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Original Research Article

Clinical Experience of Intraoperative Device Closure of Interatrial Septal Aneurysm with Atrial Septal Defects

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Abstract: The objective of this study is to summarize the clinical experience and efficiency of intraoperative device closure of interatrial septal aneurysm with atrial septal defect (ASD). From April 2012 to October 2014, 4 ASD cases with interatrial septal aneurysm had been completed intraoperative ASD closure. One male and three females were 41-69 years, with height range was 158-174cm. The weight range was 52-67 kg. One patient was suffering from hypertension and atrial fibrillation. Another patient had a stroke. The chest X-ray, echocardiography and electrocardiogram had been performed before the procedure. The details of procedure have been described in literatures. All patients were asked to come back each month in the first 3 months and then once every 3 months. The diameter of defects was 8-13 mm. The diameter of aneurysms was 15-20mm. All patients were closured successfully. None of them needed blood transfusion and suffered from various complications. During a follow-up period of 20 to 50 months, no residual shunt, noticeable mitral regurgitation, significant arrhythmias, thrombosis, or device failure were found. Intraoperative device closure of interatrial septal aneurysm with ASDs achieves satisfied results by reasonable techniques and devices.
Keywords: Interatrial septal aneurysm; Atrial septal defect; Cardiac intervention; Surgery

INTRODUCTION

Atrial septal defect(ASD) is one of the most common congenital cardiac abnormalities, accounting for 30-40% of congenital heart disease in adults, and it is more frequent in females by a ratio of 2:1 [**1**]. Atrial septal aneurysms is a relatively rare but well recognized clinical significance, which has been related to atrial septal defect, pulmonary embolism and atrial arrhythmias. In many patients, the diagnosis is made following a paradoxical embolic event. In other patients, the diagnosis follows an incidental finding on routine echocardiography. Diagnosis of ASD in atrial septal aneurysms can be established using transthoracic or transesophageal echocardiography (TEE). Both two abnormalities are independently associated with ischemic stroke. Intraoperative device closure of ASDs has been demonstrated to be safe and effective relative to surgical repair. The aim of this study is to summarize the feasibility of intraoperative device closure of interatrial septal aneurysm with ASDs with transthoracic minimal incision.

PATIENTS AND METHODS

The study was approved by the Ethics Committee of Guilin Medical University Hospital. Additionally, the written informed consents were obtained from the patients.

Clinical data

During the period of April 2012 to October 2014, four patients who underwent transthoracic minimally invasive device closure of interatrial septal aneurysm with ASDs in our institution were reviewed for the current study. There were 3 males and 1 females. The age range was 41 to 69 years and body weight range was 52 to 67kg. The height range was 158-174cm. One patient was suffering from hypertension and atrial fibrillation. Another patient had a stroke.

The indications for our procedure were the same as those used for surgical or percutaneous closure, which included a hemodynamically significant left-to-right shunt, mild-to-moderate pulmonary hypertension [2,3]. Those with other coexisting cardiac anomalies were excluded from our study. Using transthoracic echocardiography, all patients were diagnosed with interatrial septal aneurysm with ASDs. We used different transthoracic echocardiographic measurement views to assess the diameter of the ASDs, and chose the largest measured diameter as our pre-closure

measurement. Right ventricular size and function was evaluated from apical, para-sternal and sub-costal views. In these patients, pulmonary artery systolic pressure was 30 to 45 mm Hg. No patient had severe pulmonary hypertension (See table 1).

Surgical procedure

The locations, sizes, and margins of interatrial septal aneurysm and ASDs were identified using transthoracic echocardiography prior to the procedure for screening cases for the study. An appropriately sized occluder (which was manufactured by Lifetech Scientific, Shenzhen, China) was selected according to the preoperative echocardiography measurement, and was placed in the delivery sheath after soaking in heparin saline. TEE examination was performed with Philips echocardiography machines (IE33) utilising a multiplane two dimensional probe. Standard views were acquired at different angles to assess the maximum ASDs and septal aneurysms diameter. All procedures also involved further sizing of the defects with an occluders size, which provided a maximal "stretched diameter''. Then the largest diameter was obtained. During the procedure, under the guidance of a parasternal ultrasonographic 4-chamber view, the delivery sheath was placed into the left atrium through the ASD. ASD occluder selection is larger than the defect 8-10mm. Then, via the sheath, the occluder inside the left atrium was opened, and it was then pulled back tightly. Thereafter, the occluder inside the right atrium was opened. After the margin of the ASD was clamped with the bilateral occluder, echocardiography was performed again to confirm the tightness of the occluder, making sure that there was no residual shunt and that there was no adverse impact on the structure and function of the superior vena cava, inferior vena cava, mitral valve,tricuspid valve, coronary sinus orifices and the pulmonary veins [4].

To avoid device-related thromboembolic events, our patient was discharged on antiplatelet therapy with aspirin for 6 months. The patients with atrial fibrillation received lifelong anticoagulation therapy with warfarin.

Follow up

All patients were asked to come back each month in the first 3 months and then once every 3 months. Physical examination, transthoracic echocardiography, electrocardiography and chest X-ray were performed at each scheduled follow up visit.

RESULTS

Our initial results are encouraging. All patients underwent successful closure of an ASD. The mean diameter of the defect ranged from 12 to 24mm and the ASD occluder size ranged from 14 to 22mm. The duration of the procedure was in 45-65 minutes. The intensive care unit stay was about 15-26 hours, and hospital stay was 5-9 days. No significant residual shunt or device dislodgement occurred. The echocardiography in all of our patients were excellent. Mild mitral regurgitation developed in 1 patients after device occlusion, which were disappeared after 3 months. No pneumothorax, hemothorax, severe atrioventricular block, pericardial effusion, device embolization and neurologic problems were seen.

