The purpose of this retrospective study was to determine the CT findings diagnostic of cardiac and pericardial injury, including signs of pericardial tamponade, in patients suffering from blunt and penetrating trauma. A search of the CT radiology database at a level I trauma center was performed to identify cases in which injury to the heart or pericardium was diagnosed, as well as to identify cases of pericardial tamponade. All cases were reviewed to ascertain the specific CT findings, and medical records were reviewed to assess the influence of CT findings on management and to assess for clinical evidence of pericardial tamponade. Eighteen patients had direct CT evidence of cardiac or pericardial injury, including nine cases of pneumopericardium, eight cases of hemopericardium, and one case of intrapericardial gastric herniation. Four of these patients were found to have direct cardiac injuries. Three additional cases with CT evidence of pericardial tamponade were identified, two secondary to cardiac compression by an anterior mediastinal hematoma and one following repair of left ventricular rupture. Of 11 patients with CT evidence of tamponade, only three were suspected clinically. Cardiac and pericardial injuries are usually diagnosed surgically and are often clinically unsuspected, particularly in blunt trauma. As CT is increasingly utilized as a general screening test for thoracic/abdominal trauma, these injuries may be first suspected on the basis of CT findings, and knowledge of the CT findings of cardiac injury or tamponade is crucial.

Key words Heart, CT – Thorax, CT – Thorax, injuries – Heart, tamponade

Introduction

Until recently, cardiac and pericardial injuries have been considered lethal. However, in the past two decades, several small series and case reports have demonstrated that these injuries are no longer uniformly fatal, particularly with recent improvements in prehospital care and in transport of severely injured patients to major trauma centers [1, 2, 3, 4, 5, 6]. In one series reported by Fulda et al., one-third of patients with cardiac or pericardial injuries were stable enough to allow diagnostic evaluation [1].

Clinically, pericardial and cardiac injuries are difficult to diagnose, as they depend to a good extent on the site of rupture and integrity of the pericardium. Signs of pericardial tamponade can be inconsistent in the patient with multi-system trauma, and often the diagnosis is dismissed when low blood pressure responds to aggressive fluid resuscitation [5]. Pericardiocentesis is not entirely reliable, as a false-negative rate of up to 25% has been reported in patients with hemopericardium [7]. Echocardiography has been used for diagnosis [8, 9]; however, it is not always easily obtained, is operator-dependent, and is suboptimal in patients with severe chest wall trauma [10].

Case reports of CT identification of cardiac injuries are rare [11, 12]. As abdominal CT scans usually include images of the lower chest, hemo- or pneumopericardium can be an unsuspected finding. Additionally, as CT examination of the thorax is now commonly performed to examine the mediastinum, care must be taken to ensure adequate evaluation of the cardiac chambers and pericardium. We review the CT findings diagnostic of cardiac and pericardial injury, including the CT signs of pericardial tamponade, in patients suffering from blunt and penetrating trauma.
Materials and methods

A computer search aided by Access software (Microsoft, Redmond, Wash.) of the trauma radiology registry at a level 1 trauma center from June 1991 to March 1999 was performed to identify all patients with CT findings suggestive of cardiac or pericardial injury or pericardial tamponade. Twenty-three patients were identified. However, hospital charts for two patients were not available, and therefore these patients were not included in the study. The remaining 21 patients included 18 with direct CT signs of cardiac injury and three with CT evidence of pericardial tamponade from another source. Seven patients were female and 14 were male. The patients ranged in age from 17 to 78 years (mean 32 years). Mechanisms included: motor vehicle collision (16), fall (1), gun shot wound (2), nail gun shot wound (1) and stab wound (1). Two of the 21 patients died as a result of their injuries. All cases were reviewed to ascertain the specific CT findings, and medical records were reviewed to assess the influence of CT findings on management and to assess for clinical evidence of pericardial tamponade.

Results

Hemopericardium

Eight patients had CT evidence of hemopericardium, one of which had active extravasation of intravenous contrast medium into the pericardium (Fig. 1). Three of the patients had cardiac chamber rupture, including left ventricle, right atrial appendage, and bilateral atrial appendages. A fourth patient evaluated and discharged from an outside hospital for stab wounds to the abdomen and left chest presented 2 weeks later with chest pain and was found to have hemopericardium (Fig. 2). Pericardial window at that time revealed 850 ml clotted blood. Pericardiotomy performed 1 week later revealed a number of adhesions with a gelatinous exudate but no evidence of myocardial injury. A fifth patient had hemopericardium following traumatic aortic rupture. The remaining three patients were observed clinically.

Pneumopericardium

Nine patients had pneumopericardium on admission CT scan. One patient had an associated left hemothorax and was found to have a left ventricle punctured by a rib fragment (Fig. 3). One patient had pneumopericardium with associated bilateral pneumothoraces and pneumomediastinum on admission, and subsequently developed hemopericardium (Fig. 4). Pericardial window performed 2 weeks after admission yielded 700 ml bloody fluid, and median sternotomy revealed a pericardial laceration laterally adjacent to the right atrium without direct myocardial injury. Four patients had associated pneumothoraces or pneumomediastinum, and these patients were observed clinically. Two patients without evidence of associated pneumothorax or pneumomediastinum underwent pericardial window, at which time no injuries were found. One patient underwent surgery for associated ascending aortic rupture, at which time the pericardium was determined to be intact.

CT tamponade

Eleven of the 21 patients had CT evidence of pericardial tamponade, including dilated inferior vena cava and renal veins, deformed ventricular contour, and periporal lymphedema (Fig. 5). Seven of these patients had hemopericardium, one had pneumopericardium, and two had compression of the heart by anterior mediastinal hematoma (Fig. 6). The final patient had clinical evidence of pericardial tamponade following a nail gun shot wound to the chest, underwent median sternotomy, and was found to have a perforation of the right ventricle. Immediately following the procedure, diagnostic peritoneal lavage revealed chylous fluid, and CT exam at that time demonstrated CT findings consistent with tamponade. The chylous fluid was felt to be secondary.