Septal Versus Non-Septal Right-Atrial Pacing

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Summary

There is a variety of approaches to pacing the right atrium. Pacing can be performed from the right appendage, the lateral wall, or the septum; multisite pacing is also possible. Right-atrial septal pacing has been shown to have a positive influence on atrial tachyarrhythmias by synchronous depolarization of the atria. This type of stimulation requires bipolar screw-in leads with a short tip-ring distance to minimize ventricular far-field sensing. We studied the differences between conventional and septal pacing in pacing thresholds, sensing behavior, and complications in 12 patients with septal pacing and 36 patients with a conventional pacing site. Standard, atrial, screw-in leads were placed on the distal atrial septum at Koch's triangle, using a guiding stylet. The acute threshold was 0.75 V (0.3 – 1.3 V) for the septal and 0.77 V (0.3 – 1.6 V) for the conventional group; the sensing values were 2.6 mV (1.2 – 6.8 mV) for the septal group and 4.0 mV (1.9 – 7.5 mV) for the conventionally paced patients. The impedance measurements were 644 W (476 – 931 W) for septal and 587 W (418 – 893 W) for conventional atrial pacing. We observed one dislocation and one threshold increase in the septally paced group. Three patients who were initially intended to receive septal pacing had to be switched to conventional pacing due to threshold problems. Far-field sensing was not seen in either group when an atrial sensitivity of 0.5 mV was used. At 0.2 mV, two patients in the septal group showed signs of far-field sensing. Septal pacing at Koch's triangle is possible after a learning curve with equal thresholds but lower sensing levels than in conventional pacing. A guiding stylet is very useful in lead placement. Far-field sensing was not a problem in our patients. Due to the simultaneous innervation of both atria, adjustment of the atrioventricular delay is necessary.

Key Words

Atrial septal pacing, pacing thresholds, conventional pacing

Introduction

Permanent, transvenous, atrial pacing leads have been placed traditionally in the right appendage and on the lateral wall. In patients with paroxysmal atrial fibrillation, pacing the interatrial septum has been shown to have a positive influence on decreasing the number of episodes [1]. Interatrial septal pacing requires screw-in bipolar leads, and the feasibility of this approach was reported in small numbers by various centers [1-3]. Smaller tip-to-ring spacing tends to have a higher discrimination for bipolar signals [4]. Therefore, bipolar screw-in leads with short tip-to-ring spacing are recommended for the septal location. The threshold and sensing behavior of the leads in comparison to the conventional pacing sites in the right atrium have not been examined very closely. We report here our experiences with standard, screw-in leads in the septal and conventional pacing sites, as well as the influence of the pacing site on programming the pacemaker after implantation.

Materials and Methods

Pacemaker implantation was carried out in 12 patients with paroxysmal atrial fibrillation by septal placement

ECG at standard deviations	Isoelectric P-wave at surface ECG lead I
	Negative P-wave at surface ECG lead II and III
	Shortening of the P-wave duration
X-Ray	Lower position in the right atrium
	Tip of the leads toward the vertebral column in left anterior oblique view

Table 1. Criteria for septal lead positioning.

of the atrial lead (seven female, five male, mean age 67 years, 55 – 76 years) using a Tendril SDX atrial screw-in lead with a Locator guiding stylet (all from Pacesetter, USA). The tip-to-ring spacing of this lead is 13 mm. The correct septal position of the lead was verified by ECG (isoelectric P-wave in the surface ECG of lead I, negative P-wave in lead II and III) and by fluoroscopy (tip direction toward the vertebral column) as shown in Table 1, Figures 1 and 2. We defined as the control group the 36 other patients with an indication for dual-chamber pacemaker and conventional positioning of the same atrial lead. Intraoperative measurements were performed using a pacing system analyzer (Medtronic, USA); postoperative follow-ups were conducted at discharge and at 1 month and 6 months after implantation.

Results

In three patients, the initial intention of septal positioning of the electrode was not possible because of high thresholds. The other leads showed a normal mean threshold of 0.75 V (0.3 – 1.3 V), a mean P-wave amplitude of 2.6 mV (1.2 – 6.8 mV), and a mean impedance of 644 Ω (476 – 931 Ω). In comparison, the conventionally placed leads had a mean intraoperative threshold of 0.77 V (0.3 – 1.6 V), a mean sensed P-wave amplitude of 4.0 mV (1.0 – 7.5 mV), and an impedance of 587 Ω (418 – 893 Ω). Because of the small numbers in all reports, we summarized the values of previous investigators with ours in Figures 3 and 4. During the follow-up period, we observed one threshold increase over 2.5 V and one dislocation in the group with septal implantation. Far-field sensing was not a problem at a sensitivity of 0.5 mV; at 0.2 mV, far-field sensing occurred in two patients.