Table 1: The patients' data

	Sex	Age	ASD	interatrial septal aneurysm	Comorbidity	Occluder	PAP	NYHY
Case 1	Female	50	5	20	Stroke	14	30	II
Case 2	Female	48	13	20		22	40	I
Case 3	Male	69	8	15	Hypertension, Atrial Fibrillation	18	45	II
Case 4	Female	41	6	17		14	30	I

DISCUSSION

Patients with ASD are usually asymptomatic. Many patients with this condition could wait to undergo elective intracardiac repair under Cardiopulmonary Bypass(CPB), or undergo percutaneous closure. Elective open-heart repair with midsternotomy and CPB has been considered as the gold standard for the closure of ASD in such patients. Although surgical closure of ASD has been proved safe and effective, it is still associated with midline sternotomy and CPB in a longer hospital stay. With the development of interventional devices, percutaneous trans-catheter occlusion of ASD gradually becomes the first choice for selected patients. However, due to the poor medical resources and knowledge, many hospitals have no resources in developing this technology in the low-income areas. In recent years, many surgeons have tried to repair ASD using transthoracic minimally invasive device closure, and have achieved satisfactory clinical outcomes [5-7]. This technique can completely avoid CPB, and the small incision (3–5cm) in the right anterior chest wall is acceptable. In addition, both medical expenses and medical resources may be less with this technique than with surgical closure, and there is no need for X-rays or other expensive equipment [2,3, 8]. We applied a new minimally invasive technique, intra-operative device closure of ASD, imitating percutaneous closure of ASD [5, 9].

Interatrial septal aneurysmis a congenital abnormality of the interatrial septum, generally at the level of the fossa oval, which bulges into the right or

left atrium or both. With the development of echocardiography and more recently, it has become more easily and more frequently found in adult patients. Atrial septal aneurysm is associated with congenital and acquired heart diseases but also can present as an isolated abnormality. The diagnostic criteria for ASA was made if a deformity in the interatrial septum or the foramen ovale region was seen. The minimal aneurysmal base amplitude (width) accepted in this study was 15 mm in diameter [10]. An interatrial septal aneurysm is a thin, localized segment of the atrial septum that bulges into the right or left atrium [11]. ASA is becoming more prominent in clinical cardiology. Its association with cardiac abnormalities, inparticular caused cardiogenic embolic events. It has been suggested that a left atrial dysfunction induced by large shunt and large atrial septal aneurysm may act as a concurrent mechanism of arterial embolism in patients with patent foramen ovale and prior stroke [12]**.** The combination of ASD and interatrial septal aneurysm can facilitate paradoxical embolism through several mechanisms: (1) by redirecting the blood flow from the inferior vena cava toward the patent foramen ovale; (2) by representing itself an embolic source; (3) by determining mechanical atrial dysfunction, especially in atrial fibrillation. These features make intraoperative device closure of interatrial septal aneurysm with ASDs a valuable option [13, 14].

A unique morphological variation of interatrial septal aneurysm with ASDs is associated significant left-to-right shunt. Such cases present a technical challenge for the physicians, and some cases reported in the literature are technical difficulties entailing the use of multiple devices, residual shunts and at times, requiring surgical repair [15-17]. The existence of ASD along with a septal aneurysm is relatively rare, but it represents a speciall technical challenge [18]. In such cases, it is not only crucial to achieve complete closure of the defect, but also important to ensure that both the left and right atrial discs of the selected device should be larger than the maximal diameter of the aneurysm (strong rim to strong rim) in order to ensure stability. This also enables entrapment of the aneurysm within the occluder, reducing the chances of potential thromboembolism from within the septal aneurysm. Since the maximum diameter of the interatrial septal aneurysm on TEE was achieved, we wanted the occluder to be at least 8-10 mm larger than this so as to achieve complete covering of the aneurysm within the occluder and stable disc positions post deployment. These cases were successfully achieved with the complete closure and no residual shunt.

Although there is a consensus that significant ASD should be repaired in pediatric and young patients, limited information is available for older patients with ASD [19-21]. Previous studies showed that surgical or transcatheter closure of ASD resulted in improvement of life quality in adult patients with ASD, particularly symptomatic adult patients [22, 23]. In our study, NYHA functional class improved dramatically in one patient over 60 years of age after transthoracic closure of ASD. Our cases demonstrated that intraoperative device closure of interatrial septal aneurysm with ASDs in patients with permanent atrial fibrillation is also feasible and that cardiac function can be improved even in elderly patients over 60 years of age with permanent atrial fibrillation after device closure of ASD. Since most adult ASD patients with permanent atrial fibrillation are of advanced age and they often have significant comorbidties, open heart surgery with CPB may be at great risks. From this point of view, intraoperative device closure should be safer and more acceptable for elderly patients than surgical treatment, because technique is not required for thoracotomy and cardiopulmonary bypass.

This study has several limitations. First, the number of the patients was small. Further study and more patients are required. Second, the follow-up period was relatively short. Although thrombus formation could not be detected by transthoracic echocardiography during our follow-up period, long-term follow-up evaluation is mandatory.

CONCLUSION

Intraoperative device closure of interatrial septal aneurysm with ASDs with transthoracic minimal incision achieves satisfied results by reasonable techniques and devices. There were no complications postoperation. Further study using more patients is required.

AUTHOR'S CONTRIBUTION

Haiyong Wang and Jianfei Song wrote the paper. Fang Lei, Yujing Yang, Fugui Ruan, Jianbin Sun, Zhenzong Du and Xiaolin Sun supervised the composition of the paper. All authors read and approved the final paper.

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