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A new hybrid sutureless patch repair utilizing chitosan for left ventricle rupture after myocardial infarction: A case report

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ABSTRACT

INTRODUCTION: There are many publications reporting the use of TachoSil sheets for sutureless repair. Trauma doctors have recently reported that chitosan-based sheets can efficiently achieve hemostasis for active bleeding.

PRESENTATION OF CASE: An 85-year-old man was diagnosed with left ventricle free wall rupture that caused cardiac tamponade and cardiogenic shock. Extracorporeal membrane oxygenator (ECMO) was started immediately and surgical repair was planned. Bleeding occurred from a 1-cm tear in the center of the necrotic area in the territory of the left circumflex artery. The tear was treated with a chitosan-based HemCon Bandage. After hemostasis of the myocardium was achieved, the bandage was peeled off and a patch repair was performed using collagen fleece with fibrinogen-based impregnation. His condition subsequently improved. The tracheal tube was extubated and ECMO was removed 2 days after the surgery. One month later, the patient had no complications at his postoperative follow-up visit.

DISCUSSION: To our knowledge, this is the first report of a hybrid patch repair utilizing chitosan-based sheets for a left ventricle rupture after myocardial infarction. Further studies are necessary to evaluate the short- and long-term efficacy of this procedure, and these results must be compared with those of classical surgical repairs.

CONCLUSION: The new hybrid sutureless patch utilizing chitosan was demonstrated as safe, easy and effective.

1. Introduction

We report a case of left ventricle rupture after myocardial infarction repaired successfully with a new hybrid sutureless patch utilizing chitosan. The procedure was performed on the beating heart without cardiopulmonary bypass.

1.1. Clinical summary

An 85-year-old man exhibited chest pain for 2 days and visited our hospital. Acute myocardial infarction was strongly suspected based on ST-segment depression in V2-5 of the 12-lead electrocardiogram. Emergency coronary angiography showed 90% stenosis in Segment 7 of the left anterior descending artery, and Segment 13 of the left circumflex artery was occluded. Urgent balloon angioplasty and implantation of a stent in each site was successfully performed, and the patient was admitted to the coronary care unit. Approximately two days after catheter intervention, he went into cardiogenic shock suddenly and the systolic blood pressure fell to 50 mmHg. To ascertain the cause of the unstable hemodynamics, we immediately performed 2-D echocardiography. The apical 4-chamber view demonstrated severe hypokinesis in the lateral wall with moderate pericardial effusion. Pericardiocentesis revealed bloody effusion, indicating left ventricle free wall rupture that caused the cardiac tamponade and cardiogenic shock. Extracorporeal membrane oxygenator (ECMO) was started immediately and a surgical repair was planned.

The patient was placed in the supine position and the skin was draped. A median sternotomy was performed under general anesthesia and ECMO. Just after the pericardiotomy, pericardial effusion was observed and the hemodynamics improved. We lifted up the heart and identified the left circumflex artery. The territory of the left circumflex artery showed an area of myocardial necrosis that was about 5 × 4 cm. Bleeding occurred from a 1-cm tear in the center of the necrotic area (Fig. 1). The tear was treated with two sheets of chitosan-based HemCon Bandage, 5 × 5 cm in size (Fig. 2). The bandage was applied with manual pressure to prevent blood penetration through the tear for 5 min. The bandage was moistened with saline and then carefully peeled off to inspect the site.

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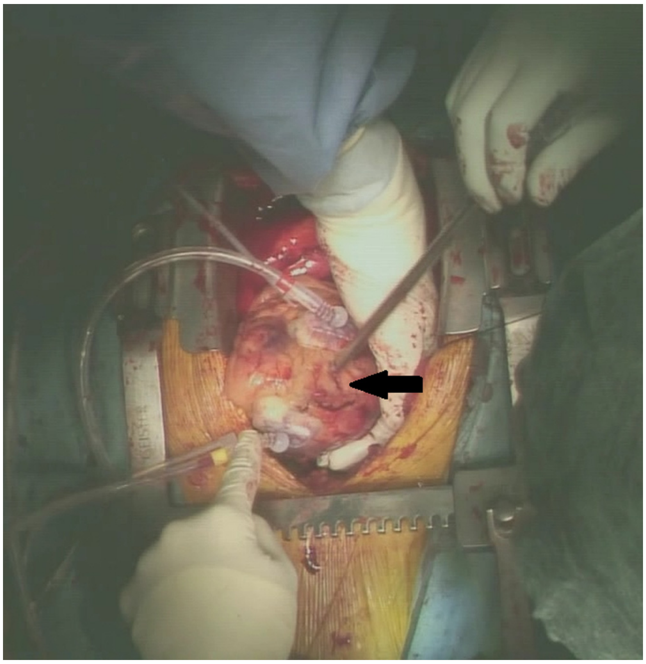

Fig. 1. Operative view of the ruptured left ventricle. The major source of bleeding was from the rupture in the area of the left circumflex artery (black arrow).

