Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(10D):3842-3845 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i10.057

Original Research Article

Intraoperative Device Closure Atrial Septal Defect in Adults: Immediate, Short, and Intermediate-Term Results

Tianci Qian[1], Xianzhu Liang[1], Jiangwei Hu[1], Fugui Ruan[1], Xiaolin Sun[1], Jiangbin Sun[1], Jianfei Song[2], Zhenzong Du[2], Haiyong Wang[1]*

[1]Department of Cardiovascular Surgery, Affiliated Hospital of Guilin Medical University, Guilin 541001, China;
[2]Department of Cardiothoracic Surgery, the Second Affiliated Hospital of Guilin Medical University, Guilin 541199, China

***Corresponding author**
Haiyong Wang
Email: docwanghy@gmail.com

Abstract: The intraoperative device closure of the atrial septal defect (ASD) has become an alternative technique to surgical procedures. The aim of this study was to assess the immediate, short, and intermediate-term results of the intraoperative device closure the secundum ASD in adult. Between September 2012 and November 2014, the intraoperative device closure the ASD was attempted in 21 consecutive, adult patients. The mean age of the patients was 17.25 ±20.41years (range =1-62 years). All the procedures were performed under general anesthesia with transthoracic or transesophageal echocardiography guidance. The diameter of the ASD was determined with echocardiography, and device selection was based on and matched to the diameter of the septal defect. Transthoracic echocardiography or transesophageal echocardiography was performed immediately after the release of the device and before discharge. Further follow-up at one month, six months, and yearly thereafter included physical examination, chest X- ray, electrocardiography, and transthoracic echocardiography. The mean ASD diameter, as measured by echocardiography, was 11.4± 5.3 mm (range = 5- 32 mm). Deployment of the occluder was successful in 21 (91 %) patients and failed in 2 (9%). Echocardiography at 24 hours, 1 month, 6 months, and 12 months after the procedure showed residual shunts in 0 (0%), 4(19%), 3(14%), and 2 (9%) patients, respectively. At the end of the follow-up, 2 (9%) patients had mild residual shunts: The shunt was small in the 2 (9%). The overall success rate of the intraoperative device closure of the ASD was 91% (19 of 21 cases). The intraoperative device closure of the secundum ASD in our adult patient population was associated with high degrees of success, minimal procedural complication rates, and excellent short and midterm results. Further experience and long-term follow-up are required before a widespread clinical use can be recommended.
Keywords: Atrial septal defect, minimally invasive surgery, Adult, Treatment outcome

INTRODUCTION

Atrial septal defect (ASD) is the common congenital cardiac disorder requiring intervention in adult patients [1]. ASDs can present at any age. Female patients constitute 65% to 75% of patients with secundum ASDs [2]. In past several decades, surgical closure has been considered the standard method of repairing a secundum ASD [3]. Surgical repair has a high success rate, negligible mortality, and good longterm outcome, but it is associated with morbidity, discomfort, and thoracotomy scars [4]. That is why the transcather device closure the ASD has more recently become an alternative to the surgical procedure [5]. The transcather device closure the ASD was first described by King *et al*. in 1976 [6]. Currently, there are multiple devices clinically available with variable degrees of success

During the last decade, intraoperative device closure of ASDs, with its unique design and easy handling, has finally replaced surgical ASD repair in most adult patients as the standard method of repair for the secundum ASD [7]. We herein report our immediate, short, and intermediate-term results of the ASD use for the non-surgical intraoperative device closure the ASD in adults.

PATIENTS AND METHODS

Between September 2012 and November 2014, 21 consecutive patients with a significant ASD, as demonstrated by initial transthoracic echocardiography

(TTE), were considered for intraoperative closure. The inclusion criteria for the patients with the ASD were the presence of a secundum ASD with a significant left-to-right shunt; with a suitable septal rim of at least 5 mm from the mitral and tricuspid valves. Patients were excluded from the analysis for the following reasons: (1) there was severe pulmonary artery hypertension (pulmonary artery systolic pressure > 80 mmHg and pulmonary artery resistance > 8 woods) and there were small superior, inferior, or posterior rims of the ASD during the TEE examination. Finally, 19 patients underwent the intraoperative device closure the ASD. Informed consent was obtained from all the patients or their guardians.

Before operation, all the patients were evaluated via TTE or TEE was conducted under general anesthesia a using a PHLIPS IE33 echocardiography device to evaluate the size, location, and margin of the defect.

