Management of Blunt Cardiac Injury

Lawrence Nair[1], Brendan Winkle[2]*and Eshan Senanayake[1]

[1]Department of Cardiothoracic Surgery, The Prince Charles Hospital, Brisbane, Queensland, Australia

[2]Department of Surgery, Royal Darwin Hospital, Darwin, Northern Territory, Australia

Corresponding Author*

Brendan Winkle
Department of Surgery,
Royal Darwin Hospital, Darwin, Northern Territory, Australia
E-mail: bdwinkle@gmail.com
Tel: 61406300393

Received: 13 Mar 2020; **Accepted:** 03 Apr 2020; **Published:** 10 Apr 2020

Abstract

Blunt chest trauma can cause a spectrum of injuries ranging from simple arrhythmias to chamber ruptures. There is a wide range of literature supporting investigation and management. Surgical intervention should be prompt, appropriate and occur in conjunction with other teams with the aim of managing the complications of cardiac injury.

This article aims to provide a brief overview of the initial investigations and management of blunt trauma and provide evidence to assist in decision making when assessing BC.

Keywords: Trauma• Cardiac injury• Cordial dysfunction• Ventricular rupture

Introduction

Trauma is the leading cause of death worldwide. Approximately 2/3 of the patients have a chest trauma with varying severity from a simple rib fracture to penetrating injury of the heart or tracheobronchial disruption. In Australia, blunt chest trauma is more common than penetrating trauma and directly comprises 90% of trauma admission 20% to 25% of trauma deaths. Blunt cardiac injury (BCI) is a severe and potentially life threatening complication of chest trauma. The exact incidence of (BCI) is unknown as diagnosis often missed in the complex, multi-trauma patient. This article aims to review the mechanisms behind BCI and provide a framework for management based on current best evidence.

Case Report

BCI can present as an arrythmia due to myocardial contusion [1]. The incidence of cardiac contusion in patients with blunt chest trauma is not well known. Depending on the criteria used for diagnosis, the reported incidence ranges from 5 to 50% of blunt chest trauma cases and is the most common form of BCI. Mainstays of treatment are serial ECG, troponin I and T and an echocardiogram [2]. By monitoring these, complications of myocardial contusion can be identified and treated early. Currently, while arrythmia and cardial dysfunction occurs in up to 16% of patients, mortality is 1.5% due to early detection [2].

More severe complications of BCI include the rupture of a cardiac chamber, which has a much higher mortality than a simple contusion. The mechanism of cardiac chamber rupture secondary to blunt thoracic trauma can be from myocardial infarction and necrosis secondary to contusion, a consequence of rapid deceleration or from direct praecordial impact [3,4]. Survival following single-chamber cardiac rupture is more likely with atrial injuries as well as injuries involving the right heart chambers [5]. Atrial rupture, often occurring at the junction of the atrium with the vena cava or pulmonary veins, is likely the result of rapid deceleration. The mechanism of this injury is thought to be due to differing deceleration rates of structures in the mediastinum, depending on how fixed or mobile they may be. As the vena cava is a fixed structure, as compared to the right atrium, the difference in deceleration creates a large shearing force, resulting in injury [6]. Right atrial ruptures are likely more common due to weakness of the right atrial appendage [7]. Parmely et al. demonstrated that 43% of ruptures from BCI were in the right atrium, compared to 13% in the left atrium and 13% in the intraventricular septum [8].

The lower rates of ventricular rupture are thought to be due to a difference in mechanism. Rather than deceleration, ventricular rupture is more likely to occur following direct trauma to the precordium. This results in compression of the heart between the sternum and the vertebral column. The incidence of ventricular rupture is also related to the stage of the cardiac cycle at time of injury. If the heart is maximally distended, as at end-diastole, the force required for compression is less and thus the risk is increased [9].

Management of BCI in the acute setting should be dictated by patient presentation and clinical findings. In the stable patient with significant risk factors and mechanism for BCI, the appropriate tests should be performed. In the unstable patient with a more significant injury, timely and effective surgical intervention is the be predictor of survival [10]. Patients with evidence of cardiac injury, either clinical or echocardiographic, should receive urgent surgical consultation. If tamponade is demonstrated on echocardiogram or suspected clinically, pericardiocentesis can be performed urgently. Tamponade secondary to an atrial tear may be suitable for pericardiocentesis and intermittent drainage however this should not delay definitive surgical repair.

