Journal of Interventional Cardiac Electrophysiology 5, 97–99, 2001

Editorial Comment

Transseptal Catheterization for the Electrophysiologist: Modification with a "View"

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First described by Ross and Cope in 1959 and later modified by Brockenbrough, Braunwald and Mullins [1–4] transseptal catheterization was basically introduced as an alternative technique for measuring left atrial and left ventricular pressures. Subsequent introduction of pulmonary artery floatation catheters and retrograde left heart catheterization resulted in a significant decline in the number of transseptal procedures. In fact the numbers reported were as few as 42 in 1973, 45 in 1978, eight in 1984 and 15 in 1985 [5,6]. Interest in the procedure renewed with the dawn of interventional technique for percutaneous balloon dilatation of mitral stenosis. Since then its application has steadily increased with wide utility in a number of procedures like anterograde percutaneous aortic valvotomy, pediatric blade atrial septostomy, decompressing the right atrium in primary pulmonary hypertension and for radiofrequency ablation of left sided arrhythmogenic substrates, such as accessory pathways, left atrial tachycardias, atrial fibrillation and ventricular tachycardia.

Transseptal puncture demands a precise understanding of anatomical landmarks on fluoroscopy for an indirect assessment of the location of the fossa ovalis [7]. Earlier studies that had used only a single antero-posterior view reported high morbidity and mortality [7]. Lateral fluoroscopy allowed orientation of the catheter posterior and inferior to the aorta and reduced inadvertent penetration of the aorta or the pericardial cavity. A right anterior oblique view is also used routinely by many operators for providing an enface view of the atrial septum for defining the inferior, posterior and superior borders of the right atrium. A pigtail catheter in ascending aortic root is recommended for defining the position of right aortic sinus. The point of puncture lies midway between the posterior border of right atrium and aorta and 1–3 cm below the aortic valve [7].

Transseptal puncture requires a skilled and experienced operator since the associated complications can have disastrous consequences. In a series of 1,279 transseptal catheterizations reported from the Massachusetts general hospital, a total of 17 major complications were reported including cardiac tamponade in 15 patients, systemic emboli and death due to aortic tear in one case each [7]. Indirect information regarding location of fossa ovalis, frequent distortion of atrial anatomy in pathologic hearts, technical expertise and occurrence of complications with unpredictable outcomes provide a steep and a difficult learning curve for a beginner. It is desirable that the puncture site be at the fossa ovalis for obviating complications and for facilitating easy manipulation of the catheters. Traditionally transseptal catheterization has relied on fluoroscopic guidance in which catheters are guided by its relative position in the cardiac silhouette. However under fluoroscopy it can never be clear whether the transseptal needle is in an optimal position. Simultaneous performance of echocardiography can help the operator by allowing direct visualisation of transseptal catheter in relation to atrial septum. Hurrell et al. [8] prospectively evaluated the role of transthoracic two-dimensional echocardiography in cases who were undergoing transseptal puncture. Initial placement of transseptal needle was in the conventional manner guided by fluoroscopy. Transthoracic echocardiography was then performed to confirm or alter the position of the needle to a more desirable location in 33 cases. On the basis of echocardiography, the needle was adjacent to the fossa ovalis in only 17 (52%) cases, and was not located in the region of fossa ovalis in the remaining 16 (48%) cases. Misdirections of the needle occurred in several directions — anteriorly in 26%, inferiorly in 37%, superiorly in 21% and posteriorly in 16%,

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Received 16 November 2000; accepted 16 November 2000

reflecting the inaccuracy of fluoroscopic guidance in providing the correct anatomic information. Echocardiography may obviate this shortcoming by allowing precise placement of the catheter. On echocardiography, the area of fossa ovalis is identified as a thin membranous region surrounded by thicker muscular portion. Imaging through the transthoracic route, however, may not be able to accurately localize the tip of the needle. Thus transthoracic echocardiography, despite being able to precisely locate the fossa ovalis, can rarely demonstrate the puncture of the fossa.

Transesophageal echocardiography can provide better imaging; however, it reduces patient compliance during the procedure and can cause esophageal bleeding. These shortcomings can be obviated by performing intracardiac echocardiography [9–11]. The needle tip is identified to be in contact with the atrial septum as an echogenic point with its acoustic shadow and septal indentation. Moreover intracardiac echo may be specifically useful in patients with kyphoscoliosis, atrial septal aneurysms and giant left atrium where the fluoroscopic landmarks may be unreliable. Intracardiac echocardiography has been shown to be useful technique during catheter ablation of arrhythmias since it improves catheter contact by providing a better spatial resolution regarding cardiac anatomy. The role of intracardiac echo for transseptal puncture during radiofrequency ablation of left sided arrhythmias, either alone or in conjunction with fluoroscopy has been evaluated in a limited number of studies and reported to be useful [9–11].

The success of transseptal radiofrequency ablation of left sided arrhythmogenic substrates has been an important stimulus for electrophysiologists to become familiar with the technique of transseptal catheterization. De Ponti et al. [12] simplified this approach for the electrophysiologists by using diagnostic electrophysiology catheters positioned in the His bundle area and coronary sinus to identify anatomic landmarks such as the aortic root and the posterior inferior limit of the atrial septum. In the 30° right anterior oblique view, the fossa ovalis lies just above the level of the His bundle catheter. The distance between the tip of the transseptal assembly and the aortic root can easily be evaluated. The authors also recommended that the orientation of the transseptal assembly should be parallel to the plane of the coronary sinus catheter, in order to prevent penetration of inappropriate structures. Transseptal puncture was performed during sinus rhythm only, using single plane antero-posterior fluoroscopy view.

In this issue of the journal [13], Gonzalez et al. have further modified the utility of this approach by using biplane fluoroscopy in right and left anterior oblique projections. Additional landmarks e.g. posterior wall and roof of right atrium and the posterior wall of left atrium were utilized to enhance the safety of the technique. Using these landmarks, they found that the plane of the transseptal assembly at the site of the puncture was at variance with the standard technique in 58 % of patients. Slight alterations in the direction of the needle hub from the standard 4 o'clock position are sometimes required in patients with enlarged atria or large aortic roots. In patients with left atrial enlargement, the septum lies more horizontally. The site of the puncture is more posterior and inferior, and may require a clockwise rotation of the assembly to 5 o'clock or even 6 o'clock positions. In aortic valve disease or dilated aortic root, the septum is more vertical. The fossa ovalis and puncture site are therefore more superior and slightly anterior, requiring counter clockwise rotation of the needle hub to 3 o'clock position. Puncture of the interatrial septum with the needle hub at 2 o'clock position is rather unusual, yet it was reported in 13 % of the cases by Gonzalez et al. [13]. The authors also used the 3 o'clock position quite frequently (45 %), though the number of cases with anatomic abnormalities of the atria or aortic root was rather small (12 and 5 respectively). Given the findings of Hurrell et al. [8], it would have been interesting to validate the exact site of the transseptal puncture by a simultaneous, alternate imaging technique such as transthoracic or transoesophageal echocardiography. With increasing operator experience and refinement of the technique of transseptal catheterization, complications are rather uncommon. Nevertheless, use of electrophysiology catheters as landmarks and biplane fluoroscopy would certainly help to enhance the confidence of the electrophysiologists, who may not be as adept in transseptal puncture as their interventional cardiology colleagues.

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