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CLINICAL CASE

Left ventricular rupture of mitral valve prosthesis implantation treated using an intra-aortic balloon pump counterpulsation

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Abstract

Left ventricular rupture is an infrequent but potentially fatal complication of mitral valve replacement. In spite of the fact that several methods of repair have previously been described, the mortality rate remains nearly 85%. The use of the intra-aortic balloon pump counterpulsation may increase the possibilities of success in the repair of this dreaded complication. We present here three cases of left ventricular rupture associated to mitral valve prosthesis implantation successfully treated with the aid of intra-aortic balloon pump counterpulsation. (Gac Med Mex. 2015;151:746-8)

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Introduction

Left ventricular rupture associated with mitral valve prosthesis implantation is a rare but very dreaded complication of mitral prosthetic replacement surgery. It occurs in 0.5-2% of cases of mitral prosthesis replacement, with a mortality rate as high as 85%[1]. The use of intra-aortic balloon pump counterpulsation may offer an efficacious therapeutic complement in the management of this complication[2,3].

We present three cases of left ventricular rupture associated with mitral valve prosthetic implantation successfully managed with the aid of intra-aortic balloon pump counterpulsation.

Case 1

Female patient of 59 years of age diagnosed with double mitral valve lesion of rheumatic origin. In September 2006 she underwent mitral valve replacement surgery via superior biatrial septal approach due to the relatively small size of the left atrium. The posterior mitral valve apparatus could not be preserved due to its thickening and calcification. A bileaflet 27 mm On-X mechanical mitral valve prosthesis (Medical Carbon Research Institute, Austin, TX, USA) was placed. During sternal closure, intense bleeding was appreciated originating in the posterior part of the pericardial sac. A type III left ventricular rupture was corroborated. Cardiopulmonary bypass and aortic clamping were reinstituted. External repair was performed by applying a layer of fibrin sealant (Beriplast, ZLB Behring GMBH, Hamburg, Germany), later reinforced with caliber 0 polypropylene horizontal sutures. A second Beriplast layer was applied on the involved zone, including the external sutures. An intra-aortic counterpulsation balloon was placed prior to extracorporeal circulation weaning. No bleeding was observed in the repair site.

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Table 1. Classification of the different types of left ventricular rupture associated with mitral valve prosthesis implantation

Type	Location	Cause
I	Left atrioventricular groove	Deficient surgical technique, native ring excessive traction, deep placement of sutures for prosthesis, placement of prosthesis of larger size than required, posterior cusp excessive resection
II	Medial ventricular part, posterointernal papillary muscle insertion region	Low resection of papillary muscles, ventricular nailing of a bioprosthesis post
III	Intermediate zone between types I and II location	"Unrolled loop" hypothesis, posterior valvular structures resection (cusp, tendinous cords and posterointernal papillary muscle)

Post-operative evolution had no further complications. Echocardiographic tests performed 3 and 12 post-operatively showed no evidence of left ventricle (LV) pseudoaneurism.

Case 2

Female patient of 74 years of age diagnosed with calcified mitral valve stenosis. In August 2007 she underwent mitral valve replacement. Due to intense calcification, the posterior mitral valve apparatus could not be preserved. She had a 27 mm Perimont Plus 6900 mitral bioprosthesis placed (Edward Lifesciences, Irvine, CA, USA), with no technical difficulty. When extracorporeal circulation was suppressed, moderated bleeding was observed coming out of the posterior portion of the heart. After visual inspection, a large hematoma was identified on the medial posterior portion of the LV. An intra-aortic counterpulsation balloon was installed. With no extracorporeal circulation support, a Beriplast layer was applied along the hematoma, applying compression with gauzes for several minutes. The gauzes were removed, and the disappearance of ventricular bleeding was corroborated. The chest was closed with the standard procedure, and the patient evolved uneventfully. The echocardiography practiced one month after the surgery demonstrated the absence of LV pseudoaneurism.

