Simultaneous Endovascular Coronary Angioplasty (Direct Stenting of the Marginal Branch, Recanalization and Stenting of "Chronic" Occlusion of the LAD) and Closure of Secundum Atrial Septal Defect

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The authors present a clinical case of successful simultaneous endovascular myocardial revascularization for stenotic and occlusive coronary lesion and closure of ASD secundum. The dilatation of the LAD and the OMB with balloon catheter has been performed followed by DES implantation. During the second stage endovascular closure of the ASD using Amplatzer occluder has been performed. 16 similar cases have been described in the literature. The issue of reasonability of simultaneous performance of two independent endovascular procedures remains open. The necessity of ASD closure is dictated by the possibility of serious complications, such as ischemic stroke and migraine, in the presence of an open interatrial communication.
Keywords: *ASD, coronary stenting, occluder, coronary artery disease.*

Atrial septal defect comprises 5 to 15% of al congenital heart defects (3). In the absence of radical correction 30% of patients with this pathology die within the first 20 years of life (4). However the reasonability of this defect correction in patients who survived this age is not evident. In some patients the atrial septal defect (ASD) does not produce a significant impact on intracardiac hemodynamics (1), while in others the ASD can lead to progressive volume overload and right heart dilatation, development of arrhythmias and persistent pulmonary hypertension (6). Moreover, independently of the state of intracardiac hemodynamics, in all patients with ASD pathological interatrial communications can cause such serious complications as migraine and ischemic stroke (13). Also with the course of time such patients can develop coronary artery disease (CAD). In case of AMI and postinfarction cardiosclerosis the presence of pathological blood stream within the heart chambers can contribute to a more marked postinfarction remodeling of the left ventricle, volume overload, right heart dilatation and development of significant circulatory insufficiency. If such patients develop clinical signs of coronary artery disease, they should be examined for the detection of coronary pathology, and if it is revealed, a special treatment is mandatory. Thus, all grown-up patients with ASD should be continuously followed in order to receive timely medical care, including endovascular and surgical treatment.

Moscow City Center of Interventional Cardioangiology has an experience with simultaneous treatment of ASD and CAD in three patients. We describe one clinical case of successful simultaneous endovascular myocardial revascularization for stenotic and occlusive lesions of the coronary arteries and closure of a secundum ASD.

The patient P., 72 years old, was admitted to Moscow City Center of Interventional Cardioangiology with the diagnosis: CAD; angina of effort class II; postinfarction cardiosclerosis; 3rd degree arterial hypertension; circulatory insufficiency class I; congenital heart defect: secundum ASD; dysplasia of the interatrial septum.

The analysis of medical history revealed a long-standing arterial hypertension (max. to 200/110 mm Hg). The patient did not follow a regular hypotensive therapy. In 2004, without prior angina, he had a Q-wave anterior myocardial infarction, and received systemic thrombolysis with Alteplasa. Transesophageal EchoCG and MRI performed on the same occasion revealed for the first time a congenital heart defect — secundum atrial septal defect (ASD) with volume overload of the right heart. Endovascular ASD closure was suggested, but the patient refused this procedure. After that he started complaining of angina pain and heart rhythm disturbances (extrasystoles) and had several hospital stays. Selective coronary angiography performed in 2007 revealed an occlusion in the proximal segment of the LAD and a stenotic lesion in the marginal branch. The patient refused special treatment and continued conservative therapy. In October 2010 he applied to the consultative and diagnostic department of Moscow City Center of Interventional Cardioangiology complaining of decreased physical tolerance, increased fatigue, dyspnea of effort and heart rhythm disturbances. Multihelix computed tomography confirmed the diagnosis of an oval-shaped ASD secundum located in the upper part of the septum, measuring 1.07 x 1.25 cm and surrounded by an aplastic interatrial septum (IAS) with marked aneurysmatic bulging into the right atrium (Fig. 1).

