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Surgical Outcome of Postinfarction Left Ventricular Free Wall Rupture

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Abstract

Background: Left ventricular free wall rupture (LVFWR) is a rare and fatal complication after acute myocardial infarction. Early recognition and aggressive treatment are recommended.

Methods: Between August 1999 and February 2023, 11 patients aged between 64 and 79 years developed LVFWR after acute myocardial infarction (mean interval, 3.5 days). Three patients had active bleeding (blowout-type LVFWR), and the other 8 patients experienced the oozing or sealed state. Eight patients were treated using a sutureless technique with Teflon felt and glue, 2 patients were treated using the primary suture closure technique, and 1 was treated using both the primary suture and the sutureless technique with Teflon felt and glue.

Results: One patient died in the operating room as a result of bleeding. Cardiovascular stability and hemostasis were achieved in the other 10 patients. There were 3 early deaths (all 3 cases as a result of area bleeding; 1 was treated with primary suture, 2 with sutureless glue). Three patients received percutaneous coronary intervention before discharge. All 8 remaining patients survived and were discharged. Three patients were lost to follow-up. The follow-up period ranged from 2 to 97 months, with 4 patients exhibiting New York Heart Association class I symptoms and 1 exhibiting New York Heart Association class II symptoms.

Conclusion: Optimal surgical treatment for postinfarction LVFWR remains controversial. The sutureless technique may be a promising strategy for treating postinfarction LVFWR.

Keywords: Myocardial infarction; heart rupture; surgical procedures, operative

Introduction

Cardiac rupture after acute myocardial infarction (AMI), which includes ventricular free wall rupture (VFWR), septal rupture, and papillary muscle rupture, can result in lethal complications.[1] These life-threatening complications mainly occur within 7 days after MI. Left VFWR (LVFWR) is a rare but catastrophic mechanical complication that can occur after AMI and is associated with high mortality rates.[2] The rupture and subsequent development of cardiac tamponade result in sudden and critical hemodynamic changes. Early recognition and aggressive treatment are recommended; however, LVFWR's clinical outcomes are poorly studied because of the condition's rarity. Here, the author reviews the surgical results of ischemic LVFWR.

Patients and Methods

The author reviewed the charts of 11 patients with LVFWR following AMI between August 1999 and February 2023. The patients' clinical characteristics are outlined in Table I. Their average age was 71.0 years; 7 were men, and

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4 were women. All patients showed clinical signs of cardiac tamponade. The diagnosis was established by bedside monitoring and echocardiography, which showed pericardial effusion with compression of the right ventricle. Cardiac catheterization was not performed. Three patients had been treated with thrombolytic agents and percutaneous coronary intervention for AMI. One patient had undergone surgery for ascending aortic graft replacement and a coronary artery bypass graft in the left anterior descending coronary artery as a result of acute type I aortic dissection and left main coronary dissection a day before.

Table II summarizes the surgical course. A rapid sternotomy was performed in all patients, and clots and blood were removed from the pericardium. Cardiopulmonary bypass was not used when the patient's postevacuation vital signs were stable. Cardiopulmonary bypass was instituted in 2 patients (mitral valve replacement in patient 7; blowout rupture in patient 10), and 1 patient (patient 11) was assisted preoperatively with extracorporeal membrane oxygenation. After the intraoperative evacuation of blood and clots, a tear was discovered in all patients. All had an obvious area of necrosis, with an epicardial hematoma in the infarction area. There was active bleeding in 3 patients; the other 8 showed oozing or a sealed rupture (subacute LVFWR type).

In 2 cases, bleeding from a blowout rupture was repaired using a primary suture closure with pledget reinforcement under cardiopulmonary support, but multiple LVFWRs could not be controlled in 1 patient (patient 7), who died in the operating room. In another patient, a blowout-type rupture was repaired with a primary closure in an active bleeding site and was covered with cyanoacrylate glue (2-butyl cyanoacrylate, so-called

Key Points

- LVFWR is a rare and fatal complication of AMI.
- Early and aggressive treatment for LVFWR is recommended.
- The sutureless patch technique for post-AMI LVFWR is simple and effective.

