



Benefits of delayed revascularization following ligation of anterior descending artery after a stab wound

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Abstract

Penetrating cardiac trauma often results in death. However, in rare cases when patients survive, there is almost always a need for damage control by artery ligation. Following that, revascularization is recommended as soon as possible. The extent to which revascularization is effective has not yet been studied and agreed upon. A 24-year-old man with a penetrating stab wound to the heart and left anterior descending (LAD) artery received primary life-saving treatment with artery ligation and was then referred for revascularization. Nonetheless, the patient did not consent to coronary artery bypass grafting (CABG) and was discharged against medical advice with ejection fraction (EF) of 20%. He returned three months later due to chest pain and heart failure, then underwent revascularization which increased the patient's EF to 45% and significantly improved the symptoms. Although CABG revascularization is recommended as soon as possible after main coronary arteries are ligated, our patient showed that such patients benefit from delayed revascularization surgery and that they should not be deprived of its benefits only because of the long time passed.

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Introduction

Cardiac trauma (both blunt and penetrating) often results in death (1). Despite numerous articles about managing a blunt injury to the heart, the literature on management of penetrating cardiac trauma is scanty, probably due to the high mortality rate of this injury. When the patient survives a penetrating cardiac trauma in rare cases, the patient will be rescued by coronary artery bypass grafting (CABG) revascularization within the first few hours to repair the injuries (2).

We report a patient that could not undergo immediate CABG revascularization after coronary trauma repair. Three Four months later, the patient developed severe cardiac failure following left anterior descending (LAD) injury and underwent delayed repair and CABG. Accordingly, all studies recommend the quickest LAD repair and CABG (2-4).

To the best of our knowledge, no study has yet examined the question how much time there is to repair penetrating cardiac trauma after LAD ligation and whether the patient benefits from delayed revascularization surgery. This is the first case report that presents the effects of delayed coronary

Key point

Patients with ligation of coronary artery benefit from delayed revascularization surgery and that they should not be deprived of its benefits only because of the long time passed.

repair on cardiac function.

Case Presentation

The patient was a 24-year-old man with penetrating trauma to the chest and a stab wound to the anterior part of the chest in a fight. The patient was immediately referred to general hospital and immediately underwent thoracotomy by a general surgeon due to hypotension shock. It was observed that the heart was cut in the interventricular septum at the junction of proximal and mid segments of LAD, and it was ligated accordingly. Then the patient referred to Shahid Modarres hospital. Angiography showed distal LAD had no blood flow and echocardiography showed ejection fraction (EF) of 20%.

After consultation with a cardiac surgeon, revascularization with CABG was planned for the patient, however as the patient was being prepared for surgery, he developed severe and persistent fever up to 40°C and

then had septic shock due to pneumonia caused by stab wound infection. The patient was treated with antibiotics and surgery was not permitted. After about 20 days, the patient left the hospital against medical advice, and continued medical treatment for heart failure. After about three months, the patient presented to the hospital with severe heart failure symptoms and chest pain, was scheduled to have CABG surgery after angiography. The patients underwent CABG three months after LAD ligation. After opening the sternum, severe adhesions were observed in pericardium, which were gradually released. Cardiac pulmonary bypass (CPB) was employed and the left internal mammary artery was anastomosed to LAD distal to the ligation site. After surgery, chest pain was resolved, the patient's EF increased to 40%-45% within two weeks, and heart failure symptoms resolved.

Discussion

Penetrating cardiac trauma is potentially fatal and has much higher mortality rate than tamponade or coronary heart injuries.

An extensive review of over 15 years on penetrating cardiac trauma by Kaljusto et al (5) showed that penetrating cardiac trauma is usually fatal. Case reports showed less than 10% of chest injuries lead to cardiac injury and even less to coronary injury (6).

In our patient, LAD was damaged by a stab wound. A retrospective study of 532 autopsy reports revealed that LAD is the most affected artery (7), which leads to death in most cases, and therefore few articles are available on it. Most of those who survive, often survive through emergency thoracotomy and ligation of the injured artery (2).

