

Missile cardiac injuries: review of 16 years' experience

Ateşli silahlarla olan kardiyak yaralanmalar: 16 yıllık deneyimin gözden geçirilmesi

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BACKGROUND

Penetrating cardiac trauma represents an increasingly important form of trauma due to the frequent use of firearms and bombs in civilian violence. We report our experience over the past 16 years with missile-induced cardiac injuries.

METHODS

A retrospective study reviewing 40 cases (30 males, 10 females) of missile cardiac injuries was conducted. The nature of injuries, management and outcomes were analyzed.

RESULTS

The ages ranged from 14-68 years. The mean time in which patients reached the hospital was 4.1 hours. Forty percent of the patients had firearm injuries and the remaining 60% had pellet or splinter injuries to the heart. Survival was noted in 37.5% in the gunshot group and in 66.6% in the splinter/pellet group. The survival in patients with isolated cardiac injury was 60%, while it was only 40% in those with associated injuries. Single-chamber injury was noted in 87.5% of the patients and the survival in these was 62.8%. Fourteen complications were noted in the patients who were resuscitated. One patient was re-explored for excessive bleeding and a missed right ventricular perforation was repaired.

CONCLUSION

In missile cardiac injuries, results are best if operated early, and outcome depends upon multiple factors including clinical status at arrival, time interval till management, nature of injury, and associated injuries.

Key Words: Cardiorrhaphy; missile; pellets; splinters.

AMAÇ

Sivil toplumdaki şiddet olaylarında ateşli silahların ve bombaların sık kullanılması nedeniyle, penetran kardiyak travma, ciddi travma formunu oluşturmaktadır. Silahlarla oluşan kardiyak yaralanmalarla ilgili olarak 16 yıllık deneyimimizi bildiriyoruz.

GEREÇ VE YÖNTEM

Ateşli silahla, kardiyak yaralanmalı 40 olguyu (30 erkek, 10 kadın) gözden geçiren retrospektif bir çalışma gerçekleştirildi. Yaralanmaların şekli, tedavisi ve sonuçlar değerlendirildi.

BULGULAR

Olgular 14 ile 68 yaş arasında idi. Hastaların hastaneye ulaştırılması için geçen ortalama süre 4,1 saat idi. Hastaların %40'ı ateşli silah ile yaralanırken, %60'ı da kalbe gelen saçma veya şarapnel nedeniyle yaralanmıştı. Kurşun yaralanması bulunan grubun %37,5'i hayatta kalırken, şarapnel/saçma grubunun %66,6'sı hayatta kaldı. İzole kardiyak yaralanması bulunan hastalardaki sağkalım %60 iken, diğer yaralanmalar da eşlik edenlerde sağkalım yalnızca %40 oldu. Kalbin tek odacığına yönelik yaralanma hastaların %87,5'inde kaydedildi ve bu hastalarda sağkalım %62,8 oldu. Resüsite edilen hastalarda 14 komplikasyon kaydedildi. Bir hasta aşırı kanamaya yönelik olarak yeniden ameliyata alındı ve gözden kaçmış bir sağ ventrikül yaralanması onarıldı.

SONUÇ

Ateşli silahla kardiyak yaralanmalarda en iyi sonuçlar hastalar erken ameliyata alındığında elde edilir ve klinik sonuç, hastaneye başvuru sırasındaki klinik durum, tedaviye kadar geçen zaman, yaralanmanın şekli ve eşlik eden yaralanmaları da içeren çok sayıda faktöre bağlıdır.

Anahtar Sözcükler: Kardiyografi; ateşli silah; saçma; şarapnel.

There has been a sudden increase in violence since militancy started in Kashmir. Thus, since 1990, there has been a higher incidence of missile-induced penetrating cardiac injury.

In this study, we examined our experience of over 16 years in managing missile cardiac injuries in the Department of Cardiothoracic and Vascular Surgery at Sher-I-Kashmir Institute of Medical Sciences, Srinagar.

