
PAPILLARY MUSCLE RUPTURE AS A COMPLICATION OF ACUTE MYOCARDIAL INFARCTION

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Abstract: Papillary muscle rupture is one of the rarest complications, with incidence of 1-5%¹ in patients with acute myocardial infarction (AMI), and usually happens 5-7 days after the initial event.

This complication has a high mortality of 50% in the first 24 hours, often leading to decompensation and pulmonary edema. The acute rupture and the severe dysfunction of the mitral leaflet finally result in a severe mitral regurgitation and in most of the cases leads to cardiogenic shock and death. The competence of the mitral valve is maintained by the actions of the anterolateral and posteromedial papillary muscles, but this mechanical complication occurs dominantly on the posteromedial muscle, with greater incidence of more than ten times compared to the anterolateral one.

Transthoracic echocardiography (TTE) is a diagnostic tool with 65-85% sensitivity in visualizing structural abnormalities of the heart and is the most available and fast method in diagnostic this mechanical complication. Besides the structural abnormalities that can be detected, echocardiography can provide precise assessment of the regurgitant jet through the color doppler and continuous doppler ultrasound. It is very important to follow the guidelines from both the European and the American heart associations that recommend urgent echocardiography in patients that become hemodynamically unstable during or after acute myocardial infarction.

However, the diagnosis of papillary muscle rupture is not always easy because patients are often elderly and frequently diagnosed with a particularly severe clinical presentation, or hemodynamic instability, which are all factors associated with high operative mortality.

The only definite treatment for this condition is the cardiosurgical treatment, which in the last 10 years has an improved success and reduced mortality². Intra-aortic balloon counter-pulsation may be necessary for severely unstable patients, or other mechanical circulatory support devices. Mitral valve repair can be done in patients who have a partial papillary muscle rupture, in case of detachment of the main insertion of a head which still remains fixed to the remnant papillary muscle via muscular bridges, unlike the complete rupture (or rupture of the main head) where mitral valve replacement is the main surgical therapy because complete post-MI papillary muscle rupture generally requires MVR due to the friable infarcted tissue.

We describe a clinical case of a patient with severe mitral regurgitation after acute myocardial infarction and discuss the management for such patients in the current era.

Keywords: acute myocardial infarction, mechanical complication, papillary muscle rupture

1. CASE REPORT

65-year-old patient was hospitalized in a secondary center with AMI, and after applying antithrombotic and anticoagulant treatment, the patient developed melena in the next two days with significant reduction in the erythrocyte and hemoglobin count, and was transferred to our tertiary center for further treatment.

On admission

EKG: sinus rhythm with a heart rate of 101/min, rS form in V3-V4, ST segment elevation in lateral leads and ST segment depression and biphasic T wave in inferior leads.

Laboratory

¹ Burton, L.V. and Beier, K., 2019. Papillary muscle rupture. *StatPearls [Internet]*.

² Fradley, M.G. and Picard, M.H., 2011. Rupture of the posteromedial papillary muscle leading to partial flail of the anterior mitral leaflet. *Circulation*, 123(9), pp.1044-1045.

Hgb	68 g/dL
RBC	2.08 x 10 ¹² /L
HCT	17.7%
PLT	219 x10 ⁹ /L
Glu	19 mmol/L
Urea	24 mmol/L
Creatinine	85 nmol/L
Na	141 mmol/L
K	3.9 mmol/L
CRP	7
Troponin I	864ng/L