In almost all survivors, a general surgeon has been able to successfully control the damaged blood vessels through thoracotomy or sternotomy (1). Our patient was fortunately near the referred hospital, the general surgeon was available, and saved the patient's life. Surgery and ligation are the method of choice for treating damaged and ruptured coronary arteries (4). Coronary ligation is associated with a mortality rate of 75% due to cardiac ischemia (8). In such cases, it is better to refer the patient to a center with cardiac surgery for CABG revascularization after life saving measures. According to a study, sending cardiac surgeons to distant hospitals with a takeaway kit to trauma centers for revascularization concurrently or with a short delay did not improve the results due to the need for special equipment (9). Revascularization is best to be conducted in the centers specialized for cardiac surgery (3).

The most commonly injured artery in thoracic injuries is LAD, which is because of its anatomical position (10).

Surgical options for patients with rupture of coronary artery include ligation or revascularization, which are selected based on patient's condition and location (2). LAD closure affects perfusion in more than half of the

left ventricle. The survival of these patients is improved by CPB and revascularization performed by a cardiac surgeon.

Revascularization can be conducted with total arrest or off-pump coronary artery bypass (OPCAB) (10, 11). In rare circumstances, coronary angiography and stenting can be used if the rupture of the coronary artery is partial and the patient is stable (2). Ligation saves the life of patients with sharp trauma to the chest, whose arteries are either directly or indirectly damaged and cut (2, 10). CABG is the appropriate treatment after ligation (10).

When the coronary arteries are blocked, depending on the location and severity of stenosis, the patient may suffer from angina pectoris or myocardial infarction, or even heart failure sometime later (2).

In a review study by Christensen et al, almost all patients with coronary trauma developed angina pectoris (12). Therefore, all stable patients with a chief complaint of chest pain, ECG signs of myocardial infarction, or increased cardiac enzymes should undergo coronary angiography (2). The decision about whether to have revascularization after ligation depends on the amount of remaining ventricular muscles affected by the coronary cut (2). Trauma to proximal segment of main coronary arteries leads to extensive infarction, leading to intractable heart failure and fatal arrhythmia. Revascularization, which is CABG in these patients, is indicated (2). Damage control strategies include ligation of the artery, revascularization and rewarming of the patient. Coagulopathy should be managed and then revascularization should be performed if necessary (8).

Trauma to distal segment of main coronary arteries and most secondary coronary arteries such as diagonal, obtuse marginatus or acute marginal arteries are treated with ligation (13). Ligation of such traumas may lead to minor infractions in the affected areas, which often does not lead to significant cardiac dysfunction (8).

In our patient, EF dropped to 20% after the ligation of proximal segment of LAD artery.

In the case reported by Abu-Hmeidan et al, they had to ligate distal LAD as a result of trauma, and the left ventricular function remained 60% immediately after surgery. However, transthoracic echocardiogram in a follow-up four weeks later revealed EF reduced to 25% and wall motion abnormality was observed in the apical and apicolateral regions and the patient received anti-heart failure medication (2).

Another case reported by Marcio had an artery cut following trauma to the proximal and middle segments of LAD, which decreased EF to 22%, and single photon emission computed tomography (SPECT) scan revealed no viable tissue 20 days later and the patient received maintenance medical treatment (13).

In our patient, 120 days after LAD artery ligation, the patient underwent CABG revascularization, which increased EF from 20% to 45% and significantly improved

the patient's symptoms.

Conclusion

Our patient is the first to show that patients benefit from delayed revascularization and should not be denied the benefit of surgery only because of the long time passed.

It is recommended that cardiac muscle viability be investigated through modalities such as thallium 201 SPECT (13), or cardiac MRI (10) in patients who suffer trauma to main coronary arteries regardless of the time of trauma. If the heart muscles are non-viable, patients should be monitored and receive medications, however if the muscles show viability, they will benefit from CABG and must undergo revascularization.

Authors' contribution

MBM is the head of the surgical team who managed this complication. ZAA and HGH were a member of the surgical team and helped in data collection. RBM was the anesthesiologist. SAM had a major contribution to the literature search and drafting of the discussion. HGH drafted the manuscript and provided administrative, technical, and material support. ZAA and MH edited the final draft. All writers contributed to editing the final draft and approval of the manuscript.

Conflicts of interest

None of the authors has any conflict of interest.

Ethical issues

Written informed consent was obtained from the patient for publication of this report (ethical code #IR.SBMU.RETECH. REC.1399.677). Besides, ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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