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Penetrating wounds of the heart. Report of a case and literature review

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ABBREVIATIONS:

SBP: Systemic blood pressure.

HR: Heart rate.

RR: Respiratory rate.

ASA: American Society of Anesthesiology.

FiO₂: Fraction of inspired oxygen.

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SUMMARY

In our means the cardiac wounds appear in a 10% as unique injury in the patients with trauma and although most of the victims dies without obtaining the medical resource, the mortality of the patients who enter to the services of urgencies and manage to be taken part is hardly of 5%, in agreement with the statistics of our means of the most important situations and urgent than they appear actually surgical, is the penetrating injury of the heart and in the great vessels. A great percentage of the individuals with serious wounds in the heart passes away before arriving at the hospital. Those that still they arrive with life at the casualty department are «a self-selection» group that has anatomical and physiological factors to their favour. These «lucky» patients will need an immediate and decisive action to survive provided by a surgical-medical equipment suitably enabled. A case is reported and Literature is reviewed.

Key words: Heart, cardiac trauma, hypovolemic shock, tamponade.

RESUMEN

En nuestro medio las heridas cardíacas se presentan en un 10% como lesión única en los pacientes con trauma y aunque la mayoría de las víctimas muere sin lograr el recurso médico, la mortalidad de los pacientes que ingresan a los servicios de urgencias y logran ser intervenidos es apenas de 5%. De acuerdo con las estadísticas de nuestro medio, entre las situaciones más importantes e impostergables que se presentan en la práctica quirúrgica, está la lesión penetrante del corazón y en los grandes vasos. Un gran porcentaje de los individuos con heridas graves en el corazón fallecen antes de llegar al hospital. Los que aún llegan con vida a la sala de urgencias son un grupo «autoseleccionado» que tienen factores anatómicos y fisiológicos a su favor. Estos pacientes «afortunados» necesitarán una acción inmediata y decisiva para sobrevivir, proporcionada por un equipo médico-quirúrgico capacitado. Se reporta un caso y se revisa literatura.

Palabras clave: Corazón, trauma cardíaco, choque hipovolémico, taponamiento cardíaco.

INTRODUCTION

Traumatic heart injuries can be induced by direct impact, acceleration-deceleration or penetrating wounds caused by firearms, knives or other razor-sharp objects⁽¹⁾ (Table I).

Heart trauma should be suspected in all patients who have wounds in the anterior chest and hemodynamic instability. The areas of risk for these injuries are: precordial area, epigastrium and upper mediastinum (Murdock zone II)⁽²⁾.

In 70% and 30% of cases, injuries affect the left and right ventricle, respectively. In at least 50% of cases there are commitments associated to lung, diaphragm, liver, spleen or gastrointestinal tract⁽³⁾. Vascular lesions are all venous, not by chance but they allow a longer survival⁽⁴⁾ (Table II).

In penetrating trauma, the clinical picture of patients with heart injuries ranges from hemodynamic stability, in asymptomatic patients, to acute cardiopulmonary collapse and cardiorespiratory arrest.

One form of presentation is cardiac tamponade, showing the Beck's triad (consisting of jugular post-ingurgitation, breath heart sounds, and paradoxical pulse), only it manifests in less than 40% of cases. Other manifestations most commonly found in these patients are hypotension, psychomotor agitation, and jugular ingurgitation (Table

III). Hypovolemic shock: In some patients with penetrating heart injuries there is direct communication from the pericardial sac to pleural space through which massive volumes of blood are escaped causing hypovolemic shock. Asymptomatic: When the injuries are not transmural or are small and are in left ventricle may be occluded due the muscle mass or may cause small pericardial effusions that does not produce physiological changes and they effusions does not cause late manifestations. Patients with cardiac tamponade and/or hypovolemic shock should be operated immediately^(6,7).

If there is time and if technical resource and patient's clinical conditions are the appropriate ones for reasons of safety and confidence, the widely recommended diagnostic tests are thoracoscopy or subxiphoid pericardial puncture guided by Doppler echocardiography performed by medical experts⁽⁸⁾. In determining cardiac injury with hemopericardium, the morbidity is from 2 to 5%, given by infections and the postpericardiotomy syndrome. Choice method is the transthoracic Doppler echocardiography performed at the bedside of patient, although it has higher sensitivity and specificity, less than the pericardial window (which in our environment has not been a useful and appropriate resource), especially if there is pleural effusion. Some studies have shown, for subxiphoid pericardial window, a specific-

Table I. The classification of the cardiac traumatism is based on the mechanism of the injury.

