Learning Process for Transseptal Puncture Guided by Intracardiac Echocardiography

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We prospectively analyzed the learning process for transseptal catheterization guided by intracardiac echocardiography, in 50 patients who underwent radiofrequency ablation for left atrial arrhythmias. In 20 patients the intracardiac echocardiography catheter was positioned in the right atrium to visualize the fossa ovalis and the tenting of the fossa caused by the Brockenbrough needle. In the other 30 patients, the intracardiac echocardiography catheter was positioned so that it impinged upon the fossa ovalis, and the needle was advanced alongside the intracardiac echocardiography catheter under fluoroscopic guidance in two orthogonal projections. In all but one patient, transseptal catheterization was performed successfully on the first attempt. The learning process for transseptal puncture guided by intracardiac echocardiography was uncomplicated, resulting in a procedure that is safe and effective. The intervention is simplified by positioning the echocardiography catheter at the fossa ovalis and using this as a reference point for fluoroscopic monitoring of the progress of the Brockenbrough needle.

Key words: Ablation. Echocardiography. Hemodynamics.

INTRODUCTION

Transseptal catheterization requires the use of the Brockenbrough needle to puncture the interatrial septum in the region of the fossa ovalis. Anatomical reference points that are not visible fluoroscopically, such as the aortic valve, are used to position it.\textsuperscript{1} Transesophageal echocardiograms are useful, but they are uncomfortable for the patient and expose the professionals who carry out the procedure to ionized radiation.\textsuperscript{2} These problems are avoided with intracardiac echocardiogram, for which reason it is used in electrophysiology procedures.\textsuperscript{3,4} We describe the results of the learning process for transseptal puncture guided by intracardiac echocardiography and propose modifications to conventional techniques.

PATIENTS AND METHODS

Transseptal puncture was performed in 50 consecutive patients by 2 researchers without previous
personal experience in transseptal catheterization, but with broad experience (more than 200 arrhythmia ablation procedures) in therapeutic electrophysiology. The clinical characteristics of the patients included in the study are summarized in Table 1. The right femoral vein was cannulated with an 11 F introducer sheath, a 135-cm by 0.89-mm (0.035") guide was inserted up to the vena cava superior, and a 60-cm sheath with a 55° angle was advanced through it. A 9 F intracardiac echocardiography catheter (EP Technologies, Boston Scientific Corp; San Jose, California) was introduced via the sheath, which was withdrawn by clockwise rotation until it was in contact with the fossa ovalis. For transseptal catheterization, the Brockenbrough needle was placed within a dilator introduced into an 8 F sheath (Mullins Transseptal Catheter Introducer Set, Medtronic, AVE Ireland).

In the first 20 patients, the intracardiac echocardiography catheter was placed in the medial right atrium to visualize the foramen ovale. The Mullins sheath, with the dilator and the needle inside, was positioned in the superior vena cava and was withdrawn with a clockwise rotation until verifying that the characteristic tenting deformation of the membrane was visualized (Figure 1). In the other 30 patients the intracardiac echocardiography catheter was positioned so that it was in contact with the fossa ovalis yielding the characteristic echocardiographic image (Figure 2). Subsequently, the intracardiac echocardiography catheter was utilized as the reference and the Mullins sheath, dilator and needle were advanced passing as near as possible to the intracardiac echocardiography catheter, in right (30°) and left (45°) anterior oblique projections (Figure 3). When it was verified that they followed the same trajectory, the needle was advanced in order to cross the interatrial septum. This was checked by contrast and/or pressure.

**RESULTS**

The interatrial septum and the fossa ovalis could be visualized in all patients with intracardiac...
echocardiography. The margins were not well defined in 6 patients and the fossa ovalis just appeared as a septal thinning area. In order to stabilize the catheter in two of these patients, the 55° sheath was replaced with a 90° one.

In all but one patient, transseptal catheterization was carried out successfully at the first attempt in 19±12 min. In 4 patients in whom the intracardiac echocardiography catheter was located in the fossa ovalis, the catheter was passed directly to the left atrium without need for puncture.

The patient in whom the first attempt at transseptal catheterization failed belonged to the group of 6 subjects in whom the fossa ovalis was not well defined. Even though it was punctured while observing septal tenting, pressure curves from the left atrium were not obtained. Thus, contrast was used, and impact was observed on the posterosuperior wall of the left atrium. The procedure was interrupted without the need for anticoagulants. The procedure was repeated one week later without complication.

