Multiple atrial septal defects closure with a single device using radiofrequency energy-assisted wire atrial septostomy: A new method

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ABSTRACT

Percutaneous closure of multiple atrial septal defects can be more challenging. It is often discussed whether a single or dual device closure is appropriate for two or more large atrial septal defects with insufficient distance between defects. In this case, we used radiofrequency energy-assisted wire atrial septostomy to break intervening tissue between two adjacent oval fossa defects, thereby combining them into a single hole and facilitating device closure using a single device. This technique could be considered in patients with multiple adjacent secundum defects separated by intervening tissue.

Keywords: Congenital heart disease, multiple atrial septal defects, percutaneous closure of atrial septal defect

INTRODUCTION

Percutaneous atrial septal occlusion using various devices has been performed in many institutions.[1] However, closure of multiple atrial septal defects can be more challenging than single defect. A technique for combining defects into a single one by performing an atrial septostomy has been reported.[2] Kitano *et al.* have reported wire atrial septostomy to create a large defect in a thickened interatrial septum using a soft wire cut the septum by the hand.[3] Recently, radiofrequency energy-assisted wire atrial septostomy was reported to resect septum more safely and effectively.[4] In this technique, Nykanen radiofrequency wire (Baylis, Mississauga, ON, Canada) was advanced through a guide catheter to cauterize the intervening atrial septum snared with a wire loop. In this report, we describe percutaneous closure of multiple atrial septal defects with a single device after combining two adjacent moderate defects with radiofrequency energy-assisted wire atrial septostomy.

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CASE REPORT

A 13-year-old girl with multiple atrial septal defects was electively admitted for percutaneous device closure. Transesophageal echocardiography (TEE) showed two central, vertically adjacent defects with right ventricular volume overload. The superior one was 11.4 mm × 9.9 mm and the other 5.6 mm × 8.4 mm (angles 0° and 90°, respectively), and they were separated by 2.9 mm of interdefect septum [Figure 1a]. Except for the deficient aortic rim, all other rims were over 5 mm.

After induction of general anesthesia, a 6-Fr short sheath was inserted into the right femoral vein, and a standard right cardiac catheterization was carried out. The Qp/Qs was 1.6 and pulmonary artery pressure was 21/12 (17) mmHg. A 6-Fr guiding catheter (Launcher Multi-purpose type; Medtronic, Minneapolis, MN, USA) was then advanced into the right atrium, after which

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a 0.035-inch wire was advanced into the left atrium through the superior defect. Real-time three-dimensional TEE was used to check which defect the wire had gone through [Figure 2a]. Once the 6-Fr guiding catheter had been advanced into the left atrium through the wire, a 7 mm-diameter GooseNeck snare wire (Amplatz Goose Neck Snare Kit; Covidien, Plymouth, MN, USA) was substituted for it through a guiding catheter. A 0.010-inch soft wire (RG3; Asahi Intecc, Aichi, Japan) was advanced into the left atrium through the inferior defect through the same guiding catheter [Figure 2b]. The tip of the wire was snared with a GooseNeck snare and pulled back into the guiding catheter to create an exteriorized loop. The target segment of the interdefect septum encompassed by the guidewire loop was pulled back into the tip of the guiding catheter and held. Next, a radiofrequency wire was advanced through the same guiding catheter where the target segment of the interdefect septum was held. We pushed radiofrequency wire to the center of the intervening atrial septum, and the wire loop was pulled from outside of the body to press the atrial tissue against the guiding catheter. Then, we succeeded in cutting the site in 13 times with the application of radiofrequency energy at 20 W for 1s [Figure 2c]. This procedure safely succeeded in combining the two separate defects. After the procedure, TEE showed a large defect with the resection flap measuring 9.7 mm × 16.6 mm [Figure 2d]. A stretched diameter of the defect by a sizing balloon was found to be 18.8 mm. A 21-mm Figulla Flex II ASD occluder (FF II; Occlutech International AB, Helsingborg, Sweden) was successfully deployed [Figure 1b]. Echocardiography showed no shunting at the periphery of the device. The total fluoroscopy time was 38.3 min, and the procedure time was 118 min. No adverse events occurred for 2 years from discharge.

