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Abstract Blunt trauma patients with myocardial ruptures rarely survive long enough to reach a trauma center; however, for the survivors, prompt diagnosis and surgery are mandatory and save up to 80% of patients. Preoperative diagnosis of myocardial ruptures is assessed by echocardiography or, more rarely, by angiocardiography. We report two cases of blunt trauma patients with an atrial appendage rupture which could be retrospectively identified on admission CT survey.

Key words Wounds and injuries · Thoracic injuries · Heart injuries · Traumatic heart rupture · CT

Introduction
Myocardial ruptures are rarely diagnosed in blunt chest trauma patients, since 80% of patients die at the scene of the accident [1]; however, immediate surgery saves up to 80% of the survivors [2, 3, 4, 5, 6, 7, 8, 9]. Depiction of myocardial ruptures relies mainly on a high clinical index of suspicion and on echocardiography, especially transesophageal echocardiography [5, 8, 9]. In rare cases, subtle signs on the initial CT survey allow an early diagnosis of myocardial rupture. Our report deals with two cases with blunt traumatic ruptures of left and right atrial appendages which could be retrospectively identified on the admission spiral CT examination.

Case reports
Case 1
A 64-year-old male patient involved in a truck head-on crash at 90 km per hour was transferred to our institution. He was intubated at the accident site and admitted with stable vital signs. The systolic blood pressure was 100 mmHg. Examination of his chest displayed, as part of a steering-wheel syndrome, an extensive bruising of the anterior thoracic wall, with palpation of a sternal shift, related to a sternal fracture. Discrete cyanosis and distended neck veins could also be noticed. Neurological and abdominal examinations revealed no major pathological findings.

The supine front chest radiograph obtained on admission (Fig. 1a) disclosed a major but non-specific mediastinal widening, with a rightward displacement of the trachea and a downward displacement of the left mainstem bronchus. A right hemothorax, featuring a dense stripe displacing the lung away from the chest wall, was also present.

Such features justified performance of a contrast-enhanced incremental CT survey of the chest (185 kVp, 330 mAs, 8-mm thickness, intravenous administration of 120 cc of iodinated contrast
material with a 3-cc/s injection rate). The CT sections (Fig. 1b,c) disclosed a hemopericardium, outlining the epicardial fat, as well as bilateral moderate hemothoraces and an anterior fracture of the sixth right rib.

Transesophageal echocardiography (TEE) confirmed the presence of the hemopericardium, which was demonstrated to be partially clotted, and additionally revealed a severe tricuspid regurgitation secondary to a traumatic leaflet tear. The hemopericardium induced a cardiac tamponade, featuring a right atrial wall compression, reinforced at inspiration. The consecutive high right atrial pressure resulted in a reopening of the foramen ovale and in a right-to-left shunt, which contributed to the observed cyanosis.

Clinical evidence of cardiac tamponade – distended neck veins and paradoxical arterial pulse – and its TEE confirmation justified immediate surgery. The surgeon identified and sutured a myocardial rupture located on the left atrial appendage. He also repaired the tricuspid valve. The patient recovered and was discharged 1 month after admission.

Retrospective examination of the CT sections (Fig. 1c) allowed the identification of a contrast-enhanced spot, located on the anterior aspect of the left pulmonary veins and overhanging the left ventricle, which related to the left atrial appendage rupture.

Case 2

An unbelted 27-year-old male driver was involved in a high-speed truck accident. The initial Glasgow score was 13. During helicopter transportation to our institution, the patient became confused and was intubated. On admission, the patient was pale, tachycardic, normotensive and disclosed a steering-wheel syndrome. No jugular distension could be observed.

The admission supine plain film disclosed a moderate mediastinal enlargement. Head CT turned out normal and was followed by a contrast-enhanced chest spiral CT survey (120 kVp, 180 mAs, 3-mm thickness, intravenous administration of 150 cc of iodinated contrast material with a 4-cc/s injection rate; Fig. 2a,b); the latter displayed a hemopericardium, as well as an abnormal tiny contrast material leak at the level of the right atrial appendage. Demonstration of the hemopericardium let a lesion of the root of the ascending aorta be suspected and thus justified immediate surgery.

The TEE obtained during thoracotomy (Fig. 2c,d) disclosed an important hemopericardium, with compression of the right cardiac chambers and deviation of the atrial septum to the left. A gap in the right atrial wall (Fig. 2d) was demonstrated by the surgeon as relating to a right atrial appendage rupture. This myocardial rupture readily explained the CT contrast material leak.

The right atrial appendage rupture was sutured and the patient survived without sequela, except for a permanent right bundle branch block.

Fig. 1a–c. A 64-year-old male patient whose truck was involved in a head-on crash at 90 km/h. a Admission front chest X-ray displays a major mediastinal enlargement and a right hemothorax. b, c Incremental CT survey (8-mm thickness) discloses a hemopericardium (arrowheads). This pattern of cardiac tamponade justified immediate surgery, during which the surgeon identified and sutured a left atrial appendage rupture. c Retrospective examination of the CT sections allows for the identification of a contrast-enhanced spot (arrow), lying on the anterior aspect of the left pulmonary veins and overhanging the left ventricle. This spot relates to the ruptured left atrial appendage (From [13]).