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Original Article

Low interatrial septal pacing: A simple method

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ABSTRACT

Background: Sinus node disease is associated with widespread structural and electrophysiological changes in the atria in addition to abnormalities at the sinus node. The atrial conduction disorder in patients with atrial pacing results in higher incidence of atrial fibrillation. Studies have shown that low interatrial septal pacing is superior to right atrial appendage pacing in preventing persistent or permanent atrial fibrillation in these patients. However, implantation of active fixation lead in low interatrial septal position is difficult and time consuming with conventional stylet, inhibiting application of this method in routine practice.
Method: The technique of implanting atrial pacing lead in low interatrial septum with hand-made stylet is presented in this study with emphasis on fluoroscopic landmark and electrocardiographic P wave pattern.
Results: The results indicate acute and short-term success of low interatrial septal pacing in 10 patients out of 11 patients without major complications. Pacing parameters during implantation and 3 months post procedure were within normal limits.
Conclusion: The initial favorable results of this study indicate low interatrial septal pacing with conventional active fixation lead using fluoroscopic landmark and electrocardiographic characteristics is feasible and reproducible with a simple technique.

1. Introduction

Atrial lead insertion during permanent pacemaker implantation is done for either symptomatic sinus node dysfunction (SND) or for maintenance of atrio-ventricular synchrony in a dual chamber pacemaker for atrio-ventricular conduction disease or both sinus and atrio-ventricular disease.1 In addition to abnormalities at the sinus node, SND is associated with widespread structural and electrophysiological changes in the atria.2 Atrial conduction disorder is electrocardiographically defined as P wave duration (traditionally measured in lead II) of more than 120 ms.3 This atrial conduction disorder in patients with permanent pacing results in higher incidence of atrial fibrillation.4 The occurrence of atrial fibrillation (AF) after pacemaker implantation in SND is associated with an increased risk of stroke, systemic embolism, heart failure, and mortality.5 Saksena et al. suggested dual-site atrial pacing using electrodes positioned in the high right atrium and at the coronary sinus ostium ("dual-site RA pacing") for prevention atrial fibrillation in these patients.6 However, it requires one extra pacing lead. Two large prospective randomize studies (EPASS and SAFE) have shown that low inter atrial septal (IAS) pacing is superior to right atrial appendage (RAA) pacing in preventing persistent or permanent AF in patients with SND and intra-atrial conduction delay.7,8 De Voogt has described the technique and electrocardiographic features of low IAS pacing in several studies.9 However, for this procedure we need two types of special delivery systems; first is a steerable stylet (Locator) and the second system is a catheter delivery system (Select Secure pacing lead system) which is not widely available.10,11 So, we prepared and used a hand-made stylet (applying a generous curve to the distal end of the straight stylet resulting in a "C" type curve) in this study. Feasibility and safety of this kind of hand-made stylet for lower atrial septal pacing are not well validated.

2. Method

In our hospitals, from 1st February 2015 till 31st January 2016 we had recruited 15 patients for low IAS pacing who were undergoing dual chamber pacemaker. We selected the patients with sinus P wave duration of more than 120 ms in lead II (atrial

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conduction disorder). With hand-shaped ('C" type) stylet we positioned the atrial lead in the target area. The lead parameters (P wave sensitivity, threshold, lead impedance) were noted during implantation and 3 months after the procedure. We used conventional active fixation leads whichever was available at the time of implantation.

After having venous access to the left Subclavian vein, the ventricular lead was placed in the right ventricular apex. The position was observed in left anterior oblique (LAO) fluoroscopic view which served as the reference. The target region for the implantation of the lead in low IAS pacing was the part of the atrial septum just above the coronary sinus ostium (Fig. 1). To locate the lower IAS region, the atrial lead was first advanced into the lower part of the right atrium in Postero-anterior projection. Then the fluoroscope was moved to the 40° LAO position. A generous curve was applied then to the distal end of the conventional straight stylet to form a "C" shapes (Fig. 2). Iterative adjustment to the curve was done according to the shape of the loop of the RV lead in 40° LAO view. This hand made stylet was then advanced through the lead and a counter–clock wise rotation was given on the lead which advanced the lead to the target site. The fluoroscope was then positioned in the 40° right anterior oblique (RAO) view, and the lead was fixed in the anterior position. In both left anterior oblique as well as left lateral view it faced posteriorly towards spine. Fig. 3 demonstrates LAO and RAO view of the leads (ventricular lead positioned at the RV apex and atrial lead positioned at the lower atrial septum).

The fluoroscopic criteria we used for low IAS pacing were: (i) the position of the lead tip in the posterior–anterior view near the indentation of the right ventricular lead at the base of its descendant curve from the superior vena cava (inferior border of tricuspid annulus) and; (ii) in the 40° left anterior oblique view the lead tip pointing posteriorly towards the spine.

