

## Penetrating cardiac injuries 10 year experience

Cemalettin Aydın<sup>1</sup>, Kadri Ceberut<sup>2</sup>, Y. Metin Aksoy<sup>3</sup>,  
Halil Basel<sup>4</sup>, Ekrem Bayar<sup>5</sup>

### ABSTRACT

**Objective:** To evaluate clinical findings and surgical interventions and their results in the patients referred to our hospital with cardiac injuries. Penetrating heart injury is potentially a life-threatening condition due to cardiac tamponade or exsanguinating hemorrhage.

**Methodology:** The data of 20 patients undergoing surgical intervention due to penetrating cardiac injury between 2001 and 2010 were retrospectively evaluated. In this series of 20 patients all were male between the ages of 14-65 years, with a mean age of 33.2±14.15 years.

**Results:** Age interval of the participating patients was between 14 - 65. Eighteen of these patients were diagnosed with right ventricular injuries while two were diagnosed with left ventricular injuries. All the diagnoses were established with clinical examination, direct radiograph, CT, echocardiography and ECG. Four of the patients admitted in emergency service were in agony, four were in shock, and six presented with hypotensive hemodynamic, and four with stable hemodynamic. Right anterior thoracotomy was applied to four patients in agony in the emergency service. Two of these patients died. None of other patients died. All the postoperative patients were followed with echocardiography. Post - pericardiotomy syndrome was detected in one of the patients.

**Conclusion:** Our experience shows that early diagnosis and immediate surgical intervention are the main factors affecting patient survival after penetrating heart injuries. Penetrating cardiac injuries have high mortality. This rate may be 80% in those patients in agony. Emergent intervention in emergency services for the patients under emergent conditions may be life- saving.

**KEY WORDS:** Cardiac injury, Cardiac tamponade, Ventricular injury.

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1. Cemalettin Aydın MD  
Bezmi Alem Vakif University Department of Cardiovascular Surgery
2. Kadri Ceberut MD  
Community Hospital of Tokat
3. Y. Metin Aksoy MD  
Community Hospital of Tokat
4. Halil Basel MD  
Bezmi Alem Vakif University Department of Cardiovascular Surgery
5. Ekrem Bayar MD  
Medical Park Hospital Department of Cardiovascular Surgery,  
Turkery.

Correspondence:

Halil Basel, MD,  
Email: hbasel@mynet.com

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### INTRODUCTION

Physicians have been interested in cardiac injuries since ancient times. Cardiac injury was described in Homer's Iliad. Penetrating thoracic injuries were reported by Edwin Smith Papyrus in 1700 BC.

The first attempt at repairing a cardiac injury was by Cappelen in 1896. He repaired a laceration of the left ventricle and ligated the distal LAD artery, but the patient died in the immediate postoperative period. The first successful attempt is credited to Ludwig Von Rehn in following year, when he repaired a wound of the right ventricle in 1897.<sup>1</sup> Hill was the first to successfully repair a stab wound to the left ventricle in 1902. Pool in 1912 also collected additional cases and his own series and fully

described surgical techniques in the management of heart injuries, concluding that the treatment of cardiac wounds should be surgery. Beck in 1942 pointed to the necessity of sparing ligation of proximal coronary arteries in wounds adjacent to these structures.<sup>2,3</sup>

The clinical courses of the individuals vary from the time for referring to the trauma center, the size of the injury, the availability of the cardiac tamponade, intravascular volume loss associated agony to stable status. Although it is life saving to immediately intervene the patient in the scene in case of non – cardiac injuries, it is of great importance to immediately transfer the patient to the hospital, and to establish a rapid diagnosis, and go for surgical intervention immediately.

### METHODOLOGY

Data including age, sex, emergency condition, injury types, examination histories, operations, surgical procedures, and post operative follow up of the 20 patients presenting with penetrating cardiac injury, referred to the emergency service of our hospital between the years 2001 and 2010 were retrospectively evaluated.