Abbreviations and Acronyms

AMI	acute myocardial infarction
LVFWR	left ventricular free wall rupture

TABLE I. Preoperative Patient Profiles

Patient	Sex/age, y	Onset of post-AMI rupture[a]	AMI territory	Preoperative percutaneous coronary intervention	Severity of rupture
1	M/71	3 d	Inferior	—	Subacute
2	M/69	7 d	Inferior	—	Subacute
3	M/68	6 h	Anterior	Yes	Subacute
4	F/72	2 d	Anterior	Yes	Subacute
5	F/69	5 d	Anterior	—	Subacute
6	M/75	2 d	Anterior	—	Subacute
7	F/79	0 d	Anterior	—	Blowout + papillary muscle rupture
8	M/70	3 d	Anterior	Yes	Subacute
9	F/72	2 d	Inferior	—	Subacute
10	M/73	1 d	Anterior	—	Blowout
11	M/64	1 d	Anterior	Coronary artery bypass graft	Blowout

AMI, acute myocardial infarction; F, female; M, male.
[a]The mean (SD) onset of rupture post-AMI was 2.5 (1.9) days with a median onset of 2 days.

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"instant glue" or "super glue") applied with 4-cm Teflon felt (Boston Scientific/Meadox Medicals, Inc). This sutureless technique was repeated 3 times, using overlapping patches to ensure coverage of the surrounding infarcted area of the left ventricular free wall. The other 8 patients were treated using a sutureless technique with Teflon felt and glue. They were treated with the 1-patch technique, which is fashioned in such a manner as to be larger than the area of the hematoma and muscle necrosis so that the whole perimeter of the patch lies on the healthy myocardium and the area of the infarction is covered. The patch is usually between 4×5 cm^2 and 5×6 cm^2 in size and is trimmed to an elliptical shape.

Cyanoacrylate glue was purchased preoperatively from general stores. The glue was soaked in an antiseptic solution (CIDEX; Advanced Sterilization Products) for more than 5 minutes. A Teflon felt, herein referred to as the "patch," with 1 side soaked in commercially available cyanoacrylate glue, was placed on the infarcted area of the myocardium. After 2 to 3 minutes, the patch hardened and became hemostatic (Fig. 1). Cyanoacrylate glue is easily hardened and strongly adhesive. It must therefore be handled carefully when used as a glue for a Teflon patch or it may adhere to surgical gloves and the surrounding tissues. The patch must be attached quickly. The attachment is easier to apply to the anterior surface of the left ventricular myocardium than to the inferior surface of the left ventricular wall as the inferior wall is less visible, making it more difficult to confirm the size of the infarcted wall.

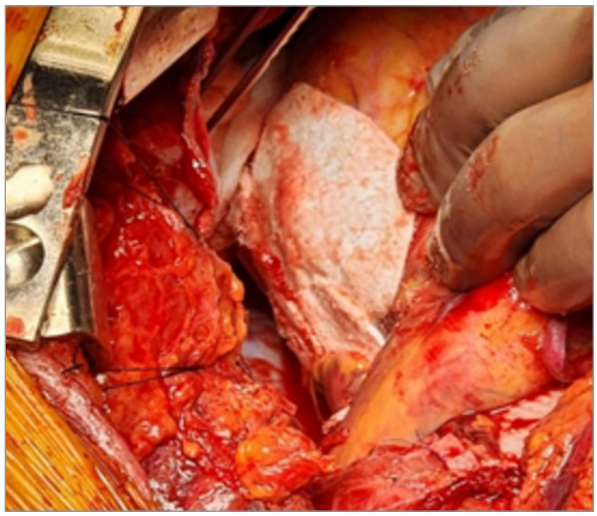

Fig. 1 An intraoperative photograph shows the "patch-and-glue" sutureless technique. A Teflon patch is fixed to the left ventricular wall of patient 11 with synthetic glue.

