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Left atrial appendage occlusion by invagination and double suture technique

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Abstract

Left atrial appendage (LAA) plays a crucial role as a source of atrial thrombus in patients with atrial fibrillation (AF). Thus, the need to close LAA becomes evident in patients with AF who undergo concomitant mitral valve surgery. Unfortunately, it has been reported a high rate of unsuccessful LAA occlusion, regardless of the technique employed.We propose a safe and simple method for LAA occlusion consisting in invagination of the appendage into the left atrium, followed by two sutures (purse string suture around the base of the LAA and a reinforce running suture).

Keywords: Left atrial appendage • Suture closure • Atrial fibrillation

INTRODUCTION

Left atrial appendage (LAA) plays a crucial role as a source of atrial thrombus formation in patients with atrial fibrillation (AF). It has been observed that up to 90% of clots in patients with AF are located in the LAA [1], and it increases the risk of stroke [2] threefold. For this reason, all current techniques described for the surgical treatment of AF with concomitant mitral disease include occlusion of the LAA. Furthermore, valve guidelines firmly suggest the need to obliterate the LAA in all patients requiring mitral valve surgery [3]. Because LAA is a fragile structure, it can be easily damaged, thus increasing the risk of postoperative bleeding. For this reason, various techniques were described by direct suture or stapling (including or not excision), not having been defined a technique safer than others. Moreover, it has been reported a high rate of unsuccessful LAA occlusion, regardless of the technique used. According to the literature, up to 60% of closed appendages remain either permeable or with a residual stump in the pouch of LAA (considered previously as a pouch greater than 1 cm) [4], situations that are considered highly thrombogenic. In opposite, and according to some authors, the occlusion of LAA might not only be necessary as harmful or even more; it could also be a procedure with an increased risk of thromboembolism [5, 6].

We propose a safe and simple method for LAA occlusion consisting in invagination of the LAA, and two sutures (purse-string suture and a running suture).

TECHNIQUE

We perform the following technique in eight patients with AF submitted to surgery of AF and mitral valve replacement.

After entering the left atrium (LA) by the atrio-ventricular groove, the LAA is completely invaginated into the LA with forceps (Fig. 1A). Care must be taken in this maneuvre, avoiding damage to the LAA apex. A 4/0 polypropylene purse-string suture is placed along the base of the appendage. Four or five stitches are enough for encircling the oval shape that composes the inlet orifice. It is important to pass across the intimal and medial tears, avoiding transfixing. While LAA are pulled outward with forceps, the two ends of the suture are pulled together gently, and purse-string suture is tied up (Fig. 1B and C). It is important that the suture is not overtight, because the aim is to delineate the rims, not to obliterate completely the orifice. Finally, a second running suture goes from the knot side to the distal end and back again (Fig. 1D) and then tied up.

COMMENT

There is a historical reluctance to manipulate and sew the LAA due to its fragility and proximity of surrounding structures that could be seriously damaged. Besides, unsuccessful results regardless of the technique employed, have been reported. With suture exclusion, an incomplete LAA occlusion has been reported from 10% to 73% of patients [4], depending on if simple running suture or double suture was performed. Otherwise, although excision seemed more effective (with a success rate of 73%), it was observed a likelihood of leaving a residual stump in 27% of them [4].

In our opinion, the most important concern related to suture occlusion techniques is the recognition of the rims that encircles the LAA. Although the superior and posterior borders of the orifice are well demarcated by a ridge-like fold that separates the appendage from the left superior pulmonary vein, the

