International Journal of Cardiovascular and Thoracic Surgery
2022; 8(4): 39-41
http://www.sciencepublishinggroup.com/j/ijcts
doi: 10.11648/j.ijcts.20220804.11
ISSN: 2575-4866 (Print); ISSN: 2575-4882 (Online)

Right Atrial Rupture Due to Non-thoracic Deceleration Injury

Sujith Neralakere Suresha[1], Paritosh Ballal[2, *], Navin Lal[3]

[1]Department of Cardiothoracic and Vascular Surgery, Sri Sathya Sai Institute of Higher Medical Sciences, Bangalore, India
[2]Department of Cardiothoracic Surgery, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bangalore, India
[3]Department of Cardiothoracic Surgery, St. John's Medical College, Bangalore, India

Email address:
sujithnsin@gmail.com (S. N. Suresha), paritoshballal@hotmail.com (P. Ballal), shafigehlal@gmail.com (N. Lal)
[*]Corresponding author

To cite this article:
Sujith Neralakere Suresha, Paritosh Ballal, Navin Lal. Right Atrial Rupture Due to Non-thoracic Deceleration Injury. *International Journal of Cardiovascular and Thoracic Surgery*. Vol. 8, No. 4, 2022, pp. 39-41. doi: 10.11648/j.ijcts.20220804.11

Received: March 23, 2022; **Accepted**: April 19, 2022; **Published**: July 28, 2022

Abstract: Right atrial rupture is predominantly caused by direct thoracic trauma. Non thoracic injuries leading to cardiac rupture is rare. Cardiac injury is responsible for a majority of the deaths following trauma. Exact figures are unavailable in our country. With the increasing number of high-speed vehicular accidents, many patients sustain cardiac rupture, but are not transported to the hospital in time and they succumb to the injuries. There are reports of patients having survived following surgery for cardiac rupture. Most of these are secondary to direct trauma. We describe our experience of treating two cases of cardiac rupture due to non-thoracic trauma and the anatomical and pathophysiological rationale for the occurrence of this rare, but eminently treatable injury. With modern technology, it is easy to diagnose these injuries by echocardiography, if the treating team is aware of the condition. Most patients who survive the initial hours have injury localized to the right atrium. There may be associated injuries to the other cardiac chambers, and all require rapid diagnosis and treatment. The key to diagnosis and treatment is in high index of suspicion of this injury within the golden hour; recognition of hemopericardium on echocardiogram and emergency explorative surgery and repair of the atrial tear.

Keywords: Cardiac Rupture, Atrial Injury, Trauma, Shock

1. Introduction

Cardiac injury accounts for a large number of fatalities following trauma. It may result from blunt trauma or direct penetrating injuries to the heart due to high velocity missiles and sharp objects. A less common, yet important mechanism of injury as seen in our case report, is trauma to the legs and abdomen leading to cardiac rupture due to a sudden increase in intra-cardiac pressures [1].

With the increasing number of high speed vehicular accidents, a large number of patients probably develop cardiac rupture, but are not transported to the hospital in time and they succumb to these injuries. A high index of suspicion for these injuries can aid in salvaging such patients. One should suspect atrial rupture in a patient presenting with hypotension, tachycardia and pulsus paradoxus without any external injury. An echocardiogram will reveal cardiac tamponade due to hemopericardium. The site of rupture is usually on the anterior surface of the right atrium and is easily identified and repaired.

2. Case Presentation

2.1. Patient One

A 28-year-old man presented with history of blunt trauma to his upper abdomen. Six hours prior to the presentation, he was cycling and trying to cross a railway line. He was hit by the beam of the railway crossing gate onto his upper abdomen, following which he recovered and continued to pedal. Four hours later he developed breathing difficulty and a general feeling of ill health. On arrival his blood pressure was 70/40 mm Hg with tachycardia and pulsus paradoxus. There were no external signs of injury. Echocardiography revealed cardiac

tamponade. Abdominal ultrasonography was normal. He was operated through a median sternotomy incision and after evacuating the haemopericardium, a 1.5 centimeter linear tear was found on the anterior surface of the right atrium, just below the right atrial appendage, which was repaired with direct sutures.

