Atrial septal defect (ASD), device or surgical closure ?

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Abstract

In this article,we present 2 rare complications of device closure of Atrial Septal defects(ASD),and review the literature for device and surgical closure of these defects.In one case device embolisation and in the other case device perforation of heart and the way we managed them is presented.

Keywords: Atrial septal defect (ASD), Device closure,surgical closure

Introduction: Atrial septal defect (ASD) is a very prevalent congential heart disease (3.78 per 10000 live birth)(1) .Surgical treatment is safe and effective but there are complications related to thoracotomy, bleeding, arrhythmia, post pericardectomy syndrome, and residual defects(1). ASD closure device was first described by Ring et al. in 1976(2). The devices used for closure are composed of cardioseal, amplatzer septal occluder (ASO), and the angelwings(2). The amplatzer septal occluder (ASO) is a device approved by FDA for transcatheter closure of secundum atrial septal defects and fenestrations of Fontan operation(3,4).

The ASO is a self-expandable, double disc device made from a Nitinol wire mesh. Nitinol is a metal alloy used in many medical appliances. The two discs are linked together by a short connecting waist corresponding to the size of ASD. In order to increase its closing ability, the discs and the waist are filled with polyester fabric(3).2 rare complications following device closure of ASD are presented here and the literature is reviewed for surgical versus device closure of these defects.

A 12 year-old boy with symptoms of palpitation and fatigue underwent transthoracic echocardiography, which showed a 20 mm diameter ASD, and EF=77%. The patient therefore seemed to be a good candidate for ASD closure using ASO. After positioning and releasing, the device was embolized to LA and subsequently to LV. Efforts for percutanous extraction of the device were failed, and the patient was transferred to OR in cardiogenic shock.

A midsternotomy insicion was made, mediastinal cavity opened and CPB established using 2 venous cannulae and caval tapes. We made an incision in RA, and approached LA and then LV through ASD. The occluding device was then removed, ASD closed primarily and CPB was terminated easily and without any difficulties(pictures 1 and 2). Postoperative echocardiography showed no residual ASD and after an uneventful and normal post operation period, the patient was discharged from hospital.

Case2: A 26 years old woman with symptoms of palpitation and dyspnea on exertion ,and with the below signs and paraclinical findings was reffered for closure of Atrial septal defect(ASD) with Amplatzer septal occluder.

ECG: normal sinus rhythm, chest x ray:normal

Transthoracic and TEE :

Moderate size ASD secondum type, defect size: 17mm, left to right shunt Qp/Qs=1.8, Anterosuperior rim:2mm, posteroinferior rim: 16 mm, anteroinferior rim:78mm, posterosuperior rim:11mm,superior rim:10mm, inferior rim:19mm,

ejection fraction: 50%

Patient underwent catheterism and an Amplatzer septal occluder number 26 was inserted successfully for closure of the defect. she was in good condition

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for 2 days ,but suddenly deteriorated, blood pressure decreased, pulse rate increased and very soon she was in shock.With the impression of tamponad ,percutanous aspiration of pericardial cavity was performed, and it led to transient improvement in vital signs, emergently a pig tail catheter inserted percuanously,and in a preshock state she was transferred to operating room. In operating room, with a mid sternotomy incision ,pericardial cavity opened and copious amounts of blood aspirated from pericardial cavity. An active bleeding point in supero-anterior aspect of right atrium,and near aortic root was found (picture 3). Canulation of aorta ,and SVC and IVC were performed,after cardiopulmonary bypass was established ,right atrium opened ,amplatzer device was pulled back in its sheath by interventionist,and removed. ASD was repaired using pericardial patch,and right atrial perforation was repaired by direct suture and pericardial patch reinforcement.CPB terminated without any difficulty and operation terminated uneventfully. After a normal and uneventfull postoperative course she was discharged from hospital in good general condition.