Results

In LVFWR following MI, the mean (SD) time of symptom onset was 2.5 (1.9) days (median, 2 days) (Table I). One patient (patient 7) died in the operating room because of multiple free wall ruptures at the lateral area of the left ventricle. Preoperatively, this patient was in cardiogenic shock as a result of severe mitral valve regurgitation with papillary muscle rupture following AMI. After mitral valve replacement, multiple ruptures of the lateral area of the left ventricle occurred, and the active bleeding from multiple blowout ruptures could not be controlled (Fig. 2).

Cardiovascular stability and hemostasis were achieved in the other 10 patients. Another 2 early mortalities occurred because of rebleeding (one after 1 postoperative day and the other after 3 postoperative days). Prolonged ventilator support (>3 days) was provided to 3 patients. Three patients underwent percutaneous coronary intervention before discharge. All 8 remaining patients survived and were discharged. At discharge, the left ventricular ejection fraction on transthoracic echocardiographs ranged from 20% to 50% (mean [SD], 40% [9.9%]; median, 38.7%) (Table II). Three patients (patients 1, 6, and 10) were lost to follow-up. The follow-up period ranged from 2 to 97 months, with 4 patients exhibiting New York Heart Association class I symptoms and 1 patient exhibiting New York Heart Association class II symptoms. This last patient had a left ventricular ejection fraction of 30% before discharge from the hospital.

Discussion

Left ventricular free wall rupture and cardiac tamponade occur in 2% to 4% of AMIs and are associated with high mortality rates.[3] Autopsy studies reveal that LVFWR accounts for 5% to 24% of deaths from MI,[3] and the condition occurs up to 10 times more often than papillary muscle rupture or interventricular septal rupture.[4] Left ventricular free wall rupture appears in the first week (usually on the fourth or fifth day) after AMI, although this time frame may vary from a few minutes to more than a month.[3,5-8] It is reported as occurring more often after the first transmural MI.[1,9,10] The average time from symptom onset to hospital admission in this study population was 24 hours, with a maximum onset of 94 hours.[9] Although the time from

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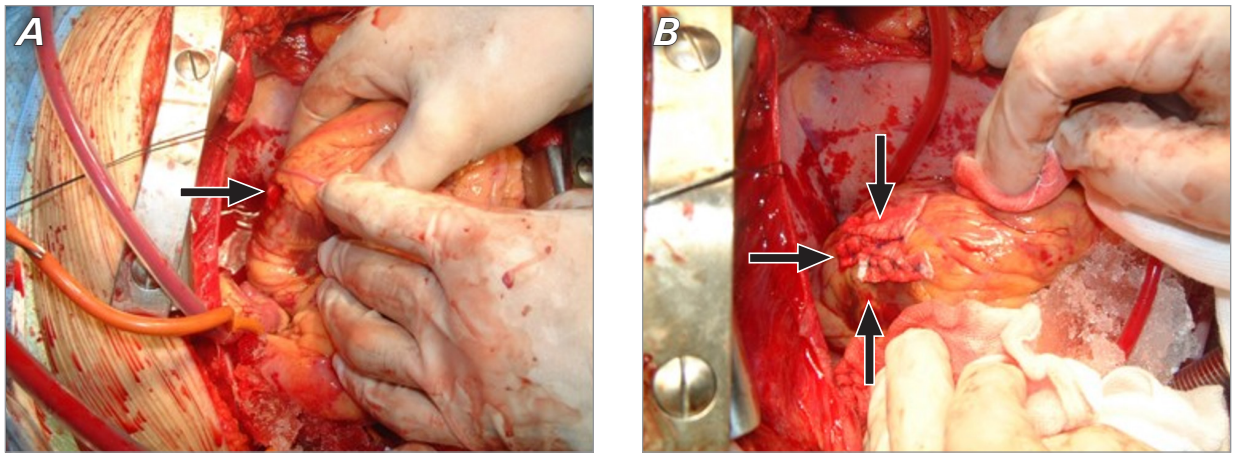

Fig. 2 A) An intraoperative photograph shows a left ventricular free wall blowout rupture (arrow) in patient 7; **B**) multiple repairs are shown, with pledget sutures (arrows) applied to the left ventricular free wall blowout rupture.