Classification of the cardiac traumatism	
Penetrating	Hurt by white weapon: knives, swords, ice picks, fence posts, wires Hurt by fire arms: caliber under-high, hand weapon, rifles. Hurt by gun
Non penetrating wounds (Bruises)	Automobile accident (Safety belt, Air bag) Accidents with vehicle-pedestrian Falls from height Industrial accident (Compression) Explosion: explosives, grenades Assault (aggravated) External or rib fracture Recreation: Sporting events: run of bulls
Iatrogenic	Induced by catheters Induced by pericardiocentesis
Metabolic	Traumatic answer to the injury Systemic inflammatory response syndrome (SIRS)
Others	Burns Electricity Factice: needles, strange bodies Embolic

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Table II. Severity of cardiac injury.

Grade	Description of injury
I	Closed cardiac injury with minimal changes in the ECG Pericardial injury without cardiac affectation, cardiac tamponade or cardiac herniation
II	Closed cardiac injury with onset of heart block or ischemic changes without heart failure Tangential myocardial injury without extension to the endocardium or tamponade
III	Closed cardiac injury with multifocal or sustained ventricular extrasystole Cardiac injury with septal rupture, pulmonary valvular insufficiencies or tricuspid, papillary muscle dysfunction or coronary artery occlusion without sign of heart failure Injury with pericardial tear and cardiac herniation Closed cardiac injury with heart failure
IV	Open tangential myocardial injury without endocardial affectation but with tamponade Cardiac injury with septal rupture, pulmonary valvular insufficiencies or tricuspid, papillary muscle dysfunction or coronary artery occlusion with signs or heart failure Cardiac injury with aortic or mitral value insufficiency Cardiac injury with impairment of the right ventricle or one of the two auricles
V	Cardiac injury with occlusion of a proximal coronary artery Cardiac injury with left ventricular perforation Injury by cardiac outbreak with less than 50% loss of the right ventricle, right atrium or left atrium
VI	Closed injury with avulsion cardiac or penetrating wound with loss greater than 50% of a camera Progress from one grade to the presence of multiple penetrating wound, on one or more cavities

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Table III. Associated arrhythmias with cardiac injury.

Penetrating injury
Sinus tachycardia
ST segment changes associated with ischemia
Supraventricular tachycardia
Tachycardia/ventricular fibrillation
Contusion injury
Sinus tachycardia
Abnormalities of the ST segment and T wave
Atrioventricular block, bradycardia
Tachycardia/ventricular fibrillation
Electrical injury
Sinus tachycardia
Abnormalities of the ST segment and T wave
Right bundle branch block
Axis deviation
QT prolongation
Paroxysmal supraventricular tachycardia
Atrial fibrillation
Ventricular tachycardia, fibrillation
Asistolia

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ity of 100% with sensitivity from 89 to 100%; while for echocardiography, the sensitivity varies from 50 to 90% and specificity from 97 to 100%, then it is recommended to use echocardiography and guided subxiphoid puncture in stable patients without pleural effusion in any situation of diagnostic doubt⁽⁹⁾.

Useful Diagnostic studies

ECG may present various changes⁽¹⁰⁾.

Chest radiograph may also show fissures, pleural fluid or signs of pulmonary contusion, increasing the likelihood of cardiac contusion⁽¹¹⁾.

Elevated cardiac enzymes by trauma considering that the MB fraction is specific to cardiac muscle⁽¹⁾.

The echocardiogram is undoubtedly the most useful diagnostic study, which performs an anatomical, functional and hemodynamic scan of the heart, which allows the detection of pericardial effusion, magnitude and impact on the heart (tamponade), alterations in the contractility of the walls by trauma, the presence of fistulas, short-circuits or abnormal steps of blood, lesions of the valves, rupture of cavities, aneurysms, thrombus, lesions in the large vessels (aorta and pulmonary artery), and pulmonary vein lacerations. It is suggested to complement the study with transesophageal echocardiography⁽⁵⁾.

Other diagnostic methods such as isotope ventriculography (nuclear medicine), computed axial tomography and

nuclear magnetic resonance can clarify issues not clearly defined, but for its implementation it is essential the patient's condition is stable and that any life threatening risk factors have been solved⁽⁷⁾.

We conclude that patients should be transferred to a hospital with all available resources for a proper diagnosis and treatment of cardiac injuries⁽⁸⁾.

The frequency of surgically treated cardiac and vascular injuries has been increased considerably due the overall increase in violence and improved systems of care for trauma patients⁽³⁾.

The final survival is attributed to: 1) a rapid treatment; 2) wounds caused by knives with a reduced magnitude of the lesion with less associated damage; and 3) a strong intensive perioperative support. However, the key factor for achieving a higher survival is a timely action⁽⁵⁾.