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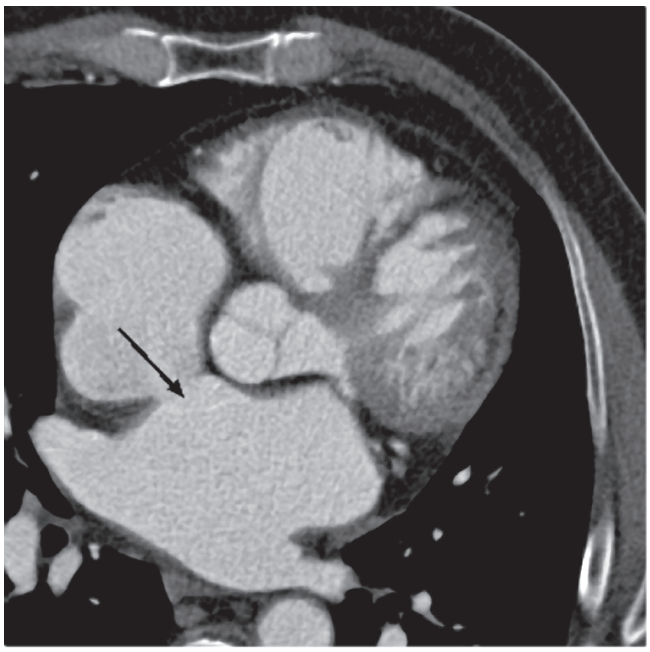

Fig. 1. Axial heart section at the ASD level. The arrow marks the defect

A pathological left to right shunt was seen an the level of the middle segment of the IAS (assumed size >0.6 cm), a moderate dilatation of heart chambers was noted: LVEDD — 5.46 cm, RVEDD –4.86 cm, LAEDD — 6.94 cm, RAEDD — 5.81 cm.

After a necessary out-hospital examination the patient was admitetd to the Center with the diagnosis: CAD; postinfarction cardiosclerosis; angina of effort and at rest; arterial hypertension; circulatory insufficiency class I; congenital heart defect: secundum atrial septal defect (ASD). At admission the patient's condition was satisfactory, with skin and mucosa of normal color and humidity. Pitting lower leg edema was present. The chest at the heart area looked normal, the borders of relative heart dulness were enlarged to the right by 1 cm from the right parasternal line at the level of the 3rd intercostal space. A soft systolic murmur was heard, maximal in the 3rd -4th right intercostal space. Heart rate — 84 b/min., blood pressure — 150/80 mm Hg.

ECG revealed sinus rhythm, 77 b/min. Transmural scars were present at the anterolateral segment of the left ventricle. 24-hour ECG monitoring revealed mean heart rate of 62 beats per minute. Several episodes of 1st degree AV block were registered. 428 isolated atrial extrasystoles were revealed. During the monitoring no ischemic changes of ST segment were registered. Transthoracic EchoCG revealed dilated LV cavity: end-diastolic dimension (EDD) — 6,0 cm; end-systolic dimension (ESD) — 4,8 cm. The thickness of interventiricular septum (IVS) was 8 mm, of left ventricular posterior wall — 9 mm. Left ventricular ejection fraction was 41%. The disturbances of local left ventricular contractility included apical akynesia, marked hypokynesia of the apical and middle segments of the anterior wall and interventricular septum. A large aneurysm measuring up to 40 mm with a central 9 mm defect resulting in the left-to-right shunt was located in the IAS area. Transesophageal EchoCG performed in order to precise the defect's details and determine its edges' dimensions showed a markedly dilated (up to 7,0 cm) right atrium with a surface area of 32 cm2. The right ventricle was moderately enlarged, RV EDD — 4,3 cm. Tricuspid regurgitation of the 2nd degree and moderate pulmonary hypertension (mean pulmonary arterial pressure —

65 mm Hg) were also revealed. An IAS aneurysm measuring 40 mm with a 20 mm bulging into the RA cavity was seen. Marked bulging into the RA caused a moderate obstruction to the blood flow. An ASD measuring 9 x 6 mm, with left-to-right blood shunting and a peak gradient of 21 mm Hg was located in the superoanterior part of the aneurysm (Fig. 2).