TABLE II. Operative Procedures and Results

Patient	Type of rupture	Procedure	Cardiopulmonary bypass or extracorporeal membrane oxygenation	Result	Cause of death	Left ventricular ejection fraction at discharge, %[a]	Follow-up time, mo
1	Subacute	Sutureless patch and glue	—	Survived	—	30	63[b]
2	Subacute	Sutureless patch and glue	—	Death (postoperative day 3)	Rebleeding	—	—
3	Subacute	Sutureless patch and glue	—	Survived	—	40	47
4	Subacute	Sutureless patch and glue	—	Survived	—	40	72
5	Subacute	Sutureless patch and glue	—	Survived	—	40	97
6	Subacute	Sutureless patch and glue	—	Survived	—	50	38[b]
7	Blowout + papillary muscle rupture	Mitral valve replacement + primary suture (multiple)	Cardiopulmonary bypass	Death (operation day)	Intraoperative bleeding	—	—
8	Subacute	Sutureless patch and glue	—	Survived	—	40	91
9	Subacute	Sutureless patch and glue	—	Death (postoperative day 1)	Rebleeding	—	—
10	Blowout	Primary suture	Cardiopulmonary bypass	Survived	—	50	49[b]
11	Blowout	Primary suture + sutureless patch and glue	Extracorporeal membrane oxygenation	Survived	—	20	2

[a]The mean (SD) left ventricular ejection fraction at discharge was 40% (9.9%); the median left ventricular ejection fraction was 38.7%.
[b]The follow-up time refers to the number of months the patient survived.

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AMI to LVFWR diagnosis is usually several days, there is no clear correlation between mortality and the length of this delay.[8] In this study, all blowout-type ruptures occurred within 1 day of AMI, and no subacute late presentations were blowouts (Table I).

Formica et al[8] demonstrated that mortality in patients with LVFWR was not affected by early (5-10 hours) vs late (≥10 hours) presentation; they concluded that hemodynamic status at presentation (cardiac arrest, cardiogenic shock) was the most important predictor of in-hospital mortality. Emergency surgery is the treatment method of choice for LVFWR because conservative treatment has been shown to confer a poor prognosis.[11] Several surgical techniques have been used in the past, such as closing the rupture with a prosthetic patch combined with sutures or resecting the infarcted myocardium, both of which are performed with the use of extracorporeal circulation[11]; a technique using a patch combined with tissue glue emerged around 2008.[10] These strategies are preferred in select patients, mainly when an oozing rupture is observed during surgery. The first attempt to repair an LVFWR with a patch fixed with glue over the area of rupture was reported by Lofstrom and colleagues[12] in 1972, but the Dacron patch loosened soon after the operation, causing the patient's death. In 1993, the first series of patients successfully treated with a sutureless epicardial patch technique was described.[13] Padro and colleagues[13] successfully treated 13 patients with subacute LVFWR using a Teflon patch fixed onto the heart surface with only surgical glue. Matteucci et al[12,14] found that the so-called "patch-and-glue" sutureless technique had a clinically significant protective effect, reducing in-hospital mortality by approximately 40% compared with the suture technique. They reported that the patch-and-glue sutureless technique had a greater protective effect on the oozing rupture type than on the blowout rupture type: The mortality rate associated with the oozing rupture was reduced by approximately 50% compared with the rate for the blowout rupture presentation.[12] The sutureless technique is simple and fast, and it can be done without cardiopulmonary bypass support; it also preserves left ventricular geometry and leaves the necrotic tissue untouched, providing complete hemostasis. Further investigations, however, are needed before this approach can be considered safe and suitable for all types of LVFWR.

