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USE OF CARDIOPULMONARY BYPASS TO SALVAGE PATIENTS WITH HEART WOUNDS: A CONSECUTIVE SERIES OF 36PATIENTS FROM A SCANDINAVIAN HOSPITAL

***[1,2]Pazooki, D., Zeraatian, S., [3]AJ Khamooshi, [1]Granhed, H., [1]Nerlander, M.P., [4]Mesbah, M [2]Hosseini, S. H. [2]Mousavie, [2]Negahi, A.R., [1]Haghighikian, M.**

[1]Sahlgrenska University Hospital, Department of Surgery, Gothenburg Sweden
[2]Iran University, Hazrat Rasol Akrm Hospital, Department of Surgery and Cardiovascular & Thoracic surgery Tehran Iran
[3]Shahid Rajaei Cardiovascular Surgery Center, Tehran Iran
[4]Iran University, Hazrat Rasol Akrm Hospital, Department of Cardiovascular & Thoracic anesthesia Tehran Iran

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ABSTRACT

Abstract: Thoracic injuries account for 25% of all trauma deaths annually. Immediate deaths involve disruption of the heart or great vessel injury.
Early deaths (those occurring within 30mins to 3 hours) are due to cardiac tamponade, tension pneumothorax, aspiration, or airway obstruction. Pulmonary sepsis and missed injuries account of the late deaths.
Objectives: To review our experience with penetrating heartinjuries at the SU/Sahlgrenska University hospitalwith cardiopulmonary bypass (CPB) in trauma, complemented by a comparison with European and global experience with penetrating heart injuries and CPB treatment to outline indications for its expanded use in trauma management.
Methods: Medical records were reviewed for demographicand physiological data, operative findings, and outcome.A retrospective study of 36 consecutive patients with penetrating, and blunt trauma to the chest was conducted over 6 years at our trauma unit. Patient details, mechanism of injury, operativeprocedure and in-hospital mortality and morbidity rates were recorded. All available published English-language articles from peer reviewed journals, found by MEDLINE database.
Conclusions: Cardiopulmonary bypass is essential in some patientswith complex multiple-chamber cardiac injuries that could notbe exposed andrepaired by other means.Further studies by other trauma centers will be needed for standardized indications for the use of CPB in trauma.

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INTRODUCTION

Patients with penetrating cardiac injuries can present either in a stable condition, or in shock, and can consitute diagnostic challenges to emergency physicians and trauma surgeons. physical examination and invesigations, such as, chest X-rays, pericardiocentesis andelectrocardiograms are usually inconclusive in establishing the diagnosis which may result in a diagnostic dilemma (Kang, 2007; Cardiothoracic Surgeon, 2006). Cardiac catheterization is a useful method to accurately diagnose penetrating trauma to the heart (Jon, 1998 and Bowley, 2002).

Corresponding author: **[1,2]Pazooki, D.,**
[1]Sahlgrenska University Hospital, Department of Surgery, Gothenburg Sweden
[2]Iran University, Hazrat Rasol Akrm Hospital, Department of Surgery and Cardiovascular & Thoracic surgery Tehran Iran

This procedure provides information about the specific area of the heart involved, shows damage to the cardiac valves or coronary vessels and reveal intracardiac shunts.2However, this approach is time consuming and is not appropriate for the initial evaluation of the trauma patient. One effective technique is the use of subxiphoid pericardial windows, which represent a rapid method for the accurate diagnosis of cardiacinjuries and should be considered as gold standard for the evaluation of penetrating cardiac trauma (Cardiothoracic Surgeon, 2007; Loogna, 2006; Jon, 1998; Bowley, 2002). An alternative approach is toutilize serial echocardiography. In a recent series of patients with penetrating cardiac wounds and stable vital signs, two-dimensional echocardiography was found to be 90% sensitive and 97% specific for the diagnosis of cardiac penetration. Penetrating cardiac injuries are among the most dramatic and lethal of all injuries. The mortality of

patients with this type of injury is high, with many patients dying prior to reaching hospital (Degiannis, 2005; Campbell, 1997; Fulda, 1991).

patients (62%) had penetrating and 14 patients (38%) had blunt injuries. Thirty-two patients (89%) were male and 4 patients female (11%).

Tab. 1. The records of all patients with cardio thoracic trauma for whom the CPB team was activated between 2004 and 2010.(ISS = or <25)

	Age	Sex	Penetrating	Blunt	CPB	EDT
36 thoracic trauma patients	14-51	M=32 (89%) F=4 (11%)	22 = (62%) (ISS = <25)	14= (38%) MVA/MC ISS =16-24	4= (11%) Male	N=7
GSW	18-29	M=7	N=7		N=2	N=5
Mitral valve rupture =2 (5%) AVR=2 (5%)	29 and 32	M=2	N=2	N=2	CPB =4	N=2
Severe cardiac contusion= 1	42	M=1	N=0	N=1	N=0	N=0
GSW= 1 cardio-pulmonary penetration	32	M=1	7 patients (31,8%) survived after EDT		N=1	EDT=7
Mortalitypre-hospital=8	18-36	M	7, died pre-hospital	1 =MVA		
Mortalityin hospital	18-29	M	7, died in hospital	N=1		N=4
Cause of death		3 with mutitrauma, most likely resulting in death.	4 patients died. 1 with multiple cardiac wounds 3 with MOF.	1=MOF	N=0	4 died. 1 = with multiple cardiac wounds 3= MOF.

