Penetrating cardiac injuries

Two case reports

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Penetrating injuries. Two case reports

INTRODUCTION: *Penetrating cardiac injuries is still a diagnostic problem at this time. Their management requires immediate surgical intervention and excellent surgical critical care postoperatively.*
PRESENTATION OF CASES: *A 15-year old male patient was stabbed with a knife to the right chest. The chest radiograph showed an haemothorax and the angiography showed an intercostals artery and a right auricle injury. After an emergency operation the patient was released home in good condition after the toracotomy had healed.*
A 19-year old male patient was stabbed with a knife to the chest more than once. By a left toracotomy we sutured the lesion of the left ventricle with multiple single stitch in non-absorbable suture, we covered the suture with a sealant. The patient released home in 24 days.
DISCUSSION: *Penetrating cardiac injuries is one of the leading cause of death from urban violence. To evaluate a thoracic trauma with cardiac injury it's clear the use of thorax X-ray and multislice angio-Tc scan. Echocardiography has clearly emerged for the diagnosis in patients haemodynamically stable. When the patient is haemodynamically unstable the emergency thoracotomy is mandatory.*
CONCLUSION: *Despite the high mortality of penetrating cardiac injuries new surgical and radiological tecniques may help surgeon to save this patients*

KEY WORDS: Cardiac injury; Thoracic trauma

Introduction

First report of a cardiac surgical procedure is considered to be a penetrating injury repair of the left ventricle through a left anterior thoracotomy performed by Alex Cappelen about one hundred and sixteen years ago in Oslo [1]. Nowadays penetrating cardiac injuries are still surgical challenges. We report two cases of young man with penetrating cardiac injuries that had their lives save because of a timely intervention. In addition we present a literature review from 1986-2012.

Presentation of cases

CASE N. 1

A 15-year old male patient was stabbed with a knife to the right chest. He had first aid in a peripherical hospital and after 3 hours he was transferred to referral hos-

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Fig. 1: Chest X-ray (first patient).

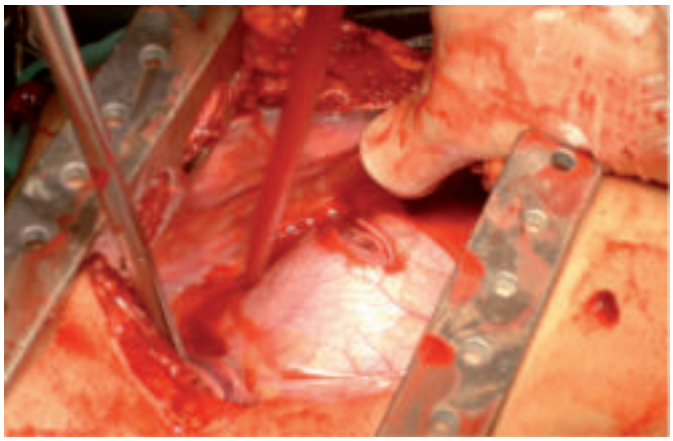

Fig. 2: Right auricle injury (first patient).

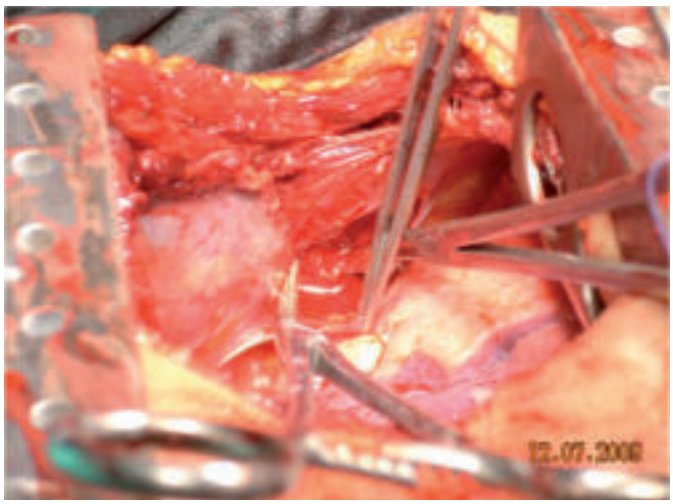

Fig. 3: Right intercostal artery injury (first patient).

