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DEVICE OCCLUSION OF ATRIAL SEPTAL DEFECT THROUGH MINIMALLY INVASIVE RIGHT ANTERIOR CHEST APPROACH

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FERMETURE D'UNE COMMUNICATION INTER-AURICULAIRE PAR UNE PROTHÈSE INTRODUITE PAR VOIE THORACIQUE ANTÉRIEURE DROITE MINI-INVASIVE

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Occlusion of atrial septal defects through a small right chest incision is minimally invasive and safe.

La fermeture d'une communication inter-auriculaire à travers une incision minime thoracique droite est peu invasive et sécurisante.

Introduction

Atrial septal defect (ASD) is one of the more common congenital heart defects, with an incidence of 3.2-5.7/10,000 live births[1]. Presently, there are 3 therapeutic approaches: medical management with aspirin; open heart surgery with cardiopulmonary bypass, and primary or patch closure; and percutaneous transcatheter closure[2]. Surgery is safe with excellent results, but more invasive. The transcatheter occlusion approach is minimal invasive, but can be complex and time consuming .It is also difficult to control when complications arise[3]. It is difficult to perform in patients less than 2 or 3 years old because of smaller femoral venous access.

Patient Presentation

A 12-month-old Chinese girl presented with a secondum ASD. The diameter was 1.8 cm by transthoracic echocardiography (TTE) and the pulmonary artery pressure was 40 mmHg. She had a persistant cough and recurrent upper respiratory tract infections. Because of small femoral venous access, a trans-thoracic per-atrial approach, utilizing an Amplatz device, was employed.

Operative Procedure

The operation was performed under general endo-tracheal anesthesia. Pre-incision and intra-operative TEE (HP Sonus 4500 Doppler, 4-7mHz) was used. A 2cm incision extending from the sternum along the right fourth intercostal space provided access through the 4th intercostal space (**fig.1a, b**). The pericardium was opened vertically, 2cm anterior to the phrenic nerve and marsupiliazed to the skin. Two purse-strings were placed in the right atrium using 4-0 polypropylene (Prolene®) suture. The patient was administered 1mg/kg IV heparin systemically.