Taking into account the history of myocardial infarction, clinical presentation of angina, significant size of atrial septal defect and the signs of volume overload of the right heart, we decided to perform endovascular ASD closure as well as diagnostic left ventriculography and selective coronary angiography. Contrast left ventriculography (right oblique view) showed LV EF — 49%, moderate dilatation of LV cavity (EDV–202 ml, ESV — 104 ml). Hypokynesia of the anterolateral and apical segments of the LV were revealed. Diagnostic coronary angiography revealed left type of coronary circulation, an occlusion of the proximal segment of the LAD. There was over 75% stenosis in the obtuse margin branch (Fig. 3). The RCA was moderately changed without significant stenosis.

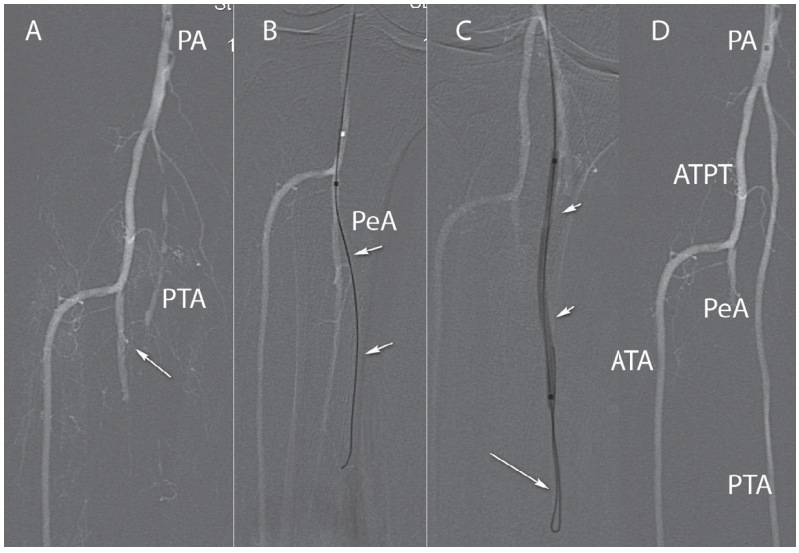

Fig. 2. Aneurysm of the IAS

On the base of CAG data (occlusion of the LAD and >75% stenosis of the OMB) multiple coronary angioplasty was performed before ASD closure. The left coro-

nary artery was catheterized with the guiding catheter Mach 3.5 SH (Boston Scientific), mechanical recanalization of the occluded LAD was performed using hydrophyle Shinobi guidewire (Cordis). The LAD was dilated using balloon catheter 1,5 x 20mm (Cordis), and then stented with a DES Taxus express 3,0 x 20 mm (Boston Scientific) (Fig. 4 a,b). The stent was completely deployed under 14 Atm. pressure.

After that we performed direct stenting of the OMB using Promus Element stent 3,5 x 28 mm (Boston Scientific) (Fig. 5 a,b) with good angiographic results.

At the second stage of the procedure endovascular ASD closure was performed. The right femoral vein was punctured under local anesthesia and a 6F introducer was inserted. The catheterization of the left upper lobe pulmonary vein was performed using multipurpose 6F catheter. Then a 34-mm sizing balloon was advanced using Amplatzer guide 0,035 x 260 cm and the defect size was determined. As the defect's edges were dysplastic, we have chosen 33 mm Figula Flex occluder. The occluder was placed under fluoroscopic guidance using generally adopted technique. At first the left occluder branch was deployed into the left atrium and the safety of occluder fixation at the defect's edges was checked with recurrent tractions of the delivery system. Only after that and after echocardiographic control of distal occluder branch position relative to the defect and the valvular apparatus of the LV, the proximal branch was deployed in the right atrium (Fig. 6).

Control transthoracic EchoCG revealed adequate positioning of the occluder and complete deployment of both discs, there was no shunt through the ASD. After the confirmation of secure occluder fixation the delivery system was removed. In our opinion, the process of this delivery system detachment — the removal of fittings' block — is simple and more convenient in comparison with the widely used Amplatz ocluders. The hemostasis was achieved using manual compression. We did not observe any complications during and early after the procedure. Control transthoracic EchoCG carried out in 4 days after ASD closure confirmed good effect of the procedure, the shunt through the defect was absent. In-hospital period was eventless and the patient was discharged at day 6 in a satisfactory condition. After the angioplasty the angina attacks stopped and

