J Surg Med. 2020;4(5):387-389.
DOI: 10.28982/josam.729522

Research article
Araştırma makalesi

Journal of Surgery and Medicine
e-ISSN=2602-2079

Eight-year experiences in penetrating cardiac injury: A multi-center retrospective cohort study

Penetran kalp yaralanmalarında sekiz yıllık tecrübelerimiz: Çok merkezli retrospektif kohort çalışma

Zafer Cengiz Er [1], Kıvanç Atılgan [2]

[1] Department of Cardiovascular Surgery, Yozgat Bozok University Medicine Faculty, Yozgat, Turkey
[2] Department of Cardiovascular Surgery, TOBB ETU Hospital, Ankara, Turkey

ORCID ID of the author(s)
ZCE: 0000-0001-7129-1157
KA: 0000-0001-9907-9879

Abstract

Aim: Penetrating cardiac injuries (PCI) are mostly caused by sharp objects and comprise pericardial and myocardial deformation, which lead to myocardial dysfunction. Fifty percent of overall mortality in penetrating chest injuries are caused by PCIs. The aim of this study is to evaluate the results of patients who underwent cardiac surgery due to PCIs.

Methods: In this retrospective cohort study, twenty-seven cases undergoing cardiac surgery due to PCI in Van Yuzuncu Yil University Hospital, Yozgat City Hospital and Bozok University Hospital between 2012 and 2019 were evaluated in terms of clinical findings, treatment methods and surgical techniques.

Results: There were 3 females and 24 males. The mean age was 34.2 (13.2) years (range: 14-65 years) years. Firearms caused two and penetrating stab wounds caused twenty-five injuries, respectively. The patients were transported to the hospital within a mean time of 29.7 (14.6) minutes (range: 15-98 minutes). 29 injuries were observed in 27 patients, 18 (62.06%) of which were isolated cardiac injuries, and 11 (37.94%) were mixed type. Fourteen patients (51.8%) were operated following a transthoracic echocardiography, 12 patients (44.5%) due to clinical findings and one patient (3.7%) due to the contrast-enhanced thoracic computed tomography (TCT) result. The mean pericardial blood volume was 290 mL (range 140-460 mL) in patients with a cardiac tamponade. The most frequently injured cardiac section was the right ventricle, followed by the left ventricle. Coronary artery injuries were observed in two patients. Overall mortality rate was 44%.

Conclusion: Early diagnosis, fast and safe transport, providing qualified surgical equipment, and a multidisciplinary approach are mandatory to decrease mortality and morbidity rates. It is also crucially important to prevent individual armament in preventing penetrating cardiac surgery cases.

Keywords: Penetrating cardiac injury, Mortality

Öz

Amaç: Penetran kalp yaralanmaları (PKY) sıklıkla kesici-delici alet yaralanmaları sonucu gelişir ve perikard ile miyokard hasarına sebep olarak miyokardial disfonksiyona yol açar. Penetran göğüs yaralanmalarında görülen mortalite oranının %50'den fazlasından PKY sorumludur. Bu çalışmanın amacı PKY sebebiyle kalp cerrahisi uygulanan hastaların sonuçlarını değerlendirmektir.

Yöntemler: Bu çalışma retrospektif kohort çalışması olarak tasarlanmıştır. Van Yüzüncü Yıl Üniversitesi Hastanesi, Yozgat Şehir Hastanesi ve Bozok Üniversitesi Hastanesinde 2012 ve 2019 yılları arasında PKY sebebiyle kalp cerrahisi uygulanan 27 hasta klinik bulguları, tedavi ve cerrahi teknikleri açısından retrospektif olarak değerlendirilmiştir.