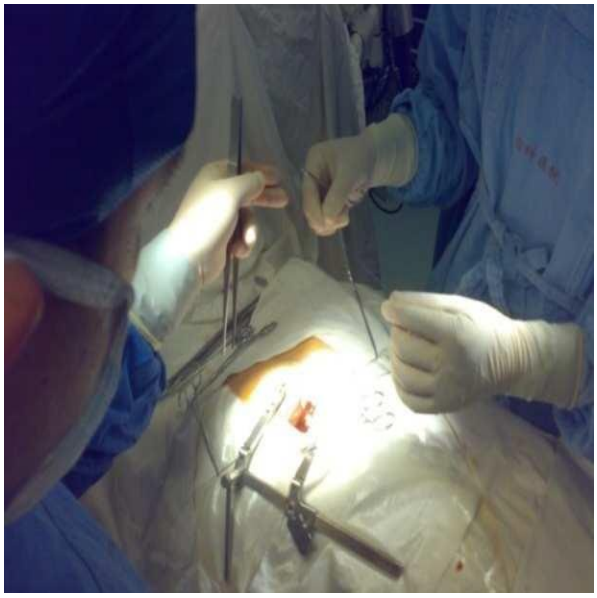

Fig 1(a) : Right anterior approach through 4th intercostal space

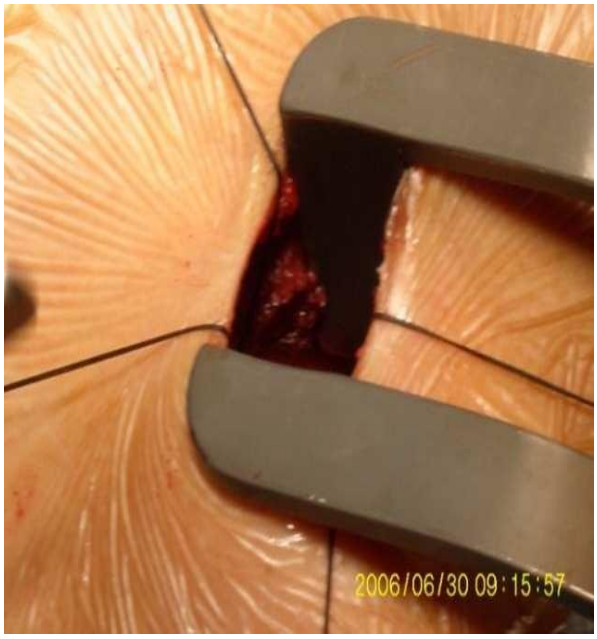

Fig 1(b) :

Device / Deployment

The occluder system (Shanghai Memory Alloy Company, Shanghai, China) is composed of an Amplatz-like occluder, and is woven to form 2 disks with a connecting waist, and a sheath with a pusher (**fig. 2a,b,c**). Utilizing the TEE data, the appropriate size occluder (in this case, a 2.0cm occluder) was placed into the sheath. An incision was made within the purse string to place the sheath into the right atrium, and with TEE guidance, the sheath was advanced through the ASD and the first disc released, then withdrawing the sheath just to the right atrium, releasing the second disk, then pushing and pulling the occluder repeatedly to assure that the occluder is not removable (fig.3 a,b). Finally, it is assessed with TEE to check for leakage, and whether the mitral valve, tricuspid valve, and the superior and inferior vena cava are affected by the occluder. If all is satisfactory, the sheath is removed and the purse string tied (fig. 4). Heparin is neutralized with protamine, and the surgical wound is closed in routine fashion without chest tube drainage.

Fig 2 (a): Amplatz occluder device

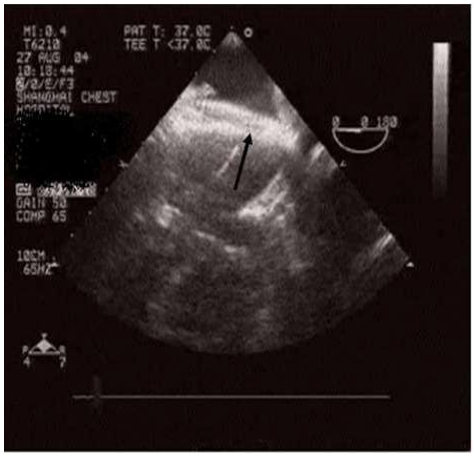

Fig. 3 (a): Pushing the occluder to test. (Black arrow points to the occluder)

Figure 2 (b) : First generation introducer device

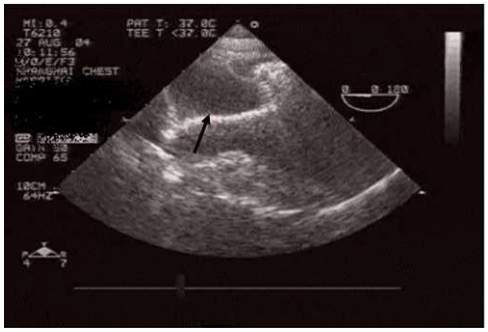

Fig. 3 (b): Pulling the occluder (Black arrow points to the occluder)

Fig 2 (c): Current sheath and pusher device

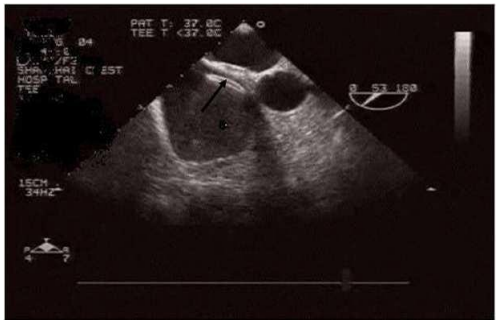

Fig. 4: The occlusion is completed (Black arrow points to the occluder).