Discussion

Surgical ASD closure has been in use since 1948 with good results and low mortality and morbidity. The operation needs a sternotomy or less commonly thoracotomy incision , CPB and 3-7 days of hospital admission(5). During past few years, different devices for percutanous closure of ASD have been used for more than 2700 cases worldwide. Amplatzer has been used since 1995 and compared to other competitive devices, and it has passed tests of superiority and applicability. The superiorities of Amplatzer are its simple use and possibility of changing its position. This is due to compositon of nitinol (memory wire) and excellent design, which could retract into the catheter and removed if it was not properly placed in the heart. It is available in 40 mm size(3). Most ASD secondums can be closed by Amplatzer. Common criteria for a patient being suitable for closure by Amplatzer included a defect with less than or equal to 34 mm, a 4 mm rim of septal tissue surrounding the defect and sufficient distances from surrounding valves and structures(3).The hazards of ASO are thick profile of device and high amount of nitinol in device and the potential for nikle toxicity(6).Complications of percutanous ASD closure are air embolism,vascular trauma resulting from large sheathes, device embolization, clot embolization through AV valve, occlusion of pulmonary or systemic venous return, perforation of atrial septum, aortic perforation, infective endocarditis, atrial arrhythmia, device malposition necessitating its removal, delayed breakdown of device and residual atrial shunt (7,8,9,10).

According to reports of FDA, the most common complications following Amplatzer insertion are early erosion and perforation of heart. There are some reports of this complication occurring many years after insertion(4). Embolization does not commonly occur but if developed, the reasons were insufficient rim around the defect, early release of device, and mismatch between the size of ASD and Amplatzer which was due to the use of small Amplatzer for a large ASD. The reason for embolization in our patients seemed to be due to both insufficient rim, and mismatch between the size of defect and device. Most cases of embolization were localized to RA and RV in decreasing order of frequency. The reason for this propensity was due to lower pressure in RA and RV compared to those in the left chambers. Contrary to previous reports, embolization in th case we presented here was restricted to left side and LV due to technical error(9,11,12,13).In a study conducted by Berger et al. in one of 61 cases of ASD closure using Amplatzer, embolization of the Amplatzer device was observed in the left ventricle. The device could be retrieved from the heart, but vascular surgery was required to extract it from the femoral artery(9). In another study performed on 236 patients by Fischer et al. with transcatheter closure of ASD, at cardiac catheterisation, devices were not implanted in 18 patients because of overstretched diameter of the ASD,the unstable device, compromised mitral valve, or obstructed upper right pulmonary vein(14). Bialkowski et al. compared closure and complication rates in 91 children with secundum atrial septal defects. Of these, 44 with mean age, 8.1±4.7 years were treated surgically and 47 with mean age, 10.1±4.9 years were treated by percutaneous Amplatzer septal occluder with complications classified as mild, moderate, or severe. The closure rate was similar in both groups with 42/44 children (95.5%) in the surgical versus 46/47 patients in the device groups (97.5%). As for complications, mild forms were observed in 17/44 patients in the surgical group vs 2/47 in the device group, moderate in 11/44 in the surgical vs 1/47 in the device group; and severe in 2/44 in the surgical group vs none in the device group. Blood products were administered to 18 cases