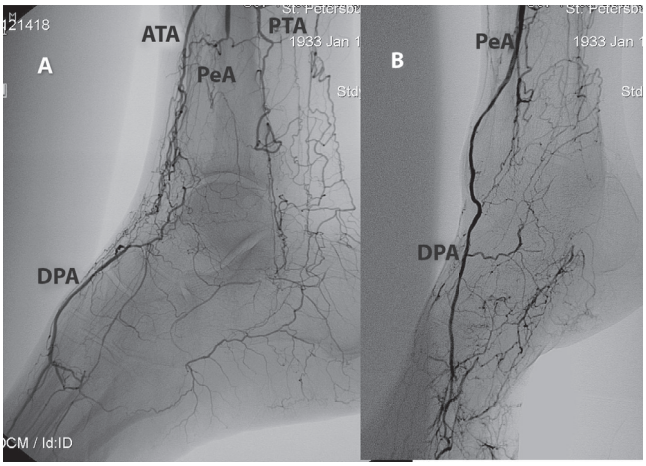

Fig. 3. Selective coronary angiogram of the left coronary artery: the LAD cannot be visualized. The middle segment of the OMB is stenotic (>75%)

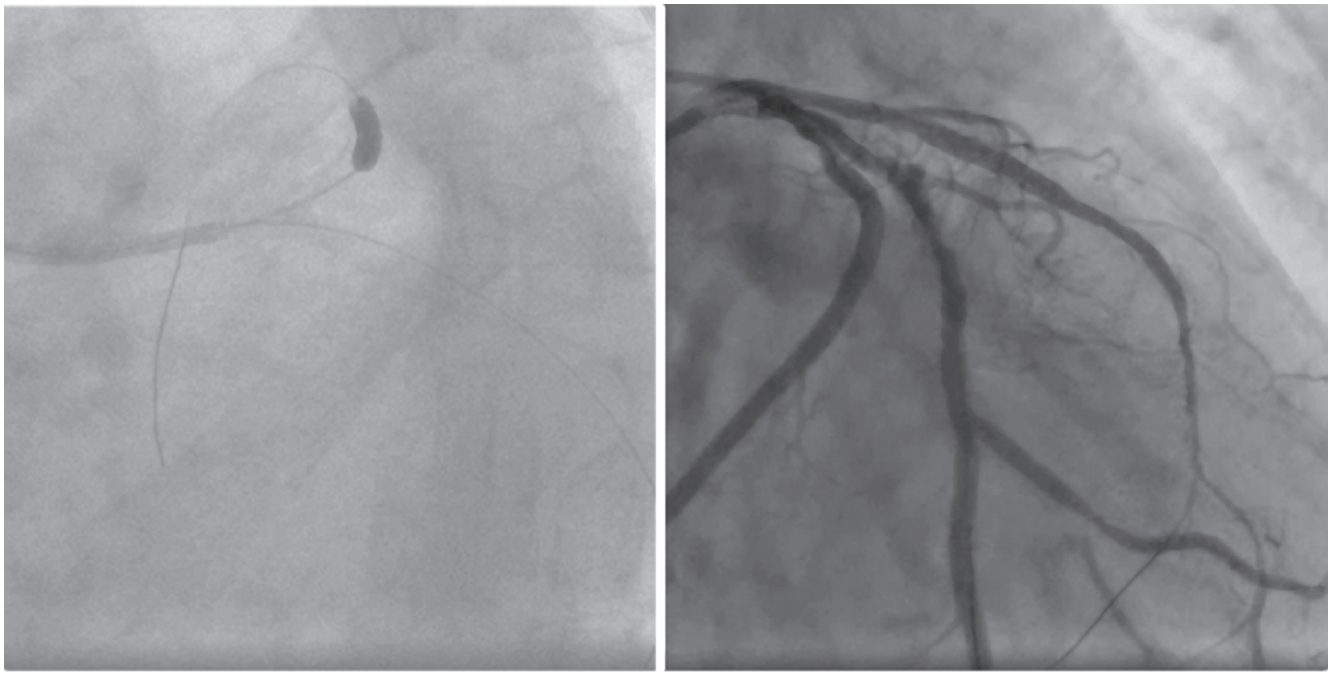

Fig. 4. a) Stenting of the proximal segment of the LAD using Taxus express DES (3x20mm); b) Immediate result of stenting

