Cardiol Young 2001; 11: 233–235

ISSN 1047-9511

Brief Report

Late cardiac tamponade after transcatheter closure of atrial septal defect with Cardioseal® device

Fátima F. Pinto,[1] Lídia Sousa,[2] José Fragata[3]

[1]Pediatric Cardiology Department; [2]Cardiology Department; [3]Cardiac Surgery Department, Hospital de Santa Marta, Lisboa, Portugal.

Abstract Cardiac tamponade occurring late after interventional closure of defects within the oval fossa is a very rare but life-threatening complication. We describe such an occurrence after use of a Cardioseal device to close an interatrial communication. Two arms of the device had perforated left atrial wall. The device was removed at surgery, and the defect closed uneventfully. All available means should be used to identify this complication.

Keywords: Interventional catheterisation, atrial septal defect, complications, perforated atrial wall

TRANSCATHETER CLOSURE OF INTERATRIAL communications within the oval fossa is now an accepted alternative to surgery in properly selected patients. Several devices are now available for this purpose, with different mechanisms of closure, and methods of implantation. The Cardioseal® device is one such occluder, being used currently on an investigational basis. This device has a non-self centering mechanism of closure. We found several reports on clinical trials of this device, but references to its potential complications remain limited. We report here the first instance, as far as we know, of late cardiac tamponade due to perforations of the atrial wall, a complication which occurred several months after initial closure of the interatrial defect.

Case report

An eight-year-old boy was admitted to our emergency department with syncope and clinical signs of shock. Seven months previously, an interatrial communication in the oval fossa, having a stretched diameter of 8.5mm, had been closed with a 23mm Cardioseal® device. The procedure, performed in another Institution, had been achieved without complications, and the child had remained completely asymptomatic until this admission. There was no history of thoracic trauma. On examination, he had peripheral cyanosis, weak pulses, tachycardia, diminished heart sounds and hypotension. The X-ray revealed an enlarged heart, and the electrocardiogram showed sinus tachycardia, but was otherwise normal. Transthoracic echocardiography revealed a large pericardial effusion, the heart "swinging" with diastolic collapse of the right atrial cavity, raising the suspicion of perforation of the left atrial wall.

Emergency pericardiocentesis was performed and 150 ml of blood was drained, stabilizing the patient.

A transoesophageal echocardiogram performed under general anesthesia confirmed the presence of the pericardial effusion, and showed that the left atrial wall had been perforated by one arm of the device, which protruded towards the aortic wall (Fig. 1).

Surgery was therefore undertaken on an emergency basis. The pericardial cavity contained a moderate amount of blood, and systemic pressure increased when the pericardium was open. Some clots were adherent to the left atrial wall above the rim of the oval fossa, where the atrial wall relates to the noncoronary aortic sinus, and on the lateral wall in front of the right upper pulmonary vein. No

Correspondence to: Fátima Ferreira Pinto, MD, Serviço de Cardiologia Pediàtrica, Hospital de Santa Marta, Rua de Santa Marta, 1169 Lisboa, Portugal. Tel: + 351213594331; Fax: + 351217277993; E-mail: fatimapp@ mail.telepac.pt

Accepted for publication 30 October 2000

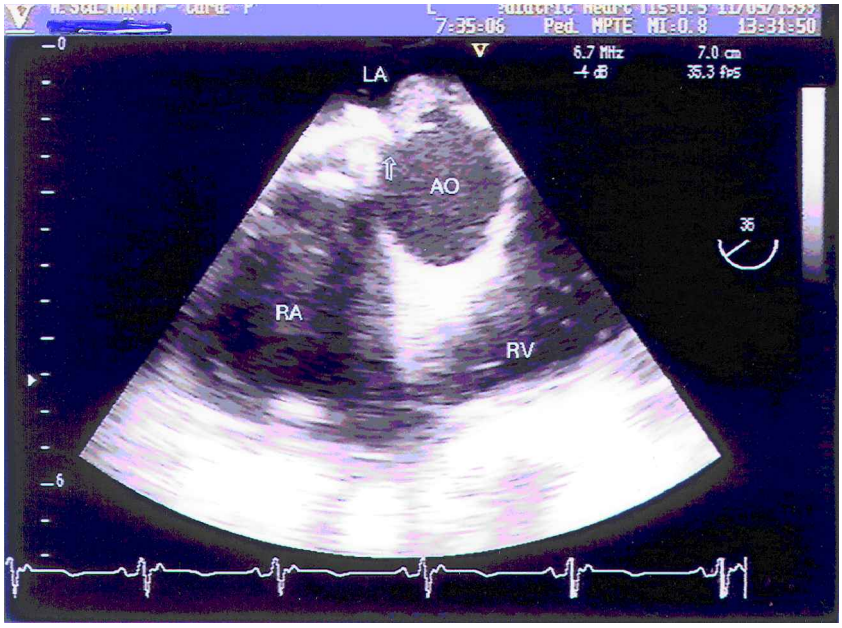

Figure 1.
Longitudinal transoesophageal view of the Cardioseal™ device with one arm protruding (arrow) through the antero-medial wall of the left atrium.
Ao: aorta; LA: Left atrium; RA: right atrium; RV: right ventricle.

