

## Blunt Rupture of Left Ventricle Diagnosed Using Two Phase Contrast Enhanced CT: A Case Report<sup>1</sup>

이중 시기 전산화단층촬영으로 진단된 둔상으로 인한 좌심실의 파열: 증례 보고<sup>1</sup>

Do Young Kim, MD<sup>1</sup>, Dae Shick Ryu, MD<sup>1</sup>, Jae Hong Ahn, MD<sup>1</sup>, Man Soo Park, MD<sup>1</sup>,  
Seung Mun Jung, MD<sup>1</sup>, Soo-Jung Choi, MD<sup>1</sup>, Dong Rock Shin, MD<sup>1</sup>, Dong Gon Yoo, MD<sup>2</sup>

Departments of <sup>1</sup>Radiology, <sup>2</sup>Thoracic Surgery, Gangneung Asan Hospital, College of Medicine, University of Ulsan, Gangneung, Korea

This report is about a case of left ventricle rupture after blunt trauma diagnosed using two phase contrast enhanced CT. Arterial phase images suggest presence of cardiac tamponade. Delayed images suggest cardiac injury that shows a linear low density on the left ventricle wall.

### Index terms

CT

Cardiac Rupture

Trauma

Received January 25, 2014; Accepted March 6, 2014

Corresponding author: Dae Shick Ryu, MD

Department of Radiology, Gangneung Asan Hospital,  
College of Medicine, University of Ulsan, 38 Bangdong-  
gil, Sacheon-myeon, Gangneung 210-711, Korea.  
Tel. 82-33-610-3483 Fax. 82-33-610-3490

E-mail: [ryu@gnah.co.kr](mailto:ryu@gnah.co.kr)

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

Cardiac rupture is rarely diagnosed in blunt chest trauma patients since 80% of patients die at the scene of the accident (1). However, immediate surgery can save up to 80% of the survivors (1-3). Detection of cardiac rupture relies mainly on clinical suspicion and echocardiography, especially transesophageal echocardiography (2, 3). In rare cases, leaking of the contrast material in hemopericardium patients can be detected on the initial CT examination, allowing early diagnosis of cardiac rupture (3-5). However, there have been no reports on early diagnosis of cardiac rupture using two phase contrast enhanced CT. Therefore, we report a case of a blunt traumatic rupture of the left ventricle wall using two phase contrast enhanced multidetector-row computed tomography (MDCT).

## CASE REPORT

A 28-year-old intoxicated man arrived at the emergency de-

partment following a car accident. On initial examination, he was hemodynamically stable (blood pressure 132/103 mm Hg, heart rate 87/min, respiration rate 22/min, body temperature 36.1°C) but showed signs of impaired cognitive function. Physical examination revealed a lip laceration and hip dislocation. His chest displayed extensive bruising of the anterior thoracic wall. Neurological and abdominal examinations revealed no major pathologic findings. Portable echocardiography showed moderate pericardial effusion without hemodynamic significance and ventricle injury in the emergency room. But there was a limit to the evaluation of echocardiography on ventricular wall injury due to the poor echo window in supine position.