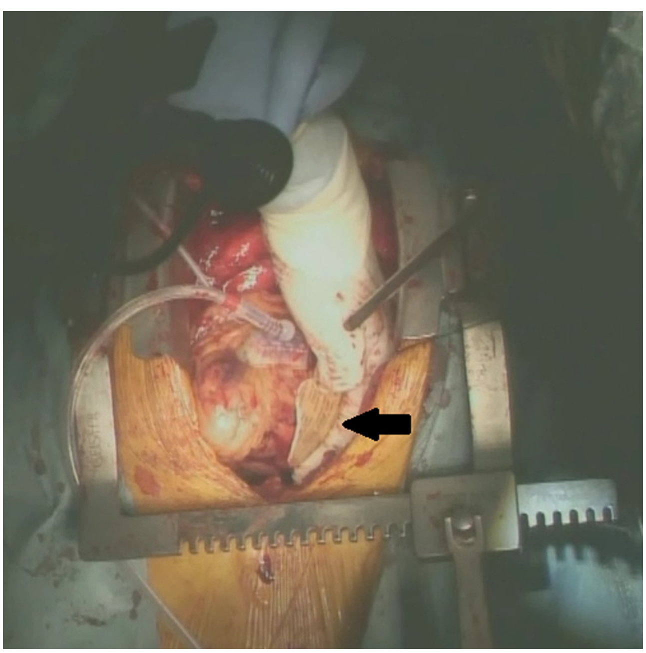

Fig. 2. Operative view of the ruptured left ventricle. The tear was treated with two sheets of chitosan-based HemCon Bandage, 5 × 5 cm in size (black arrow).

After hemostasis of the myocardium was achieved, a patch repair was performed using collagen fleece with fibrinogen-based impregnation (TachoSil; Takeda Pharmaceuticals, Zurich, Switzerland). The tear, including the whole necrotic area, was covered with a sheet (about 5 × 5 cm) of TachoSil and compression was applied for 5 min (Movie 1).

After the surgery, the patient was admitted to the intensive care unit. The tracheal tube was extubated and ECMO was removed 2 days after the surgery. Echocardiography was performed every day for a week and detected no signs of re-rupture or pseudoaneurysm. One month later, the patient had no complications at his postoperative follow-up visit.

2. Discussion

Many surgeons have recently reported that sutureless repair using TachoSil sheets can efficiently achieve hemostasis [1–3]. However, this strategy is not always suitable for ruptures, where the myocardial tear is often large and bleeding is copious [1,4].

Recently, a novel chitosan-based HemCon Bandage has been shown to efficiently control aggressive hemorrhaging from severe traumatic injuries in animal models [5]. Chitosan-based HemCon Bandages is composed of positively charged molecules that attract red blood cells and platelets, thereby, promoting hemostasis [6]. Chitosan-based HemCon Bandages have a stronger capability of hemostasis than others, however chitosan-based HemCon Bandages must not be left in the body.

Comparisons of chitosan-based HemCon Bandages with current available topical hemostatic methods in left ventricular rupture have not been reported. However, there are several advantages in using this technique. Chitosan-based HemCon Bandages provides an easy and rapid method to control bleeding and seal a left ventricular surface.

Success of sutureless repair depends on achieving complete hemostasis. After applying a sutureless patch, the remaining blood from the rupture site may penetrate the adhesive under the sutureless patch and weaken the adhesion between the patch and myocardium. This may cause re-rupture or pseudoaneurysm. Therefore, hemostasis completed before the use of a sutureless patch is helpful for stabilization and can be achieved using chitosan-based HemCon Bandages [7].

We have developed a new hybrid method that combines the use of chitosan-based HemCon Bandages and TachoSil sheets to fully utilize the advantages of both products.

Our report has some limitations. First, the report here describes a single case. Further investigation, including postoperative follow-up in a large number of patients, will be necessary to support our hypothesis. Second, our technique does not address left ventricular aneurysms, which could lead to heart failure and/or thromboembolisms. TachoSil sheets covering the left ventricular surface may complicate a concomitant or subsequent coronary artery bypass graft.

3. Conclusion

To our knowledge, this is the first report of a hybrid patch repair utilizing chitosan-based sheets for left ventricle rupture after myocardial infarction. The procedure was demonstrated as safe, easy and effective. Further studies are necessary to evaluate the short- and long-term efficacy of this procedure, and these results must be compared with those of classical surgical repairs.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Funding

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Ethical approval

The institutional review board in Awaji medical center approved the study.

Consent

We had consent to publish a case report.

Author contribution

Y. Morimoto: study concept, data collection, interpretation, writing the paper.

T. Sugimoto : study concept, interpretation.

F. Haba and H. Sakahira: data collection.

Guarantor

Takaki Sugimoto.

Disclosures

None.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ijscr.2016.07.032.

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