Six patients formed another group with particular difficulties. Their fossa ovalis was clearly visible, but the membrane was so elastic that, upon applying pressure with the needle, the septum was displaced without perforating it (Figure 4). Advancing and withdrawing the needle with small, brief, fast movements led to successful puncture in all these patients without complication.

During the procedure, 2 patients experienced hypotension with symptoms suggestive of vagal reaction. In both cases, intracardiac echocardiogram confirmed the absence of pericardial effusion and hypotension was resolved by administration of liquids and atropine.

**DISCUSSION**

Transseptal catheterization is becoming increasingly frequent in electrophysiology clinics where there is a lack of previous experience in this technique which is
has investigated the learning process involved. 7-9

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used for treating patients with radiofrequency ablation
for atrial fibrillation.10,11 Although transseptal cathete-
rization can be carried out successfully in most cases
under fluoroscopic guidance, this technique can incur
a fairly high number of complications, even in the
hands of experienced interventionists. It is also
difficult to do it with sufficient frequency to both learn
it and maintain a suitable level of expertise.1

We have verified that intracardiac echocardiography
facilitates the learning process for transseptal
puncture. This technique makes it possible to visualize
the fossa ovalis. This is important in diseased and
small hearts, typical of patients without structural
heart disease where crossing the interatrial septum
away from the target site may increase the risk of
perforation and cardiac tamponade.1

Various studies have previously demonstrated the
usefulness of transesophageal or intracardiac
echocardiography for transseptal puncture, but none
has investigated the learning process involved.7,9

Intracardiac echocardiography has the added
advantage of making it possible to observe the
pericardium to rule out effusion.12 This is of great
assistance in patients with atrial fibrillation in which
the pulmonary veins are normally the substrate
targeted for radiofrequency ablation. This is because,
in addition to requiring strong anticoagulation therapy,
precordial pain is reported fairly frequently as a
consequence of applying radiofrequency in the
pulmonary veins or hypotension due to vagal reflexes.

The only drawback of this technique is the cost. This
should be assessed together with the probability of
preventing serious complication, especially during the
procedural learning process.

In conclusion, intracardiac echocardiography
facilitates learning and carrying out transseptal
puncture. This can be done effectively and safely in
the patient by personnel experienced in interventionist
cardiology procedures without specific previous
experience in this technique. The modification
proposed, i.e. placing the echocardiography catheter
in the fossa ovalis and advancing it under fluoroscopic
guidance with the Brockenbrough needle, facilitates
the procedure even more.

REFERENCES
1. Baim DS. Percutaneous approach, including transseptal and
apical puncture. In: Baim DS, Grossman W, editors. Cardiac
catheterization, angiography, and intervention. 5th ed. Baltimore:
Williams & Wilkins, 1996; p. 57-81.
2. Ballal RS, Mahan EF, Nanda NC, Dean LS. Utility of transeso-
phageal echocardiography in interatrial septal puncture during
percutaneous mitral balloon commissurotomy. Am J Cardiol
3. Tardif JC, Vannan MA, Miller DS, Schwartz SL, Pandian NG.
Potential applications of intracardiac echocardiography in
Radiofrequency catheter ablation guided by intracardiac
5. Chu E, Kalman JM, Kwasman MA, Jue JC, Fitzgerald PJ,
Epstein LM, et al. Intracardiac echocardiography during
radiofrequency catheter ablation of cardiac arrhythmias in
6. Ban J, Schwartzman D, Callans D, Mareblioski FE, Gottlieb CD,
Chaudhry FA. Imaging technique and clinical utility for
electrophysiologic procedures of lower frequency (9 MHz)
7. Epstein LM, Smith T, TenHoff H. Nonfluoroscopic
transseptal catheterization: safety and efficacy of intracardiac
echocardiographic guidance. J Cardiovasc Electrophysiol
8. Daoud EG, Kalbkleisch SJ, Hummel JD. Intracardiac
echocardiography to guide transseptal left heart catheterization
for radiofrequency catheter ablation. J Cardiovasc Electrophysiol
Jordaens LJ. Transseptal left heart catheterization guided by
Lavergne T, et al. Spontaneous initiation of atrial fibrillation by
11. Cooper JM, Epstein LM. Use of intracardiac echocardiogra-
phy to guide ablation of atrial fibrillation. Circulation 2001;104:
3010-3.
12. Clark CB, Davies LR, Kerber RE. Intracardiac echocardiography
identifies pericardial fluid and can monitor the success of
pericardiocentesis: experimental studies. J Am Soc Echocardiogr