2.2. Patient Two

A 19-year-old man presented with history of head on collision with a motor vehicle while riding a motor bike. He complained of pain in the jaw, right lower limb and vague chest pain. Clinical examination on arrival revealed blood pressure of 90/60 mmhg, tachycardia, muffled heart sounds, with no external signs of injury anywhere on the body. Radiographs showed cardiomegaly, fractures of the mandible, right femur and tibia. Patient was intubated as he developed hypotension not responding to resuscitation. Bed side emergency echocardiogram revealed cardiac tamponade. Pericardiocentesis showed frank blood and he was shifted immediately to the operating room. Median sternotomy done, 1.5 litres of haemopericardium was evacuated. A 0.5 x 1 centimeter rent was noted on the anterior aspect of the right atrium, which was closed with direct sutures. Both patients had uneventful post-operative recovery. They continued to recover from musculoskeletal injuries and were noted to do well during follow up.

3. Discussion

Over 70% of all cases of blunt cardiac injury is due to motor vehicle accidents [2]. National Trauma Data Bank (USA) report, cardiac chamber rupture represents 0.041% of all injuries that occur during trauma with a mortality rate of 89.2% [2]. Most patients succumb to these injuries prior to arrival at a hospital [3]. It is easy to diagnose these injuries via echocardiography, if the treating team maintains a high index of suspicion for this condition [4]. Most patients who survive the initial hours, have an injury localized to the right atrium [5]. There may also be associated injuries to the other cardiac chambers, which require rapid diagnosis and treatment.

Our patients had no evidence of chest trauma, yet both survived beyond six hours following injury. Sudden compression of the legs and abdomen causes a rapid increase in venous return to the right heart. This sudden increase in preload may overwhelm the integrity of the right atrial wall causing it to give way and rupture [1]. These are a group of patients who are of particular interest. Though they present with cardiac tamponade, they survive to reach the hospital and have no external evidence of cardiac injury. The anatomical basis for this would be, that the wall of the right atrium is not of uniform thickness due to the presence of crista terminalis and musculi pectinati on its inner surface. The left atrium by contrast, has a more uniform wall, with the average thickness more than the right atrium.

Though the average thickness of the right atrial anterior free wall is higher compared to the posterior wall, the wall between the pectinate muscles is less than 1 millimeter thick and is described as being paper thin. On the contrary, the posterior wall is less likely to rupture as it has a thicker endocardium. Figueiredo AM et al concluded in their study, that wall thickness is not a predominant factor in rupture, as the incidence of right atrial (wall thickness of 1.11 ± 0.42 millimeter) rupture was higher, in spite of a significantly thicker wall compared to the right atrial appendage (wall thickness of 0.53 ± 0.33 millimeter) [6, 7]. The respiratory phase and the stage of the cardiac cycle at the time of accident also have a very important bearing in the causation of cardiac rupture. Deep inspiration at the time of injury leads to increased venous return into the right atrium. The late systolic phase of the cardiac cycle causes the atrioventricular valves to close, leaving no place for blood in the atrium to decompress into. All these events put together, lead to an eventuality consisting of a ballooned right atrium being compressed, leading to its rupture.

Following rupture, there is pouring out of blood into the pericardial space, causing increase in intra-pericardial pressure. This pressure continues to increase until it becomes equal to or more than the pressure in the right atrium, hence causing cessation of venous return to the heart. The sudden fall in venous return causes a sudden drop in cardiac output, leading to cardiogenic shock. Therefore, the victim eventually dies of pericardial tamponade leading to cardiogenic shock, rather than hypovolemic shock due to haemorrhage from the heart. This situation is similar to the hemodynamic changes brought about by a Valsalva maneuver. Once the diagnosis is confirmed on echocardiography, if the patient is in shock an emergency Anteloteral thoracotomy can be performed in the emergency room, the bleeding is localized and temporary controlled and then shifted to the operating room for definitive repair [8-10].

