

Surgical Technique

Double Patch Hybrid Technique for Treatment of Complex Left Ventricle Acute Free Wall Rupture

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Abstract

Left ventricle free wall rupture (LVFWR) is a potentially catastrophic complication of acute myocardial infarction (AMI). Despite its incidence has been significantly reduced in the recent era, it still carries a high mortality as it is the cause of up to 15% of all death following AMI. Prompt surgical treatment of subacute (oozing type) LVFWR can prevent a more devastating rupture (blow-out type), thus improving patients survival. Here we report our original hybrid “double patch” technique which combined sutureless and stitched repair to treat complex cases of LVFWR.

Keywords

myocardial infarction; mechanical complications; free wall ventricle rupture

Background

Left ventricle free wall rupture (LVFWR) is a catastrophic mechanical complication of acute myocardial infarction (AMI) [1]. The overall incidence of mechanical complications has been significantly reduced by strategies of primary revascularization, but they still represent a challenging situation with significant in-hospital mortality. Clinical symptoms are often related to hemodynamic instability and sudden onset of pericardial effusion causing cardiac tamponade. Patients suffering LVFWR are, therefore, often referred to cardiac surgeon in emergency without a clear history of previous AMI. Sutureless patch-covering technique has been shown to carry favourable postoperative survival in case of “oozing” LVFWR [2–6] and it is now considered the gold standard approach in such situation. Frequently, however, LVFWR has a more complex morphology and could need a different approach. Here we describe an original hybrid double-patch technique which could be helpful in case of complex LVFWR with a combination of “oozing” and “blow-out” characteristics.

Technique Description

Following US evaluation highly suspicious for post-AMI LVFWR (Fig. 1a), prompt surgical indication should be considered. Following sternotomy, the left ventricle is examined, and if a combined type of cardiac rupture is detected, our technique can be utilized. In these cases, the typical scenario is characterised by (Fig. 1b) a diffuse area of left ventricle infarction (“oozing” type of LVFWR), together with a limited extension of a complete wall rupture (Fig. 1c) (“blow-out” type of LVFWR rupture). When cardiopulmonary bypass (CPB) and cardioplegic arrest are established, the full infarcted area, surrounding the blow-out rupture zone, is identified and covered by a large pericardial patch directly glued with BioGlue surgical sealant (Cryolife, Inc. 1655 Roberts Blvd. NW, Kennesaw, GA 30144, USA) using a standard patch and glue technique (Fig. 2a). At this point the blow-out rupture is identified on the surface of the pericardial patch, and 2 or 3 polypropylene pledgetted-stitches are placed, with the plication of the left ventricle anchored to the pericardial patch and not on the injured ventricular wall, thus obtaining a safe and complete closure of the blow out area (Fig. 2b). Furthermore, a second large pericardial patch is glued on top of the previous patch in order to cover completely the stitched area, obtaining a sandwich-like closure (Fig. 2c). After having completed the surgical procedure, the patient can be weaned from CPB. So far we applied this technique in 5 patients (see Table 1) out of 13 cases presenting with LVFWR in the last 8 years (standard patch and glue technique was used in 4 cases and sutured patch in 1). All patients were treated with emergent procedure and were later evaluated for myocardial revascularization following LVFWR treatment. In all cases we obtained good early outcome without further pericardial bleeding.

Discussion

Diagnosis of LVFWR is the result of combination of hemodynamic instability and sudden onset of pericar-