Bulgular: Hastaların 24'ü erkek 3'ü kadın, 24'ü erkek idi. Yaş ortalaması 34,2 (13,2) (14 ila 65 yaş aralığında) idi. İki vakada ateşli silah yaralanması, 25 vakada kesici delici alet yaralanması mevcuttu. Hastaneye olay yerinden intikal süresi 29,7 (14,6) (15 ila 98 dakika aralığında) dakikaydı. 27 hastada 29 kardiyak yaralanma mevcuttu. Bu vakaların 18'inde (%62,06) izole kalp yaralanması, ve 11'inde (%37,94) birden fazla yaralanma mevcuttu. İki hastada koroner arter yaralanması vardı. On dört hasta (%51,8) transtorasik ekokardiyografi, 12'si (%44,5) klinik bulgular ve bir hasta (%3,7) kontrastlı toraks tomografisi sonrası operasyona alındı. Tamponat kliniği veren vakalarda perikardiyal kan hacmi ortalama 290 ml (140-460 ml aralığında) idi. En sık yaralanan kalp bölgesi sağ ventrikül idi ve ikinci sırada sol ventrikül gelmekteydi. İki hastada koroner arter yaralanması tespit edildi. Genel mortalite oranı %44 olarak tespit edildi.

Sonuç: Mortalite ve morbiditenin azaltılmasında olay yerinden başlayarak erken tanı, doğru ve hızlı transport, deneyimli cerrahi travma ekipleri ile multidisipliner yaklaşım faydalı olacaktır. PKY'de hayatta kalmayı artırmamız için sağlık hizmetlerinin geliştirilmesinin yanı sıra bireysel silahlanmanın önlenmesine özellikle dikkat çekmek isteriz.

Anahtar kelimeler: Penetran kalp yaralanmaları, Mortalite

Corresponding author/Sorumlu yazar:
Kıvanç Atılgan
Address/Adres: Beştepe Mah., Yaşam Cad., No:5, TOBB ETU Hastanesi, Yenimahalle, Ankara, Türkiye
e-Mail: kivancatilgan@gmail.com

Ethics Committee Approval: Ethics committee approval was not received due to the retrospective design of the study. All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.
Etik Kurul Onayı: Etik kurul onayı çalışmanın retrospektif dizaynından dolayı alınmamıştır. İnsan katılımcıların katıldığı çalışmalardaki tüm prosedürler, 1964 Helsinki Deklarasyonu ve daha sonra yapılan değişiklikler uyarınca gerçekleştirilmiştir.

Conflict of Interest: No conflict of interest was declared by the authors.
Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Financial Disclosure: The authors declared that this study has received no financial support.
Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

Published: 5/30/2020
Yayın Tarihi: 30.05.2020

Copyright © 2020 The Author(s)
Published by JOSAM
This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License 4.0 (CC BY-NC-ND 4.0) where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite/Atıf için: Er ZC, Atılgan K. Eight year experiences in penetrating cardiac injury: A multi-center retrospective cohort study. J Surg Med. 2020;4(5):387-389.

Introduction

Penetrating cardiac injuries (PCI) are mostly caused by sharp objects and comprise deformation of pericardium and myocardium, which lead to myocardial dysfunction. PCI is life-threatening due to bleeding, cardiac tamponade, coronary arterial and valvular injuries. Fifty percent of the overall mortality rate of penetrating chest injuries are caused by PCIs. Clinical presentation may range from a stable condition to cardiac arrest [1,2]. Hemodynamic stability strongly depends on the kind and volume of trauma, time of transportation to the hospital, intravascular volume loss, and the occurrence of cardiac tamponade [3].

In this multicenter study, we evaluated 27 patients undergoing cardiac surgery due to PCI in terms of associated traumas, the means of the trauma, operational techniques, clinical outcomes, and results.

Materials and methods

Study design and patient population

This retrospective cohort study was conducted in Van Yuzuncu Yil University Hospital, Yozgat City Hospital and Bozok University Hospital, in accordance with the standards defined by the Declaration of Helsinki. Twenty-seven cases undergoing cardiac surgery due to penetrating cardiac injury between 2012 and 2019 were evaluated. Patients with hemodynamic instability underwent emergent surgery without preoperative tests. Hemodynamically stable patients underwent electrocardiography (ECG), transthoracic echocardiography (TTE), chest radiography, and thoracic computerized tomography. Pericardiocentesis was not performed to any patient for diagnosis or treatment. Thoracotomy, sternotomy, or both were performed in some cases. Cardiac tamponade was relieved, hemorrhage was controlled, and traumatic section was repaired. Two patients required coronary artery bypass grafting due to coronary arterial injuries. 3-0 and 5-0 pledged prolene sutures were preferred in ventricular and atrial injuries, respectively. The injuries around the coronary arteries were repaired by longitudinal sutures crossing under the coronary artery. A pericardial window was formed to allow pericardial drainage through the pleural cavity. Before discharge and at the end of the 2nd postoperative month, all patients underwent TTE.

