



Post-trauma “abrasive” right ventricular rupture without mediastinitis early post-CABG. Is the Robicsek closure technique necessary for all elderly patients?

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ABSTRACT

INTRODUCTION: Right ventricular (RV) rupture with mediastinitis, is a very rare but extremely dangerous (even fatal) complication, following CABG surgery.

PRESENTATION OF CASE: In this paper, we present the case of a post-trauma (after fall) RV rupture (without mediastinitis) in a patient who had undergone cardiac surgery several days ago. The cause of the rupture proved to be a broken bone piece from the lower sternal edge.

DISCUSSION: RV rupture post-operatively caused by broken bone pieces or bone dislocation may occur through two mechanisms: either penetration of the RV, or through the “sandpaper effect”. In order to prevent the rupture, we should be able to recognize patients with aggravating factors (age, weight) and choose intra-operatively a suitable closure technique.

CONCLUSION: We propose that the technique that could prevent such ruptures is the Robicsek technique.

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1. Introduction

Right ventricular (RV) rupture is a well-described and widely documented complication, following endocarditis, trauma or infection,^{1–5} with high mortality rates, especially post-trauma (13–17%).⁶ The existence of a previous sternotomy, proves to be a factor that increases the mortality (mostly due to pericardial adhesions).^{6–8}

2. Case report

A 76-year-old overweight male was diagnosed with coronary artery disease (80% stenosis at the left main and two-vessel disease). The chosen approach was surgical revascularisation (LIMA-LAD, SVG-OM1; Left internal mammary artery to left anterior descending and saphenous vein graft to obtuse marginal) via standard sternotomy. The patient was stable post-operatively, and his recovery was satisfying, with no complications reported, leading to his discharge, 6 days after the procedure.

Two weeks after his discharge, the patient visited our hospital for his routine follow-up. At his arrival, he accidentally fell on the floor, with the most impact stress being absorbed by his chest and sternum. Post-fall management involved chest X-rays, laboratory assessment and an ECG, with no findings. The only noted symptom, by the patient, was an exacerbating cough, with no blood in sputum.

In the next few hours, the patient became hemodynamically unstable; signs of cardiac tamponade were observed, such as distended neck veins, indicating high CVP (central venous pressure), low BP (blood pressure) and distant heart sounds, presenting typically as Beck’s triad. Chest X-ray repetition revealed widening of the mediastinum. An ultrasound was also performed and revealed a huge pericardial effusion.

The patient was immediately transferred to the operating room. After sedation, re-opening of the existing sternotomy was required in order to assess the situation and identify the causes of the patient’s shock. Sternal click in the xiphoid process was also observed.

Intra-operatively, we were faced the following findings:

- i. A pulsatile bleeding jet, through a tear on the right ventricle (6–7 cm), caused by a detached sharp piece of sternum bone (Fig. 1).

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Fig. 1. Sternum bone found penetrating the heart.

- ii. The piece's origin, was obviously the lower sternal edge, adding lacerations during its course to finally spearing the RV.
- iii. The tear was 0.5 cm close to the LAD and the LIMA, and the fact that it was parallel to them (although not having damaged them), made the repair extremely difficult to be achieved.

Although the bone fragment was removed, initial attempts for tear restoration without CPB were unsuccessful, due to the friability of tissues and the site of rupture. CPB was initiated and a repair with a pericardial patch and CABG distally of the rupture with a vein graft were decided. However, due to the friability and damage of the surrounding tissues, it was ultimately impossible to repair the rupture.

Finally, despite our surgical efforts to repair the tear and the team's efforts to maintain hemodynamic stability, the bleeding was such, that led to the most unfavorable outcome.

3. Discussion

Cardiac bleeding after a tear at the heart muscle, following a blunt trauma is a rare but severe condition, usually associated with high mortality. Age and body weight prove to be aggravating factors.⁹ Aged patients are more prone to osteoporosis or lower bone density, making bone fractures easy to occur and difficult to mend. Overweight patients (with previous sternotomy) carry an extra risk as the integrity of the skin and subcutaneous tissues could preclude extensive sternal bone movements making mechanical RV erosion unlikely. In such cases, extra care must be advised in order to avoid accidents, which may cause wound disruption, leading to inoperable cases.

A right ventricular rupture is very difficult to successfully operate on, as proven in several cases.² When the rupture is also characterized by several abrasions, the complexity of the damage caused, has proven fatal. The case is strengthened when the patient has recently undergone cardiac surgery as the sternum may have become tender and thereby more prone to damage, leaving the heart more exposed. An important aspect that should be taken into consideration is the "sandpaper" effect, where the actual damage to the heart muscle is not caused by penetration of the bone piece, but damage and inflammation due to the extensive movements of the free bone piece.¹⁰

As far as prevention is concerned, we are led to the assumption that the method of sternal closure in such cases should be chosen very carefully. The use of more wires (>9), has better outcomes in patients with pre-operative factors, such as diabetes mellitus, renal insufficiency and chronic obstructive pulmonary disease.¹¹ Literature also indicates that aged and overweight patients have better

outcomes, and should, eventually, be managed with the Robicsek technique, in order to avoid wound disruption.¹²

The gold standard of sternotomy closure technique is the integrity of the sternum. Nevertheless, this integrity depends on static and dynamic elements in apposition: the holding power of the sternal sutures and the compactness of the sternal body on one side, and the strain exerted by the traction of the respiratory muscles and also the intrathoracic pressure fluctuation, on the other.¹³

During the early postoperative period, an impact injury to the sternum can produce traction forces that may lead to wires cutting the bone. The Robicsek weave technique ensures the integrity of the reunited sternotomy, preventing fracture and detachment of piece of the sternum because forces of the horizontal sternal wires are acting on the vertical weave suture wires.

In our opinion, surgeons should more often perform the Robicsek technique, as it may also act as a useful precaution for any future traumas etc. According to this, we propose that the possibility of a future trauma or patient groups more prone to injuries or falls, should be considered as an indication for the Robicsek technique.

Splicing of the myocardium is more difficult to achieve in patients who have recently undergone surgery than in cases of patients with a healthy myocardium or who had undergone surgery in the past. Should RV rupture occur a number of years post-operation, it may not cause tamponade, and the patient may be saved by an operation to repair the damage.^{6–8} This is because pericardial adhesions formed after a sternotomy, may prevent cardiac hemorrhage and protect against cardiac tamponade.¹⁴

4. Conclusion

In conclusion, a minimal sternum trauma during the initial post-operative period could cause dislocation of bone pieces and, subsequently, laceration to the heart. The severity and the high mortality of this complication, creates the need for prevention, especially as far as the closure technique is concerned. The Robicsek closure technique in certain patients could prove lifesaving.

Conflict of interest

Nothing to declare.

Funding

Nothing to declare.

Ethical approval

Written informed consent was obtained from the patient's next of kin for publication of this case report and case series and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Haris Georgiou, Vasileios Patris, and Kostas Soultanis were involved in data collection. Niki Lama and Orestis Argiriou were involved in writing the paper.

Key learning points

- Sternal trauma in recently operated-on patients with median sternotomy can lead to fatal consequences, through sternal fracture.
- A rather common complication is the ventricular rupture, due to sternal fragments.
- The bone fragment can tear the ventricle, an effect described as “sandpaper effect”.
- The ventricular rupture, can be, promptly diagnosed when signs of cardiac tamponade are observed, and confirmed by chest x-rays and echocardiogram.
- The Robicsek technique provides better integrity of the sternum and protects against such complications.

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