



## Iatrogenic Splenic Laceration from Cardiopulmonary Resuscitation – A Rare Complication

Sim KS<sup>1</sup>, Lee SY<sup>2\*</sup>, Tay HT<sup>1</sup> and Chan CY<sup>2</sup>

<sup>1</sup>Department of General Surgery, Singapore General Hospital, Singapore

<sup>2</sup>Department of Hepatopancreatobiliary & Transplant Surgery and General Surgery, Singapore General Hospital, Singapore

### Abstract

**Background:** Chest compressions during cardiopulmonary resuscitation have been shown to cause unintended injury to its receiver. Intra-abdominal complications remain a rare but dangerous occurrence. We present a rare case of an iatrogenic splenic laceration and its management in a patient who had received cardiopulmonary resuscitation prior, along with a brief review of the literature.

**Case Presentation:** A 69-year-old gentleman with ischaemic heart disease underwent an elective cardiac catheterization and coronary angioplasty. The procedure was complicated by a rupture of the left circumflex artery, pericardial tamponade and cardiogenic collapse. He received cardiopulmonary resuscitation and required extracorporeal membrane oxygenation, intra-arterial balloon pump insertion and a sternotomy for haemostasis. On post-operative day one, he presented with a tense abdomen with haemodynamic instability. Computed tomography of his abdomen revealed a significant amount of haemoperitoneum with no definite source identified. Emergency exploratory laparotomy was performed with intra-abdominal four quadrant packing. The bleeding source was identified to be a splenic laceration. Haemostasis was secured with capsular stitching and the use of topical haemostatic agents without requiring a splenectomy. There was no occurrence of re-bleed post operatively. A brief review of the literature revealed 12 documented cases of splenic injuries post cardiopulmonary resuscitation. Of these, 7 patients were successfully managed with a splenectomy and 1 with splenic artery embolization.

**Conclusion:** The importance of early detection of rare but life-threatening extra-thoracic complications of cardiopulmonary resuscitation is thus highlighted, and should be routinely considered in patients who have received chest compressions so as to allow for early intervention.

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#### \*Correspondence:

Ser Yee Lee, Department of Hepatopancreatobiliary & Transplant Surgery, and General Surgery, Singapore General Hospital, Outram Road, 169608, Singapore, Tel: +65 6326 5564;

E-mail: lee.ser.yee@singhealth.com.sg

Received Date: 25 Jul 2016

Accepted Date: 17 Aug 2016

Published Date: 14 Sep 2016

#### Citation:

Sim KS, Lee SY, Tay HT, Chan CY. Iatrogenic Splenic Laceration from Cardiopulmonary Resuscitation – A Rare Complication. Clin Surg. 2016; 1: 1113.

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### Introduction

External cardiac massage from chest compressions was first described in 1960 by Kouwenhoven et al. [1]. Prior to that, cardiac resuscitation from cardiac arrest or ventricular fibrillation warranted an open thoracotomy for direct cardiac massage- a procedure that undoubtedly resulted in much morbidity if the patient survived. However, external cardiac massage is not without its own complications. Though life-saving, it can be considered to be a form of blunt trauma, resulting in well-documented injuries that at times require surgical intervention. The majority of injuries from cardiopulmonary resuscitation (CPR) are thoracic due to the direct transmission of force from chest compressions. Intra-abdominal injuries are considered rare; though post-mortem studies suggest that their occult incidence may be as high as 30% [2]. These included liver lacerations, gastric rupture and splenic lacerations.

### Case Presentation

A 69-year-old gentleman had been electively admitted for cardiac catheterization and angioplasty. He had ischaemic heart disease and had undergone a quadruple-vessel coronary artery bypass graft surgery in April 2010. He was admitted in April 2016 with symptoms consistent with unstable angina. During this admission, he underwent a diagnostic cardiac catheterization which revealed three vessel coronary disease and significant left main coronary artery stenosis. He underwent percutaneous coronary intervention. Severe stenosis of the coronary circulation was noted but the procedure was complicated by a coronary rupture of the left circumflex artery. Hemostasis was secured using the deployment of two covered stents and the administration of protamine sulphate



