

Plaies pénétrantes cardiaques : l'expérience de 22 ans d'un centre universitaire Tunisien

Penetrating heart injuries: a 22-year-experience from a university Tunisian hospital

Nabil Ajmi¹, Taieb Cherif¹, Marah Jamli¹, Molka Zlitni¹, Imene Mgarrech¹, Amine Tarniz², Chokri Kortas¹, Sofiane Jerbi¹

1 : Service de chirurgie cardiovasculaire et thoracique – CHU Sahloul de Sousse, Tunisie

2 : Cabinet privé de chirurgie cardiovasculaire – Immeuble « Ibn El Jazzar Médicale », Sousse, Tunisie

Résumé

Contexte : Les blessures cardiaques pénétrantes sont peu fréquentes mais extrêmement mortelles. La mortalité est liée au retard du traitement. Le but de cette étude est de rapporter notre expérience dans la prise en charge des lésions cardiaques pénétrantes et des gros vaisseaux.

Méthodes : Pendant 22 ans, de 1996 à 2018, 35 patients ont été admis dans notre service pour le traitement des lésions cardiaques et des gros vaisseaux. Des données comprenant la localisation des blessures, les soins préopératoires, les techniques chirurgicales et les soins postopératoires ont été collectées et analysées rétrospectivement dans cette étude.

Résultats: Vingt-cinq patients étaient de sexe masculin (89,2%) et l'âge moyen était de 26 ± 8 ans. L'approche chirurgicale était une sternotomie verticale médiane chez 27 patients, une thoracotomie gauche chez 7 patients et une thoracotomie convertie en sternotomie chez un patient. Les lésions peropératoires étaient uniques chez 22 patients (62%). Le ventricule droit était le site le plus touché (50%). De multiples lésions du cœur et des gros vaisseaux ont été observées chez 13 patients (37,1%). Le taux de mortalité global était de 14,2%, deux patients sont décédés en peropératoire.

Conclusion: le facteur pronostique le plus important chez ces patients est le retard de prise en charge chirurgicale. La principale technique chirurgicale pour les blessures cardiaques est la cardiomyorrhaphie avec de très bons résultats

Mots-clés

Chirurgie cardiaque ;
traumatismes cardiaque ;
traumatisme thoracique
pénétrant ; arrêt
cardiaque

Summary

Background : Penetrating cardiac injuries are infrequent but highly lethal. Mortality is linked to the delay of treatment. The aim of this study is to report our experience in the management of the penetrating heart and great vessels injuries.

Methods: During 22 years, from 1996 to 2018, 35 patients were admitted to our department for the treatment of cardiac and great vessels injuries. Data including location of injuries, pre operative care, surgical techniques and post operative care were collected and analyzed retrospectively in this study.

Results: Twenty five patients were male (89.2%) and the average age was 26 ± 8 years, The surgical approach was a median vertical sternotomy in 27 patients, left thoracotomy in 7 patients and thoracotomy converted to sternotomy in one patient. Per operative injuries were unique in 22 patients (62%). Right ventricle was the most affected site (50 %). Multiple injuries of the heart and great vessels were seen in 13 patients (37.1 %). The overall mortality rate was 14.2%, two patients died peroperatively.

Conclusion: The most important prognostic factor in these patients is the delay in surgical management. The main surgical technique for cardiac injuries is cardiomyorrhaphy with very good results. The use of extracorporeal circulation remains exceptional. The after-effects of heart wounds are not uncommon but are, for the most benign.

Keywords

Cardiac surgery ; cardiac
trauma ; penetrating
thoracic injury ; cardiac
arrest

Correspondance

Dr Nabil AJMI

service de chirurgie cardiovasculaire et thoracique – CHU Sahloul de Sousse, Tunisie

E-mail : dr.nabilajmi@gmail.com

INTRODUCTION

Penetrating injuries of the heart are serious and challenging surgical emergencies in which mortality is essentially linked to the delay of adequate treatment [1].

Indeed, only 11 to 25% of patients arrive alive in the hospital. Among the survivors, 20% have a stable hemodynamic state. In these patients, the survival rate is high, up to 89% when diagnosis is made early with immediate surgical management [2]. This survival rate has recently increased due to the evolution of pre-hospital care, rapid transportation to specialized centers, and advances in trauma surgery [3]. In the last decade, our country has encountered deep socioeconomic changes with a worsening of the urban violence. A consequent increasing number of chest traumas has been recorded, especially among young patients.