Discussion

The technical aspects of this technique are important to elucidate. Transcatheter closure of secundum atrial septal defects utilizing the Amplatzer septal occluder is well suited for small and medium size ASDs, yet seldom for larger ones[2,5]. The occlusion of ASDs through a small right anterior chest incision has distinct advantages compared with the transcatheter route. These include a shorter entrance route, the convenience to manipulate the stiff and straight sheath, the shorter time of intra-cardiac manipulation (usually within 5 minutes), and no radiation exposure[6,7]. Per-atrial technique is not restricted to patient's age whereas the transcatheter technique is only suitable for patients older than 3 years of age because of smaller peripheral vessel diameter. An important aspect of the technique is releasing the occluder while the sheath is vertical to the atrial septum. This can be performed precisely and quickly, even in large ASDs. We use a one sheath technique and the occluder is placed inside the sheath in advance, so once the sheath is inside the left atrium, the occluder is released only once. In contrast, with the transcatheter closure, the catheter is easy to parallel the atrial septum in larger ASDs, but can be very difficult to release the occluder, thus utilizing more time, and often failing to occlude. With the surgical approach, the sheath is bigger than the catheter, so it can accomodate a stiffer occluder. After the stiffer occluder is released, it becomes flatter than the occluder released by catheter. The flat occluder will cause less obstruction within the atrium as well as not obstruct the mitral valve, tricuspid valve, or superior and inferior vena cava. The stiffer occluder also generates more support, making it less likely to dislodge, or drop from its position. This allows occlusion of ASD's with shorter rims, and even no rims in other locations. This is more difficult with the interventional transcathter approach[4].

After the occluder is released, it is pulled and pushed repeatedly to determine the optimal way to prevent it from dropping out of position. Because the sheath is stiff and the performing route is short, it is very easy to pull and push. Serious complications from droping off seldom occure. If the occluder is easy to drop off when pulling and pushing, and occluder size mismatch is ruled out, we advise enlarging the incision and converting to open repair of the ASD utilizing CPB.

The procedure is done under TEE, which is clear and reliable, and doesn't affect the operative field. When there is no TEE available or unable to be performed, then TTE on the operative field is employed. Six cases in our experience were completed with TTE, and the operative time was not prolonged.

An important decision at operation is to choose the proper occluder size. Clinically, the waist diameter of the ASD is the size of the occluder. If there is only one ASD orifice, an imaging plane is selected so that the largest diameter is calculated. When the ASD rim is soft, the soft rim should be recognized as part of the defect of the ASD. Usually the size of occluder is the biggest diameter of ASD plus 2-4mm, adjusting for left atrial septum size, the position of the mitral and tricuspid valves, and the age of patient[6]. For example, we choose as small as possible occluder for infants. If the occluder is too large, the waist cannot be stretched naturally, the disks of the left and right atrium cannot clamp the tissue of both atria, and the occlusion will fail. When there are 2 or more atrial septal orificies, then each orifice size and position and the tissue between orifices should be considered. In our experience, there were 2 cases of 2 orifices, and both were occluded successfully with only one large occluder.

Other considerations to discuss include comparison of this technique to surgical closure or the transcatheter approach.

Complications related to the catheter placed Amplatzer device have been reviewed by Hamden et al[3]. In four series with 100 or more cases, the complication rate was 1.0% to 5.0%. The most common complication was displacement. Other

complications included heart block, arrhythmia, esophageal tear, deep vein thrombosis, endocarditis, CVA, TIA and marker band embolization.

Other complications include thrombosis and mitral valve regurgitation[6,8].

In summary, occlusion of atrial septal defects through a right small right chest incision is minimally invasive and safe. It is suitable for most secundum ASDs, even in patients with severe pulmonary hypertension, as well as in young females and infants. It is cosmetic, and has excellent early and midterm results.

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