

Off-Pump Repair of a Post-Infarct Ventricular Septal Defect: How Safe Is the Hamburger Procedure With Oximetry Guidance?

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Abstract

We are reporting an off-pump technique for the surgical closure of a post-infarct ventricular septal defect (VSD). Our case report describes the case management of a 75-year-old man, who underwent the Hamburger procedure for the closure of his apical VSD. We are showing that oximetric guided off-pump posterior-anterior septal plication is a safe and effective method for closing post-infarct VSD in hemodynamically unstable patients in the absence of TOE.

Keywords: Post-infarct ventricular septal defect; Hamburger procedure; Oximetry; Guidance

Introduction

Ventricular septal defect (VSD) is an infrequent mechanical but portentous complication following myocardial infarction. VSD was first described by Latham in 1846 [1, 2]; it is known to develop in approximately 1% of cardiac arrest survivors after acute myocardial infarction (AMI) [3] and generally occurs 1 week after the acute event [4]. Medical management alone is lacking and surgical intervention is usually the only option. Assorted guidelines for surgical techniques have been described, requiring the use of cardiopulmonary bypass (CPB). The 30-day mortality ranges from 23% to 42% [5-7]. The development of shock is the most important predictor of mortality. Persistence of class IV cardiogenic shock in VSD is associated with 100% mortality [8]. VSD, characterized by hemodynamic compromise, is treated by intra-aortic balloon pump (IABP) followed by early surgical repair [9].

Recently, an off-pump closure technique called the Hamburger procedure was performed as an alternative to open procedures that require CPB and ventriculotomy [10].

The aims of our presenting case were to describe how a post-infarct VSD may be repaired without CPB and to highlight the importance of shunt measurement using oximetric methods for VSD closure in the absence of TOE.

Case Report

A 75-year-old patient arrived at a province hospital with an AMI and was treated with thrombolysis. Two hours after his admission to the cardiology unit, the patient suffered cardiac arrest and cardiopulmonary resuscitation was performed for 30 min. He was transported to the intensive care unit (ICU) and intubated for further management of his condition. During his hospital admission, he underwent angiography, which showed a distally occluded left anterior descending (LAD) artery and rest coronary arteries with no critical stenosis.

A week later, it was noted that he had a pansystolic murmur and transthoracic echocardiography (TTE) using a Vivid 7 Pro confirmed a 2.5 cm antero-apical VSD, an akinetic ventricular apex, Qp/Qs 6.33, and an ejection fraction of 20%. Because of agitation upon awakening, the patient underwent a brain CT, which showed an ischemic shock, however, without neurological semiotics.

To manage his hemodynamic instability, inotropes were added, an IABP was inserted and diuretics and nitrates were commenced. Due to deterioration, 2 weeks after his admission, the patient underwent an off-pump Hamburger post-infarct VSD repair in an emergency base and in the absence of TOE (as the only TOE was out for repair), under the guidance of oximetry measurements.

VSD closure was assessed using the ratio of the volume of pulmonary flow (Qp) and systemic flow (Qs) for shunt quantification.

In our case, before intervention, the aortic blood oxygen saturation was 99%, mixed venous blood oxygen saturation was 61%, the left atrial blood oxygen saturation was 99%, and the pulmonary artery blood oxygen saturation was 92%. The ratio Qp/Qs was approximately 6.33.

After median sternotomy, the heart was approached in order to perform a posterior-anterior septal plication in the use of

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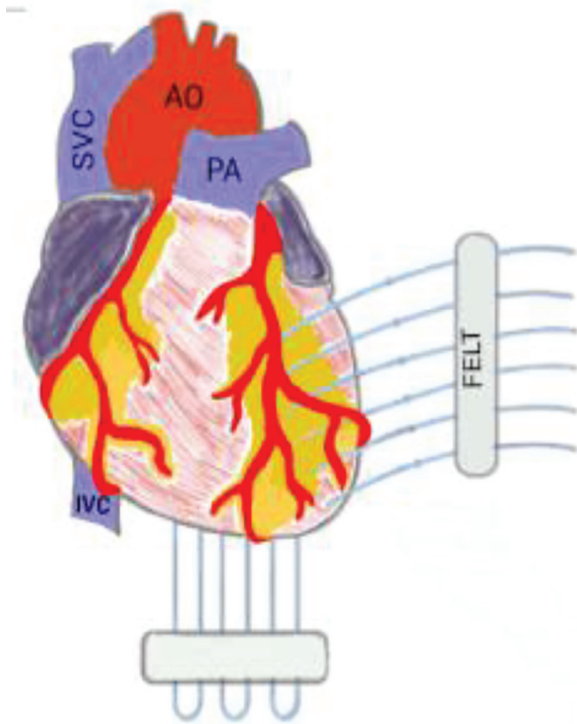


Figure 1. Diagram of the heart demonstrating suture position for the Hamburger procedure. AO: aorta; PA: pulmonary artery; SVC: superior vena cava; IVC: inferior vena cava.

four double-armed teflon felt sutures.