All the procedures were performed under general anesthesia. Then they were placed in a supine position and draped for exposure of the entire chest, with the right hemithorax elevated approximately 30 degrees. A 3-cm incision was made through the fourth intercostal space. The exact location of the incision was chosen according to the chest film where the most prominent part of the right atrium was projected. For the female patients, a right submammary incision was used. A small rib spreader was used in this manipulation incision to facilitate instrumentation. The pericardium was incised and suspended to expose the right atrium. The opened pericardium was sutured with five 2/0 sutures stay sutures to expose the right atrium. Two parallel purse-string sutures of 4-0 Prolene (Ethicon, Inc) were placed on the right atrium, with a diameter of about 10 mm. Heparin was then administered at 1.0 mg/kg to achieve an activated clotting time of greater than 250 seconds at the time of device deployment. The delivery system included a short plastic sheath with a side arm and a delivery cable. The delivery sheaths were used in the operation. The sheath was allowed to draw blood from the side arm to ensure there was no air entrapment. Under continuous echocardiography guidance, the sheath was advanced through the ASD into the left atrium. The left disc was deployed first by pushing the rod. Adjusting the left disc to be parallel to the atrial septum, then sheath was withdrawn, and the right disc was deployed on the other side to occlude the ASD. A to-and-fro motion of the sheath was made to ensure a secure position across the defect. Care was taken to ensure that the device did not obstruct the coronary sinus, pulmonary veins, caval veins, or the mitral valve. Any residual shunt was evaluated by two-dimensional color-flow Doppler. The residual shunt was defined as a leak traversing or passing between the two discs of the ASO or around the device edges to the right atrium and was detected by two-dimensional color-flow Doppler. The residual shunts were classified as mild, moderate, and severe, respectively. The thread was cut and the sheath was withdrawn with the suture snugly tied. Final assessment of the position of the device was made via TTE. The chest was closed routinely with no drainage tube placement. Oral aspirin or dipyridamole was taken for three months as anticoagulation.

As a matter of routine, after ASD closure, the patients remained in ICU of the hospital for one night. Standard bacterial endocarditis prophylaxis was recommended for three days. Repeat TTE was performed one, six, and twelve months after the procedure and yearly thereafter.

RESULT

Between September 2012 and November 2014, the intraoperative device closure the ASD was conducted in 19 of 21 consecutive patients who presented at our institution. On account of the fact that there were small superior or inferior rims of the ASD were considered unstable or unsuitable after implantation, these two devices were not released and were withdrawn.

The mean age of the study population was 17.25±20.41 years (range =1-62years)**.** On echocardiography, the mean defect diameter was 11.4± 5.3 mm (range = 5- 32 mm). The average procedure time was 64.51 ± 28.71 minutes (range = 33 - 135 minutes), with a tendency to shorter procedural and screening time after the learning curve. The follow-up period range was 21-48 months.

At the end of the procedure, on color flow Doppler, residual shunting (including foaming through the wire mesh of the device.) was seen in 0 patients. By the time of discharge, the rate of the residual shunt had decreased to 19% (four patients). The residual shunt remained persistent, however, 6 months after the procedure in three patients. At the end of the follow-up, the residual shunt was detected in two patients. Two patients with a mild residual shunt at the time of discharge; the shunt was no change one month after the procedure and this mild shunt persisted at one year's follow-up.

There were two major procedure-related complications: There was no cardiac death during the study. Another patient developed transient atrial fibrillation and was reverted in the other case with amiodarone. Two patients presented with supraventricular tachycardia, which was spontaneously resolved in one patient and was reverted in the other case with verapamil.

At the end of follow-up, all the defects, with the exception of two cases with moderate and small shunts, were completely closed and remained closed afterwards. Also, the integrity of the occliuder was evaluated using echocardiography in all the cases. No one late device wire fracture was observed.

DISCUSSION

ASD is one of the most of congenital heart anomalies adult patients with ASD have benefited from important recent advances in the diagnosis, evaluation, and management of their conditions. Surgical ASD closure requires cardiopulmonary bypass(CPB) and median sternotomy, which provides generous operative exposure and cardiac access. Nowadays, percutaneous occlusions of ASD have gradually become the first choice. Now many ASDs are closed percutaneously, but it is harmful for patients and surgeons to be exposed to X-rays for a long time. Moreover, percutaneous closure is limited to a maximal defect size of 34 or 36 mm [8, 9]. The largest defect in this group was 32 mm, the largest size of occluder was 34 mm. Patients who have 2 defects are easy to treat with this technique, all ASDs were occluded successfully.

Arrhythmia is a common complication of surgery. Reducing intraoperative stimulus was also beneficial for transient arrhythmias. Pneumothorax is a common complication. Of the 3 patients with pneumothorax, one patient underwent closed thoracic drainage, and the others needed no treatment [10].

The sheath diameter was 6–11 F, which was selected according to the size of the occluder. The purse string suture in the right atrial wall should be close to the atrioventricular groove.

The cases must be selected carefully preoperatively; patients who simultaneously have other heart diseases such as mitral valve prolapse with moderate to severe regurgitation and infective endocarditis should be operated normally with CPB. Thorough preoperative evaluation to get an exact anatomical diagnosis is necessary to be able to decide whether patients are suitable for the minimally invasive approach. This includes excellent echocardiographic images to complete the anatomical diagnosis, including the anatomy of the pulmonary veins [11].

Our study was conducted in a low-income country, where health care resources were limited. The high cost was a challenge in popularizing a percutaneous approach in developing countries. We chose a domestically made device to maximally reduce the medical costs [10]. In our institution, the intraoperative device group was still cheaper in comparison with the percutaneous close of ASDs. This technique did not need an X-ray machine and also could be easily mastered. However, given these circumstances, the cost-effective intraoperative device closure should be the treatment of choice to allow the secundum ASD infants to be treated effectively.