All the patients were categorized in four groups considering their clinical conditions as suggested by Ivatury et al from their admission to the emergency service.<sup>2</sup> The patients without any vital findings, and unconscious, and in agony were involved in the 1<sup>st</sup> group (four patients), and those with half conscious and whose superficial pulse blood pressure might not be measured were included in the 2<sup>nd</sup> group (six patients), and those patients whose open blood pressure was 80 mm Hg or below with conscious were included in the 3<sup>rd</sup> group (six patients), and those patients with stable vital findings were involved in the 4<sup>th</sup> group (four patients). All the patients were post operatively followed for one year.

Repair of ventricular wounds were accomplished with mattress suture of 3-0 polypropylene tied over Teflon or pericardial pledgets. The first mattress suture was placed in the middle of wound in the larger wound (Figure 1). Atrial wounds were controlled by

placing a finger into the defect. Subsequent repair was accomplished with running 5-0 Prolene placed in a pursestring manner. Larger atrial wounds were controlled by placing a satinsky clamp. Subsequent repair was accomplished with running 5-0 polypropylene. The patients were taken to the cardiac intensive care unit postoperatively. All survivors had a two-dimensional echocardiography before discharge and at follow up two months after discharge.

### RESULTS

There were 17 male 3 female and the mean age of the patients was 33.2±14.15 (the youngest patient was 14 and the oldest was 65). All the patients presented with penetrating stab injuries which were caused by other persons. All these patients were taken to the hospital by the emergency team on the emergency and first aid ambulance. As suggested by Ivatury et al,<sup>2</sup> those patients were categorized under four groups considering their clinical conditions when accepted in the emergency service (Table-I).

Endotracheal intubation, volume replacement, chest intubation as required for all the patients were immediately performed and the patients were taken to the operation room, afterwards. 1<sup>st</sup> and 2<sup>nd</sup> group patients were diagnosed by considering their clinical course, and other methods were ignored. In order to support the diagnosis in the 3<sup>rd</sup> and 4<sup>th</sup> group patients CT or echocardiography was employed. Right anterior thoracotomy was applied to three patients in the 1<sup>st</sup> group. One of these patients died in the emergency service. The death of this patient was due to hypovolemic shock. The other patient underwent operation after ruling out the cardiac tamponade and response to resuscitation in a control way. Four out of five patients in the 3<sup>rd</sup> and 4<sup>th</sup> groups presented with extended pericardial shadow in the PA lung graph (40%). In all the patients (50%), on the other hand, voltage criteria were low in ECG. Other than the patient who died due to hypovolemic shock all the patients presented with cardiac tamponade findings. The patients were subjected to either right or left antero – lateral toracotomy as required, cardiac tamponade was eradicated by pericardiotomy.

Table-I: Ivatury classification.

<i>Group</i>	<i>Sayi</i>	<i>Clinical Status</i>
1	4	Unconscious, No vital sign, agoni
2	6	Mid Unconscious, philiphorm pulse, no tension arteriel
3	6	Whether tension arteriel 80mm/Hg' or low, Conscious
4	4	Stable, tension arteriel 80mm/Hg' diagnosed intraoperatively

Bleeding due to cardiac injury was controlled with 6/0 or 5/0 atraumatic propylen sutures with pledget after finger pressure procedure.

All the patients were subject to endotracheal intubation, as well as fluid replacement. Twelve patients were exposed to injuries from left 6<sup>th</sup> costa, two from left 5<sup>th</sup> costa and six from the junction of 6<sup>th</sup> costa with sternum and the peripheric regions. Following the first intervention in the emergency service, all the patients were subject to emergent operation. Seven patients (35%) were applied with left anterior thoracotomy, three (15%) with right anterior thoracotomy, and 10 (50%) of the patients underwent median sternotomy, as well. Those patients subjected to median sternotomy were operated by being connected to the heart - lung pump. Two patients (10%) presented with intercostal arterial laceration in addition to cardiac injury. Two patients (10%) presented with left ventricular injury, while 12 patients (60%) presented with right ventricular injury, while four (20%) patients presented with right atrium injuries and two (10%) patients with left atrium injuries (Table-II). 6/0 propylen sutures were employed in the cardiac repairs. All the postoperative ecocardiographies were normal. Two patients (20%) were diagnosed with post pericardiectomy due to high temperature after 15<sup>th</sup> days, angina pectoris, respiratory distress, high sedimentation, and detection of pericardial frotman, and the appropriate treatment procedure was applied. Three weeks later, those patients without any complaints were evaluated as to be normal as a result of the echocardiography. The mean hospitalization period for all the patients was 14 (7 - 21) days.