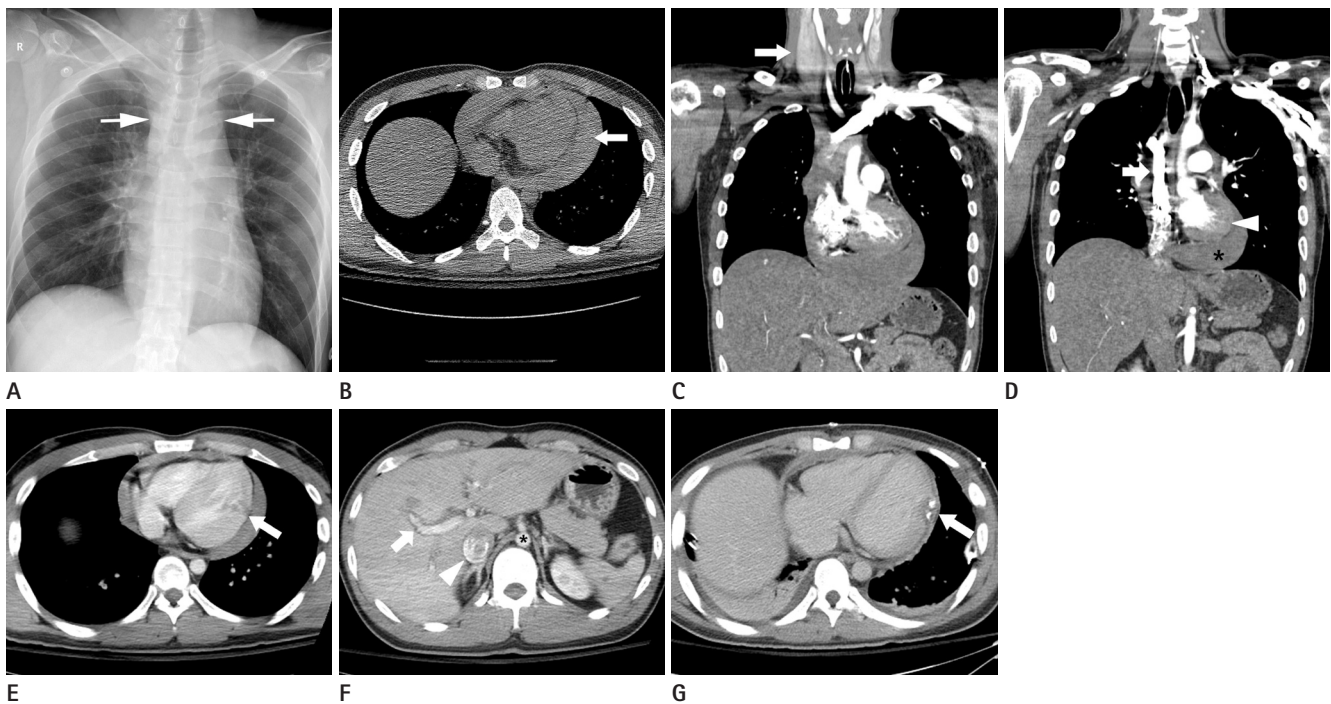
The supine front chest radiograph obtained on admission revealed a superior mediastinal widening (Fig. 1A). Contrast enhanced chest images were acquired using a General Electric LightSpeed VCT MDCT scanner (GE Medical System, Milwaukee, WI, USA), with a slice thickness of 2.5 mm and pitch of 0.87 for 0.5 seconds per rotation at 120 kV and 400 mA. Arterial phase enhancement images were obtained at 45 seconds after

administration of the iodinated contrast agent (100 mL, Iopromide, Ultravist 300, 300 mg/mL, Schering, Berlin, Germany) at the rate of 2 mL/min. Delayed phase enhancement images were obtained 90 seconds after administration of contrast agent. Un-enhanced MDCT scan shows a large volume of pericardial fluid collection with CT density measurements (56 Hounsfield units; HU) consistent with hemopericardium (Fig. 1B). The arterial phase CT examination confirmed hemopericardium, distended right jugular vein, reflux of contrast material within the inferior vena cava (IVC) and azygos vein, and decreased diameter of abdominal aorta without hypovolemia. These findings pointed to the presence of cardiac tamponade (Fig. 1C, D). The delayed phase CT examination showed decreased density in the left ventricle wall, suggesting ventricular injury (Fig. 1E). It showed periportal edema in the liver, distended IVC with reflux of the contrast material, and decreased diameter of the abdominal aorta-

ta, suggesting cardiac tamponade (Fig. 1F). From these CT findings, a diagnosis of cardiac injury with cardiac tamponade was suggested.

On arrival at operating room, the patient's blood pressure was 50/30 mm Hg, and the heart was arrested. Cardiac resuscitation was needed for a short period. Through a median sternotomy, we identified a massive hemopericardium and a perforated left midventricular lateral wall with active bleeding. Blood clots were evacuated, and the injured ventricle was repaired using pledgeted sutures. The patient had undergone an unremarkable recovery.