This minimally invasive method of secundum ASD closure is safe and cosmetically superior to conventional surgery. Avoidance of CPB can reduce recovery time and complications. The indications are more extensive than percutaneous transcatheter closure, and the results are encouraging.

In our cases, we did use intraoperative device closure of ASDs with small superior, inferior, or posterior rims. But Chen Q and his colleagues report that intraoperative device closure of atrial septal defects with inferior vena cava rim deficiency is a safe and feasible technique [12]. We need to accumulate more experience. Our strict inclusion criteria may partly explain such a low incidence of complications in our series.

A limitation of this study is that some variables used in this study, such as length of intensive care unit stay and hospital stay, were determined largely by the speed of the patient's recovery from surgery, which can be influenced by subjective factors. In addition, a postoperative assessment of the quality of life was not performed.

CONCLUSION

In summary, operative occluder can be used successfully to close selected secundum ASDs in most adult patients with low complication rates and good short and intermediate-term outcomes. Be that as it may, the utilization of this device requires careful attention in that the procedure may be unsuccessful. Strict case selection criteria, expertise, and careful device selection may help reduce the incidence of complications. The device may show short and intermediate-term good results but further experience and long-term observation of adult treated with the operative close is needed in order to draw definite conclusions.

CONFLICT OF INTERESTS

None declared.

AUTHOR'S CONTRIBUTION

Haiyong Wang and Tianci Qian wrote the paper. Jiangwei Hu, Tianci Qian, Fugui Ruan, Jianbin Sun, Zhenzong Du, Jianfei Song and Xiaolin Sun supervised the composition of the paper. All authors read and approved the final paper.

ACKNOWLEDGEMENTS

This work was supported by Guilin Bureau of Science and Technology [Grant 20110119-1-1] and

Health Department of Guangxi Zhuang Autonomous Region Grant [Z2014313]. We thank Donghua Pan and for his contribution to this article.

REFERENCES

1. Dickinson DF, Arnold R, Wilkinson JL. Congenital heart disease among 160 480 live born children in Liverpool 1960 to 1969. Implications for surgical treatment. British heart journal. 1981 Jul 1; 46(1):55-62.
2. Webb G, Gatzoulis MA. Atrial septal defects in the adult recent progress and overview. Circulation. 2006 Oct 10; 114(15):1645-53.
3. Kirklin JW, Barratt-Boyes BG. Atrial septal defect and partial anomalous pulmonary venous connection. In: Cardiac surgery, 2nd ed. Churchill Livingstone: New York; 1993:609–44.
4. Chen Q, Sun XD, Cao H, Zhang GC, Chen LW, Hu YN. Echocardiographic Evaluation of Changes in Cardiac Hemodynamics and Loading Conditions after Transthoracic Minimally Invasive Device Closure of Atrial Septal Defect. PloS one. 2015 Jul 6; 10(7):e0128475.
5. Çeliker A, Ozkutlu S, Karagöz T, Ayabakan C, Bilgiç A. Transcatheter closure of interatrial communications with Amplatzer device: results, unfulfilled attempts and special considerations in children and adolescents. Anadolu Kardiyol Derg. 2005 Sep; 5(3):159-64.
6. King TD, Thompson SL, Steiner C, Mills NL. Secundum atrial septal defect: nonoperative closure during cardiac catheterization. Jama. 1976 Jun 7; 235(23):2506-9.
7. Chen Q, Cao H, Zhang GC, Chen LW, Chen DZ. Safety and feasibility of intra-operative device closure of atrial septal defect with transthoracic minimal invasion. European Journal of Cardio-Thoracic Surgery. 2012 Jan 1; 41(1):121-5.
8. Ohno N, Chaturvedi R, Lee KJ, Benson L. Characteristics of secundum atrial septal defects not percutaneously closed. Catheterization and Cardiovascular Interventions. 2015 Feb 1; 85(2):234-9.
9. Zeng XJ, Chen XF, Cheng D, Ma XJ, Hu XS, Tao L. Peratrial closure of atrial septal defects without cardiopulmonary bypass. Asian Cardiovascular and Thoracic Annals. 2007 Jun 1; 15(3):191-3.
10. Zhang H, Chen Q, Chen LW, Cao H, Zhang GC, Chen DZ. Intraoperative device closure of atrial septal defects in the older population. Journal of cardiothoracic surgery. 2011 Sep 29; 6(1):1.
11. Wan L, Yu BT, Wu QC, Zeng L, Wang Q, Tang J, Xu QR, Xu H, Wang WJ, Cao YP, Liu JC. Transthoracic closure of atrial septal defect and ventricular septal defect without cardiopulmonary bypass. Genet Mol Res. 2015 Jan 1; 14:3760-6.
12. Zhang H, Chen Q, Chen LW, Cao H, Zhang GC, Chen DZ. Intraoperative device closure of atrial septal defects in the older population. Journal of cardiothoracic surgery. 2011 Sep 29;6(1):1.