Management of a ventricular rupture should be based around controlling haemorrhage and repairing the defect. These two objectives need to be balanced and managed in conjunction with each other. Control of the injured myocardium can be achieved with digital pressure, the use of vascular clamps or application of prosthetic material anchored with surgical glue until a primary repair can be completed. If this is unable to be achieved, cardiopulmonary bypass (CPB) has been reported may be necessary [11].

Following diagnosis and appropriate resuscitation, surgical management of the injured myocardium remains challenging as patients may demonstrate significant haemodynamic instability despite resuscitative measures, as a result rendering them a high-risk surgical candidate. Induction agents with cardio-depressive effects and positive pressure ventilation following intubation may further compromise cardiac function. Mortality in surgical patients with ventricular rupture is directly related to the degree of pre-operative haemodynamic instability10. Mortality in these patient ranges from 39% to 100%.

While the utilisation of CPB may be necessary to achieve stabilisation of the critical patient, this can also complicate the surgery and make diagnosis of the rupture site more difficult, thus most rupture repairs are still carried out without the use of CPB [11].

Once the site of injury has been identified, surgical fixation can commence. Cardiorapphy should be achieved with non-cutting sutures used in a buttress technique, with or without artificial patches [7,12]. This technique may be inappropriate if the surrounding tissue has been compromised as well, as in the case of myocardial infarction due to trauma. In this istance, the use of a Dacron, Teflon or Bovine Pericardial patch may be employed to cover both the defect, and the surrounding, weakened tissue [4,11,12]. These patches, can be adhered using cyanoacrylate glue, thus obviating the need for sutures and risking further tissue damage. The off-pump, sutureless patch technique provides a relatively safe and reproducible surgical approach for management of ventricular free wall rupture if direct closure cannot be performed [12].

Conclusion

The incidence of BCI following blunt thoracic trauma remains variable with no current best practice guidelines or accepted treatment algorithms. Diagnostic tests should be performed to identify significant complications arising from BCI, however these should not delay definitive surgical management. While mortality from this injury remains high, prompt and effective surgical management has been show in increase survival.

References

1. Rodríguez, G. F. &Martínez-Q E. "Cardiogenic shock following blunt chest trauma". *J Emerg Trauma Shock 3* (2010): 398.
2. Sybrandy, K.C. "Diagnosing cardiac contusion: old wisdom and new insights". *Heart* 89 (2003): 485-489.
3. Kato, K., et al. "Blunt traumatic rupture of the heart". *J Trauma Inj Infect Crit Care* 36 (1994): 859-864.
4. Roberts J.D., et al. "Successful management of left ventricular free wall rupture". *Can J Cardiol* 23.8 (2007): 672-674.
5. ahodil, V. "Traumatic rupture of the heart and left pulmonary vein". *IntSurg* 57 (1972): 168-170.
6. Bansal, M.K., et al. "Myocardial contusion injury: redefining the diagnostic algorithm". *Emerg Med J* 22 (2005): 465-469.
7. Pevec, W.C., et al. "Blunt rupture of the myocardium". *Ann ThoracSurg* 48 (1989): 139-142.
8. Parmley, L.F., et al. "Nonpenetrating Traumatic Injury of the Heart". *Circulation* 18 (1958): 371-396.
9. Pollock, B.E., et al. "Isolated traumatic rupture of the interventricular septum due to blunt force". *Am Heart J* 43 (1952): 273-285.
10. McMullan, M.H., et al. "Surgical experience with left ventricular free wall rupture". *Ann ThoracSurg* 71 (2001): 1894-1899.
11. Flajsig, I., et al. "Surgical treatment of left ventricular free wall rupture after myocardial infarction: case series". *Croat Med J* 43 (2002): 643-648.
12. Lachapelle, K., et al. "Sutureless patch technique for postinfarction left ventricular rupture". Ann ThoracSurg 4 (2002): 96-101.

Cite this article: Lawrence Nair ,Brendan Winkle,Eshan Senanayake. "Management of Blunt Cardiac Injury". MRCS, 2020,5(1), 1-3.