MATERIAL AND METHODS

This retrospective study comprised data acquired from January 1991 to September 2007. During this period, 21,860 patients were admitted to the hospital through the Accident and Emergency Department, with firearm- or blast-related missile injuries. Of these, 40 patients (0.18%) were operated for missile injuries to the heart. Excluded from the study were patients who were pronounced dead on arrival to the hospital after missile injuries to the precordium and those with penetrating cardiac injuries due to causes other than missile injuries. The patients were categorized into three groups based on physiological parameters.

Group I (Stable): systolic pressure >90 mmHg, alert, no respiratory distress.

Group II (Shock): systolic pressure <90 mmHg, conscious, mild respiratory difficulty.

Group III (Agonal): no recordable pressure, semi-conscious, gasping respirations.

All nine patients who were stable were subjected to computed tomography (CT) to evaluate cardiac and other thoraco-abdominal injuries. Among these, two were further subjected to cardiac ultrasound because of lack of sufficient evidence on CT to rule out cardiac injury. Of the 16 patients in shock, seven were successfully resuscitated and subsequently underwent CT; one of these patients required cardiac ultrasonography (USG) to establish diagnosis. The remaining nine patients all underwent cardiac USG in the operating room while preparing the patient for thoracotomy. Emergency room thoracotomy is not available in our hospital and all the agonal patients were immediately explored in the emergency operation theater without further investigations (Table 1). All patients were managed by cardiorrhaphy using 2/0 or 3/0 silk or prolene. In addition, ligation of terminal coronary branches was done in two and direct repair of main coronary vessels was done in two

Table 1. Investigations prior to surgery

Clinical status	Total number of patients	CT	Cardiac ultrasound
Stable	9	9	2
Shock	16	7	10
Agonal	15	0	0

Table 2. Clinical status of patients on admission

Clinical status	Total number of patients	Number with gunshot injury	Number with missile injury
Stable	9 (22.5%)	3 (33.3%)	6 (66.6%)
Shock	16 (40%)	3 (18.7%)	13 (81.2%)
Agonal	15 (37.5%)	10 (66.6%)	5 (33.3%)

Table 3. Site of injury

Site of injury	Number of patients	Percentage
Right ventricle	26	65%
Left ventricle	11	27.5%
Right atrium	6	15%
Left atrium	2	5%
Multiple-chamber injury	5	12.5%
Coronary vessel injury	6	15%

using 7/0 prolene. All procedures were performed without cardiopulmonary bypass.

RESULTS

The patients' ages ranged from 14-68 years. There were 30 males and 10 females. The mean age in males was 30 years and in females was 35 years. The patients were received in the Emergency Department between 24 minutes (min) and 8.4 hours (h) after the injury (mean 4.1 h). The clinical status of the patients on admission is shown in Table 2.

Twenty-eight (70%) underwent left anterior thoracotomy, sternotomy was done in 6 (15%), and both thoracotomy and sternotomy were needed in 6 (15%). The site and nature of injuries found are shown in Table 3.

Clinical status on admission had bearing on the outcome and the results are demonstrated in Table 4. Forty percent of the patients (16/40) in our series had firearm injuries and the remaining 60% (24/40) had pellet or splinter injuries to the heart due to bomb blasts. In the gunshot group, 37.5% of patients (6/16) survived, while 66.6% (16/24) survived from the

Table 4. Outcome based on the clinical status on admission

Clinical status	Number of patients	Number survived	Percentage survived
Stable	9	8	88.8%
Shock	16	10	62.5%
Agonal	15	4	26.6%
Total	40	22	55%

Table 5. Site of additional injuries

Site	Number of patients
Abdominal	7
Pulmonary	5
Head injury	2
Extremities	2

Table 6. Complications

Sepsis	
Empyema	1
Pneumonia	2
Wound infection	3
Cardiac	
Ventricular septal defect	2
Arrhythmias	5
Cerebral	
Anoxic encephalopathy	1

splinter/pellet group. Isolated cardiac injuries were noted in 75% (30/40) of the patients; the other 25% (10/40) had other sites of injury, some having injury at more than one site, as demonstrated in Table 5. The survival in patients with isolated cardiac injury was 60% (18/30), while it was only 40% (4/10) in those with associated injuries. Single-chamber injury was noted in 87.5% (35/40) of the patients. The survival in these was 62.8% (22/35). However, none of the five patients with multiple-chamber injury in our series survived, including two patients who underwent direct repair of coronary arteries.