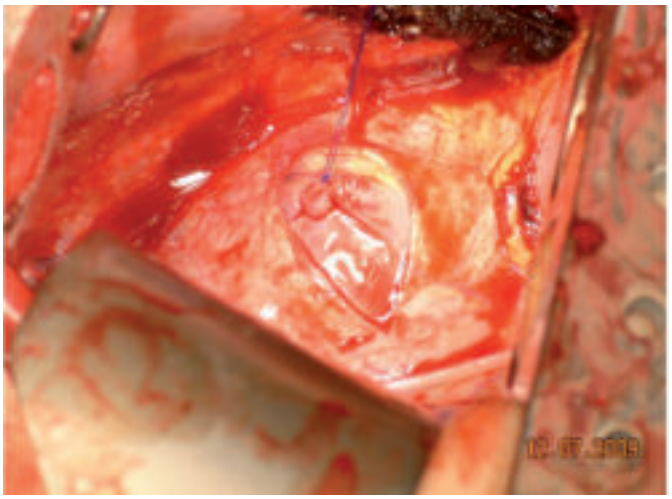

Fig. 4: Right intercostal artery repair a (first patient).

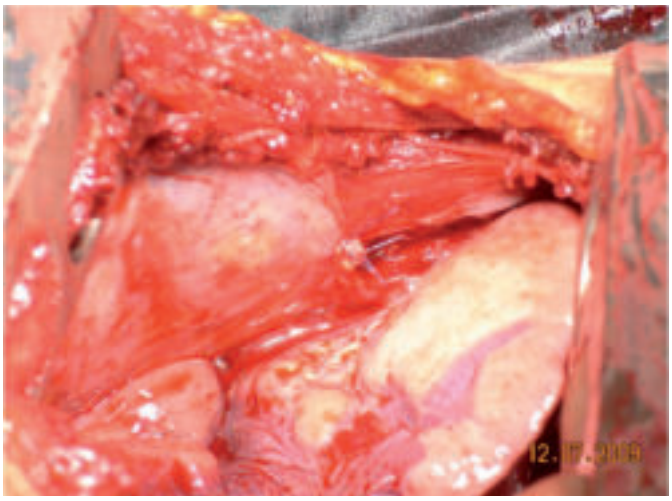

Fig. 5: Right intercostal artery repair b (first patient).

pital. Upon arrival he was orientated and conscious (GCS = 15), with a light dyspnea, blood pressure was 125/80 mmHg, satO_2 97% without inalation of O_2, Hb 11,3. The chest radiograph showed a right haemothorax and, according to the type of injury we indicated an angiography that showed an intercostals artery and a right auricle injury. The general patient condition after one hour and 30 minutes get worse (systolic pressure 75-80 mmHg, Hb 7,2, pO_2 91%, heart rate > 110) so we indicated an emergency operation. With a right toracotomy we located and closed the arterial lesion, then we sutured the hole in the right auricle with single stitch in non-absorbable suture. The patient was released home in good condition after the toracotomy had healed.

Case n. 2

A 19-year old male patient was stabbed with a knife to the chest more than once. He had first aid in a peripherical hospital and after 3 hours he was transferred to referral hospital. The TC showed a bilateral haemotho-

Fig. 6: Chest X-Ray (second patient).

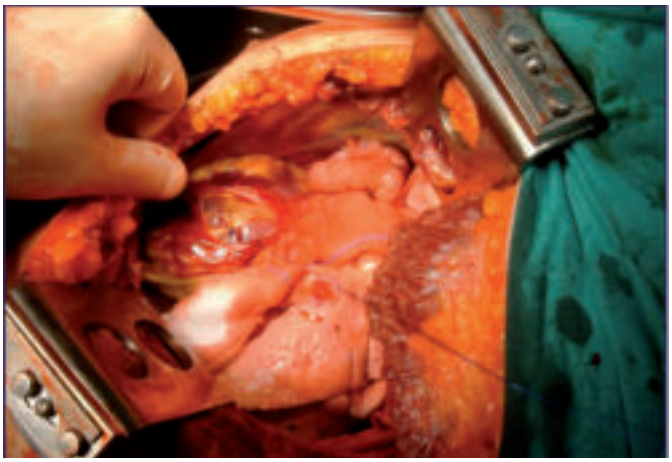

Fig. 7: Left ventricle repair (second patient).

rax with a left ventricle lesion. By a left toracotomy we sutured the lesion of the left ventricle with multiple single stitch in non-absorbable suture, we covered the suture with a sealant (Floseal®). During the operation he had a cardiac arrest, but the heart restarts beating with a manual cardiac massage. The patient released home in 24 days.