In the present study, we report our experience with surgery of penetrating heart injuries in Sahloul University Hospital of Sousse (Tunisia), identifying the risk factors of complications and in-hospital mortality.

PATIENTS AND METHODS

This is a retrospective, descriptive study reporting patients operated for heart and great vessels injuries in the Cardiovascular and thoracic surgery department of Sahloul university hospital. The study period spans over 22 years, from January 1996 until December 2018.

Thirty-five patients with proven or suspected penetrating injury to the heart or great vessels were included in our study and patients presenting blunt and iatrogenic injuries were excluded from this study.

Data were collected and analyzed retrospectively from emergency records and operative reports.

All demographic characteristics, mechanisms and types of injury, pre hospital care, vital signs on arrival, emergency investigations for stabilized patients, operative details, postoperative care and follow-up were reviewed.

The severity of trauma was evaluated using Revised Trauma score (RTS) and Simplified Acute Physiological Score (SAPS). Data have been analyzed using SPSS 19.

RESULTS

During a 22-year-period, ending in December 2018, 35 patients with penetrating cardiac injuries were admitted and managed in our department. Twenty five patients were male (71,4%) and the average age was 26 ± 8 years reflecting young male predominance in violent trauma. (table 1). All patients sustained stab wounds.

In 26 patients (74,3%), wounds were in the left hemithorax. For the others, four were in the right hemithorax, four were bilateral and one subxyphoid. Injuries were anterior in 29 patients (82,8%), posterior and anterior in six other cases.

Extra thoracic injuries have been noticed in 8 patients (22,8%) mainly in face, neck and upper limb.

Elements of the lethal triad of hemorrhagic shock (hypocalcemia, Hypothermia, acidosis) were detected in 23 patients (65,7%).

Sixteen patients with a penetrating chest wound presented with RTS between 3 and 10.

Of these patients, two died respectively with an RTS of 5 and 8. Thirteen patients had an RTS at 11, one of whom died. Four patients with RTS to 12 have evolved favorably. Two patients passed away with an RTS at 0.

The median value of the SAPS of our patients was 34, with extremes ranging from 17 to 77. Only one patient presented with SAPS > 70, and died. Five patients had SAPS between 50 and 70, three of them died. Only one patient had SAPS at 43, and died.

Medical transport was the most used method with 27 patients, and the median time between the emergency call and first aid was 20 minutes.

The median time between first take-up and operative room entry was 85 minutes, with a minimum of 10 minutes. Five patients required pre hospital orotracheal intubation and artificial ventilation.

The surgical approach was a median vertical sternotomy in 27 patients, left thoracotomy in 7 patients and thoracotomy converted to sternotomy in one patient.

Per operative injuries (table 2) were unique in 22 patients and right ventricle was the most affected site (50 %). Multiple injuries of the heart and great vessels were seen in 13 patients. The mean size of injuries was 1 ± 0.6 cm (table 3) . We found extra cardiac injuries in 9

patients and treated them in the same operative procedure. Injuries affected lungs and thymus in 3 times each one. Left phrenic pedicle, gastric antrum and tail of pancreas were injured once.

Table 1 : Demographic, clinical and preoperative data

N = 35	
Age	26±8 ans
Male	25 (71,4%)
Wound localization	
Left hemithorax	26 (74,3%)
Right hemithorax	4 (11,4%)
Right and left hemithorax	4 (11,4%)
Subxyphoid	1 (2,8%)
Anterior	29 (82,8%)
Anterior and posterior	6 (17,2%)
Extra-thoracic	8 (22,8%)
Lethal triad (one element or more)	23 (65,7%)
RTS	
0	2 (5,7%)
3-10	16 (45,7%)
11	13 (37,1%)
12	4 (11,4%)
Perfusion of Macromolecules	23 (65,7%)
Catecholamines	15 (42,8%)