Fourteen complications were noted in the series. One patient was re-explored for excessive bleeding and a missed right ventricular perforation was repaired. Ventricular septal defects in two patients were small (less than 1.5:1 left to right shunt) and they are both under follow-up. Three patients developed ventricular tachycardia requiring direct current (DC) cardioversion. Two had right bundle branch block. One of the four survivors from the agonal group had anoxic brain injury due to prolonged

shock. The details of the complications noted are shown in Table 6.

DISCUSSION

Cardiothoracic injury causes 25% of deaths immediately following trauma, and the majority of these fatalities involve cardiac or great vessel injury.^[1] Penetrating cardiac trauma represents an increasingly important form of trauma due to the observed increase in use of firearms and bombs in civilian violence. The management of penetrating cardiac injury has evolved from conservative management during World War II to aggressive early surgical intervention.^[2-4] Penetrating cardiac trauma presents two clinical manifestations, exsanguinating hemorrhage or pericardial tamponade. Pericardiocentesis in patients with acute tamponade is unreliable,^[2,3] and was not used in our series. All patients were subjected to early surgical intervention in the emergency operation theater.

The overall survival in our series was 55% (22/40). This is comparable with survival rates reported by others for gunshot and missile cardiac injuries.^[5,6] In our series, survival of patients with pellet splinter injuries to the heart was found to be better than that with gunshot injuries (66.6% versus 37.5%). Variable mortality rates ranging from 12% to 81% have been reported after gunshot wounds to the heart by others.^[5,7,8] In 2006, a retrospective study of penetrating cardiac injury in South Africa found 81% mortality among the 21 patients who sustained gunshot wounds to the heart.^[6]

The clinical status on admission has a significant bearing on the outcome. Only one patient in our series who was stable on admission died, while 11/15 who were admitted in an agonal state died. This high mortality of 74% in these agonal patients could be due to the lack of facilities for emergency room thoracotomy in our hospital.

In the present series, survival was better in patients with isolated cardiac injury as compared to those who had associated injuries (60% versus 40%). However, previous studies have shown that risk of mortality was not higher in patients with associated injuries.^[7]

None of the patients in our series with multiple-chamber injury survived. However, the risk of death was not found to be different between patients sustaining single or multiple cardiac injuries in the series by Degiannis.^[7]

The most commonly involved chamber was found to be the right ventricle in 65% of patients followed by the left ventricle, right atrium and left atrium. This is easily explained by the fact that the right ventricle covers the greatest part of the anterior chest wall and represents 55% of the anterior cardiac surface. In a review of 1,802 cases of penetrating cardiac trauma from 20 reports, the right and left ventricles were injured 43% and 33% of the time, respectively. The frequency of involvement of the other chambers is directly proportional to the area of the chest wall they cover.^[9]

The coronary arteries are reported to be involved in 3.1 to 4.4% of penetrating cardiac injuries.^[1,10,11] In the present series, they were involved in 15% of the cases. Due to its anatomically anterior placement, the left anterior descending artery is the most frequently involved, being injured in 87.5% of cases of coronary artery lacerations.^[1] The right coronary is the second most commonly involved.^[10] In the present series, only two patients had main coronary artery laceration, both involving the left anterior descending branch.

All the injuries to the heart were repaired with interrupted sutures alone. Teflon pledgets have been used to assist in anchoring the sutures to prevent them from causing further myocardial damage.^[12] However, they were not used in our series.

In conclusion, missile-induced cardiac injuries are becoming more common due to the use of more sophisticated weapons in domestic violence. Exploration and repair of injuries produces the best results if done early, without delay for investigations and before serious compromise of physiological reserves sets in. Outcome depends upon multiple

factors including clinical status on arrival, time interval until management, nature of the injury, and presence of associated injuries.

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