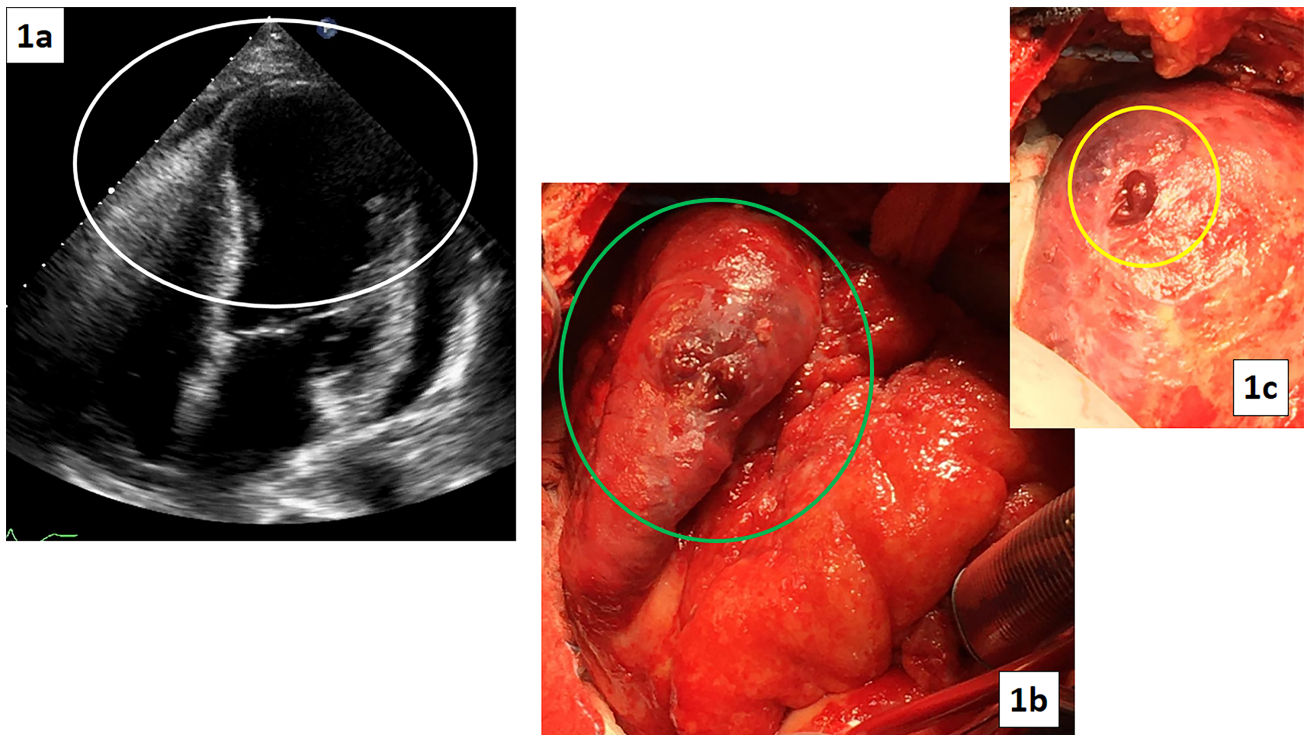


Fig. 1. ECHO evaluation and intraoperative findings. (a) Trans-thoracic ECHO, following pericardial drainage, showing an highly suspicious image of ventricular rupture highlighted by the white circle (non-homogeneous cloth stratification on antero-lateral LVFW). (b) Left ventricular infarction with an “oozing” area of LVFWR (green circle) combined to (c) a bulging apex with a limited area of “blow out” LVFWR (yellow circle). LVFW, Left ventricle free wall; LVFWR, Left ventricle free wall rupture.