Discussion

Penetrating cardiac injuries is one of the leading cause of death from urban violence and nowadays remain the most challenging of all injuries seen in the field of trauma surgery [2]. In large series, gunshot wounds are the predominant cause of cardiac penetrating trauma [2-4]. Knife is the most common weapon for stab injuries, followed by other sharp items such as screwdrivers [5], ice picks [6], chopsticks, pneumatic nailgun nails [7-9]. Most patients with penetrating cardiac injuries die before arrival to the hospital, approximately 80%, and the mortality is directly related to the mechanism of injury and the pre-hospital care [11]. Paradoxically in the region where there is a good pre-hospital care the hospital survival lower, while the applied principle of "Scoop and Run" are responsible for many more cardiac injury patients arriving alive [12]. Site injuries rate is equally divided between the two ventricles (40%), is 3% for left atrium and 24% for the right one, only in 5% of the cases coronary arteries are involved.

The clinical presentations of penetrating cardiac injuries range from complete arrest. Beck's triad of distended neck veins/high venous pressure, hypotension/low arterial pressure, and soft/muffled heart sounds may be present in up to 60% patients and represent the classical presentation of the patient arriving in the emergency department with a full blown pericardial tamponade. Another classical sign is paradoxical inspiratory distension of neck veins upon inspiration (Kussmaul's sign) [10]. Our patients maintained suboptimal circulation for approximately four hours before undergoing surgery. The time span taken into consideration, our patient was extremely lucky as the outcome is usually poor when the time from trauma to surgery increases [10,11]. An Israeli study of 14 patients reports 100% survival (8 stab wounds, 2 gunshot wounds, 1 shrapnel injury and 1 multitrauma) with the mean time from injury to surgery of 37 minutes [12]. In addition with fast admission to surgery, this outstanding result may also be due to the fact that all patients had single chamber injuries and no coronary artery injury.

We can observe the presence of a pericardial tamponade in 80-90% of stabbed wounds, rarely in patients sustaining missile wounds because the bullet open the pericardium creating huge hemorrhages in the hemithorax. The physiology of pericardial tamponade is related to the fibrous nature of the pericardium, which renders it relatively inelastic and non-compliant to any sudden increases and intrapericardial pressure. The pericardium is able to accommodate gradual accumulation of blood if the bleeding is not rapid enough to cause acute rises in intrapericardial pressures which exceed the right ventricular pressure, and subsequently the left ventricle's ability to fill, owing also to the pressure exterted by the intra-pericardial hemorrhagic blood on atria and intrapericardial caval and pulmonary veins. It is clear that pericardial tamponade can limit extrapericardial bleeding into the left hemithoracic cavity, thus preventing exsanguinating haemorrage and allowing the patient to reach a trauma center alive. The deleterious effect can lead to rapid cardiopulmonary arrest [13].

Moreno et al. in a retrospective study strongly supports the presence of a pericardial tamponade as a critical determinant for survival in penetrating cardiac injuries [16]. Buckman and Asensio in the first published prospective study of penetrating cardiac injuries did not find

pericardial tamponade to be a critical independent factor in survival [17]. Similarly, Asensio in a study of 97 patients subjected to Emergency Department thoracotomy, did not find pericardial tamponade to be a critical independent factor in survival [18]. In a one year prospective preliminary Asensio's study of 60 penetrating cardiac wounds with a overall survival of 37% and 16% survival for patients undergoing Emergency Department thoracotomy did not find, after statistical analysis, pericardial tamponade to be a critical independent factor for survival [19]. Asensio in the third and largest prospective study of penetrating cardiac injuries again did not find the presence of a pericardial tamponade to be a critical independent predictive factor [20].

No data exist to define the time after which tamponade loses its protective effect and leads to impairment of venous return by means of the compression exterted on intrapericardial veins, cardiac contractility, and diminished cardiac output. The time during which its protective effect becomes deleterious has yet to be defined.

