was fixed with a Glutaraldehyde (GA) scrub. The mitral annulus was patch-reconstructed using bovine pericardium with concomitant Posterior Mitral Leaflet (PML) augmentation using a bovine pericardial patch.

Keywords: Infective endocarditis; Mitral annular calcification; Glutaraldehyde, Valve plasty

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Introduction

Infective Endocarditis (IE) on Mitral Annular Calcification (MAC) is associated with poor survival since infected broken calcification become nidus for infection and result in residual infection [1,2]. Glutaraldehyde (GA) scrub has been reported to increase mitral repair rate owing to its effectiveness in controlling infection as disinfectant and strengthening the fragile mitral tissue as fixative [3,4].

Case Presentation

An 81-year-old female was admitted to our hospital with fever and arthralgia for two days. Echocardiography showed marked MAC without apparent vegetation (Figure 1A). Blood culture revealed *Streptococcus pyogenes* presence. Ampicillin/sulbactam was administered for 15 days. After antibiotics treatment, blood culture was negative, and the patient was discharged, in the same evening, the patient suffered from chest pain and returned to our hospital. Electrocardiogram showed ST-elevation at II III and a VF, and inferior ST-elevation myocardial infarction was diagnosed. Echocardiography revealed mobile vegetation in the size of 13 mm × 10 mm at the swollen mitral annulus, where calcification was located, and severe regurgitation at the Posterior Mitral Leaflet (PML) (Figure 1B). An empirical treatment with vancomycin and ceftriaxone was started. Multi-detector computed tomography showed occlusion of posterior descending artery, where target vessel for bypass surgery was not seen. The cause of coronary occlusion was estimated to be an embolic event post IE on MAC. The patient underwent urgent mitral surgery after written informed consent was obtained. Intraoperative use of GA was approved by the institutional review board of Fujisawa City Hospital. MAC favored the formation of an abscess with two sets of vegetation and two protrusions between Left Ventricle (LV) and Left Atrium (LA) (Figure 2). The abscess was opened from the portion of perforation, and most of MAC was broken into numerous particles surrounded by purulent discharge. Most of the calcification, except the medial and external edge, that did not seem infected, was removed with the assist of an ultrasonic surgical aspirator. During

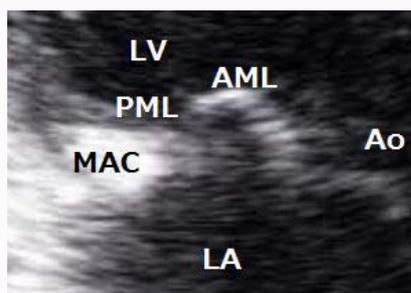


Figure 1A: Echocardiography at first admission.

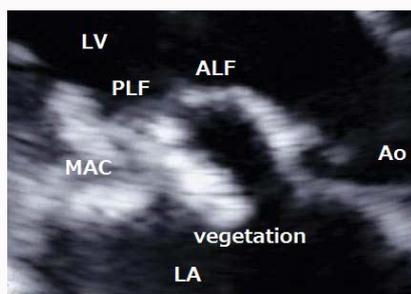


Figure 1B: Echocardiography at second admission; Vegetation arose from mitral annulus, and mitral annular calcification appeared swollen as the "puffed-up" description of Eisher et al. [1].

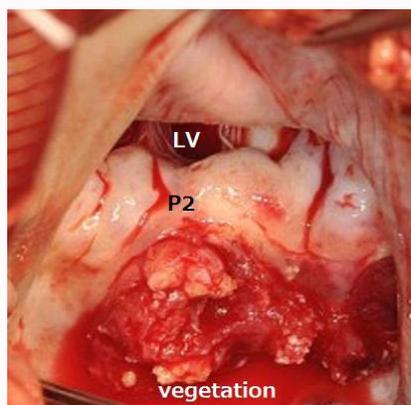


Figure 2: Intraoperative view of mitral valve; Vegetation and fistulization with ventriculoatrial communication was observed at mediolateral and medial portion of the annulus of P2 segment.

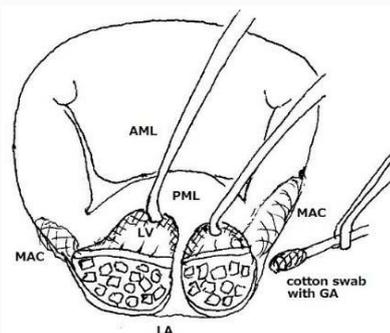


Figure 3: Schematic drawing of the operative view during debridement of mitral annular abscess with fistulization between LV and LA using GA scrub.