Case 3

Female patient of 61 years of age with preoperative diagnoses of stenosis with mitral insufficiency of rheumatic origin and an aortic valve tumor. On June 11th 2013, she underwent implantation of a 27 mm Mosaic biological porcine mitral valve prosthesis (Medtronic, Inc. Minneapolis, MN, USA) and aortic valve noncoronary cusp tumor resection. The mitral posterior subvalvular apparatus was preserved, including the second and third order tendinous cords of the posterior cusp. Immediately after the cardiopulmonary circulation was weaned, an important bleeding was observed at the pericardial sac coming out from the posterior part of the heart. After visual inspection, the diagnosis of type II left ventricular rupture located on the posterior free wall of the LV was established. Extracorporeal circulation was reinstituted, with aortic clamping and anterograde cardioplegia being applied again. Trauma caused by one of the bioprosthesis posts on the free wall of the LV was established as the cause. Using a self-heart transplantation technique[4], the biological prosthesis was removed and a smaller 27 mm St. Jude Medical mechanical prosthesis was placed (St. Jude Medical, Inc. St. Paul, MN, USA), after combined internal repair with an autologous pericardium patch and external with sutures aided with teflon. A layer of Beriplast was applied onto the wound and external sutures. An intra-aortic counterpulsation balloon was installed prior to exiting the cardiopulmonary bypass. The successful repair of the ventricular lesion was corroborated with no bleeding observed on site. The patient evolved uneventfully, with hospital discharge on the ninth post-operative day. Transthoracic echocardiographies practiced at 3, 6 and 12 months showed no complications or LV pseudoaneurism formation.

Discussion

Since the classic report by Roberts and Morrow[5], three different types of LV rupture associated with mitral valve implantation have been described (Table 1). Type I[6] is characterized by a true separation between the atrium and the LV. Traditionally, it is associated with deficient surgical technique, such as excessive traction or deep resection of the native ring, posterior annular decalcification, too deep placement of sutures for

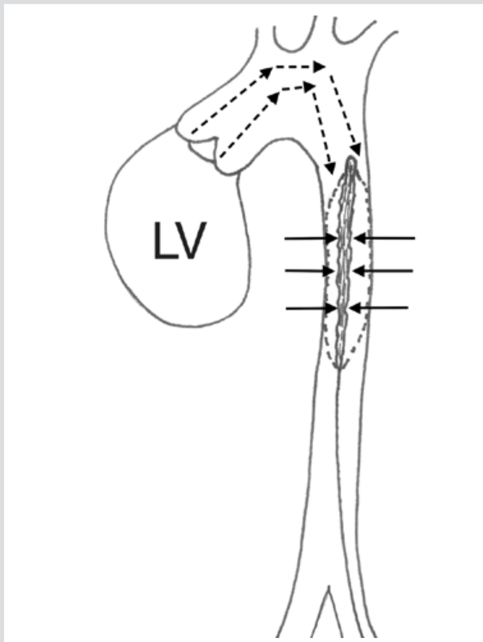

Figure 1. *Depiction of the intra-aortic balloon pump counterpulsation effect. The continuous arrows indicate the inflation-deflation cycle of the balloon, and the discontinuous arrows show the suction effect exerted by the deflation of the balloon. This reduces postcharge and tension in the repair of the LV wall.*

the prosthesis and placement of a prosthesis of a larger size than required. Type II[6] is due to an extremely low resection of the head of the posteromedial papillary muscle, with the resulting lesion of the LV adjacent wall. It also can be due to nailing of one of the biological bioprosthesis legs or posts. Type III is located in an intermediate zone between type I and II, in the posterior medial part of the LV. It is directly related to the "unrolled loop" hypothesis proposed by Cobbs[7]. The supportive structures of the LV posterior wall originate in the same embryologic yoke and form a loop. The external part is composed of longitudinal muscle fibers of the LV posterior wall, and the internal part consists of papillary muscles tied to tendinous cords and to the mitral posterior cusp up to its insertion onto the native ring. Thus, the surgical incision of the posterior valvular elements disrupts this integrity and favors for the loop to "unwind"[8]. The thinnest part in the posterior medial portion of the LV is exposed to opposing forces: the native ring becomes fixed by the mitral prosthesis, and the rest of the ventricle pulls towards the apex simultaneously with each heartbeat. Consequently, the part of the LV under the highest stress is the posterior medial portion, the weakest and thinnest of its tissue architecture[9,10].

Theoretically, a LV pseudoaneurism may develop in the area of previous rupture, as the result of bleeding contained by the surrounding pericardium or extracardiac tissue[11]. None of our cases developed LV pseudoaneurism.

All the described cases were successfully resolved with very different techniques, and the common denominator in all of them was the use of intra-aortic counterpulsation balloon, which is the temporary cardiac aid device currently more widely used. Its use has a positive impact on the parameters of the LV diastolic function through a LV relaxation increase mechanism[12]. The use of intra-aortic balloon pump counterpulsation has been shown to likely be beneficial in this type of cases, since it dramatically reduces postcharge and tension in the repair of the LV wall[2,3] (Fig. 1).

In conclusion, although these are three isolated cases, the use of intra-aortic balloon pump counterpulsation perhaps could facilitate and increase the possibilities of success in the repair of this dreadful and lethal complication. The study of a larger number of patients is needed in order to definitely be able to conclude on the effectiveness of the use of intra-aortic balloon pump counterpulsation in this type of cases.

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