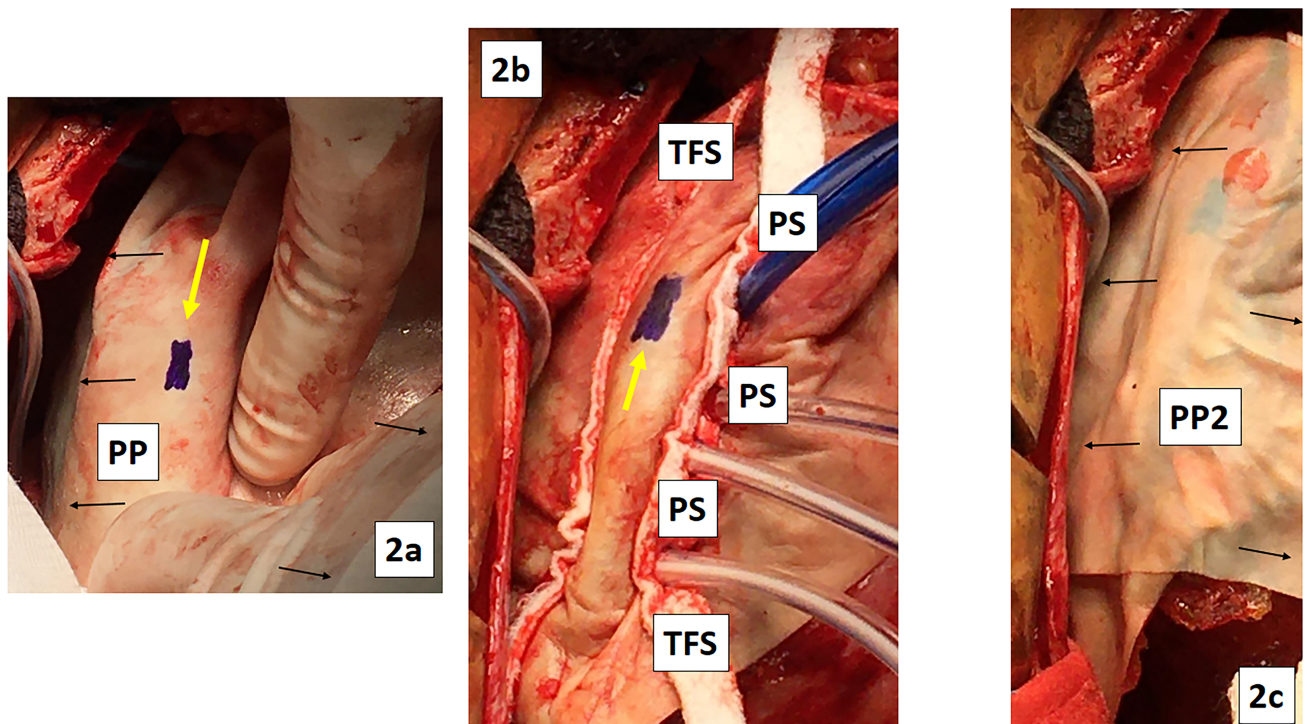


Fig. 2. Highlight of the surgical technique. (a) A first large pericardial patch (PP, black lines) was glued on the free wall of left ventricle covering the entire “oozing” area. (b) Once the area of “blow out” rupture underneath the first patch was identified and marked (yellow line), 2-0 polypropylene U stitches (PS) were placed over Teflon felts strips (TFS) to fully exclude the rupture. (c) Finally a second large pericardial patch (PP2, black lines) was glued on top of the repair obtaining a “sandwich” type hybrid repair.

Table 1. Patients Population.

Patient	Gender	Age	Time from MI	Recurrency	Revascularization	Outcome
#1	M	73	?	NO	PTCA	Died 35th POD
#2	F	70	1–2 weeks	NO	PTCA	Discharged
#3	M	58	3 weeks	NO	CABG	Discharged
#4	F	66	2–3 weeks	NO	PTCA	Died at 6 month
#5	F	74	?	NO	–	Discharged

Table 1- Patients characteristics and outcomes – MI, Myocardial Infarctum; PTCA, Percutaneous trans-luminal coronary angioplasty; CABG, Coronary artery bypass graft; POD, Postoperative day. ?, It was possible to determine the timing of the acute event in only 3 out of 5 patients.

dial effusion causing cardiac tamponade. Patients suffering LVFWR are, therefore, usually referred to cardiac surgery in emergency without a clear history of previous AMI. Prompt surgical treatment is the gold standard in case of LFVWR, but technique of choice is still debated as it could be determined by the type of rupture and therefore by the surgical finding once we open the sternum. Despite higher percentage of “blow up” (acute) LVFWR [3] is reported in literature, the vast majority of published knowledge refers to the “oozing” (subacute) LVFWR, being the “blow-out” rupture frequently lethal and therefore rarely amenable of surgical repair [2]. On the other hand, however, a limited lesion involving entirely the left ventricle wall could be detected; this could change the type classification of LVFWR to “blow up” type. To overcome definition bias in reporting results of LVFWR treatment, a simplified classification has been proposed, dividing rupture into two main types, “sealed” and “not sealed” [7], and this has actually shown to be more useful in terms of evaluation of the surgical plan.

