

Surgical Treatment of Mechanical Complications Following Acute Myocardial Infarction. A Case Series

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Abstract

Background: Acute myocardial infarction can result in ischemic, mechanical, arrhythmic, embolic or inflammatory complications. Despite high operative mortality, the lack of an effective and immediate medical alternative makes the surgery repair the mainstay of current management for these patients. Novel surgical approaches are presented to manage these complications.

Mechanical complications presented at the Department of Cardiac Surgery-Tirana University Medical Centre consisted in nine cases during the period January 2008-June 2018: two anterolateral papillary muscle rupture cases (22%), one posteromedial papillary muscle rupture case (11%), two ventricular septal rupture cases (22%), one free ventricle wall rupture case (11%), three chordae tendineae rupture cases (33%), four out of nine patients (44,5%) underwent concomitant CABG intervention. Intraoperator mortality is estimated 11% (one out of nine cases). The Department of Cardiac Surgery-Tirana University Medical Centre is limited only in open surgery techniques for repairing the post myocardial infarction mechanical complications. To our personal view key reasons for these results are conditioned from lack of medical devices, trained staff, reliable short and long outcome data from alternative procedures in order to incorporate thus in our daily practice. Further studies should be undertaken not only to create a precise image of the situation, but also to evaluate the results of the possible changes.

Keywords: Acute myocardial infarction, mechanical complications, papillary muscle rupture, ventricular septal rupture, free ventricle wall rupture, CABG intervention.

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Full Text

Introduction

Acute myocardial infarction can result in ischemic, mechanical, arrhythmic, embolic or inflammatory complications.¹ Mechanical complications include papillary muscle rupture, ventricular septal rupture, acute and subacute free-wall rupture, and right ventricular infarction.² Complications with mechanical defects are associated with poor prognosis.³ Despite high operative mortality, the lack of an effective and immediate medical alternative makes the surgery repair the mainstay of current management for these patients.^{1,4,5} Determinant factors that influence mortality in mechanical complications after an acute myocardial infarction are large time from symptom onset to hospitalization, STEMI - myocardial infarction, female gender, reperfusion delay therapy, high Euro SCORE II, low Left Ventricular Fraction of Ejection (LVFEs) and Renal Replacement Therapy.⁶⁻⁹

The Daggett and David procedures are the two most used techniques used for VSD repairing. All procedures that took place at the Department of Cardiac Surgery-Tirana University Medical Centre consist in Daggett technique even though David is superior to Daggett for early and late survival after surgery.¹⁰⁻¹¹ Apart them, there are presented novel procedures for postinfarction ventricular septal defect repair like: biseptal double

patch and gelatin-resorcinol-formaldehyde glue, CorMatrix¹², transcatheter closure¹³⁻¹⁴, a combination surgical/percutaneous hybrid closure.¹⁵ Current management of papillary muscle rupture, as another mechanical complication of myocardial infarction, include mitral valve replacement or annuloplasty. Efforts are made in using transcatheter procedures as a promising alternative (MitraClip procedure).¹⁶ Treatment of significant mitral regurgitation with MitraClip resulted in significant clinical improvements in a high proportion in the TRAMI (transcatheter mitral valve interventions) cohort study patients after 12 months.¹⁷ Also, it resulted in meaningful improvements in mitral regurgitation severity, function and quality of life measures, and low major adverse events rates.¹⁸

Heart failure remains in Albania a common complication of myocardial infarctions counting 26.6% of the entire sample group of acute myocardial infarction patients.¹⁹ Independent predictors for this occurrence are left ventricular ejection fraction, previous revascularization, peripheral vascular disease, age, sex (male), previous acute myocardial infarction, systolic blood pressure upon admission, and anemia.²⁰ However, there are no specific studies to present the incidence of mechanical

complications, risk factors and current management. Our aim is to present data about post myocardial mechanical infarction cases in the past 10 years (2008-2018) and the approach used for each type, explaining the reasons of choosing those specific procedures.

Main body

Mechanical complications presented at the Department of Cardiac Surgery, University Hospital Centre "Mother Teresa, Tirana consisted in nine cases during the period January 2008-June 2018: two anterolateral papillary muscle rupture cases (22%), one posteromedial papillary muscle rupture case (11%), two ventricular septal rupture cases (22%), one free ventricle wall rupture case (11%), three chordae tendineae rupture cases (33%), all male gender and aged between 55 to 74. *Table 1* shows the surgical procedure used in each case to manage the post infarction mechanical complication.

Four out of nine patients (44,5%) who were operated to correct the mechanical

complication, underwent concomitant CABG intervention: saphenous vein graft (SVG)-obtuse marginal artery anastomosis (3 cases), : saphenous vein graft (SVG)- left anterior descending artery anastomosis (1 case) and left internal mammary artery (LIMA)- left anterior descending artery anastomosis (1 case).

In four patients was performed a replacement of mitral valve despite the mechanical correction: anterolateral papillary muscle rupture and replacement of mitral valve with mechanical valve (two cases), free ventricle wall rupture and replacement of mitral valve with mechanical valve, posteromedial papillary muscle rupture and replacement of mitral valve with biological valve. In all cases the approach was through median sternotomy and left ventriculostomy. In all patients was used, antegrade blood crystalline cardioplegia with ice on the surface. Aortal clamping time varied from 45 to 160 min with a mean of 83.14 min.