Conclusion

Different techniques have been developed for managing LVFWR over the years, but the optimal surgical treatment for this post-MI mechanical complication remains controversial. Although the technical strategy varies, a basic principle that remains unchanged is that surgeons should put stitches in or fix patches to healthy myocardial tissue.

Article Information

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References

1. Misawa Y. Off-pump sutureless repair for ischemic left ventricular free wall rupture: a systematic review. *J Cardiothorac Surg.* 2017;12(1):36. doi:10.1186/s13019-017-0603-7
2. Lachapelle K, deVarrennes B, Ergina PL, Cecere R. Sutureless patch technique for postinfarction left ventricular rupture. *Ann Thorac Surg.* 2002;74(1):96-101. doi:10.1016/s0003-4975(02)03581-6
3. Figueras J, Cortadelas J, Soler-Soler J. Left ventricular free wall rupture: clinical presentation and management. *Heart.* 2000;83(5):499-504. doi:10.1136/heart.83.5.499
4. Vohra HA, Chaudhry S, Satur CMR, Heber M, Butler R, Ridley PD. Sutureless off-pump repair of postinfarction ventricular free wall rupture. *J Cardiothorac Surg.* 2006;1:11. doi:10.1186/1749-8090-1-11
5. Exadaktylos NI, Kranidis AI, Argyriou MO, Charitos CG, Andrikopoulos GK. Left ventricular free wall rupture during acute myocardial infarction. Early diagnosis and treatment. *Hellenic J Cardiol.* 2002;43:246-252.
6. Okamura H, Kimura N, Mieno M, Matsumoto H, Yuri K, Yamaguchi A. Sutureless repair for postinfarction ventricular free wall rupture. *J Thorac Cardiovasc Surg.* 2019;158(3):771-777. doi:10.1016/j.jtcvs.2019.01.124
7. Ohlow MA, Gey EM, Lauer B. Subacute left ventricular free wall rupture following acute myocardial infarction. *Turk Kardiyol Dern Ars.* 2013;41(3):268. doi:10.5543/tkda.2013.90868

http://prime-pdf-watermark.prime-prod.pubfactory.com/ | 2025-02-14

8. Formica F, Mariani S, Singh G. et al. Postinfarction left ventricular free wall rupture: a 17-year single-centre experience. *Eur J Cardiothorac Surg.* 2018;53(1):150-156. doi:10.1093/ejcts/ezx271
9. Varghese S, Ohlow MA. Left ventricular free wall rupture in myocardial infarction: a retrospective analysis from a single tertiary center. *JRSM Cardiovasc Dis.* 2019;8:2048004019896692. doi:10.1177/2048004019896692
10. Dencker M, Tasevska G, Grubb D, Stagmo M, Gustafsson R. Unexpected rupture of the left ventricular free wall rupture in the echo-lab. *Eur J Echocardiogr.* 2008;9(1):92-94. doi:10.1016/j.euje.2007.02.009
11. Bates RJ, Beutler S, Resnekov L, Anagnostopoulos CE. Cardiac rupture—challenge in diagnosis and management. *Am J Cardiol.* 1977;40(3):429-437. doi:10.1016/0002-9149(77)90167-9
12. Matteucci M, Fina D, Jiritano F, et al. Treatment strategies for post-infarction left ventricular free-wall rupture. *Eur Heart J Acute Cardiovasc Care.* 2019;8(4):379-387. doi:10.1177/2048872619840876
13. Padró JM, Mesa JM, Silverstre J, et al. Subacute cardiac rupture: repair with a sutureless technique. *Ann Thorac Surg.* 1993;55(1):20-23; discussion 23-24. doi:10.1016/0003-4975(93)90468-w
14. Matteucci M, Formica F, Kowalewski M, et al. Meta-analysis of surgical treatment for postinfarction left ventricular free-wall rupture. *J Card Surg.* 2021;36(9):3326-3333. doi:10.1111/jocs.15701

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