in the surgical and to 1 patient in the device group (P < 0.001). Transcatheter closure of secundum atrial septal defects with the Amplatzer device has the advantage of fewer complications, shorter hospitalization, and reduced need for blood products. Nonetheless, the surgeon's ability to close any atrial septal defects regardless of its size or location remains an important advantage of surgery. Surgical Complications include pericardial effusion headache, heartblock, rhythm disturbance, pneumonia, atelectasis,bleeding and stroke. In a report by David et al. 186 patients had atrial defects closed by means of Amplatzer device with no major complications. There were 8 (4.3%) minor complications including 4 device embolizations with 2 removed percutaneously and 2 surgically. Also, 4 instances of arrhythmia occured comprising 3 transient, and 1 persistent complete heart block. The closure rate for 121 patients with 6 months follow-up was 99%(15). According to the last reports from US, ASD was closed without any important complications in 186 cases. The patients had a low rate of complications consisting of device embolization which in 2 cases it was extracted percutanously and in 2 patients surgically, arrhythmia in 3 patients including 1 case of permanent complete heart block. Moreover, in 121 cases, the occlusion rate was 99% after 6 months. In most reports, surgical complications after ASD closure were 10-20%. In comparative studies performed by Berger et al., no difference was found between prevalence of complications in surgical and ASO closure of ASD. Embolization and percuatanous extraction of ASO, after releasing the device from its position, was reported,though the prevalence and causes of embolization and effective methods for extraction were not described systematically in a company-designated analysis. The prevalence of embolization of ASO in a wide range of sizes of ASD and device was observed in 21 cases of 3824 device closures (0.55%). Most embolizations were due to underdeveloped rim or undersized devices. Of 21 cases of embolizations, 15 cases were extracted percutanously using a goose neck snare without any morbidity or mortality and in 6 cases, it was removed surgically. Other possible causes of embolizations were early release of ASO or lack of meticulous assessment(11).Kositseth et al. studying 103 patients from April 1998 to Novemeber 2002, reported one case of embolization of ASO (ASD or ASO) in LA.In a large series, embolization of ASO was reported in 1.1% of cases that required surgical removal in 0.2% of cases. Because the prevalence of embolization of ASO in experienced hand was approximately 1 in 200 cases, operators must be familiar with techniques and instruments and be ready for percuatnous extraction of ASO if necessary. In fewer patients undergoing Amplatzer, the initial procedure for ASD occlusion was more successful than in those undergoing surgery, in some surgical closures. In regard to complication of dehiscense after surgical closure managed by amplatzer, both techniques seemed to have complementry role in the treatment of patients. Amplatzer ASD closure in a single procedure had a lower chance of success than surgery. Overally, there were more complications in the surgical group but in most cases they were minor and did not require any changes in management. Hospital stay and time taken to return to normal activities were significantly shorter in the Amplatzer group patients, but median medical costs were similar for both groups, although the cost of surgical closure seemed to be lower in developing countries(17). Postoperative changes in sizes of the left and right ventricle indices were more favorable in patients after closure of ASD with ASO (ASDorASO) compared with surgical procedure(18,19,20,6,10,11,14 ,16,17). Reports from different parts of world show that Amplatzer septal occluder-associated cardiac perforation is rare and uniquely involves the anterosuperior atrial walls and adjacent aorta. Pathophysiology remains poorly understood(4)(18). Fistulisation of different cardiac chambers is reported too(19).As reported in literature in the case we presented ,perforation was in antero superior aspect of right atrium. There are reports of early as well as late perforation by amplatzer septal occluder(20)(21). Patients with deficient aortic rim and/or superior rim may be at higher risk for device erosion(22)(23)(24). In the case we presented above ,it seems the rim was sufficient and this could not be the reason for erosion. Oversized ASO may increase the risk of erosion,and a device to defect ratio of 1:1 or a device 10-20% larger than invasively measured stretched defect diameter should be chosen and implanted on the basis of the intra cardiac echocardiographic data (22)(25)(26).The defect should not be overstretched during balloon sizing(22),and the reason for cardiac perforation in the case we presented must be mismatch between the size of defect and device,i.e insertion of a large device in a small ASD. Morphologic variations of the ASD are common. Transthoracic echo supplemented with TEE is crucial for the determination of

the ASD morphologic features, diameter, and rims, which are crucial for proper patient selection. TEE allows precise guiding and positioning of the ASO, which is essential for safe and effective transcatheter ASD closure.(24)(27).

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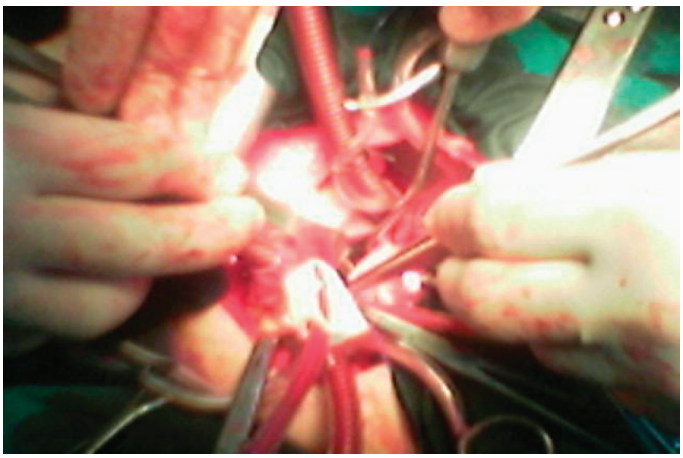
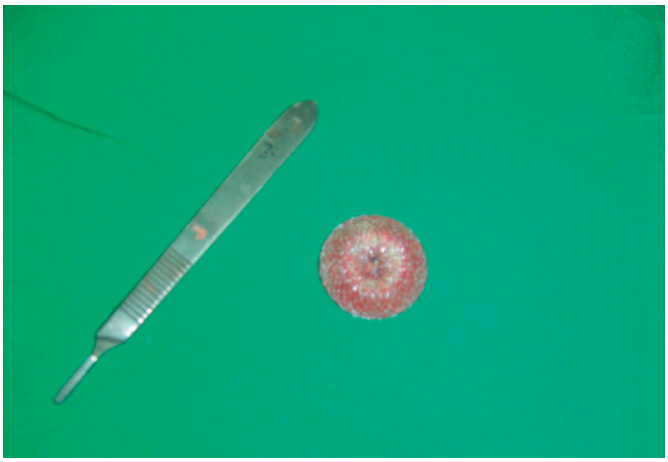
decreased in women.(Fig.1) According to STS database between 1994 and 1996, 28.2 percent of isolated CABGs were performed on women.