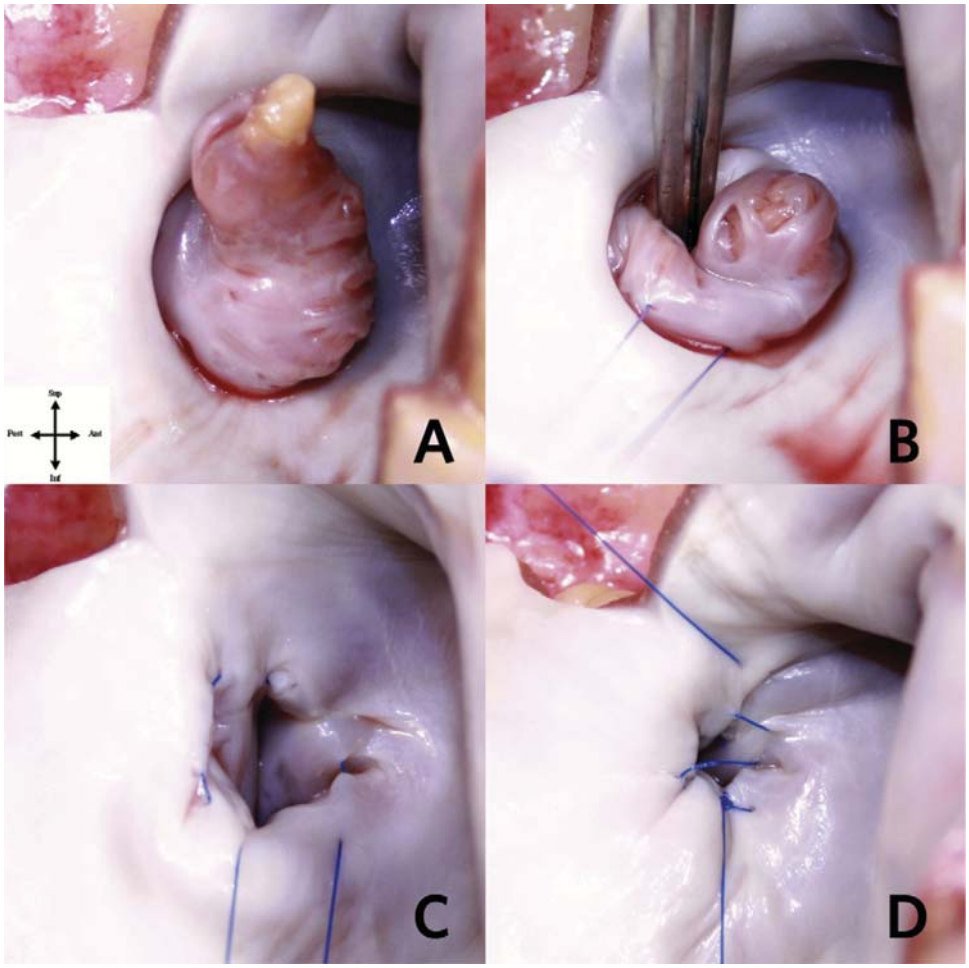

Figure 1: Internal view of the left atrium that shown the LAA in anatomic human specimen. For better understanding, the left pulmonary veins are excised.

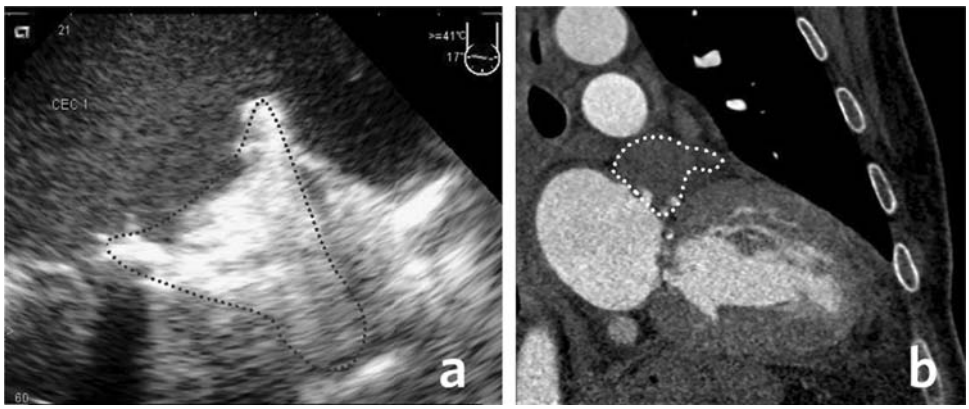

Figure 2: Transesophageal echocardiogram (a) and cardiac computed tomography (b) demonstrating complete occlusion of the left atrial appendage.

anterior and inferior borders are poorly defined and the margins and atrial wall are in the same plane [7] (Fig. 1A).

LAA invagination, followed by purse-string suture in the base of the appendage, facilitates the exposure of the real LAA rim, allowing subsequently its closure with a running suture.

Otherwise, as previously demonstrated, the base of the LAA is not circular but oval-shaped with a short and long axis [7, 8]. By purse-string suture, approaching the base of the appendage is achieved, and running suture is made more safely in a tissue with less stress, allowing the suture to run in the same direction as the long axis of LAA.

In order to assess patency and/or remained residual stump in the closed LAA, transesophageal echocardiogram was performed in all patients at the end of cardiopulmonary bypass, showing the absence of either flow inside the LAA or residual stump (Fig. 2a).

In the same manner, a contrast-enhanced cardiac computed tomography (CT) examination was performed before discharge.

The exam showed the absence of contrast enhancement of this structure, while the adjacent LA homogeneously enhances. Moreover, a delayed scan obtained 3 min after the actual cardiac CT confirmed this finding by demonstrating complete occlusion of the LAA (Fig. 2b). The postoperative course of all patients was uneventful.

In conclusion, we believe this technique is safe and does not damage nearby structures. Moreover, it prevents flow between LAA and LA and does not leave a thrombogenic residual stump remaining in early postoperative. Future imaging studies, made years after procedure, might ensure the effectiveness of this technique.

According to our opinion, this technique can be easily performed in minimally invasive procedures.

Conflict of interest: none declared.

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EDITORIAL COMMENT

Excision or exclusion of left atrial appendage?

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Stroke is one of the leading causes of mortality and morbidity today. In the majority of the cases, stroke results from cardiac emboli predominantly in patients with atrial fibrillation.

Theoretically, the most likely site for generation of thrombus formations as a prerequisite for emboli and stroke is the left atrial appendage (LAA). Here, the three characteristics of Virchow's triad are realized, especially flow abnormalities, besides those of the vessel wall and constituents in blood [1]. Therefore, it makes theoretical sense to exclude the LAA in order to prevent stroke as recommended in the ACC/AHA Guidelines [2] during mitral valve surgery and MAZE procedures, although some authors argue that LAA exclusion is not the whole story [3] of stroke prevention and that strokes occur also after LAA occlusion, related to unsuccessful exclusion [4] or other sources.

In this issue, Hernandez-Estefania report on a special technique for LAA occlusion including invagination and double-suture technique [5]. A purse-string suture is used to delineate the rim of the orifice which is facilitated by the invagination of the LAA. Although this might help to better define the borders of the os of the LAA, a clearly defined ridge is not present at the anterior and inferior borders of the LAA os [6]. Furthermore, the rim of the os is smooth [6]. Thus, there may be few firm tissues to anchor securely the sutures for occlusion. In addition, the oval area of the os is tugged together by the sutures, potentially creating tension forces in the tissue tending to reset the oval shape of the os. These are the factors that might cause some kind of re-opening of the LAA orifice years after the operation [4]. Whether this occurs with the proposed LAA occlusion technique remains to be seen. Therefore, long-term follow-up is needed to decide whether this is an effective technique for LAA occlusion.

A more definite approach would be the complete excision of the LAA. Since our negative results years after direct suture