The electrocardiographic criteria for low IAS pacing were (i) P wave morphology: negative paced P-wave in inferior leads (lead II, III, and aVF), (ii) Absence of latency: starting immediately with the pacing spike and (iii) P wave duration: shorter (30 ms shorter than sinus P waves measured on the 6-limb lead electrocardiogram).

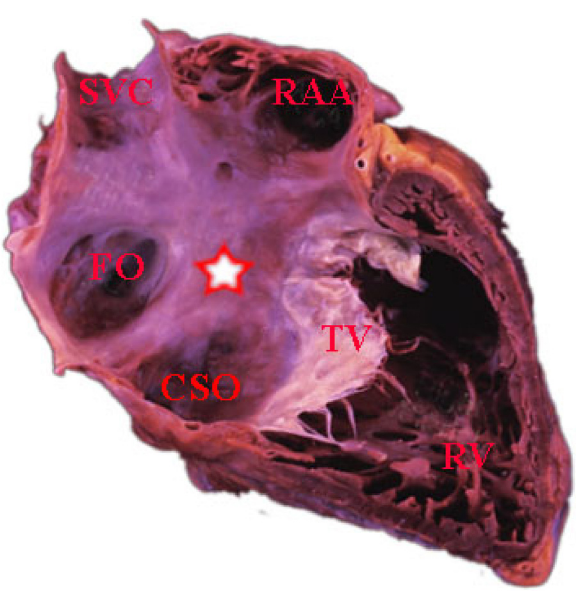

Fig. 1. An anatomic specimen of heart: the right atrial and ventricular free wall has been removed to show interatrial septum as seen in antero-posterior view. SVC = superior vena cava, RAA = right atrial appendage, FO = fossa ovalis, TV = tricuspid valve leaflet, CSO = coronary sinus opening, RV = right ventricle. Star indicates target site for low interatrial septal pacing.

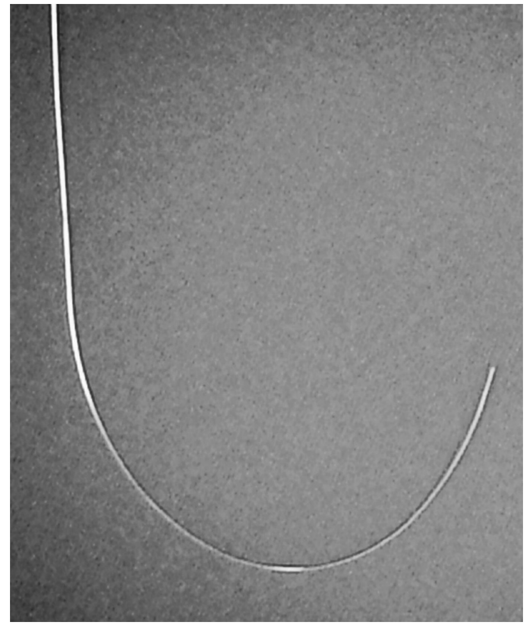

Fig. 2. Hand-made stylet with "C" curve.

Collected data were analyzed using SPSS 21 statistical package. The test was used to compare the normally distributed continuous variable between the lead parameters during implantation and 3 months post procedure. A p value of less than 0.05 was used to indicate significance. The test was also used to analyze paced P-wave characteristics. The correlation of paced P-wave in lead II, III, aVF versus lead V1 had been seen.

3. Results

We successfully implanted the atrial lead in lower IAS in 14/15 patients. In one patient we fail to position the lead in the target area because of inaccessibility and the lead was placed in right atrial appendage. The right atrium was hugely dilated in this patient. Underlying condition was corrected transposition of great arteries (CCTG). There was no procedural complication. Of these 14 patients, 8 were male and 6 were female. Mean age was 65.5 years (95% CI; 62.16–68.84). The lead position in the low IAS region was electrocardiographically confirmed by noting the paced P wave characteristics (duration, latency, and vector) in 12 lead surface ECG during implantation and on 2nd post-implantation day. The ECG was taken with 50 mm/s paper speed to better calculation of the intervals. Table 1 summarizes the paced P wave features of these 14 patients.

The mean P wave sensitivity at implantation and 3 months post procedure were 2.84 mV (95% CI; 2.48–3.20) and 2.75 mV (95% CI; 2.43–3.07) respectively. All the data had been collected in the bipolar configuration. The change were insignificant (p value is 0.12). Mean pacing threshold at implantation and 3 months post procedure were 0.76 V (95% CI; 0.55–0.95) and 0.76 V (95% CI; 0.65–0.87) respectively. The change in pacing threshold were not significant (p value is 1.0). The mean lead impedance at implantation and 3 months post procedure were 842.5 ohm (95% CI; 768.67–916.33) and 775 ohm (95% CI; 730.04–819.96) respectively. The changes were significant (p value is 0.009).

The mean shortening paced P-wave duration was 40 ms with 95% CI of 40.23–49.77 ms. The two-tailed p- value (compared to an expected mean shortening of at least 30 ms) is 0.0011. This is considered to be statistically significant. The correlation of paced P-wave morphology in lead II, III, aVF versus lead V1 shows a value