The teflon strip was preloaded with sutures; then, starting from above and aiming for the anterior part of the septum, the needles were passed through the posterior (inferior) interventricular septum and then through the second teflon and back again where they were tied smoothly. The sutures run close to the LAD to ensure plication of the thicker left ventricular wall [5] (Figs. 1-3).

During intervention, new oximetric measurements were made showing great improvement in the shunt size as flow ra-

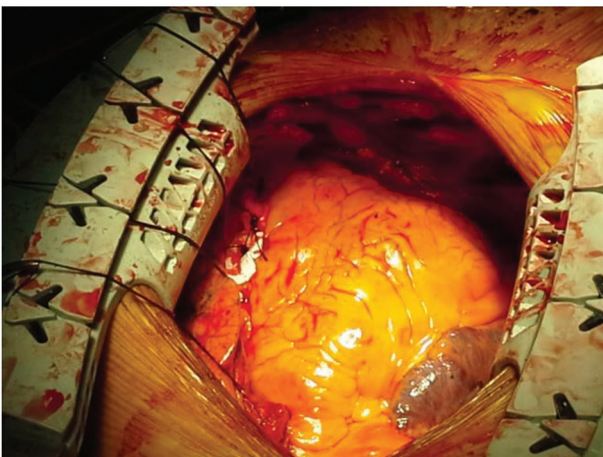


Figure 2. Sutures running just lateral to the LAD.

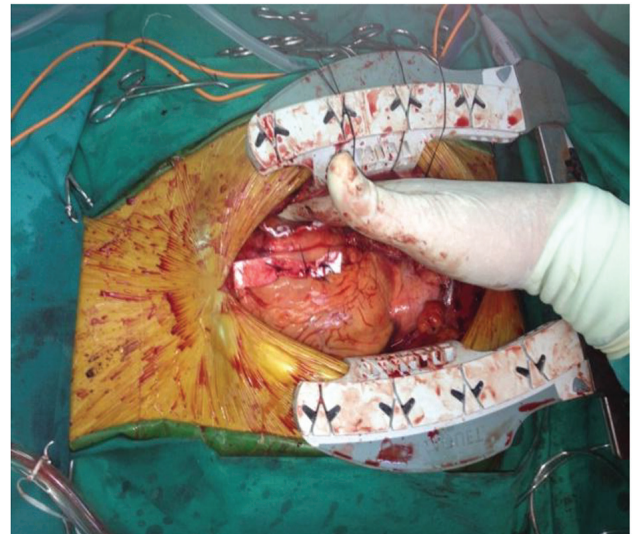


Figure 3. Needles through the teflon strip.

tio Q_p/Q_s was less than 2.0 after the last sutures were made.

Soon after surgery, the patient began to improve and his inotropes were discontinued. During his 1-month follow-up, the patient was found to be asymptomatic and mobilizing independently. A year later, the follow-up showed the patient to be well and a defibrillator was inserted according to the guidelines.

Discussion

During intervention, new oximetric measurements were made showing great improvement in the shunt size as flow ratio Q_p/Q_s was less than 2.0 after the last sutures were made, which results from the following $Q_p/Q_s = (SatAO - SatMV)/(SatLA - SatPA) = (99 - 70)/(99 - 84) = 1.93$.

Normally, this ratio is 1 as the volume of blood that is pumped to the lungs (Q_p) is equal to the volume of blood that is pumped to the body (Q_s). In patients with left-to-right shunts, the Q_p/Q_s ratio is greater than 1. In general, a Q_p/Q_s ratio of 1.5 or less is considered a small shunt; a Q_p/Q_s ratio of 1.5 - 2.0 is considered a moderate shunt; and a Q_p/Q_s ratio of more than 2 is considered a large shunt. The Q_p/Q_s ratio can be calculated if the blood oxygen saturation is known for the mixed venous return, pulmonary artery, left atrium, and aorta. The formula is $Q_p/Q_s = (SatAO - SatMV)/(SatLA - SatPA)$, where $SatAO$ is the aortic blood oxygen saturation, $SatMV$ is the mixed venous blood oxygen saturation, $SatLA$ is the left atrial blood oxygen saturation, and $SatPA$ is the pulmonary artery blood oxygen saturation.

Conclusion

The Hamburger procedure was a competent method for the repair of a post-infarct VSD. By bringing the two ventricles close using teflon supported plication sutures, the defect al-

most vanished.

As the Hamburger procedure is a short time off-pump technique, potential sequelae of CPB were eliminated. As the urgent treatment of this patient was of paramount importance, the use of this procedure proved to be more beneficial compared to the alternative longer, more complex open patch repair requiring CPB and ventriculotomy.

Although the right way is to repair the VSD under CPB and under TOE to exclude residual shunt, in this case, we attest the importance of the use of oximetry in the absence of TOE in guiding VSD closure when the Hamburger procedure is utilized. Extra sutures were added to the initial ones under the guidance of oximetric measurements so as to ensure that a satisfactory closure was achieved. Several days later, TTE was used in the post-operative period in order to show that there was no residual VSD prior to discharge.

The Hamburger procedure is a useful alternative method for antero-apical post-infarct VSD repair. In this particularly unstable case, the Hamburger procedure proved to be the best choice, so it may be an accepted, useful and valuable technique in similar cases.

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