The patient was followed-up with CT imaging 5 days post-surgery, demonstrating decreased pericardial fluid collection with pledgeted sutures on the left midventricular lateral wall (Fig. 1G). The patient no longer showed signs of distended right jugular vein, periportal edema or reflux of contrast material



**Fig. 1.** A 28-year-old male patient after a motor vehicle collision.

- A.** Anteroposterior chest radiograph shows widened superior mediastinal borders (arrows).
- B.** Un-enhanced multidetector-row computed tomography (MDCT) scan shows a large volume of pericardial fluid collection (arrow) with CT density measurements (56 Hounsfield units) consistent with hemopericardium.
- C.** Arterial phase enhanced MDCT with coronal reconstruction shows distended right jugular vein (arrow).
- D.** Arterial phase enhanced MDCT with coronal reconstruction shows reflux of contrast material within the distended azygos vein (arrow) and thickening of left ventricle wall (arrowhead) caused by compression due to hemopericardium (asterisk).
- E.** Delayed phase enhanced MDCT shows an area of linear low density in the left midventricular lateral wall (arrow), suggesting ventricle injury.
- F.** Delayed phase enhanced MDCT shows periportal edema (arrow) in the liver, distended inferior vena cava with reflux of the contrast material (arrowhead), and decreased diameter of the abdominal aorta (asterisk), suggesting cardiac tamponade.
- G.** Delayed phase enhanced MDCT 5 days after surgery shows decreased pericardial fluid collection with pledgeted sutures (arrow) on the left midventricular lateral wall.

within the IVC and azygos vein. The abdominal aorta was noted to have a normal diameter.

## DISCUSSION

Cardiac rupture is an uncommon but usually fatal consequence of blunt thoracic trauma. Atria and ventricles are injured in near equal numbers, generally involving the right side of the heart (1.5:1) (6). Patients who require in-field resuscitation for cardiac injuries have a mortality rate of almost 100%. However, if the patient survives long enough to reach the trauma center and the diagnosis is quickly made, then there is a 50% chance of survival (6). Therefore, timely diagnosis is essential in treating patients with cardiac rupture.

Chest radiography is the primary screening tool for thoracic injury. However, it is neither sensitive nor specific enough to adequately detect cardiac rupture. The cardiac silhouette is rarely enlarged in tamponade due to the fibrous nature of the pericardium (3). Our case showed superior mediastinal widening without cardiomegaly.

Depending on the patient's hemodynamic condition, cardiac rupture may be detected using echocardiography, especially transesophageal echocardiography. A number of factors (subcutaneous emphysema, pneumothorax, severe soft tissue swelling, tenderness and abdominal distension) common to severely injured patients may decrease the sensitivity of echocardiography to blunt cardiac injury (3). In our case, there was a limit to the evaluation of echocardiography on ventricular wall injury due to the poor echo window in supine position.

CT is the gold standard for assessment of blunt trauma patients. It is highly sensitive for solid organ and retroperitoneal injury and is the primary tool for guiding the non-operative management of these patients. Contrast enhanced MDCT is currently a well established protocol for establishing a diagnosis of mediastinal hemorrhage, traumatic aortic injury, and hemopericardium (3). CT imaging can be used to accurately identify and quantify hemopericardium. A CT density equal to or greater than 35 HU indicates presence of hemopericardium rather than pericardial transudates (7). While the CT image can only display a hemopericardium and sometimes its compressive nature, its origin cannot be defined. In rare cases, however, an abnormal contrast material leak can be observed (3-5). Arterial

contrast extravasation from the cardiac chambers is pathognomonic of rupture. Our patient did not show contrast extravasation or leakage on arterial and delayed phases of MDCT. We observed an area of linear low density in the left mid ventricular lateral wall on a delayed MDCT image, suggesting ventricular injury. However, we could not rule out linear low density in the left mid-ventricular lateral wall by the motion artifact of heart and respiration. Imaging findings of cardiac tamponade on CT and abrupt decrease of blood pressure in our patient suggested cardiac rupture rather than motion artifact. Because pledgeted suture site in left midventricular lateral wall on post operative CT was identical to linear low density in left ventricular wall on preoperative CT, we suggest that linear low density in ventricular wall on CT indicated ventricular wall to be injury rather than motion artifact. Until now, there have been no reports that linear low density in ventricular wall without contrast leakage on CT suggesting ventricular wall injury in the literature.