## DISCUSSION

Survival in case of penetrating cardiac injuries may vary from the size of the injury, conscious first aid, the duration until the take of the patient to the emergency service, the first resuscitation, operation requirement and existence of cardiac tamponade. Approximately 10% of the cardiac injuries are those penetrating into the thorax.<sup>4</sup> Despite being low in

Table-II: Locations of the cardiac injuries.

Location	No of injured cardiac chamber	%
Right ventricle	12	60
Left ventricle	2	10
Right Atrium	4	20
Left Atrium	2	10

penetrating thorax injuries, 50% of the total mortality arises from cardiac injuries.<sup>2,3</sup>

It was reported that the etiological cause of cardiac penetrating injuries was related to stab injuries more than 75%.<sup>4-5-6</sup> That the gun short injuries were low in our country may be associated with the fact that such cases were not taken to the centers in the given time. We did not encounter any gun short injuries cases in our retrospective study.

Severe complications may develop following the operation. These include the coagulopathy, sepsis, encephalopathy, arrhythmia, and myocardial ischemia. Coagulopathy and encephalopathy are often fatal.<sup>5</sup> The site of injury in case of penetrating injuries to the fore location of thorax, the response of patient to the immediate fluid support, and the fullness in the neck veins despite the hypotension, and the deep heart percussion should be considered as penetrating cardiac injuries (Beck's Triad).

Moreno et al observed that tamponade existence in either right or left ventricle increased the survival rates in case of stabbing and shooting.<sup>6</sup> The survival rates in the patients with cardiac tamponade were 73% but 11% in the patients without cardiac tamponades.<sup>6-7-8</sup> Other than four patients, 16 individuals who survived presented with cardiac tamponade findings in our study group. The high survival rates of our patients may be related to that fact.

Due to their anatomical localization, right ventricular and left ventricular respectively were among the penetrating cardiac injuries.<sup>5,7</sup> The common view on the incision to be performed for the operation is the left anterolateral toracotomy, as well. In the centers in which the routine cardiac surgery is performed, median sternotomy is also applied.<sup>5,7</sup> Even if the entry is the right side, the left toracotomy should be preferred rather than right toracotomy. When



Fig-1: Intra operative view of the repaired right ventricle.

required, the sternum is incised; it may be extended to the right side. It is suggested that the simple suture, when required Teflon or pericard supported and patch be employed for myocardial repair.<sup>5,8,9</sup>

The trauma cases still continue to be the most important cause of death among the young population<sup>2</sup>. 50% of the trauma cases die on the spot, 60% of those cases who were taken to hospital died within the first four hours, and approximately 80% of the patients who were subject to appropriate treatment procedures survived.<sup>5,6,10</sup> Cardiac injuries among the thorax penetrating injuries were approximately 10%<sup>5</sup>. However, despite this low death rate, cardiac injuries account for approximately 40% of the deaths due to the thorax injuries.<sup>6,11,12</sup> In the recent years, the recovery with first aid before hospital care, as well as rapid transport and application of emergent thoracotomy, the rates of survival of those patients with penetrating cardiac injuries have become normalized.<sup>7,10,13,14</sup>

Those patients presenting with cardiac injury may demonstrate no signs of life immediately when they are taken to emergency service, or in agony, hypotensive or relatively stable condition. If the cases with signs of life during transport, or in serious condition be immediately taken for thoracotomy or median sternotomy, good results may be obtained.<sup>5,9,15,16</sup>

In the hypotensive cases, on the other hand, emergency thoracotomy or median sternotomy should be followed. Contrary to these cases, it is possible to operate those cases in the operating room conditions after performing the tests in those patients who are relatively stable.<sup>9,12</sup>

### CONCLUSION

In parallel with the increase in the crimes and violent actions in our city, penetrating cardiac injuries tend to increase, as well. In these cases, the life of patients may be saved with immediate transport, adequate intervention before hospital care, and application of resuscitative or median sternotomy.

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