Trans-thoracic echography (TTE)-based diagnosis of LFVWR [8] is not always easy and surgical indication is mainly based on clinical scenario. In case of acute cardiac tamponade, early pericardial drainage is usually attempted, thus frequently obtaining a good resolution of the tamponade. At this point TTE rarely shows a clear blood flow from inside the ventricle to the pericardium, and very often it only shows a non-homogeneous cloth stratification on antero-lateral LVFW (see Fig. 1), probably associated with regional abnormality of left ventricle contractility. History of recent symptoms of chest pain (even in case of a misdiagnosed AMI) could help the surgeon’s choice and decide for surgical indication. All our patients were indeed referred to us in emergency following sudden hypotension and TTE evidence of cardiac tamponade. Prompt surgical repair is mandatory as second-stage rupture is often fatal.

Concerning surgical technique to treat LVFWR, the first reported sutureless patch and glue technique reported by Padró *et al.* in 1993 [9] has gained diffuse popularity, due to favourable results reported [3–6]. The risk of placement surgical stitches near or within an infarcted area is well known in cardiac surgery, and it is the main reason for delaying the surgical procedure in acute post AMI period. As a matter of fact, despite being still reported in literature [10],

higher mortality was reported using the stitched technique [3]. Our technique combines the advantage of sutureless coverage of infarcted area to the safer stitched suture of a full-wall lesion. The peculiarity of our technique is, indeed, the placement of suture on top of the patch, thus obtaining a good anchorage on the glued patch and not on the infarcted tissue. The second patch (sandwich repair) further increases the safety of the repair reducing the risk of bleeding recurrence. Surgical technique, of course, always has to be adapted to the peculiar clinical and anatomical condition and, therefore, our original technique should be probably limited to LVFWR particularly complex with an area of full-wall lesion (namely blow out type of rupture). Regarding this, the recently proposed new classification of LVFWR [7] seems to be helpful in standardizing the type of lesion and also the appropriate technique to be used.

Sutureless patch and glue technique has also been proposed without the utilization of cardiopulmonary bypass (CPB) thus obtaining an off-pump repair [2,4], claiming for reduced peri-operative risks. Risk of re-rupture in off-pump repair, however, seems not negligible [2,6]. In our experience we routinely use CPB to increase surgical accuracy during pericardial patch gluing in all cases of LVFWR, and as a matter of fact we manage to achieve a 0% recurrence of significant bleeding. CPB also allowed a complete unloading of the left ventricle, which has been clearly indicated as a critical issue in LVFWR treatment, especially in the acute phase which is the usual scenario requiring surgical treatment [11]. Rare case of “chronic” LVFWR are indeed intraoperative findings during cardiac surgical procedures for concomitant indication (i.e., surgical myocardial revascularization).

Conclusions

In conclusion, despite sutureless patch technique seems to be the best option for a treatment of oozing type of LVFWR, in case of sealed [7] LVFWR cases with complex pathogenesis, on the other hands, it seems there is a need for a different approach to optimize the outcomes. Each patient experiencing LVFWR should be accurately evaluated, as we could face different anatomical morphology and risk of

re-rupture is still reported with all technique described [2]. In case of concomitant area of complete erosion of ventricular wall, patch and glue technique alone could not achieve satisfactory results. Therefore, some additional surgical gesture seem advisable. In this particular scenario, the hybrid double-patch technique we describe here seems to give a further protection against recurrence of acute bleeding and unfavourable outcomes as it allows a reinforcement of the disrupted area at first step and a safely suturing at second step thus combining sutureless and sutured techniques advantages.

Author Contributions

PT: conceptualization, methodology, investigation, resource, writing and editing. CM: conceptualization, methodology, investigation. MM: methodology, writing and editing. GM: conceptualization, methodology, investigation. SP: methodology, supervision. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

In accordance with the rules n. 3/C.d.A./0145 of the Institutional Ethics Committee, ethical approval for this study could be waived. Informed written consent signed by the patient.

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Conflict of Interest

The authors declare no conflict of interest.

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