Exclusion criteria

Poisoning and toxicity cases, patients with submersion injuries, strangulation, asphyxiation, anoxic brain death and electrocution cases were excluded.

Statistical analysis

Statistical analysis was conducted with the SPSS for Windows software package (ver. 17; SPSS Inc., Chicago, IL, USA). All variables were evaluated using visual (histograms, probability plots) and analytical (Kolmogorov Smirnov test) methods to determine whether they were normally distributed. Continuous variables were reported as mean (SD) for normally distributed variables, and median with interquartile ranges for non-normally distributed variables. Categorical variables were presented as numbers and percentages.

Results

The mean age of 27 patients, out of which three were females, was 34,2 (13,2) years (range: 14-65 years). Two patients had firearm injuries, while 25 patients were injured with sharp objects. The patients were transported to the hospital within a mean time of 29.7 (14.6) minutes (range: 15-98 minutes). Twenty-one patients (77.8%) were transported to hospital by ambulance and 6 patients (22.2%) with unqualified vehicles. 29 injuries were observed in 27 patients, 18 (62.06%) of which were isolated cardiac injuries and 11 (37.94%), mixed type injuries (Table 1).

Fourteen patients (51.8%) underwent operation following TTE, 12 patients (44.5%) due to clinical findings and one patient (3.7%), due to contrast-enhanced thorax computed tomography findings. The mean pericardial blood volume was 290 mL (range 140-460 mL) in patients with a cardiac tamponade. Accompanying abdominal injury was observed in three patients. Twelve patients had hemodynamic instability and three underwent operation with cardiac resuscitation. A left anterolateral thoracotomy was performed to 14 patients, a median sternotomy was performed to eight patients and a right anterolateral thoracotomy was performed to two patients. In three patients, both a left anterolateral thoracotomy and median sternotomy were used. One patient required both left and right thoracotomy. Splenectomy was performed in three patients, and laparotomy was performed due to abdominal injuries. Injured cardiac sections are listed in Table 2.

Two patients had coronary artery injuries. The mean length of the injuries was 2.3 cm (range: 0.4-5 cm). The cardiac injuries of 25 patients were repaired primarily and two patients required a cardiopulmonary bypass. Two patients underwent a postoperative explorative laparotomy operation. Atelectasis was observed in eight patients and cerebrovascular insufficiency was seen in five patients. Mortality was encountered in 12 patients, among which three patients underwent operation with cardiac resuscitation, five patients had a cerebral infarct due to cerebrovascular insufficiency, two patients had multiple injuries and two patients had multiple cardiac injuries. Mortality rate was 44.5%.

Table 1: Type of injuries

Injured area	Number (n)	Percentage (%)
Isolated heart	18	62.06
Mixed type injury	11	37.94
*Isolated abdomen + PCI	1	3.44
*Isolated lung + PCI	7	24.13
*Abdomen + lung + PCI	2	6.89

PCI: Penetrating cardiac injury

Table 2: Localization of cardiac injuries

Localization	Number (n)
Right ventricle	14
Left ventricle	8
Right atrium	5
Left atrium	2

Discussion

Until early 1950s it was not possible even to think of cardiac suturing or repairing [4]. Cardiac injuries still have an increased rate of morbidity and mortality. In emergent operations, chest trauma is seen in 10.4% of the cases and only 1% of the cases comprise cardiac injuries [5]. Although the incidence is lower in comparison to other traumatic cases, cardiac injuries are important due to high mortality rates [6,7].