**Figure 1:** Computed tomography scan of the abdomen showing large haemoperitoneum.

to reverse the anticoagulation. However, during this time, the patient became progressively hypotensive requiring inotropic support. Bedside echocardiography revealed a small pericardial effusion. Pericardiocentesis was aborted as the effusion was assessed to be too small to be drained. The patient remained temporarily stable on inotropes but suddenly deteriorated with ventricular tachycardia. Electrical cardioversion was administered, and cardiac rhythm was converted to a pulseless electrical activity. Chest compressions were hence started according to Advanced Trauma Life Support (ATLS) principles [3]. The cardiothoracic surgeons were consulted urgently. A repeat bedside echocardiography was done which, together with angiography of the coronary sinus, revealed that the patient now had pericardial tamponade causing extrinsic compression of the left atrium and coronary sinus. Extracorporeal membrane oxygenation (ECMO) was initiated and an intra-arterial balloon pump (IABP) was inserted emergently. The patient remained hemodynamically unstable despite ECMO, IABP and inotropic support, and was thus brought to the operating theatre. He underwent a sternotomy, clipping of the left circumflex artery, repair of epicardium, exploration of the left atrium and extensive hemostasis.

On the morning of the first post-operative day, the patient was noted to have a tense, distended abdomen. He remained hypotensive despite aggressive fluid resuscitation and his inotropic requirements increased. An urgent computed tomography and mesenteric angiogram was performed which revealed a large amount of haemoperitoneum (Figure 1). No active contrast extravasation was seen to suggest a source of arterial bleeding, and there was no retroperitoneal haematoma or evidence of ischaemic bowel. In view of the intra-abdominal bleeding with haemodynamic instability, the decision was made for an urgent exploratory laparotomy. Approximately 4 litres of fresh blood was encountered in the abdomen. The abdomen was packed and thoroughly explored to look for the source of bleeding. An actively bleeding splenic laceration was found on the inferior capsular aspect adjacent to the hilum. Haemostasis was secured using capsular stitches and the use of topical haemostatic agents. The rest of the abdominal organs were found to be unaffected and there was no evidence of a concomitant retroperitoneal haematoma. The patient did not require a splenectomy as haemostasis had been secured successfully. He did not suffer any further bleeding from the splenic laceration, although his stay was complicated by multi-organ deterioration as a result of severely compromised cardiac function and organ perfusion, and prolonged hospital stay.

## Discussion

Abdominal complications from CPR, though not as common,

can be life-threatening if missed, especially solid organs like the liver and spleen which are highly vascular. Due to its location in the epigastrium, the most commonly injured intra-abdominal organ is the liver, followed by splenic injuries and gastric rupture. Krischer et al. [2] conducted a prospective post-mortem study to investigate complications attributable to CPR. Out of 705 patients who were autopsied, 2.9% of them had liver injuries attributable to CPR and 0.3% had splenic lacerations or rupture. A total of 30.8% of them were recorded to have abdominal visceral complications. The risk of intra-abdominal injury during CPR has been described to be higher with the incorrect placement of the hands – i.e. too low over the xiphisternum, which results in forces from traumatic chest compressions being transmitted directly to the abdomen [4].

Intra-abdominal complications of CPR are often challenging to detect in the setting of an ill patient with recent cardiovascular collapse. Hypotensive episodes may first be attributed to another cardiac event rather than occult intra-abdominal bleeding. This may lead to delays in diagnosis and definitive management and hence a high mortality rate from such injuries. Kandasamy described 3 cases of occult splenic rupture in patients who had received CPR, of which only 1 patient survived with a splenectomy [5]. Metesh et al. [6] and Brunkwall et al. [7] both reported cases that did not survive. Our literature review revealed that most patients in reported cases who survived splenic lacerations post-CPR required an urgent splenectomy [4,5,8-11].

Splenic injuries can sometimes be managed conservatively. Non-operative management of splenic lacerations consists of expectant management or angiembolization of the splenic artery. The decision for management is aided by a grading system for splenic injuries based on the extent of the splenic haematoma and/or laceration [12]. However, for hemodynamically unstable patients, a scan may not be possible, and surgical exploration and haemostasis – with or without a splenectomy – is still indicated.

## Conclusion

The early detection of possibly life-threatening intra-abdominal complications from CPR is extremely important so that definitive management can be instituted. They should be considered in any patient who has received CPR, especially if they remain hypotensive, and physicians need to be hypervigilant for any signs and symptoms of intra-abdominal bleeding. Management depends on the hemodynamic status of the patient and the degree of splenic injury. Emergent exploratory laparotomy with splenectomy or splenorrhaphy might be necessary for haemostasis.

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