Pictures1,2:*surgical removal of device fromLV*

What's New in Cardiac Surgery?

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1-A lesional classification to standardize surgical management of aortic insufficiency towards valve repair

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Objective: Aortic valve repair is an alternative to valve replacement for treatment of chronic aortic insufficiency (AI). In order to standardize surgical management, we suggest a classification based on echocardiographic and operative analysis of valvular lesions.

Methods: Classification was based on the retrospective analysis of chronic AI mechanisms of 781 adults operated on electively between 1997 and 2003.

Results: AI was isolated (406 patients (52%)), associated with supra-coronary aneurysm (97 cases (12.4%)), or with aortic root aneurysm (278 patients (35.6%)). Etiologies of valvular or aortic lesions were respectively rheumatic, dystrophic and atheromatous in 17%, 73.6% and 9.4% of cases. Lesional classification is based on the analysis of chronic AI mechanisms defining type I with central jet (354 cases, 45.3%) and type II with eccentric jet (54.7%). Type Ia is defined as isolated dilation of sino-tubular junction (47 supra-coronary aneurysms), and type Ib as dilation of both sino-tubular junction and aortic annular base (233 root aneurysms, 74 isolated AI). The type II associates dilation of sino-tubular junction and annular base to a valvular lesion: IIa cusp prolapse (95 aneurysms, 200 isolated AI); IIb cusp retraction (132 rheumatic AI), IIc cusp tear (endocarditis, traumatic).

Conclusion: A lesional classification aims to standardize the surgical management of aortic valve repair: type Ia, by supra-coronary graft; type Ib, by subvalvular aortic annuloplasty associated with the aortic root replacement with a remodelling technique (root aneurysm) or double sub- and supravalvular annuloplasty (isolated AI). For chronic AI type II, aortic annuloplasty associated a remodelling technique or double sub- and supravalvular annuloplasty is combined with the treatment of the cusp lesion (cusp resuspension, cusp reconstruction with autologous pericardium).

Key Words: Arterial switch operation, Coronary lesions ,Surgical revascularization

2- Pericardial patch augmentation for repair of incompetent bicuspid aortic valves at midterm

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Objective: Reoperation rates after repair of bicuspid aortic valves are higher than for mitral valve reconstruction. Satisfactory results have been reported for patch augmentation for tricuspid aortic valves. We have applied this technique for the repair of bicuspid aortic valves.

Methods: Autologous pericardium is sutured to the free edge of the prolapsing bicuspid leaflet. A large coaptation surface is created and competence of the bicuspid valve is achieved. Forty patients underwent reconstruction of their bicuspid aortic valves by pericardial patch augmentation. Patients were followed up at regular intervals by echocardiography in yearly intervals.

Results: There were no perioperative deaths. One year postoperatively, one patient died due to endocarditis. Seven patients (17.5%) had aortic regurgitation grade I, and the other 33 patients had non or trivial aortic regurgitation at discharge. At 4.2 ± 3.1 years postoperatively, only four patients (10%) had aortic regurgitation grade I. There were no cases of progression of regurgitation. Planimetric effective orifice areas ranged above 2 cm2. Mean aortic gradients dropped from 8.2 ± 4.8 mmHg at discharge to 3.8 ± 3 at four years and the mean height of coaptation surface from 14.7 ± 2 mm to 12.3 ± 4, respectively.

Conclusions: The pericardial patch augmentation technique increases coaptation surface, and thus provides reliable early and midterm competence of reconstructed bicuspid aortic valves.

Key Words: Aortic • Valve • Repair • Midterm • Follow-up