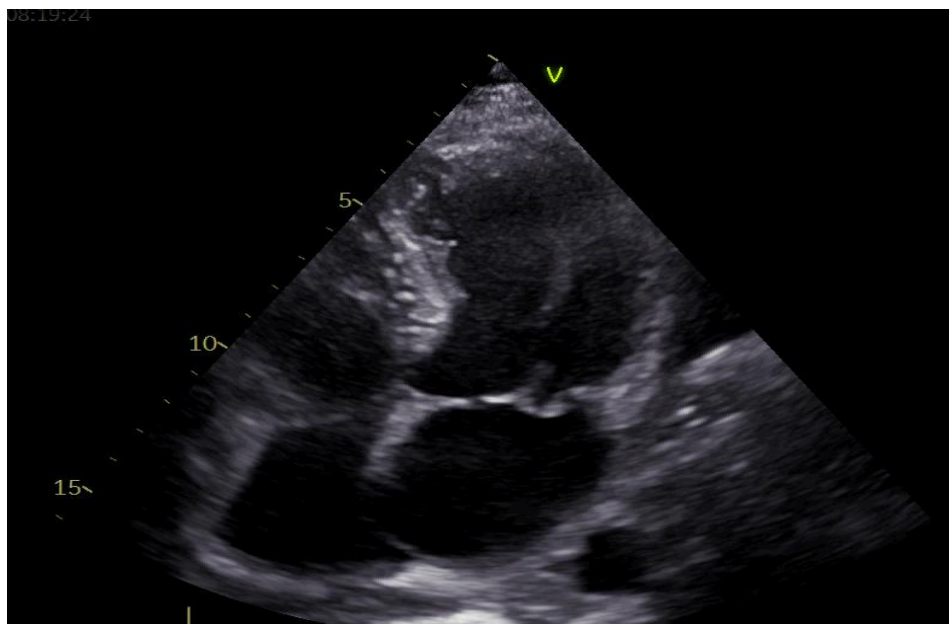
After the initial exam, the patient was substituted for the anemic syndrome and gastroscopy was initiated that showed no active bleeding from the upper digestive tract.

When the patient was stabilized, primary percutaneous coronary intervention (PPCI) was made and one endovascular prosthesis was implanted on the left descending coronary artery and two on the circumflex artery.

Coronary angiography: **pLAD** Stenosis:99%→0% TIMI flow=3→3, Mini Trek Pre-dilatation-Balloon PCI (dim>2/15x10Atm); Resolute Integrity DES-Стент PCI (Dim:2.75/18x16Atm); **pCIRC** Stenosis 99% →0% TIMI flow=3→3, Mini Trek Pre-dilatation- Balloon PCI (Dim 2/15x20Atm); Resolute Integrity DES- Stent PCI (Dim 2.75/18x16Atm); Resolute Integrity DES Stent PCI (Dim: 2.75/18x16Atm);

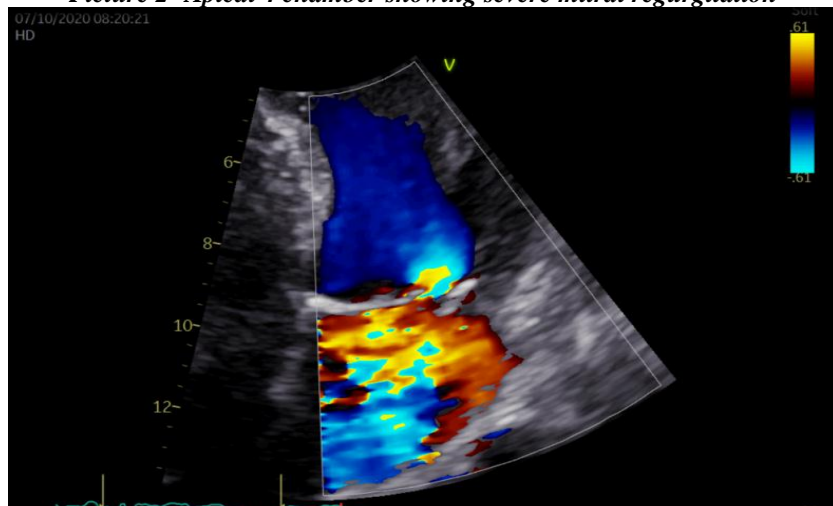
The echocardiographic assessment next day showed preserved left ventricular systolic function with acute severe mitral regurgitation as a result of a flail posterior mitral leaflet due to suspected chordal or papillary muscle rupture.³