The risk of death was not significant between patients sustaining thoracoabdominal wounds and those with isolated thoracic injury *(P=1.0).*

However, patients who arrive at the hospital with intact vital signs have a good chance of survival if well managed. The diagnostic acumen and rapid surgical intervention of physicians and surgeons can lead to successful outcomes (Degiannis, 2005 and Degiannis, 2005). Repair of cardiac wounds was considered as almost impossible a century ago. Despite progress, penetrating cardiac injury remains a highly lethal form of trauma today (Asensio, 2001; Campbell, 1997 and Fulda, 1991). Cardiac tamponade and exsanguination are the greatest immediatly life-threatening consequences. Clinical presentation is extremely variable, and diagnosis may be highly deceptive. Unlike other forms of trauma, resuscitation is of limited value and urgent operative intervention is the only meaningful treatment. Developmentsin cardiothoracic surgery and the simultaneous evolution of trauma care systems have both contributed to saving lives (Fulda, 1991; Stewart, 1997; Jon, 1998). In terms of cardiac injury, high survival rates in selected reports have given the erroneous impression that the lethality of cardiac injuries has diminished in recent years (Asensio, 1998; Rhee, 1998; Tyburski, 2000). However, mortality rates for thisconditionhave not changed much in the last century, due mainly to the rising proportion of more lethal injuries caused by gunshot wounds (Pezzella, 1998; Campbell, 1997). Penetrating wounds to the heart represent a significant surgical challenge because of their unique clinical course and the need for emergent operative care. This operative care, which may include cardiopulmonary bypass (CPB), must be initiated in a prompt yet careful fashion to optimize outcome and minimize morbidity (Karmy-Jones, 1997; Campbell, 1997 and Fulda, 1991). The need for cardiopulmonary bypass (CPB) in the treatment of trauma patients is controversial, and not all level I trauma centers have CPB readily available (Bowley, 2002). The need for cardiopulmonary bypass in thetreatment of penetrating heart injuries is still under debate (Campbell, 1997).

RESULTS

We reviewed the records of all patients with cardiothoracic trauma for whom the CPB team was activated between 2004 and 2010. Out of a total of 36 thoracic trauma patients, 22

Perfusionists were present for the initial operative management of 4 patients, (11%). Two patients (5%) had mitral valve rupture, one patient suffered severe cardiac contusion and one patient had cardio-pulmonary penetration based on a transthoracic gunshot wound.The remaining two patients (5%) had surgery with the CPB team present but standby. Twenty-two patients (62%) had penetrating chest trauma. Of this group seven patients (31,8%) survived after emergency room thoracotomy. Fifteen patients in the penetrating chest trauma group died. Out of these, eightwere pre-hospital deaths and seven in-hospital deaths. Out of the patients who died, one patient sustained multiple cardiac wounds and three patients developed multi organ failure. Of the emergency room thoracotomy group four patients died. Seven patients of the penetrating group sustained transthorasic gunshot wounds.

DISCUSSION

Our trauma unit, similar tomany other Swedish units, has relatively limitedexperience in treating patients with major cardiac injuries. We treated 36 patients (penetrating and blunt injuries) in a 7-year period. In contrast, many trauma units in South Africa and the USA treat a similar volume of patients in a period of months. The mechanism of injury in our patients was evenly divided between blunt and penetrating trauma. Patients seen at high-volume cardiac trauma units are predominantly penetrating trauma victims. In many ways our Swedish trauma experience parallels that reported from other European countries in that there arerelatively few cases of penetrating cardiac trauma, with gunshot woundsbeing an infrequent etiology. The indicators of a good outcome are right ventricular injury, which is three times more common than left ventricular injury, single chamber injury, absence of plural breach, stab injury, cardiac tamponade, single injury, early operative intervention, and aggressive resuscitation. The absence of severe thoracic trauma (ISS of chest <25) was seen in most survivors. This seems to imply that although extrothoracic wounds contributed significantly to morbidity, mortality was directly related to the presence of severe thoracic injury in almost all cases.

Conclusions

In the management of a sole penetrating cardiac injury, it is essential to have rapidtransport of the patient to a tertiary medical facility. Then, aggressive resuscitation should be initiated to stabilize the patient condition and emergency thoracotomy should be performed to increase the survival rate. Patients with major cardiac injuries and detectable vital signs on hospital arrival can be salvaged by prompt surgical intervention in the operating theatre. Major cardiac injuries are infrequently encountered at our center, but patient survivability is comparable to that reported from trauma units in other countries. Penetrating chest injury is common, and most patients can be managed without CPB. However, the patients who do merit surgical intervention have a relatively high mortality and a rapid and skilled operative approach is required to achieve acceptable results. Although CPB has traditionally been used in the setting of cardiac trauma solely, a better understanding of its potential benefit in non-cardiac injuries will contribute to improved outcomes in the increasingly diverse number of severely injured patients seen in trauma centers today. Cardiopulmonary bypass could be ineffective in salvaging patients with cardiogenic shock but is essential in some patients with complex multiple-chamber cardiac injuries that could not be exposed and repaired by other means.Further studies by other trauma centers will be needed for standardized indications for the use of CPB in trauma. Penetrating injuries to the chest are dangerous injuries. In order to decrease mortality, good systems for transportation and experienced personnel are necessary.

Disclosure

The authors declare no conflicts of interest.

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