Table 2 : Cardiac and great vessels injuries

N = 35	
Site of injury	
pericardium	1 (2,8%)
Right ventricle	14 (40%)
Right atrium	1 (2,8%)
Left ventricle	2 (5,7%)
Left atrium	1 (2,8%)
Pulmonary artery	2 (5,7%)
Pulmonary vein	1 (2,8%)
Right and left ventricle	4 (11,4%)
Right ventricle +Mammary pedicle	4 (11,4%)
Left atrium + inferior vena cava	1 (2,8%)
Innominated venous trunc + Aorta	1 (2,8%)
Pulmonary artery + mammary pedicle	1 (2,8%)
Left and right ventricle + coronary artery	1 (2,8%)
Right ventricle and atrium + Aorta	1 (2,8%)

Table 3 : Operative and postoperative data

N = 35	
Surgical approach	
Median sternotomy	27 (77,1%)
Left thoracotomy	7 (20%)
Right thoracotomy converted to sternotomy	1 (2,8%)
Size of injury	1±0,6 cm
Extra-cardiac injuries	9 (25,7%)
Hemopericardium	29 (82,8%)
Hemothorax	19 (54,3%)
Hemostasis gesture	3 (8,5%)
Intrapericardial hemostatic packing	1 (2,8%)
Foley probe	2 (5,7%)
Cardiopulmonary bypass	0
Mechanical ventilation	8 hours (0 – 12 hours)
Intensive care unit stay	3 days (1 – 21 days)
Hospitalization	7 days (1 – 21 days)
In-hospital mortality	5 (14,3%)
Cardiac sequelae	4 (11,4%)

Three patients required a hemostasis gesture to control the bleeding. One patient was stabilized by an intrapericardial hemostatic packing. In the other two patients, victims of right ventricle lesions of 1 cm and 1.5 cm, the temporary hemostasis was made with the finger, then with a Foley probe.

The ventricular wounds (figure 1) were sutured to 3/0 and 4/0 polypropylene wire, by separate U-shaped points, supported or not on strips of Teflon or by patches of autologous pericardium. A wound of the left auricle was repaired by a 4/0 polypropylene suture.

The wounds of the large vessels have been treated with beating heart; they were sutured by patched points with polypropylene 5/0 or 4/0.

A lateral aortic cross-clamping was performed only once to treat a wound of the ascending aorta.

The mean post-operative bleeding was 707 ml and 1015 ml respectively after 24 and 48 hours.

Five patients were extubated in the operating room; the others at different postoperative delays ranging from 2 to 12 hours. The median duration of postoperative ventilation was 8 ± 3.4 hours.



Figure 1 : Operative view showing a right ventricle wound (arrow).

Five patients (14,3%) died during the early postoperative period (delay <30 days). Of these deaths, two occurred during intervention. Three patients died in the intensive care unit in a variable time ranging from 3 hours to 20 days. Of the 30 survivors in our series, 19 (63,3%) were followed. The median duration of follow-up was 3 ± 5.7 months. Only four patients had cardiac sequelae : chronic chest pain in 2 patients and atrial fibrillation in 2 other patients.

COMMENT

The prevalence of traumatic cardiac injuries varies from region to region and from institution to institution. It depends on the amount of violence in society and access to medical facility [3-4].

The study we present has epidemiological characteristics comparable to those in the literature, with a majority of young men presenting injuries in the right cavities.

The retrospective series of patients hospitalized for heart injuries are the most frequently found in the literature. Unfortunately, they do not rate the frequency of this condition very well, as many of the patients who died before arriving at the hospital are not listed.

Systematic post-mortem studies should be carried out to deal with all these traumatic deaths.

The absence of gun wounds is understandable in our society, certainly more and more violent, but not

accustomed to this type of weapons. This is not the case in other countries such as the United States, Brazil or South Africa, where urban violence is more often by the use of firearms [5-9].

In the majority of patients with penetrating heart injuries, who arrived alive at the hospital, the bleeding is stopped by spontaneous factors such as hypotension, coagulation or by the local compression effect due to cardiac tamponade or hemothorax.