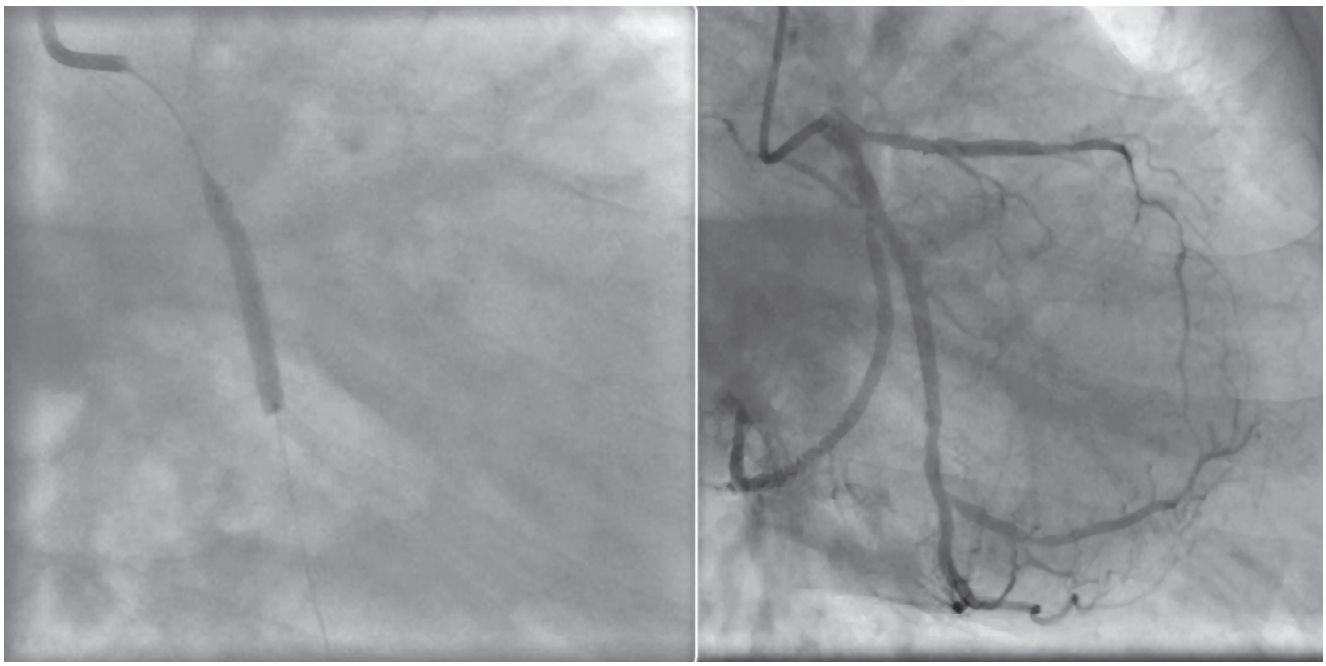

Fig. 5. a) Stenting of the OMB using Promus Element stent (3.5x28mm); b) Immediate results of OMB stenting

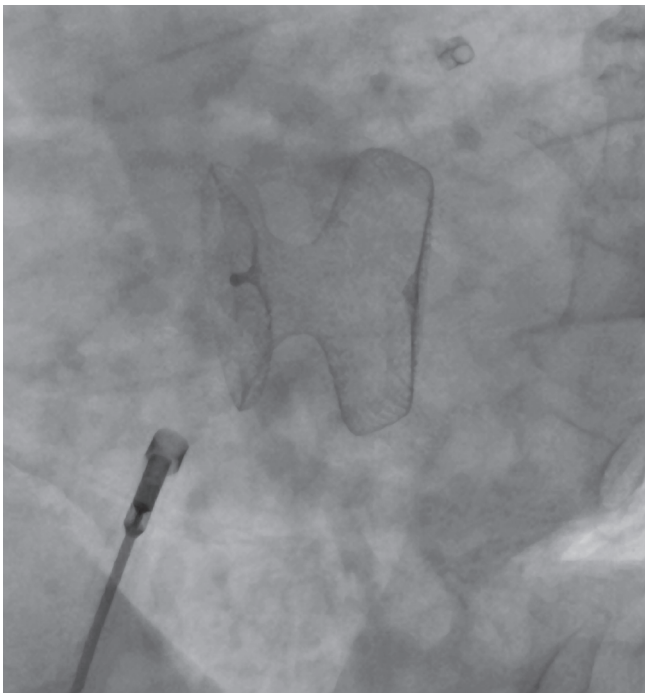

Fig. 6. Figula Flex ASD occluder (33 mm) is placed in the defect

did not recur thereafter. There were no changes on the ECG.