active site of bleeding was found but, when the clots were removed, the arms of the device could be seen causing two perforations of the left atrial wall, permitting bleeding into the open pericardial cavity. Under cardiopulmonary bypass and cardioplegic cardiac arrest, the right atrium was opened and the device removed. This was difficult, as the device seemed oversized in relation to the atrial cavities, and particularly because the two arms of the device not perforating the atrial wall were fully incorporated and endothelialized into the left atrium. Having removed the device, the defect was closed with an autologous pericardial patch, the perforations in the left atrial wall were sutured, and the patient was uneventfully weaned from bypass. The postoperative course was uncomplicated, and the patient was discharged on the 7th postoperative day requiring only furosemide medication.

Pathological examination revealed complete endothelialization of the non-protruding arms, and loss of covering cloth on the ones which had perforated the atrial wall (Fig. 2).

Discussion

Transcatheter closure of an atrial defect within the oval fossa was first described by King and Mills over 20 years ago.[1] The technique of closure has now improved to such extent, particularly because of the design of the new devices currently available, that it has become an accepted option for treatment of properly selected patients with interatrial communications.[2–4]
The Cardioseal® is a second-generation device (Nitinol Medical Technologies, Boston, USA) that has evolved from the previous double umbrella device.[5] It is a non self-centering device with four radial arms, incorporating a double umbrella and spring coil in its design.

The clinical use of the device is well described.[6] The complications recognised thus far include "silent" fractures of the arms in 6% of patients; embolization in 1–2%, and other complications related to the catheterization itself, such as bleeding, embolic strokes, and other vascular complications. As far as we can establish, there has been no report of perforation of the cardiac walls or pericardial effusion after implantation of the Cardioseal® device. The web site of Nitinol Medical Technologies does make reference to the possibility of fracture of the arms, or erosion into or through the cardiac walls, but nothing is mentioned about the timing of these potential complications.

Perforation, as a complication of interventional closure of atrial septal defect, has been reported after use of other occluders, such as the Angel-Wings® device.[7] This device also has two square metal frames covered with cloth patches and four sharp edges. The perforation usually occurs on the atrial wall towards the aorta, and can erode into the aortic wall. The process is known to occur some months after the implantation. Our experience shows that the same complication can occur after closure using the Cardioseal® device, which also has sharp tips on its arms, which can protrude through the atrial wall.

The perforation probably occurs by the mechanism of erosion, and therefore takes some time to become evident, as was the case in our patient, the protruding arms of the device having failed to

https://doi.org/10.1017/S104795110100018X Published online by Cambridge University Press

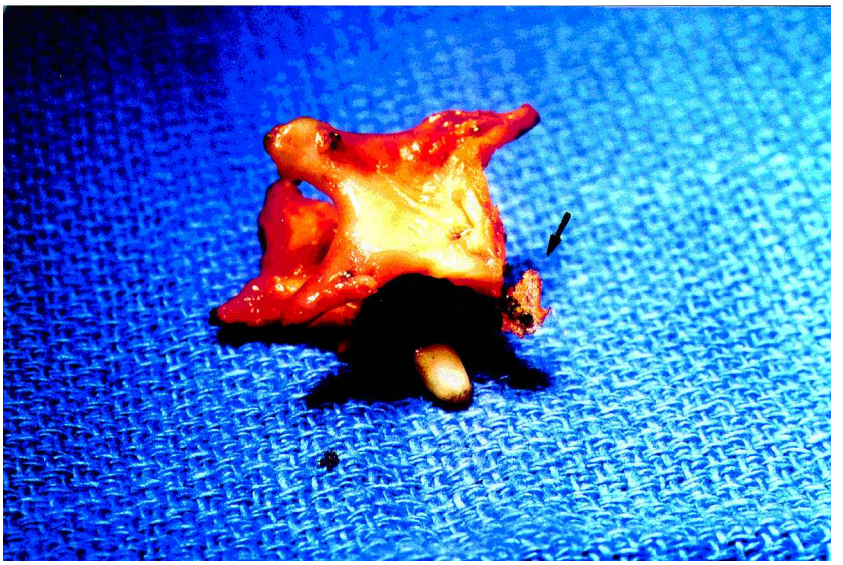

Figure 2.
The surgically removed Cardioseal® device. The device is almost completely endothelialized except for the two protruding arms which had perforated the atrial wall (arrow).

become endothelialized. Use of an oversized device, and the inability of the Cardioseal® device to center within the defect, can facilitate this complication.[7]

Diagnosis of malpositioned or protruding arms of the device by transthoracic echocardiogram can be difficult, as in our patient. Transoesophaseal echocardiography is much more accurate. Maeno et al[8] have recently reported the value of three-dimensional echocardiography for follow-up of defects closed by interventional catheterisation, claiming that the technique was able to clarify the mechanisms of deployment of the device and closure of the defect, thus providing information on potential protrusion of arms and the risk or perforation. When more widely available, this is likely to be a valuable addition to the diagnostic armamentarium.

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