Time of transportation of the patient to the hospital is one of the major factors affecting the mortality rates. Only 6% of the PCI patients are transported to the hospital alive, and only 50% of them survive [8,9].

Naughton MJ et al. published a statistical analysis of a study consisting of peroperative exitus cases involving prehospital deaths. According to this study, 33% of the patients transported to the hospital with a helicopter, 76% of the patients transported with an ambulance and 100% of patients transported with unqualified vehicles did not survive [10]. In our study, the mean time of transportation of the patient to the hospital was 29.7 minutes; 77.8% were transported with an ambulance and 22.2% with unqualified vehicles. Overall mortality rate was 44.5%, and the mortality rate of patients transported with unqualified vehicles was 83.5%.

PCI is mostly seen in the young, male population [1,2,5]. In our study, among 27 cases, 24 (88.9%) were male and 3 (11.1%) were female. The mean age was 34.2 (13.2) years (range: 14-65 years).

The survival rates of PCI cases vary with clinical presentation. Even in asymptomatic PCI cases, the mortality rate remains high, which is why early diagnosis of a possible PCI can be lifesaving. In all injuries located between the areolas, jugulum and upper abdomen, cardiac injury must be suspected unless otherwise specified [11]. The most important means of detecting a possible cardiac injury is echocardiography. Even in thoracic traumas, cardiac injury must be eliminated via echocardiography, because it is the main factor affecting surgical success [2,4,7,12,13]. In 51.8% of cases, we performed preoperative echocardiography, and 44.5% of patients underwent emergency surgery due to clinical findings. The entrance and the exit points of the injury are important in the management of the case [2,12,14]. Hypotension, tachycardia, and congestion in cervical veins may indicate a cardiac tamponade. Pericardiocentesis can be performed for diagnosis, but it is not appropriate for treatment in PCI cases [1,14,15]. We did not perform pericardiocentesis to any of patients, and PCI suspected asymptomatic patients underwent preoperative TCT.

Firearm injuries were present in two cases and sharp object injuries were observed in 25 cases. Firearm cardiac injuries cause larger deformities in the pericardium and myocardium in comparison to sharp object injuries of the heart. Cardiac tamponade is observed in 80-90% of the sharp object injuries of the heart, but only in 20% of the firearm cardiac injuries [16,17]. The mortality of firearm injuries of the heart is much higher than that of sharp object injuries. Henderson et al. found the mortality rates of firearm and sharp object injuries were 93.5% and 62.9%, respectively, in a series of 251 cases [18]. In this study, we included two cases who were admitted to the emergency service with cardiac arrest due to firearm cardiac injury and underwent emergent surgery with CPR. They could not survive. The mortality rate of firearm cardiac injury was 100% in our study, and overall mortality of 27 cases were 44%.

Firearm cardiac injuries are more commonly seen in the USA compared to England and South Africa due to the convenience of individual armament, resulting with higher mortality rates [19-21]. In recent studies of the Turkish community, sharp object injuries of the heart are reportedly higher than firearm cardiac injuries [4-6].

Limitations

Due to the retrospective nature of the study, certain variables specifically related to cardiac injuries are not available, including specific cardiac imaging or diagnostic tests. Another limitation of our study is the lack of autopsy of sudden deaths following a cardiac injury, which could not be included in the statistical analysis. There were not any resuscitative thoracotomy cases among our patients. Further multi-center studies involving larger number of cases would provide more realistic and meaningful statistical results.

Conclusion

Technological improvements result in complicated and mixed type cardiac injuries. To decrease mortality and morbidity rates, early diagnosis, fast and appropriate transport, a multidisciplinary approach with experienced surgical teams are mandatory. In addition to improving health services, preventing individual armament would be beneficial in increasing the survival rates of PCIs.