At the examination performed in one month the patient did not present any complaint, his condition was satisfactory. The results of performed endovascular procedures were assessed using control EchoCG as well as repeated MHCT, including of the coronary arteries with opacification. Transesophageal EchoCG showed the occluder with the right atrial disc closely adjacent to the IAS. The left atrial disc was fixed at the isthmus area, located at a 6,5 — 7 mm distance from the septum and separated from it by the aneurysmatic tissue. No echo-signals suspicious for thrombi or vegetations were located. No signs of residual shunt were seen (Fig. 7).

MHCT of the heart showed the occluder with signs of epithelization along its contours in the projection of the middle third of the IAS. No signs of transseptal shunt were revealed (Fig. 8). In the projection of the proximal third of the LAD a stent without restenosis signs was seen, the artery beyond the stent was moderately changed without sites of significant stenosis. The OMB and the RCA were without changes, the stent in the OMB — without restenosis.

Thus, the patient underwent successful combined procedure of ASD closure and multiple stenting of the coronary arteries. The experience with such combined procedures in adults, especially in elderly patients, is very small. While the number of such patients in the world amounts to many thousands, only 16 similar procedures have been described (14, 15, 16). Probably, the lack of clear indications inhibits wider spreading of such procedures. The procedure of coronary stenting does not raise any questions, as this procedure became a usual, even routine method for the treatment of CAD. The indications for it are also well elaborated. However the correction of ASD, especially in combination with angioplasty, is still subject to many questions. They concern mainly two moments: 1) the reasonability of congenital heart defect correction in elderly; 2) the reasonability of simultaneous performance of two independent endovascular procedures.

The problem of correction of the congenital heart disease — the ASD — in adults is still subject to discussions and not fully elucidated. Formerly it was usual to refrain from surgical intervention in

adults. On the one hand, this was due to relatively high morbidity of surgical intervention with extracorporeal circulation, and on the other hand — to the paucity of clinical manifestations of the disease and the absence of clear indications for surgery. Broad clinical introduction of endovascular methods of closure of pathological intracardiac communications, not requiring sternotomy and extracorporeal circulation and associated with an extremely low traumatism and high effectiveness again placed this problem in the agenda (2,5,9,10,11,12). While determining the tactics of treatment one should remember that despite left-to-right blood shunting within the heart — leading to: (a) diastolic overload of the RV and the RA; (b) increase of pulmonary blood flow sometimes by several times over the systemic flow; (c) decrease of blood input into the left heart and the aorta, — significant changes of intracardiac hemodynamics, including marked pulmonary hypertension, can become evident not immediately, but after a certain, sometimes a long time, for example, after 20 years and more. Hence, the absence of significant changes of intracardiac hemodynamics at the moment of examination should not be considered as a reason to refrain from ASD closure, as one has to consider this problem at a long term. In particular, this is true for the patients who already have some signs of CAD or a history of MI. This disease can enhance the appearance of significant disturbances of intracardiac hemodynamics due to the progressive LV failure. In adults this can be also influenced by the detraining of functionally underloaded left ventricle, the presence of arterial hypertension and other acquired heart diseases. Associated LV failure in patients with ASD can result in the increase of blood congestion in the right ventricular inflow tract. The more pronounced is left ventricular damage, the more significant will be these changes. In particular, they can be enhanced in the presence of postinfarction LV cardiosclerosis.

One also has to remember that the communication between the left and the right heart enhances the probability of thromboembolic complications in different organs, including the brain and the coronary arteries. Hence, the closure of the defect contributes to the decrease of the probability of thromboembolic complications.