Gao et al [10] suggested three principles to improve preoperative care. First, massive transfusions should be avoided. Ideally, a limited volume of crystalloids and red blood cells should be transfused after repairing the heart wound with a target of systolic pressure of at least 80 mmHg. This concept has been reported by several authors in the literature. [11-12]

The second principle concerns pericardocentesis, some surgeons recommend it to stabilize hemodynamic status before thoracotomy [13]. Gao shares the opinion of Demetriades [14] to proscribe this technique. From our own experience, we believe that moderate tamponade may temporarily control bleeding with a relatively low risk of defusing the heart pump. This opinion is widely shared in the literature. Indeed, Tyburski et al [12] demonstrated in a series of victims of heart and large blood vessels by a cold steel, that the presence of cardiac tamponade was associated with a better survival rate. The third principle concerns the importance of thoracic drainage, in case of hemothorax, before anesthesia.

In our study, 15 out of 35 patients had echocardiography upon arrival and a chest CT scan. Chest CT scan was required in stable patients when the clinic and ultrasound results did not point to a cardiac penetrating lesion. Transthoracic echocardiography, which can be repeated on demand, is very useful for the management of cardiac trauma. For the diagnosis of pericardial effusion, its sensitivity is up to 96%, its specificity and positive predictive value are 100% [16].

If there is any doubt about a penetrating lesion of the heart, intermediate attitude between medical treatment and surgical sternotomy or thoracotomy may be thoracoscopy. This minimally invasive approach presents some advantages: to confirm the diagnosis of heart wounds, to check associated intra thoracic lesions and to determine the best surgical approach. [17]

Other authors have suggested pericardial drainage by Marfan approach for patients who do not have signs of active hemorrhage.[18]

Nevertheless, the notion of trauma and the existence of pericardial effusion justify a systematic surgical exploration [19-20]. The choice of the best surgical approach is fundamental and depends on type of injuries, hemodynamic status and surgeon's habits.

The advantages of the median vertical sternotomy are the good exposure of the heart allowing its complete exploration and thus the reparation of the lesions under good conditions, in particular those of the right ventricle which are the most frequent. It also explores the pleural cavities, the diaphragmatic domes, and gives the possibility to treat associated lesions. Its closure is easy and solid. Nevertheless, median sternotomy requires specific equipment, usually gives a limited exposure to the left lower lobe and the posterior mediastinum, and exposes to the risk of mesdiastinitis.

The benefits of left anterolateral thoracotomy are to be easier to proceed, to allow clamping of the descending aorta after a short dissection of the parietal pleura, to better expose left pulmonary lesions. Its disadvantages are a limited exposure of the cardiac cavities and especially the right ones. Thus, a switch in sternotomy is often necessary.

The advantage of the right anterolateral thoracotomy is to expose the right pleural cavity, the right lung and partially the pericardium.

Its drawback in the case of hemopericardium is that it cannot explore the heart, therefore to impose an enlargement. The enlargement of all these surgical approaches is possible: sternotomy can be expanded into anterolateral right, left or bilateral thoracotomy.

Demetriades considers the median vertical sternotomy as the technique of choice in all situations of penetrating trauma of the cardiac-box, independently of the hemodynamic state. But most authors [17-19] are more nuanced on this principle. The sternotomy gives the best exposure in case of cardiac lesions. However, in cases of major hemodynamic instability, anterolateral thoracotomy should be performed first. It could be enlarged to sternotomy in case of a hemopericardium.

Authors mentioned that the sequelae of penetrating heart injuries are frequent and vary from 17 to 52% [20-22] and this is related to the increase of survivals after

traumatic cardiac surgery.

These complications may include valvular lesions, septal dehiscence, aortocavitary fistulas, aortopulmonary fistulas, coronary arteries fistulas, ventricular aneurysms and pseudo-aneurysms, constrictive, restrictive or recurrent pericarditis and arrhythmia.

In our study, Only four patients had cardiac sequelae : chronic chest pain in 2 patients and atrial fibrillation in 2 other patients.

CONCLUSION

In this study, we found that heart and large vessels injuries have high pre-hospital mortality. The prognosis of patients with heart injuries depends on their initial pre hospital care. On admission, the occurrence of a cardiac arrest is a sign of bad prognosis. The most important prognosis factor in these patients is the surgical management. Improved survival rates for patients with heart injuries are due to the improvement of pre-hospital care. The use of cardiopulmonary bypass is exceptional. The sequelae of heart wounds are not uncommon but are, in most cases, benign. The prevention of heart and large vessel injuries should be based on the prevention of violence among young people.

Disclosures

The authors declare no conflicts of interests.

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