Picture 1- Apical 4 chamber view showing flail posterior mitral cusp



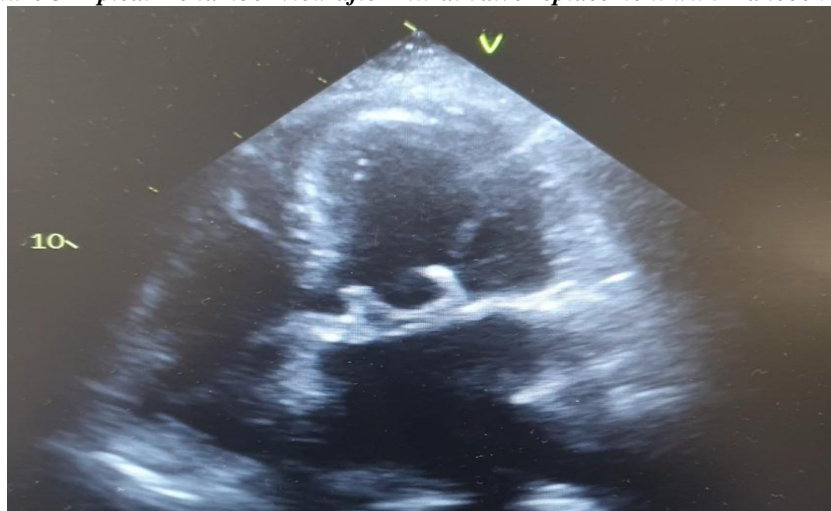
³ Valle, J.A., Miyasaka, R.L. and Carroll, J.D., 2017. Acute mitral regurgitation secondary to papillary muscle tear: is transcatheter edge-to-edge mitral valve repair a new paradigm? *Circulation: Cardiovascular Interventions*, 10(6), p.e005050.

Picture 2- Apical 4 chamber showing severe mitral regurgitation



Immediately after these findings, the patient was transferred to a cardio surgery center for further urgent treatment. After the initial pre-operative preparation, due to the rupture of the posterior mitral muscle, mitral valve replacement was made with a bio prothesis Hancock s.27. Intra-aortic balloon pump was placed because of the reduced left ventricular kinetics until day three after the surgery. Post-procedure, the clinical improvement was immediate, with improved hemodynamics and diuretic-responsiveness. The patient was extubated the day 2 after the procedure with minimal oxygen requirements. Repeat transthoracic echocardiography demonstrated ongoing significant reduction in mitral regurgitation to a mild degree. The patient was hemodynamically stable and after 10 days she was dismissed from hospital with a recommendation for further continuous medical treatment.⁴⁵

Picture 3- Apical 4 chamber view after mitral valve replacement with Hancock 27s.



⁴ Thompson CR, Buller CE, Sleeper LA, Antonelli TA, Webb JG, Jaber WA, Abel JG, Hochman JS. Cardiogenic shock due to acute severe mitral regurgitation complicating acute myocardial infarction: a report from the SHOCK Trial Registry. Should we use emergently revascularize occluded coronaries in cardiogenic shock? **J Am Coll Cardiol.** 2000; 36(3 suppl A):1104–1109.

⁵ Tavakoli R, Weber A, Vogt P, Brunner HP, Pretre R, Turina M. Surgical management of acute mitral valve regurgitation due to post-infarction papillary muscle rupture. *J Heart Valve Dis.* 2002 Jan;11(1):20-5; discussion 26. PMID: 11843502

2. DISCUSSION

Papillary muscle rupture is rare, but can be a fatal complication of the acute myocardial infarction or infective endocarditis. In most of the cases, this mechanical complication appears in the first week after posterior myocardial infarction of the posterior descending artery. The anterolateral papillary muscle is supplied with blood by two coronary arteries (left anterior descending and circumflex) ⁶, unlike the posteromedial papillary muscle who is supplied only by the right coronary artery ⁷. That's why the rupture of the posteromedial muscle is more common because of its single blood supply.