To evaluate a thoracic trauma with cardiac injury it's clear the use of thorax X-ray and multislice angio Tc scan. Subxiphoid pericardial window (SPW), firt described as an original technique by Larrey in the 1880's, it's indicated for any patient who sustains a penetrating injury in the area inferior to the clavicles, superior to the costal margins and medial to the midclavicular lines when the results of the echocardiography are not clear or it's impossible to make an ultrasounds examination. Echocardiography has clearly emerged as the newest technique for the diagnosis of penetrating cardiac injuries in patients haemodynamically stable [18]. The results of the prospective multicenter study by Rozycki et al. showed ultrasound to be 100% sensitive, with a specificity of 96.9% and an accuracy of 97.3% for detecting haemopericardium [21]. Meyer et al. found that in patients without haemothorax, echocardiography was a good as SPW: sensitivity (100% versus 100%), specificity (89% versus 91%) and accuracy (90% versus 91%) [22]. Asensio et al aggressively employ the use of echocardiography in both stable and unstable patients. Patients with positive echocardiography are subject to sternotomy, while stable patients with negative examinations are observed and discharged if they remain stable [18].

When the patient in haemodynamically unstable the emergency thoracotomy is necessary. In this case the incision of choice is the left anterolateral thoracotomy, on the other hand, when the patient is non haemodynamically compromised is possible to practice a right anterolateral thoracotomy.

To repair an atrial wound the use of a Satinsky vascular clamp could be necessary to allow the trauma surgeon to perform a rapid repair utilizing a monofilament suture in a running or interrupted fraction. All the maneuvers have to be careful because of the thin wall of the atria. The use of bioprostetic materials is not recommended.

Ventricular wounds need a different repair's technique. They may be repaired first by digitally occluding laceration in an attempt to control the massive hemorrhage while placing either simple interrupted or horizontal mattress sutures of Halsted. Frequently this injuries require multiple sutures or sealants gelatin-based. When this occurs, bioprosthetic material such as Teflon is needed to buttress the suture line.

The repair of a coronary lesion can be quite challenging. Lacerations in proximal locations of the coronary artery may demand the use of a cardiopulmonary bypass for repair, while a distal coronary lesion should be managed by ligation.

Conclusion

We discuss two patients who present to the Emergency Department with stab wounds to the chest. They had a quick and appropriate workup and an emergency operation. They both released home in good general conditions.

We believe that if a patient with a penetrating stab wound in the heart is not obviously dead on arrival, an attempt for cardiac repair should always be done.

Riassunto

Presentiamo in questo breve lavoro due casi di ferita penetrante cardiaca in giovani pazienti di sesso maschile trattati chirurgicamente presso il trauma center dell'A.O.R.N. A. Cardarelli di Napoli. La peculiarità di entrambi i casi, più che nel trattamento chirurgico, che segue i canoni prescritti dalla letteratura internazionale, è nel timing. Entrambi I giovani,infatti, hanno ricevuto le prime cure in ospedali periferici per poi essere trasferiti nel nostro centro, lasciando che le cure del caso fossero differite di ore rispetto a ciò che ci si auspica in certi casi. Nonostante ciò i pazienti superano brillantemente l'intervento e vengono dimessi senza sequele.

Per completare la discussione dei casi presentiamo una revisione della letteratura a riguardo dal 1986 al 2012.

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Commento e Commentary

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Ordinario F.R. Di Chirurgia Generale

Sulla base di un certo passato provincialismo, non disgiunto da una forse perdurante esterofilia della nostra letteratura scientifica, oltre all'utilizzo esclusivo all'epoca della lingua italiana, sfugge a molti che il primo chirurgo ad aver osato di suturare una ferita traumatica del cuore fu un chirurgo italiano e non il norvegese Alex Kappelen ricordato dagli Autori.
Proprio l'8 gennaio dell'anno 1896 citato nell'articolo, il chirurgo romano Giovanni Farina suturò una ferita da coltello del cuore in una giovane, eseguendo per primo con successo una tale operazione di emergenza nello storico Ospedale romano della Consolazione [(1)], ove si trovava in servizio di guardia.
Si trattava di un uomo che era stato accoltellato e presentava una ferita da punta e taglio al torace. L'esplorazione della ferita fece constatare una lesione da punta e taglio del ventricolo destro della lunghezza di 7 cm. Giovanni Farina suturò la parete cardiaca, il pericardio e la pleura e chiuse il torace per prima intenzione. Il decorso post-operatorio fu buono nei primi giorni ma una broncopolmonite, a quei tempi incurabile, portò a morte il paziente in sesta giornata. Il referto istopatologico mostrò la presenza di avanzato processo di cicatrizzazione della ferita e questo dato di grande rilievo scientifico, già noto negli animali, alleggerì parzialmente la delusione dell'insuccesso clinico.
Il successo iniziale dell'iniziativa fece scalpore perché rappresentava quasi un'eresia rispetto al diffuso convincimento che il cuore non poteva essere suturato perché a rischio di arresto intraoperatorio, o più tardivamente di mancata cicatrizzazione, e lo stesso Francesco Durante proponeva fino ad allora come unica terapia possibile addirittura il salasso. Per la prima volta si dimostrava dunque che anche nell'uomo le ferite del cuore potevano cicatrizzare, e su questo argomento si soffermò con insistenza, ricreduto, proprio Francesco Durante nella Seduta della Società Italiana di Chirurgia di quello stesso anno.

