

## Surviving shot through the heart: Management in two cases

Fraz Anwar Siddiqui,<sup>1</sup> Jamal Kabeer,<sup>2</sup> Syed Shahabuddin<sup>3</sup>

### Abstract

Penetrating cardiac injuries after gunshot are usually fatal and are very challenging to manage for surgeons even in fully-equipped centres. Such injuries can cause ventricular septal defect (VSD) or cardiac tamponade depending upon the distance, direction and velocity of the bullet. Stable patients can be subjected to investigations like computed tomography (CT) to avoid unnecessary intervention, but unstable patients should be rushed to the operating room. We discuss management in two cases of traversing bullet injury to the heart. In the first case, traumatic VSD was significant, requiring closure on cardiopulmonary bypass (CPB) along with repair of right and left ventricular injury. In the second case, only the repair of right and left ventricles was performed without CPB. They both had traversing bullet injury through the heart.

**Keywords:** Gunshot injuries, Cardiac trauma, Ventricular repair.

### Introduction

Direct cardiac injuries after gunshot to the heart are mostly fatal and at times are extremely difficult to manage even in a fully equipped medical setup.<sup>1</sup> However, there are several reports of survival depending upon the mechanism of firearm injury. Mostly it affects the right ventricle and can cause ventricular septal defect (VSD) in 1-5% of cases.<sup>1</sup> Decision of surgical intervention depends upon the clinical situation of patient. Some of the important factors in decision-making are cardiac tamponade, haemodynamic instability, trajectory of the bullet and haemopericardium. We report two cases of similar penetrating cardiac injury with differential surgical strategies depending upon the impact of the bullet.

### Case Report

The first case was a 35-years-old man who had sustained a gunshot injury to his anterior chest while lying in his bed on top of the roof of his house. He started to bleed and was immediately taken to a nearby hospital where a tube thoracostomy was done on the left side and haemothorax was drained. He was then brought to our hospital where he

<sup>1</sup>Section of Orthopaedics, <sup>2,3</sup>Section of Cardiothoracic Surgery, Department of Surgery, Aga Khan University Hospital, Karachi.

**Correspondence:** Syed Shahabuddin. Email: syed.shahab@aku.edu



**Figure-1:** Path of the bullet can be traced.

was investigated and computed tomography (CT) showed the presence of bullet behind the left ventricle. He remained stable during his stay in the emergency department (ED). After admission to the special care unit, he gradually developed shortness of breath, oliguria and was unable to maintain desirable oxygen saturation even with supplemental oxygen. An urgent surgical intervention was planned. In the operating room, median sternotomy was performed followed by pericardiotomy and removal of blood clots along with posteriorly lying bullet. A right ventricular bullet wound anteriorly and a left ventricular wound posteriorly was identified. An intraoperative transoesophageal echocardiography confirmed presence of VSD with left to right shunt. Cardiopulmonary bypass (CPB) was established. Both ventricular wounds and VSD were repaired. The patient remained haemodynamically stable and no complication was reported thereafter.



**Figure-2:** Closure entry wound can be seen.

The second case was that of a 48-years-old man who presented at the ED with history of sustaining a stray bullet to his chest and without realising the event he continued to drive and fainted. He received initial resuscitative management at some nearby hospital and was then brought over to us. He was stable haemodynamically and on examination an entry wound was found medial to left nipple close to midline on the left side with no exit wound. He was investigated and on CT scan was found to have haemopericardium and metallic bullet posterior to the heart. A pre-operative transthoracic echocardiography showed mild pericardial effusion. In view of the bullet trajectory and presence of pericardial fluid, he was planned for surgical intervention. A similar approach as described above for the first patient was used and the findings were haemopericardium, rent in pericardium, entry wound over the right ventricle with overlying thrombus and an exit wound posteriorly in the left ventricle with bullet lying freely in the pericardium posteriorly. An intra-operative transoesophageal echo did not show intra-cardiac defect. Since there was no intra-cardiac defect, CPB was not used. After evacuation of pericardial haematoma and removal of the foreign body (bullet), right and left ventricles were repaired with pledgeted prolene sutures (Figures-1 and 2). However, to repair the left ventricle posteriorly deep pericardial retracting sutures and Trendelenberg position was utilised as in off-pump coronary surgery to keep haemodynamics stable. The post-operative course was uncomplicated.