CLINICAL CASE

The patient is a male of 27 years old, with unknown background, who was admitted to General Hospital "Xoco" SSG DF with diagnosis of injury by razor-sharp weapon in anterior thoracic region referred from another unit with clinical course of 6 hours. Exploratory thoracotomy is performed in the operating room. On admission to the operating room, there were no laboratory tests and cabinet studies. The patient was underwent oro-intubation and had vital signs BP 70/40 mmHg. HR x 158 $\dot{}$. RR x 28 $\dot{}$, Glasgow 3, general paleness + + +, cold skin, acrocyanosis, jugular ingurgitation, paradoxical pulse; the patient was classified as ASA UVB.



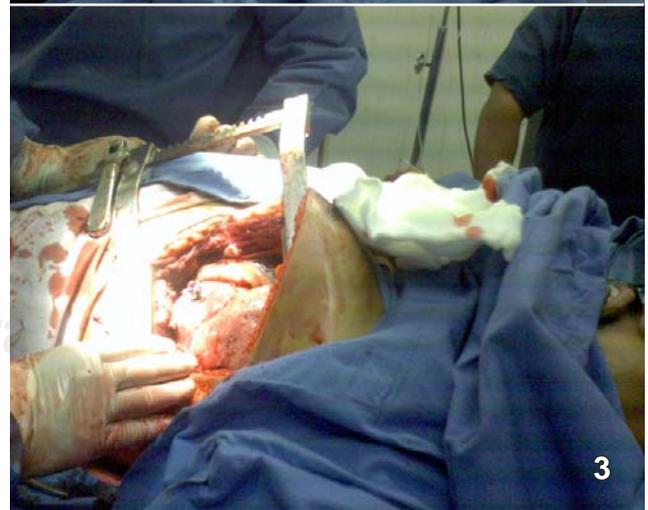
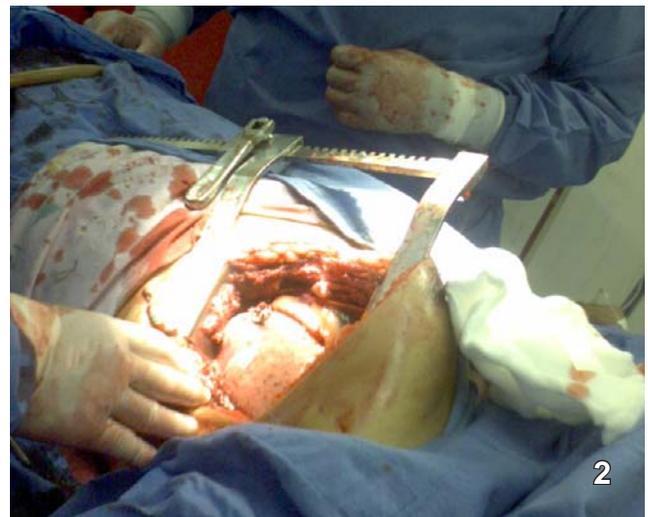
Figure 1. Exploratory thoracotomy.

It was treated with intravenous general anesthesia: 200 mg fentanyl IV, 8 mg vecuronium IV, 70 mg ketamine IV. Pressure-controlled ventilation RR: 10 x', 100%FiO₂, volume was replaced by crystalloids, colloids and blood products. The following amines were administrated: 10 mg/kg/min dobutamine, 15 mg/kg/min dopamine, and 5 mg/kg/min norepinephrine.

Findings: Electrocardiographic tracing with ST segment depressions and ventricular extrasystoles.

Drainage of 2300 cc hemorrhagic pericardial fluid, linear penetrating injury 1.5 cm in length of right ventricular, including interventricular septum. The razor-sharp weapon was found and removed (knife) (Figures 1 to 5).

Clinical course: Clumsy clinical course featuring 20 minutes of multiple organic failure secondary to pump failure, hypovolemic shock and death.



Figures 2 and 3. Visible cardiac injury.



Figure 4. Extraction of sharp weapon.



Figure 5. Penetrating injury visible.

REMARK

Precordial penetrating injuries have high incidence of cardiac injury and full engagement with or without alteration of vital signs. Over 80% of the cases tamponade occurs. Blood accumulates in the pericardial sac and by removing the weapon this latter seals, ventricular filling and ejection volume are reduced, which is compensated by releasing cat-

echolamines which cause tachycardia and increased right heart pressures, reaching the limits of distensibility. The septum is bulged toward the left side further compromising the function. Irreversible shock occurs if this condition persists and worsens.

Advanced Trauma Life Support (ATLS) and ABC must be evaluated and established, and surgery and/or damage control must be assessed.

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