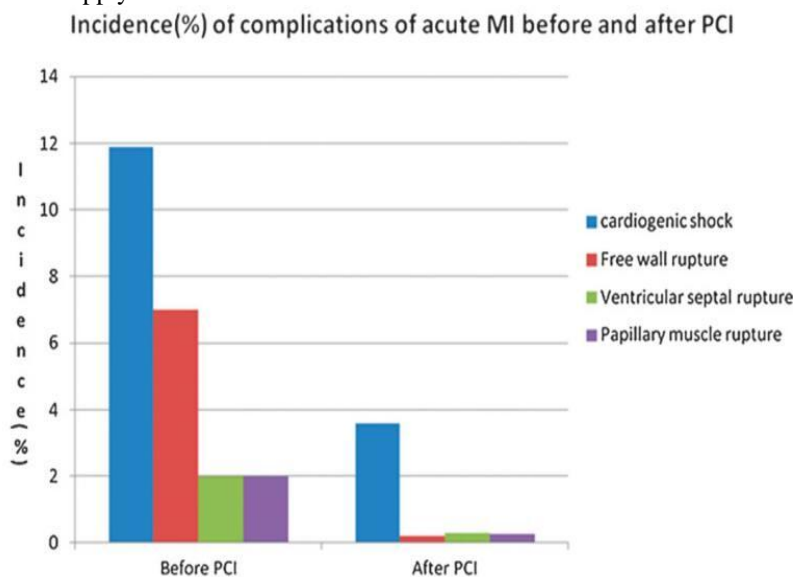


FIGURE 1. Graph comparing incidence of complications of AMI in preperfusion and PCI era. ^{2,3,3,43-45,47,49}

-Bajaj A, J Investigative Medicine 2015; 63:844

Echocardiography is easily available and most important diagnostic modality in early detection of the mechanical complications of myocardial infarction, as well as in providing prognostic information that is important for risk stratification.

The cornerstone of treatment for papillary muscle rupture includes emergency surgical treatment ⁸. Mitral valve replacement is the only definite treatment of this complication, and the urgency of the management is one of the most important factors for better outcome. Previous intraoperative mortality associated with mitral valve repair in these patients was estimated to be 20% to 25% ⁹. More recently, operative mortality from mitral surgery was decreased to 8.7%. In a recent Japanese retrospective observational data of 194 patients diagnosed with papillary

⁶ Schroeter T, Lehmann S, Misfeld M, Borger M, Subramanian S, Mohr FW, Bakthiary F. Clinical outcome after mitral valve surgery due to ischemic papillary muscle rupture. *Ann Thorac Surg*. 2013; 95:820–824. doi: 10.1016/j.athoracsur.2012.10.050.

⁷ Bouma, W., Wijdh-den Hamer, I.J., Koene, B.M. *et al.* Predictors of in-hospital mortality after mitral valve surgery for post-myocardial infarction papillary muscle rupture. *J Cardiothorac Surg* **9**, 171 (2014). <https://doi.org/10.1186/s13019-014-0171-z>

⁸ Nishimura, R.A., Otto, C.M., Bonow, R.O., Carabello, B.A., Erwin, J.P., Guyton, R.A., O’Gara, P.T., Ruiz, C.E., Skubas, N.J., Sorajja, P. and Sundt, T.M., 2014. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology*, 63(22), pp.2438-2488.

⁹ Russo A, Suri RM, Grigioni F, Roger VL, Oh JK, Mahoney DW, Schaff HV, Enriquez-Sarano M. Clinical outcome after surgical correction of mitral regurgitation due to papillary muscle rupture. *Circulation*. 2008; 118:1528–1534. doi: 10.1161/CIRCULATIONAHA.107.747949.

muscle rupture following AMI¹⁰, mitral valve replacement was chosen mainly (90%) for surgical correction of the mitral regurgitation compared to mitral valve repair as a definite treatment. Early diagnosis and treatment of postinfarction papillary muscle rupture will result in improved survival.

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