## Discussion

This report highlights the importance of mechanism, distance and velocity of bullet and patients can survive traversing bullet through the heart, provided the velocity is low. In both cases, there was no exit wound. The bullet travelled through right ventricle, septum and left ventricle lying posterior to the heart in the pericardium. However, the magnitude of the problem was different. In the first case there was significant right to left shunting through VSD and the patient started desaturating after initial period of stability. VSD was repaired on CPB, while in the second case only ventricular repair was required without CPB. Direct firearm injury to the heart is usually fatal. A study revealed death of 71% patients after penetrating cardiac damage who presented with unstable vitals.<sup>2</sup> Missile injuries affecting cardiac shadow can cause myocardial injury in 62% cases.<sup>3</sup> The knowledge regarding mechanism of injury and investigations like echocardiography and CT scanning can be helpful in diagnosis and clinical decision-making in stable patient.<sup>4</sup> However, unstable patients should be shifted to the operating room without delay as emergency thoracotomy wherever necessary may decrease mortality.<sup>2</sup> These patients

should be managed ambitiously as they can present with cardiac tamponade. Cardiac laceration is common in patients with sharp penetrating injury.<sup>4</sup> Surgical approach is indicated in penetrating ventricular injury and VSD.<sup>1,5</sup> If the patient is vitally stable, then workup can be done to trace the path of the bullet and plan specific surgical management or decide to manage conservatively.<sup>6</sup> Both of our patients were stable and underwent pre-operative workup including CT scanning and pre-operative transthoracic echocardiography. This helps plan surgery and approach through median sternotomy with CPB on standby.<sup>7</sup> Median sternotomy provides better exposure for penetrating injuries of heart and patient can be put on CPB if required. In both of our cases we used median sternotomy to approach the heart and one of them did require CPB. Dacron pledget suturing can be used to repair the heart. Mattress suturing is done for repair near the coronary arteries. VSD can develop after cardiac injury and it can result in left to right shunt.<sup>1</sup> Large VSD should be repaired urgently, but if the patient is stable it can be delayed to allow formation of fibrotic tissue which makes suturing easy<sup>1</sup> or even facilitates device closure. Follow-up after surgery is necessary as these patients can also develop valvular damage and coronary artery disease.<sup>8,9</sup>

## Conclusion

The cases indicate that the patient with traversing bullet injury can survive if the velocity is low. The magnitude of the problem may be variable depending upon the intra-cardiac damage and individualised management strategy should be used.

## References

1. Sugiyama G, Lau C, Tak V, Lee DC, Burack J. Traumatic ventricular septal defect. *Ann Thorac Surg.* 2011;91:908-10.
2. Ivatury RR, Rohman M, Steichen FM, Gunduz Y, Nallathambi M, Stahl WM. Penetrating cardiac injuries: twenty-year experience. *Am Surg.* 1987 ;53:310-7.
3. Poston RS, Sloane RW Jr., Morgan BR, Smith DC, Smithson JB, Hickey MS. Elective removal of an intramyocardial bullet. *South Med J* 2001 ;94:464-6.
4. Aksoyek A, Tutun U, Babaroglu S, Parlar AI, Ulus AT, Katircioglu SF. Penetrating cardiac injuries. *Ulus Travma Acil Cerrahi Derg.* 2007 ;13:135-41.
5. Chapman AR, Wilkie S, Regan L. Not just a toy: accidental cardiac injury from an air rifle. *Eur J Cardiothorac Surg.* 2012;42:750.
6. Sullenberger LE, Rohrer MJ. Images in clinical medicine. Shot to the heart. *N Engl J Med.* 2003 ;348:2634.
7. Gao JM, Gao YH, Wei GB, Liu GL, Tian XY, Hu P, et al. Penetrating cardiac wounds: principles for surgical management. *World J Surg* 2004 ;28:1025-9.
8. Lundy JB, Johnson EK, Seery JM, Pham T, Frizzi JD, Chasen AB. Conservative management of retained cardiac missiles: case report and literature review. *J Surg Educ.* 2009;66:228-35.
9. Aubert S, Neto OS, Pawale A, Dreyfus GD. Late mitral valve regurgitation after bullet wound to the heart. *Ann Thorac Surg.* 2006;82:737-9.