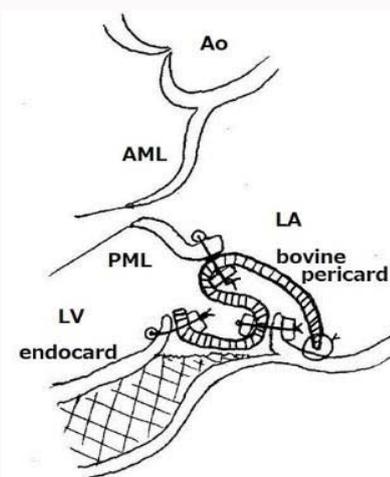


Figure 4: Schematic drawing of cross-sectional view of mitral annular reconstruction and augmentation of PML with bovine pericardial patch.

the 15 minutes of debridement the abscess was disinfected and the surrounding fragile tissue was reinforced by fixation using ten sets of cotton swab each soaked in 0.2 ml 0.6% GA solution in phosphate buffer pH 7.4 (Figure 3). Bovine pericardium (Edwards Science Co. Ltd, Irvine, CA, USA) with a size of 3 cm × 8 cm was attached to the endocardium of the LV using 7 sets of 2-0 polyester interrupted braided sutures with Expanded-Polytetrafluoroethylene (ePTFE) tube (Spaghetti 5 mm, Matsuda Co. Ltd, Tokyo, Japan) (Figure 4). Endocardium of LA, where mitral annulus was reconstructed, was attached to the patch using 8 sets of 2-0 polyester interrupted braided sutures with pledgets. Since the water test indicated that the posterior leaflet augmentation seemed to provide competent coaptation of Anterior and Posterior Mitral Leaflet (AML and PML), Mitral Valve (MV) repair was performed. The rest of the bovine patch was turned over to the edge of the PML that was attached to the patch using 6 sets of 2-0 polyester braided sutures with ePTFE tube. The rest of the

patch was turned back and attached to the anastomosis line of left atrial endocardium using continuous 4-0 BB polypropylene suture to prevent blood clot and infection to exposed pledgets (Figure 4). Transesophageal echo (TEE) revealed a trivial leak, which was acceptable.

Postoperative course was uneventful. Blood culture and vegetation culture did not show growth of pathogens, but pathological specimen showed Gram-negative rods detection. Based on the patient's clinical course a microbial substitution with HACEK group of bacteria was hypothesized. Vancomycin treatment was terminated at postoperative day 13, and ceftriaxone was administered up to 4 weeks after surgery. The patient returned home without any complication or recurrence of infection. We have followed the patient for 8 months without infection recurrence, and any symptom of heart failure.

Discussion

MAC is a chronic process involving the fibrous annulus of the MV, and was first described in 1908 by Bonninger [5]. MAC complicated with IE is relatively rare. Pomerance observed MAC in 258 of 3,334 autopsy cases, and MAC with IE was found in 3 cases [6]. Eicher et al. [1] reported 62 cases of IE in MAC in patients undergoing ultrasound exams. The 62 cases were classified in two groups: group 1 (24%) had vegetations originating from a calcified mitral annulus (annular endocarditis); group 2 (76%) had classic leaflet endocarditis. Our case is classified into group 1. The in-hospital mortality rate was higher in group 1 patients (53%) than in group 2 patients (30%).

Eicher et al. [1] described a “puffed-up” appearance, with swelling of the abscess cavity. In our case, we did not observe such sign at the first admission but observed them at the second admission (Figure 1).

The clinical outcome of annular endocarditis was unfavorable [1]. Vistarini et al. [2] reported 24 surgically treated patients with IE on MAC; of these, 18 patients were treated in acute phase and 7 patients died. Fujii et al. [7] reported a surgical case of IE on MAC.

Regarding the microorganism causing IE, Eicher et al. [1] reported that annulus endocarditis is caused mainly by bacteria of *staphylococci*, *streptococci*, *Proteus mirabilis*, and *Escherichia coli* [1]. In our case, the microorganism detected at the first admission was *Streptococcus pyogenes*, while at the second admission the blood culture was negative, but the pathological analysis revealed Gram-negative rods in the specimen, with the suspicion that the responsible microorganisms were the HACEK group bacteria [8].

Managing IE on MAC seems to be extremely difficult since numerous particles of calcification, broken by infection, become multiple niduses for infection [9]. Although thorough removal of the calcification might be beneficial to control infection, numerous niduses can hardly be removed because they have scattered in the abscess in myocardium. We used GA scrub for disinfection of the lesion and fixation/reinforcement of the infected fragile tissue, based on the cross-linking and fixation properties of GA. Isoda et al. [3] reported that IE damaged mitral leaflet treated by GA helped the repair of MV. We have repaired six consecutive cases of mitral regurgitation complicated by IE in active phase without any recurrence of IE or deterioration of mitral regurgitation. Yamamoto et al. reported 86% repair rate for mitral regurgitation with IE in active phase by using GA, and 5-year survival was 89% without recurrence of IE [4]. Moreover, an 18-year-old nursing student with active IE was successfully repaired using GA in Fujisawa-Shonan-Tokushukai-Hospital (personal communication). Application of GA to repair IE on MAC in this case seems to be the first approach reported in the literature. Our impression is quite positive about using GA in IE on MAC. First, annular infection with hundreds of calcification particles seems difficult to control, and gap between calcification seems difficult to wash and provide disinfection. Second, to reconstruct the mitral annulus the endocardium of the LV and LA needs to provide enough strength to support sutures made to fix the bovine pericardium, but these tissues are fragile and edematous due to the infection. GA, a chemical agent cross-linking proteins, is used in a wide range of applications, like disinfection, and fixation of electron microscopy samples; it is also used as hardener for surgical glue, and asceno/auto pericardial conditioner for prosthetic valve or aortic valve repair [10-12]. Typically, a 0.2% to 2% solution of GA is used as a disinfectant and can inactivate common mycobacteria within 2 min of incubation [10]. In our procedure, the infected lesion was scrubbed with a cotton swab soaked in approximately 2 ml of 0.6% GA solution, followed by saline rinsing. According to results of an animal toxicity study involving rats, oral intake of approximately 1,000 ml of 0.6% GA for 50 kg body weight is a lethal dose [13]. Since GA causes degeneration of valve leaflets, GA contact to valve leaflet should be minimal. In this case GA contact with the PML and conduction system was strictly limited, and mitral annulus was treated with GA to control infection. Gelatin-Resorcin-Formalin (GRF) glue suppression from the market might be a good example of GA toxicity vs benefit. In fact, GRF glue was quite a powerful surgical adhesive but its overuse as hardener resulted in false thoracic aneurysm [12,14]. GA use for IE on MAC