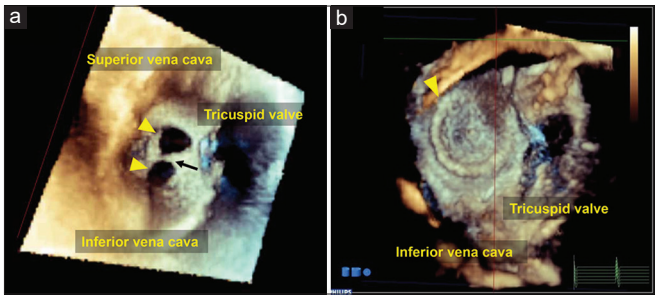

Figure 1: (a) Real time three-dimensional transesophageal echocardiography image showed the two vertically adjacent atrial septal defects. (b) A 21-mm Figulla Flex II ASD occluder was successfully deployed once (arrow head)

DISCUSSION AND CONCLUSIONS

Closure of multiple atrial septal defects remains challenging even now. With the exception of adequate interdefect septum (over 5 mm), transcatheter closure of multiple defects can typically be achieved with one device. When a single left atrial disk may be not large enough to cover both defects, closure with multiple devices must be considered.[5] Unfortunately, such overlapping of devices can create an undesirable degree of bulkiness in Amplatzer septal occluder.[6] Helex Septal Occluder (W L Gore and Associates, Flagstaff, AZ) was a low profile and relatively soft device, now recalled from clinical use. In a previous report, two or three such devices were used to close multiple atrial septal defects separated by a short distance.[7] However, this device has not been approved in our country. FF II occluder (FF: Occlutech GmbH, Jena, Germany), now available in Japan provides more flexibility and deliverability than Amplatzer septal occluder (Abbott, Chicago, IL). These attributes may permit deployment of two devices in two adjacent defects. Actually, transcatheter closure of multiple atrial septal defects using multiple FFII

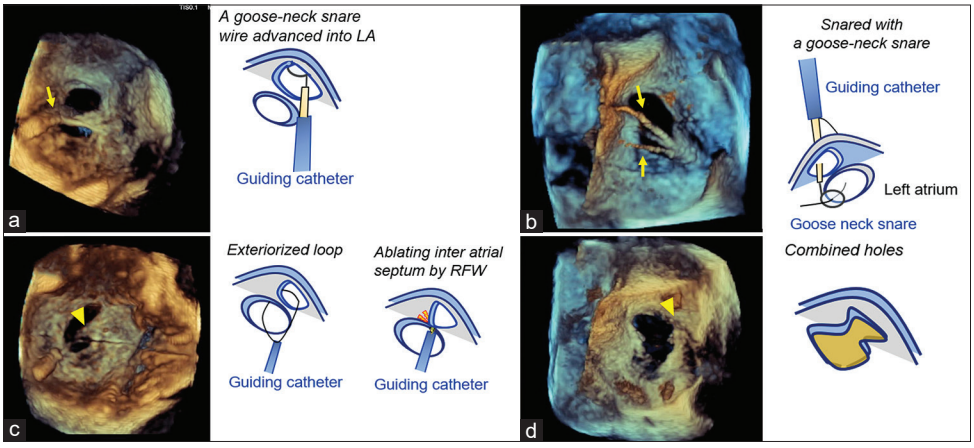

Figure 2: (a) Real time three-dimensional transesophageal echocardiography image confirming that a 7 mm-diameter goose-neck snare wire advanced into the left atrium via the superior atrial septal defect. (b) A 0.010-inch soft wire (arrows) has been inserted via the inferior atrial septal defect. (c) The tip of a 0.010-inch wire has been snared then pulled back into the guiding catheter to make an exteriorized loop (arrow head). Radiofrequency energy-assisted wire atrial septostomy was performed. (d) A large single defect was successfully made

devices has been reported previously. However, it is not well documented in cases with short intervening atrial septum (<6mm) in more than one large-sized defects. We must say its feasibility using multiple FFII devices in those patients is therefore unclear.[8] Another closure technique for combining multiple defects into a single defect by balloon atrial septostomy was first described in 2001.[2] During surgical closure of multiple atrial septal defects, resection of inter-defect septum has been generally undertaken safely. We therefore decided to perform a new procedure combining multiple defects with modified wire atrial septostomy.[3] It can simplify the closure of multiple defects even in teenager, septum gets thicker. The use of radiofrequency wire can facilitate resection of intervening atrial septum without a significant deformation of atrial septum by the pull of the catheter and resultant cardiovascular injury that may occur during wire atrial septostomy. In order to maximize the effect of the transcatheter electrosurgery by concentrating the current on the inner lacerating surface of a kinked guidewire, we used the "flying V technique" that lacerates valve leaflets before transcatheter valve implantation.[9] This technique may be one of choice to close multiple atrial septal defects with a single device in patients with two adjacent large-sized defects with a small intervening tissue. However, there is a limitation that it is only feasible when the thickness of the intervening tissue is somewhat thin. In addition, the cost of the Nykanen radiofrequency device is added, and the procedure time may be longer than with conventional techniques. Finally, a proper balloon interrogation with a sizing balloon can assess the mobility of the intervening tissue between two adjacent defects, thus permitting use of a single device without any additional techniques in nearly three-fourths of the patients with such an anatomy.[10]

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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