Il 1896 fu dunque l'anno dell'inizio della chirurgia cardiaca efficace, e l'impresa del romano Giovanni Farina venne ripetuta a Francoforte sul Meno da Ludwig Rehn il 9 settembre, e nel novembre successivo in Danimarca da Alex Kappelen. L'anno successivo, il 18 aprile ed il 3 giugno 1897, la sutura del cuore venne ancora eseguita con successo a Roma da A.Parrozzani.
Entro il 1898 ben 13 furono gli interventi eseguiti per suturare ferite del cuore, e notizie precise sono rintracciabili nel Trattato di Chirurgia di Francesco Durante al capitolo della Chirurgia del cuore, con particolari riguardo il tipo di trauma, il tempo trascorso fra il trauma e l'intervento, il tipo di sutura eseguito, il decorso post-operatorio, l'esito finale.
L'intervento di Rehn venne dunque erroneamente accreditato come il primo successo di una sutura chirurgica del cuore, mentre la palma dell'iniziativa di successo va attribuita a Giovanni Farina, successivamente diventato Primario Chirurgo dell'Ospedale Civile di Albano Laziale.
Guido Farina ebbe occasione di eseguire due nuovi interventi sul cuore e di questi il più importante fu pubblicato sulla Gazzetta Medica di Roma del 13 Ottobre 1929, dove furono descritte in maniera minuziosa e particolareggiata le fasi dell'intervento.

* * *

Based on a certain provincialism, not separated by a possibly permanent xenophilia of scientific literature, added to the exclusive use of the Italian language at the time, is overlooked by many that the first surgeon to have dared to suture a traumatic heart's wound was an Italian surgeon and not Kappelen Alex as remembered by the authors.
Just on 8 January of the same 1896 cited in the article, the roman surgeon Giovanni Farina sutured a knife wound of the heart in a young, performing successfully as the first such an emergency operation in the historic roman Hospital of Consolation (1) where he was on emergency duty.
The victim was a man who had been stabbed to the chest by a knife. The exploration of the wound revealed a tip and cut wound the right ventricle, the length of 7 cm. Giovanni Farina sutured the heart wall, pericardium and pleura and closed the chest by first intention. The postoperative course was good in the early days but bronchopneumonia, incurable at the time, brought death to the patient in the sixth day. The pathology report showed the presence of advanced process of wound healing and this was a matter of great scientific importance, already known in animals, partially eased the disappointment of failure clinic former experiences.
The initial success of the operation caused sensation because it was almost an heresy in front of the widespread belief that the heart could not be sutured because intraoperative risk of arrest, or later of non-healing of a beating heart, and the same Francesco Durante had proposed so far the bloodletting as the only therapy to lower the blood pressure. For the first time was proved, therefore, that man could heal the wounds of the heart, and on this subject dwelt insistently, changed his mind just Francesco Durante in the seat of the Italian Society of Surgery of the same year.
The year 1896 was therefore that of the beginning of effective cardiac surgery, and the enterprise of the Roman Giovanni Farina was repeated in Frankfurt by Ludwig Rehn September 9, and the following November in Denmark by Alex Kappelen. The following year, on April 18 and June 3, 1897, a suture of the heart was still successfully performed in Rome by Antonio Parrozzani.
By 1898 as many as 13 operations were performed for suturing wounds of the heart, and details are traceable in the Treaty of Surgery of Francesco in the chapter on Heart Surgery, regarding the type of trauma, time elapsed between trauma and surgery, the type of suture performed, the postoperative course, the final outcome.
The intervention of Rehn was then mistakenly credited as the first success of a surgical suture of the heart, while the palm of the initiative of success is attributed to Giovanni Farina, who later became Chief Surgeon of the Civil Hospital of Albano Laziale.
Guido Farina had the opportunity to perform two new operations on the heart, and the most important of these was published in the Official Medical Rome on October 13, 1929, where they were described in a thorough with detailed phases of the intervention.

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