Cardiac tamponade is a major cause of death in individuals who have sustained blunt cardiac ruptures. Although it is primarily a physiologic diagnosis, cardiac tamponade can be seen on CT scans. CT findings that suggest the presence of tamponade include enlargement of the superior vena cava (diameter greater than that of the adjacent descending aorta), enlargement of the infrahepatic IVC (diameter greater than that of the adjacent abdominal aorta), enlargement of the renal vein, and periportal edema (periportal radiolucency) (8). Our case showed distended right jugular vein, periportal edema, reflux of contrast material within the IVC and azygos vein, and decreased diameter of abdominal aorta without hypovolemia, suggesting cardiac tamponade. Delayed phase image showed an area of linear low density in left ventricle wall, suggesting cardiac injury. Arterial phase image showed reflux of contrast material within the IVC and azygos vein, suggesting cardiac tamponade.

In conclusion, two phase contrast enhanced CT may be most useful for assessment of patients with ambiguous clinical and ultrasonographic findings and in the detection of occult cardiac injury in trauma patients.

## REFERENCES

1. Bintz M, Gall WE, Harbin D. Blunt myocardial disruption: report of an unusual case and literature review. *J Trauma*

- 1992;33:933-934
2. Symbas NP, Bongiorno PF, Symbas PN. Blunt cardiac rupture: the utility of emergency department ultrasound. *Ann Thorac Surg* 1999;67:1274-1276
  3. Berg R, Talving P, Inaba K. Cardiac rupture following blunt trauma. *Trauma* 2011;13:35-45
  4. Wintermark M, Delabays A, Bettex D, Schnyder P. Blunt trauma of the heart: CT pattern of atrial appendage ruptures. *Eur Radiol* 2001;11:113-116
  5. Sliker CW, Mirvis SE, Shanmuganathan K, Meyer CA. Blunt cardiac rupture: value of contrast-enhanced spiral CT. *Clin Radiol* 2000;55:805-808
  6. Fulda G, Brathwaite CE, Rodriguez A, Turney SZ, Dunham CM, Cowley RA. Blunt traumatic rupture of the heart and pericardium: a ten-year experience (1979-1989). *J Trauma* 1991;31:167-172; discussion 172-173
  7. Krejci CS, Blackmore CC, Nathens A. Hemopericardium: an emergent finding in a case of blunt cardiac injury. *AJR Am J Roentgenol* 2000;175:250
  8. Restrepo CS, Lemos DF, Lemos JA, Velasquez E, Diethelm L, Ovella TA, et al. Imaging findings in cardiac tamponade with emphasis on CT. *Radiographics* 2007;27:1595-1610

## 이중 시기 전산화단층촬영으로 진단된 둔상으로 인한 좌심실의 파열: 증례 보고<sup>1</sup>

김도영<sup>1</sup> · 류대식<sup>1</sup> · 안재홍<sup>1</sup> · 박만수<sup>1</sup> · 정승문<sup>1</sup> · 최수정<sup>1</sup> · 신동락<sup>1</sup> · 유동곤<sup>2</sup>

저자들은 이중 시기 전산화단층촬영을 이용하여 진단한 둔상으로 인한 좌심실 파열 증례를 보고한다. 동맥기 영상에서 심장 압전 소견이 있었고 지연기 영상에서는 좌심실벽에 선상의 저음영으로 보이는 손상 소견이 있었다.

울산대학교 의과대학 강릉아산병원 <sup>1</sup>영상의학과, <sup>2</sup>흉부외과