References

1. Tyburski JG, Astra L, Wilson RF, Dente C, Steffes C. Factors affecting prognosis with penetrating wounds of the heart. J Trauma. 2000;48:587-91.
2. Ivatury RR, Nallathambi MN, Roberge RJ, Rohman M, Stahl W. Penetrating thoracic injuries: infield stabilization vs. prompt transport. J Trauma. 1987;27:1066-73.
3. Akay T. Kalp ve damar yaralanmaları. TTD Toraks Cerrahisi Bulteni. 2010;1(1):78-86.
4. Bilroth T. The scalpel and the heart. in Richardson RG (ed): The Scalpel and the Heart. New York, Scribner' s, 1970, p27
5. Arikan S, Yücel AF, Kocakuşak A, Dadük Y, Adaş G, Onal MA. Retrospective analysis of the patients with penetrating cardiac trauma. Ulus Travma Acil Cerrahi Derg. 2003;9:124-8.
6. Altınbaş, Ö , Tanyeli, Ö. Surgically managed gunshot injury of the heart; Bullet in the right coronary artery. J Surg Med. 2018;2(2):193-4. doi: 10.28982/josam.407946
7. Dereli Y, Özdemir R, Ağrış M, Öncel M, Hoşgör K, Özdiş AS. Penetrating cardiac injuries: assessment of 21 patients. Ulus Travma Acil Cerrahi Derg. 2012;18(5):441-5.
8. Campbell NC, Thomson SR, Muckart DJ, Meumann CM, Van Middelkoop I, Botha JB. Review of 1198 cases of penetrating cardiac trauma. Br J Surg. 1997;84:1737-40.
9. Göz M, Çakır Ö, Eren MN. Penetran kalp yaralanmaları; mortalite belirleyicilerinin analizi. Ulus Travma Acil Cerrahi Derg. 2009;15(4):362-6.
10. Naughton MJ, Brissie RM, Bessey PQ, at all:Demography of penetrating cardiac trauma. Ann Surg. 1989;209:676-83.
11. Çakır Ö, Eren Ş, Balcı AE, Özçelik C, Eren N. Penetran kalp yaralanmaları. Türk Göğüs Kalp Damar Cer Derg. 1999;7:112-6.
12. Chang WY, Hsu JY, Chang YP, Chao CS, Chang KJ. The successful management of a penetrating cardiac injury in a regional hospital: A Case Report. J Emerg Crit. Care Med 2008;19:160-5.
13. Ekim H, Basel H, Odabasi D, Tuncer M, Gumrukcuoglu HA. Management of penetrating heart and accompanying lung injuries. Pak J Med Sci. 2010;26(3):526-31.
14. Jebara VA, Scede B: Penetrating Wounds to the Heart: A wartime experience. Ann Thorac Surg. 1989;47:250-4.
15. Kocamaz F, Beşerli K, Kutluk E, Eryüksel B, Ahat E. Penetran Kalp Yaralanmaları. Istanbul Tıp Dergisi. 1998;1:1-3.
16. Attar S, Suter CM, Hankins JR, Sequeira A, McLaughlin JS. Penetrating cardiac injuries. Ann Thorac Surg. 1991;51:711-6.
17. Cihan HB, Ege E, Gülcan Ö, Yaşaroğlu O, Türköz R. Penetran Kalp Yaralanmaları. GKDC Dergisi. 1998;6:217-20.
18. Henderson VJ, Smith RS, Fry WR, Morabito D, Peskin GW, Barkan H, et al. Cardiac injuries; Analysis of an unselected series of 251 cases. J Trauma. 1994;36:341-8.
19. Reece IJ, Davidson KG. Penetrating cardiac injuries in the United Kingdom. Thorax. 1983;38:81-3.
20. Martin LF, Mavroudis C, Dyess DL, Gray LA. The first 70 years experience managing cardiac disruption due to penetrating and blunt injuries at the University of Lousville. Am Surg. 1986;52:14-9.
21. Mihmanlı M, Erzurumlu K, Türkay B, Kalyoncu A, Güney M. Penetran Kalp Yaralanmaları. GKD Cer.Derg. 1994;2:270-3.

This paper has been checked for language accuracy by JOSAM editors.
The National Library of Medicine (NLM) citation style guide has been used in this paper.