Case	Technique
<i>Anterolateral papillary muscle rupture</i>	Replacement of mitral valve with mechanical valve
<i>Two chordae tendineae rupture</i>	P2 quadrangular resection and ring annuloplasty (type of mitral annuloplastic ring Edwards No.32)
<i>Posterior ventricle septal defect</i>	Dacron patch closure of ventricular septal defect (sandwich method) and mitral valve ring annuloplasty (type of mitral annuloplastic ring Edwards No. 28)
<i>P2 chordae tendineae rupture</i>	P2quadrangular resection and ring annuloplasty (type of mitral annuloplastic ring Edwards No. 32)

<i>P2 chordae tendineae rupture</i>	P2quadrangular resection and ring annuloplasty (type of mitral annuloplastic ring Edwards No. 30)
<i>Free ventricle wall rupture</i>	Dacron double patch closure of ventricular septal defect and replacement of mitral valve with mechanical valve
<i>Anterolateral papillary muscle rupture</i>	Partial papillary muscle resection and removal of the abnormal chordae tendineae and replacement of mitral valve with mechanical valve
<i>Posteromedial papillary muscle rupture</i>	Replacement of mitral valve with biological valve
<i>Posterior ventricle septal defect</i>	Dacron patch closure of ventricular septal defect

Table 1: Surgical technique used to manage each case of post myocardial infarction mechanical complication

Discussion

Mechanical complications presented at the Department of Cardiac Surgery, University Hospital Centre "Mother Teresa, Tirana consisted in nine cases during the period January 2008-June 2018: two anterolateral papillary muscle rupture cases (22%), one posteromedial papillary muscle rupture case (11%), two ventricular septal rupture cases (22%), one free ventricle wall rupture case (11%), three chordae tendineae rupture cases (33%), four out of nine patients (44,5%) underwent concomitant CABG intervention. Intraoperative mortality is estimated 11% (one out of nine cases).

Mechanical complications of acute myocardial infarction are rare events but associated to high mortality worldwide estimated over 30%.²¹⁻²² Even though at the Department of Cardiac Surgery, University Hospital Centre "Mother Teresa, Tirana, the mortality is only 11%,

however to our best knowledge this rate is underestimated because of the lack of a follow-up program which will present the short/long-term mortality. So, this value reflects only the intraoperative mortality. In addition, at our department papillary muscle rupture had higher incidence compared to ventricular septal defect (VSD) (33% to 22% respectively), but there are studies that support the otherwise.^{5,23}

Trans-ventricular approach has several disadvantages: increased postoperative bleeding, ventricular malfunction, and ventricular arrhythmia. There is a report about a successful case of repair of posterior ventricular septal rupture via transatrial approach, thus avoiding the complications that can occur due to ventriculostomy.²⁴ Transcatheter VSD closure provides a therapeutic option for selected patients with VSD complicating acute myocardial infarction with

satisfying long-term efficacy. Although the gold standard is still surgical repair the application of this therapy to all patients might not be reasonable, especially when patients are critically ill or have multiple comorbidities. This interventional approach offers such patients the possibility of avoiding a major operation.¹³⁻¹⁴ Combined surgical/percutaneous hybrid closure may be another alternative approach. The hybrid procedure has the theoretic advantages of easier crossing of the defect and better visualization than a fully percutaneous strategy, and conversely obviates the need for cardiopulmonary bypass. Furthermore, the surgeon need not suture into freshly infarcted and structurally poor myocardium.¹⁵

In papillary muscle (PM) rupture complicating the myocardial infarction, valve replacement is recommended generally because of unstable vital signs or technical difficulties with successful repair. However, a case report describes the successful repair of a complete anterolateral PM rupture by using the single PM formation technique with subsequent ring annuloplasty.²⁵ At the Department of Cardiac Surgery, University Hospital Centre "Mother Teresa, Tirana, severe cases presented with complete papillary muscle rupture undergo through mitral valve replacement procedure and partial ruptures through ring annuloplasty. This

choice is conditioned not only as a lack of short and long outcomes data of these procedure, but also as an absence of post operator support devices (extracorporeal membrane oxygenation ECMO, Impella device).

Critical patients with acute ischemic mitral regurgitation post myocardial infarction with persistence of hemodynamic instability after coronary revascularization may benefit from MitraClip therapy acutely with favorable long-term follow-up.¹⁶

Unfortunately, limited evidence is available about MitraClip therapy in patients with acute mitral regurgitation complicating myocardial infarction.²⁶ Department of Cardiac Surgery, University Hospital Centre "Mother Teresa, Tirana is limited only in open surgery techniques for repair the post myocardial infarction mechanical complications. Despite the lack of data, to our view key reasons for these results are conditioned from lack of medical devices, trained staff, reliable short and long outcome data from alternative procedures in order to incorporate thus in our daily practice. However, further studies are needed to have a better image on our current situation and attempts should be made to include contemporary approaches.

Conclusion

Department of Cardiac Surgery, University Hospital Centre "Mother Teresa,

Tirana is limited only in open surgery techniques for repair the post myocardial infarction mechanical complications. To our personal view key reasons for these results are conditioned from lack of medical devices, trained staff, reliable short and long outcome data from alternative procedures in order to incorporate thus in our daily practice.

Despite the rarity of these complications, attempts should be made in incorporating innovative procedures in treating these complications. Furthermore, studies should be undertaken not only to create a precise image of the situation, but also to evaluate the results of the possible changes.

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