seems to be beneficial, but surgeons need to be aware of chemical toxicity risks versus clinical benefits.

Conclusion

The use of GA for debridement of active IE on MAC is beneficial for disinfection and strengthening of the mitral annulus and surrounding tissue, making mitral repair possible. Careful follow-up of the GA-treated tissue is necessary.

Compliance with Ethical Standards

Conflict of interests Dr. Masuda has research funding from Senko Medical Instrument Mfg. Co. Ltd., and Japan Association for Development of Community Medicine. The other authors have no disclosure.

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References

- Eicher JC, Nadai LD, Soto FX, Eicher SF, Dobsak D, Zanetta G, et al. Bacterial endocarditis complicating mitral annular calcification: A clinical and echocardiographic study. *J Heart Valve Dis.* 2004;13(2):217-27.
- Vistarini N, d'Alessandro C, Aubert S, Jault F, Acar C, Pavie A, et al. Surgery for infective endocarditis on mitral annulus calcification. *J Heart Valve Dis.* 2007;16(6):611-6.
- Isoda S, Yamazaki I, Matsuki Y, Tomita H, Yano Y, Gondo T, et al. Efficacy of glutaraldehyde-treated leaflets for mitral valve repair to treat active infective endocarditis: A case report. *Ann Thorac Cardiovasc Surg.* 2018;16.
- Nakamura K, Hashimoto K, Sakamoto Y, Bando K, Yoshitake M, Matsumura Y, et al. Safe use of glutaraldehyde to repair the destroyed valve in active infective mitral valve endocarditis. *Circ J.* 2018;82(10):2530-4.
- Bonninger M (a) Bluttransfusion bei pernizio seranemie: (b) ZweiFalle von Herzblock *Deutsche Medizinische Wochenschrift.* 1908;34:2292.
- Pomerance A. Pathological and clinical study of calcification of the mitral ring. *J Clin Path.* 1970;23(4):354-61.
- Fujii M, Mogi K, Sakurai M, Nomura A, Sakata T, Takahara Y. A surgical case of infective endocarditis with annular abscess into mitral annulus calcification. *Jpn J Cardiovasc Surg.* 2017;46(5):243-6.
- Chambers ST, Murdoch D, Morris A, Holland D, Pappas P, Almela M, et al. HACEK infective endocarditis: characteristics and outcomes from a large, multi-national cohort. *PLoS One.* 2013;8(5):e63181.
- Pressman GS, Rodriguez-Ziccardi M, Gartman CH, Obasare E, Melendres E, Arguello V, et al. Mitral annular calcification as a possible nidus for endocarditis: A descriptive series with bacteriological difference noted. *J Am Soc Echocardiogr.* 2017;30(6):572-8.
- Gorman SP, Scott EM, Russell AD. Antimicrobial activity, uses and mechanism of action of glutaraldehyde. *J Appl Bacteriol.* 1980;48(2):161-90.
- Ma WG, Ziganshin BA, Guo CF, Zafar MA, SiellerRS, Tranquilli M, et al. Does BioGlue contribute to anastomotic pseudoaneurysm after thoracic aortic surgery? *J Thorac Dis.* 2017;9(8):2491-7.
- Manji RA, Ekser B, Menkis AH, Cooper DK. Biprosthetic heart valves of

- the future. *Xenotransplantation*. 2014;21(1):1-10.
13. Haward PH, Meylan WM, Ed Handbook of physical properties of organ chemicals, Boca Raton, New York, London, Tokyo: CRC Lewis Publishers. 1997. p. 205.
14. Isoda S, Kimura T, Mashiko Y, Nakamura S, Maehara T. *In vitro* study of the optimal volume ratio of activator to adhesive in geratine-resorcinol-formaldehyde glue. *Gen Thorac Cardiovasc Surg*. 2011;59(5):326-8.