4. Conclusion

In the current era, the number of motor vehicular accidents is rising at an alarming rate all over the world. It is therefore imperative, for the emergency medicine team together with the cardiothoracic surgeon, to be well versed in recognizing and managing cases of cardiac rupture.

We have highlighted the pathophysiological basis of how non thoracic injuries can lead to cardiac chamber rupture. Small rents in the right atrium give the victims a few valuable golden hours, which can be put to good use for diagnosing and then treating this injury in the form of surgical repair.

Declarations

Consent for Publication

Written informed consent was obtained from the patients for publication of this case report.

Availability of Data and Material

Data sharing is not applicable to this article as no datasets

were generated or analyzed during the current study.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All authors contributed equally in the preparation of this manuscript. All authors read and approved the final manuscript.

References

[1] Bright, E. F. and Beck, C. F.: Non-penetrating wounds of the heart. A clinical and experimental study. Amer. Heart J., 10: 293-321, 1935.

[2] Teixeira PG, Inaba K, Oncel D, DuBose J, Chan L, Rhee P, et al. Blunt cardiac rupture: a 5 year NTDB analysis. J Trauma 2009; 67 (4): 788–791.

[3] Leavitt BJ, Meyer JA, Morton JR, Clark DE, Herbert WE, Hiebert CA. Survival following nonpenetrating traumatic rupture of cardiac chambers. Ann Thorac Surg 1987; 44 (5): 532–535.

[4] Karalis DG, Victor MF, Davis GA, McAllister MP, Covalesky VA, Ross JJ Jr, et al. The role of echocardiography in blunt chest trauma: a transthoracic and transesophageal echocardiographic study. J Trauma 1994; 36 (1): 53–58.

[5] Hirai S, Hamanaka Y, Mitsui N, Isaka M, Kobayashi T. Successful emergency repair of blunt right atrial rupture after a traffic accident. Ann Thorac Cardiovasc Surg 2002; 8 (4): 228–230.

[6] Figueiredo AM, Poggetti RS, Quintavalle FG, et al. Isolated right atrial appendage (RAA) rupture in blunt trauma – a case report and an anatomic study comparing RAA and right atrium (RA) wall thickness. World Journal of Emergency Surgery. 2007; 2: 5. doi: 10.1186/1749-7922-2-5.

[7] T. Maraqa, M. A. T. Mohamed, K. L. Wilson, V. Perinjelil, G. R. Sachwani-Daswani, L. Mercer. Isolated right atrial rupture from blunt trauma: a case report with systematic review of a lethal injury. J. Cardiothorac. Surg., 14 (1) (2019), p. 28.

[8] Cecil S. Johnny, Mayank Vasudeva, Julian Gooi, Benedict Waldron, Ee Jun Ban, Nathan Durbridge, Mark C. Fitzgerald. Right atrial appendage rupture and cardiac tamponade secondary to blunt trauma. Trauma Case Reports, Volume 38, 2022, 100620, ISSN 2352-6440, doi.org/10.1016/j.tcr.2022.100620.

[9] M. C. Fitzgerald, M. S. Yong, K. Martin, A. Zimmet, S. F. Marasco, J. Mathew, et al. Emergency department resuscitative thoracotomy at an adult major trauma Centre: outcomes following a training programme with standardised indications. Emerg. Med. Australas., 32 (4) (2020), pp. 657-662.

[10] Christopher Groombridge, Amit Maini, Francis O'Keeffe, Mike Noonan, De Villiers Smit, Joseph Mathew, Mark Fitzgerald, Resuscitative thoracotomy, Emergency Medicine Australasia, 10.1111/1742-6723.13689, 33, 1, (138-141), (2020).