Finally, there are evidences of the role played by ASD in the pathogenesis of migraine (13). The authors from Utah have shown that 25% of patients with ordinary migraine and 50% with migraine with aura had ASD. Certainly, this problem necessitates further investigation, however the presence of migraine in patients with ASD should be considered as an additional factor for positive solution of the problem of endovascular ASD closure.

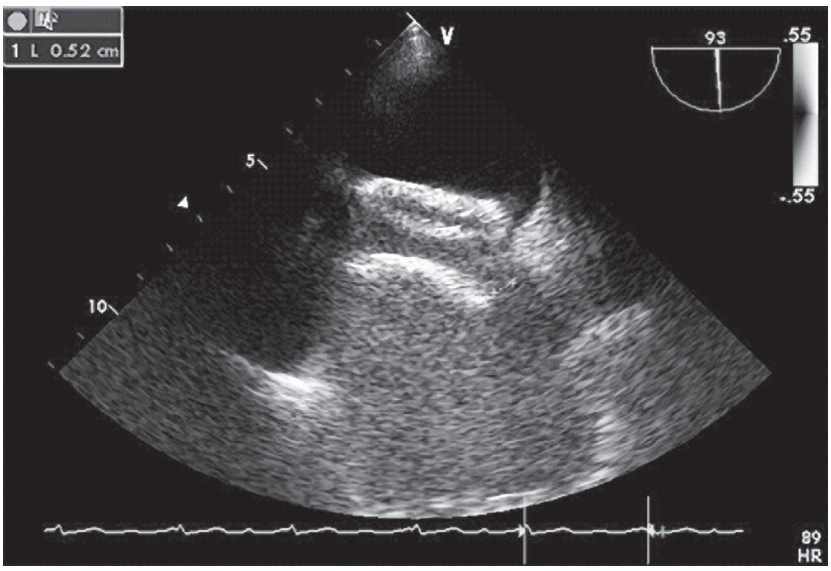

Fig. 7. Control TE-EchoCG in 1 month after the procedure

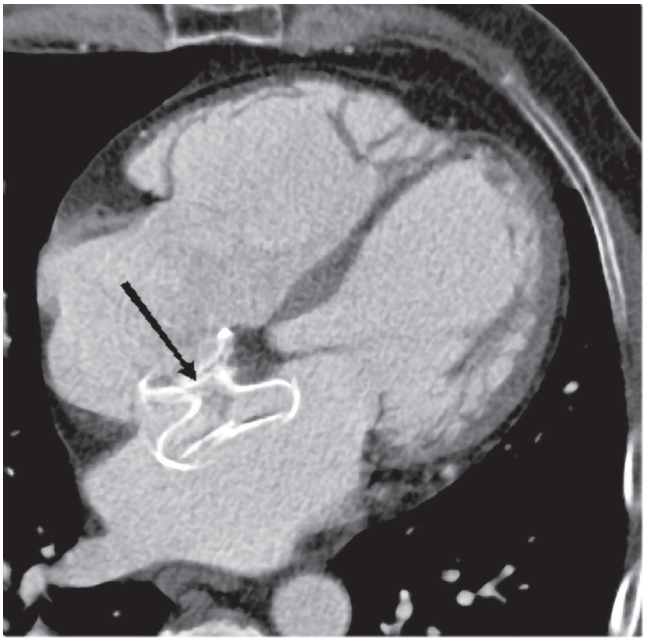

Fig. 8. Axial heart section at the level of the ASD. The arrow indicates the occluder

Thus, while solving the problem of the choice of tactics of treatment in adults with ASD one has to take into account the probability of association of other cardiovascular conditions to this disease. With the course of time these conditions can significantly worsen the prognosis in such patients. For this reason we consider reasonable to eliminate pathological communication between the heart chambers being a probable cause of heart failure.

As to the simultaneous performance of two endovascular procedures in this contingent of patients, an extremely low number of cases makes it difficult to maintain pro or contra positions. Today we can only confirm the feasibility of such concomitant procedures without any serious complications (14,15,16).

Surely it is a positive moment for patients who can avoid repeated emotional stress related to the procedure and repeated hospitalization. Also the overall in-hospital stay is reduced (17). However in order to clarify this question we need to accumulate additional experience and perform a meticulous analysis of the obtained data.

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