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ECG-gated multi-slice computed tomography in the detection of atrial septal aneurysms

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*An atrial septal aneurysm (ASA) is an uncommon cardiac abnormality. Clinical manifestation of this abnormality remains unclear: some authors have suggested an association between ASA and arrhythmias or between ASA and cerebral ischaemia. A major role in the diagnosis of ASA to date has been played by transoesophageal echocardiography and transthoracic echocardiography. The purpose of this paper is to present the role of multi-slice computed tomography with ECG gating in the detection and analysis of ASA. (*Folia Morphol 2008; 67: 126–128)

Key words: atrial septal aneurysm, multi-slice computed tomography

INTRODUCTION

Atrial septal aneurysms (ASA) are rare congenital malformations, where the interatrial septum (IAS) protrudes into the right or left atrium or both [6]. Anatomically it is a bulge in the region of the ostium primum [3]. Atrial septal aneurysm can be an isolated malformation but is very often associated with other cardiac anomalies. The most frequent anomalies which coexist with ASA are patent foramen ovale and mitral valve prolapse.

Clinical manifestation of this malformation is still poorly defined. Some authors have suggested an association with arrhythmias. Many data also suggest an association between ASA and cerebral ischaemia. There is still controversy concerning the incidence of ASA in the general population, as the incidence depends on the diagnostic method which was used to detect ASA. The reported incidence of ASA varies from 2% to 10% [3].

To date, it has been echocardiography, transthoracic and transoesophageal, which has played the major role in the diagnostic process of this anomaly. There is still unfamiliarity with this anomaly among radiologists. To our knowledge, only one paper published in 2006 attributed the major role in the diagnostic process of detecting ASA to computed tomography [6].

The purpose of this paper is to present the role of multi-slice computed tomography (MSCT) in the diagnosis of ASA and to establish the frequency of this anomaly among patients examined in our Department.

MATERIAL AND METHODS

Medical histories and databases were analysed for a group of 1650 patients examined due to the occurrence of ASA in 1st Department of Radiology of the Medical University of Lublin in the years 2002––2006. In most cases patients had been referred for MSCT examination with ischaemic heart disease.

Examinations were performed using 8-row and 64-row MSCT with the diagnostic console Advantage

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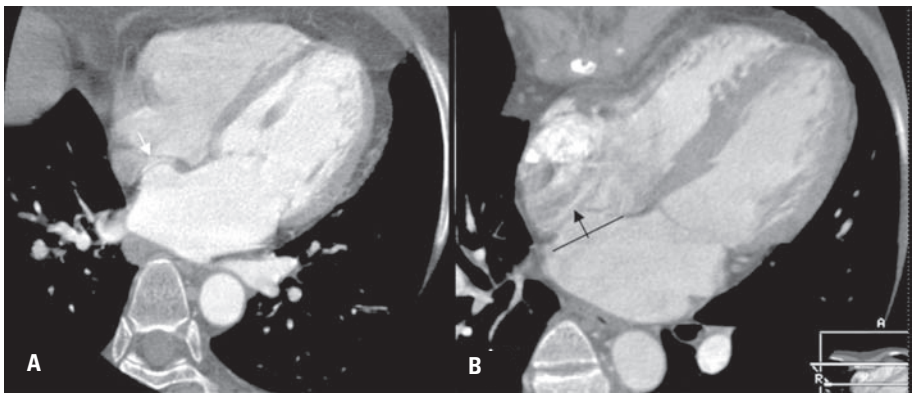

Figure 1A. Multi-slice computed tomography with ECG-gating in axial MPR-view at 45% of R-R cycle showing protrusion of interatrial septum into the right atrium (white arrow); **B.** Multi-slice computed tomography with ECG-gating in axial MPR view at 45% of R-R cycle; (—) — the diameter of aneurysmatic portion of the interatrial septum in the longitudinal size; ↑ — protrusion of interatrial septum in the horizontal size.

Windows 4.0 (General Electric Milwaukee). Precontrast scanning was conducted with ECG gating by means of the axial method in 2.5-mm slices and post-contrast spiral scanning with collimation of 1.25 mm (8-row CT) or of 0.6 mm (64-row CT). The optimal scanning time was based on the density measurement after the administration of the test bolus technique. The contrast medium was administered in a dose of 140 mL (8-row CT) and 120 ml (64-row CT) at a speed of 4 mL/s. The scans were reconstructed from 0% to 95% R-R cycle at 10% intervals. The image data sets were analysed using multiplanar reconstructions.

Atrial septal aneurysms was defined by the authors as protrusion of the IAS showing phasic excursion during the cardiorespiratory cycle (Fig. 1A).

After analysing a few examinations the authors chose the phases at 45% and 95% of the R-R cycle as the best for the analysis of ASA. The diameter of the aneurysmatic portion of the IAS was measured at 45% of the R-R cycle and protrusion into the atrium at 45% and 95% of the R-R cycle (Fig. 1B).

RESULTS

Of the group of 1650 patients examined in our Department 22 were found to have ASA, of whom 17 were women and 5 men. In all these patients the ASA was localised at the typical site of the ostium primum. In 21 patients ASA was a lone anomaly. In one patient interatrial shunting was observed through the foramen in the wall of the aneurysm (Fig. 2). Mitral and tricuspid insufficiency was found in two patients. There were two cases of patent foramen ovale diagnosed in echocardiography.

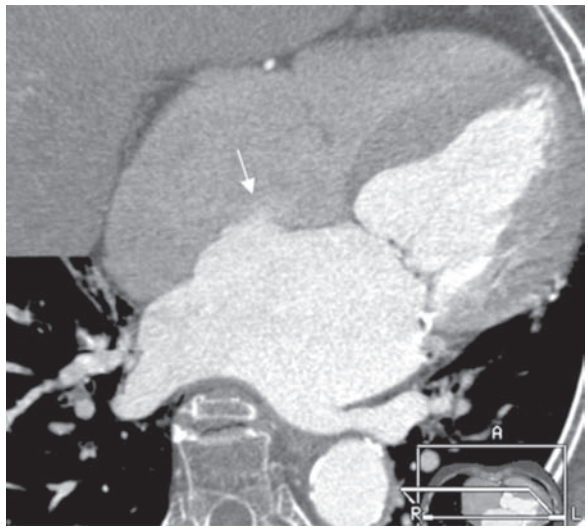

Figure 2. Multi-slice computed tomography with ECG-gating in axial MPR-view at 95% of R-R cycle showing interatrial shunting through the foramen in the wall of the atrial septal aneurysm (white arrow).

It is postulated that the surface of the ASA is a source of thrombus formation. We did not find any thromboses on the surface of the ASA in our group of patients. Some authors also suggest an association with arrhythmias. In the group analysed three patients had atrial fibrillation.

In all cases the IAS protruded into the right atrium. In 13 patients (59%) protrusion of IAS in the horizontal size increased at 95% of the R-R cycle. The minimal excursion of ASA in the 45% and 95% phase was 0.7 mm and the maximal excursion of ASA was 6.6 mm in the horizontal size. The mean value of the ASA excursion was 2.32 mm.

The diameter of the base of ASA was measured in 45% of R-R cycle and ranged from 13 mm to 39 mm in the longitudinal size.

DISCUSSION

Atrial septal aneurysms are incidentally found in adult patients. The aetiology of this anomaly is unclear. It is supposed that ASA formation is connected with raised interatrial pressure gradients and the bulging septum protrudes to the lower pressure side. Sometimes, however, this malformation is found in patients with normal atrial pressure, and it is then recognised as a primary or congenital malformation [5].

Atrial septal aneurysm is regarded as a cardiac anomaly associated with systemic embolisation [4] and cardiac arrhythmias [5]. Mugge et al. [5] noted 47 cases of atrial arrhythmias in 195 patients with ASA (24%). However, it is unclear whether the redundancy of the atrial septum itself or other associated anomalies are connected with the pathogenesis of atrial arrhythmias. In our group of patients three had atrial fibrillation.

Atrial septal aneurysms is considered to be a potential risk factor for cardioembolism [1]. An association between ischaemic cerebral stroke and ASA has been suggested in the literature. Agmon et al. [1] compared the frequency of ASA in the general population and in patients with cerebral ischaemic stroke. Atrial septal aneurysm was detected in 7.9% of patients with cerebral stroke compared to 2.2% in the general population [1]. Agmon et al. [1] also presented a higher proportion of ASA in patients after cerebral ischaemia (7.9%) than in the general population (2.2%). Cerebral stroke can be caused by a paradoxical embolism from a right-to-left shunt at atrial level. It has also been suggested that ASA is a source of thrombus formation [5].

Atrial septal aneurysms can be an isolated cardiac malformation. However, it is frequently concomitant with other cardiac anomalies such as atrial septal defects, including patent foramen ovale. Agmon et al. [1] also noted mitral valve prolapse in 20.5% and tricuspid prolapse in 7.2% of patients with ASA.

The incidence of ASA in the population is still unclear. Detection of this anomaly depends on the diagnostic method used and various diagnostic criteria. According to the echocardiographic definition published by Hanley et al. [2], ASA is recognised when the diameter of the base of the aneurysmatic portion of the IAS measures ≥ 15 mm and there is either protrusion of the ASA ≥ 15 mm beyond the plane of the IAS or phasic excursion of the IAS ≥ 15 mm in total amplitude during the cardiorespiratory cycle. However, this definition is not commonly used in clinical practice. Our criterion for ASA was visible protrusion of the IAS, showing phasic excursion during the cardiorespiratory cycle.

The incidence of ASA in the adult population reported in the literature varies from 2% to 10% [3]. Most ASA cases are detected incidentally. In our study we found ASA in 22 patients (1.33%) in a group of 1650. In our study the detection rate for the anomaly increased with our diagnostic ability. In the year 2004 we detected two cases of ASA, in the year 2005 6 cases and in the year 2006 14 cases!

To our knowledge there is only one case report in the world literature where MSCT was the main diagnostic tool for detecting ASA [6]. Atrial septal aneurysms is poorly known by radiologists. The first step in recognising this anomaly is to know that such malformation may occur. It seems that MSCT with ECG gating is extremely sensitive in the diagnosis of ASA. Multi-slice computed tomography enables ASA and associated heart anomalies to be accurately visualised. In our opinion MSCT, especially with ECG gating, which precisely visualises the anatomical details of the atrial septum, is a valuable method in the diagnosis of ASA.

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