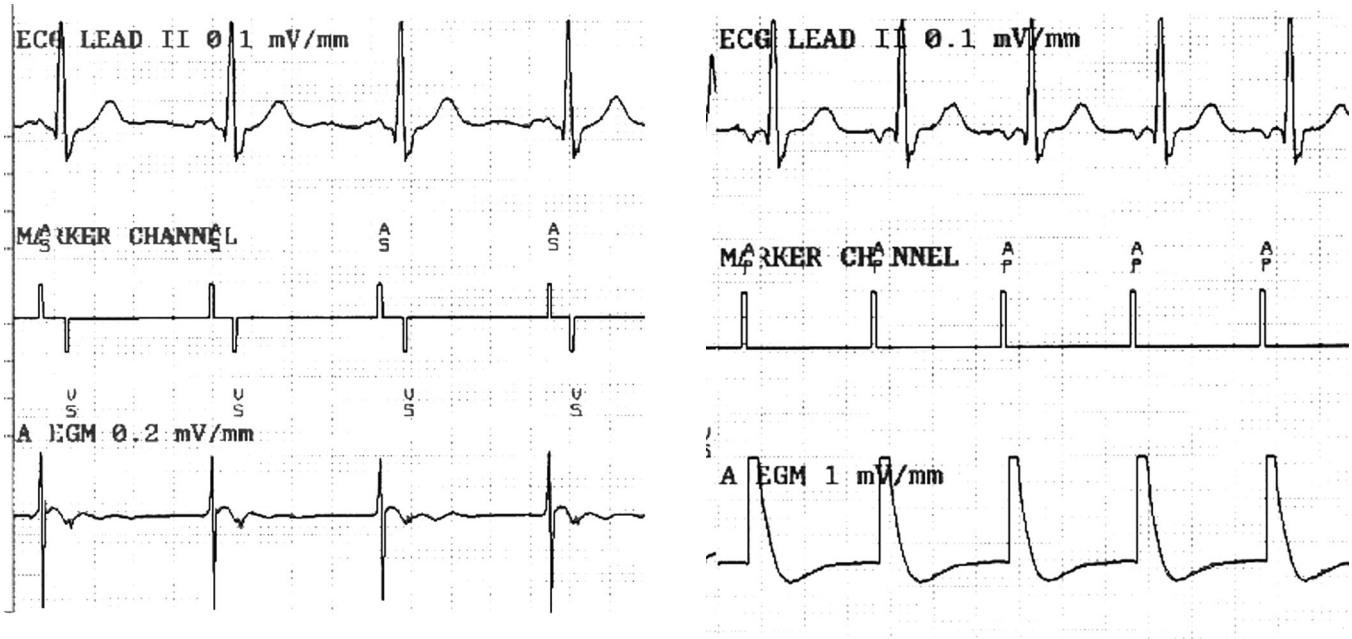


Figure 1. Intraoperative ECG (pacing system analyzer, Medtronic, USA) without and with atrial septal stimulation.

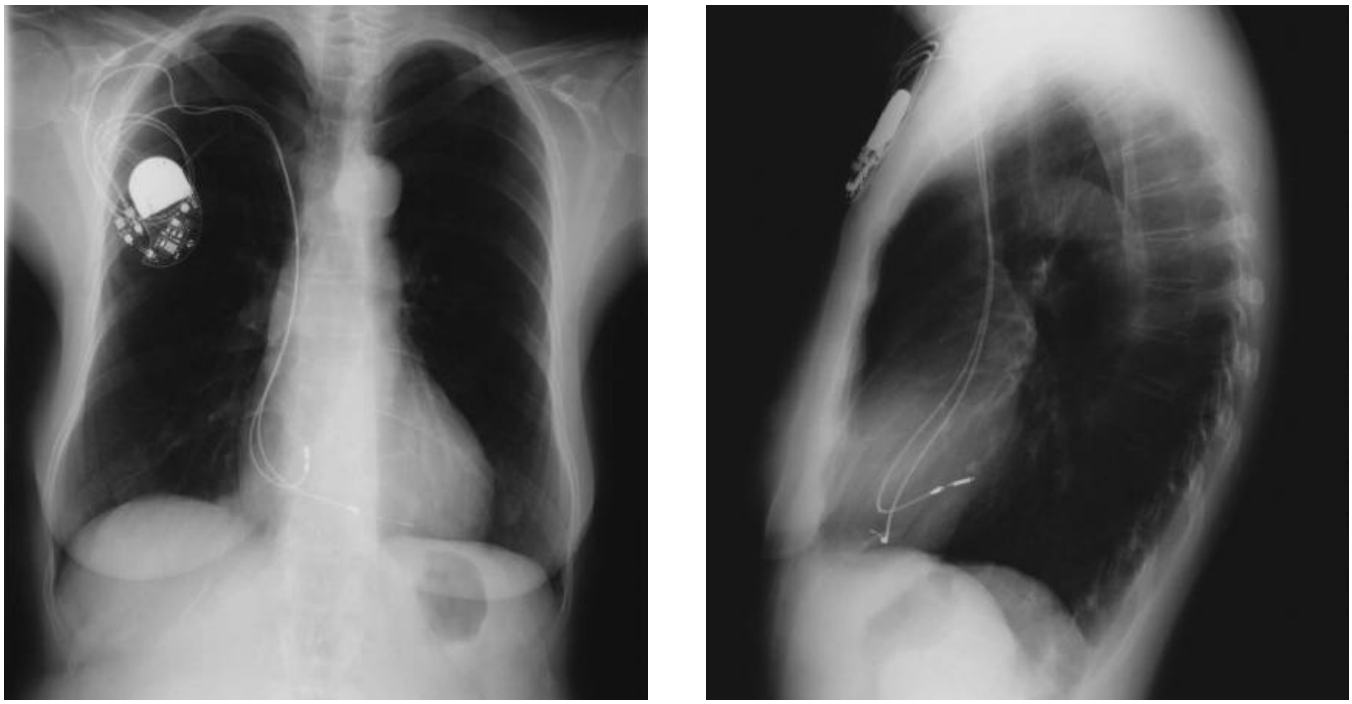
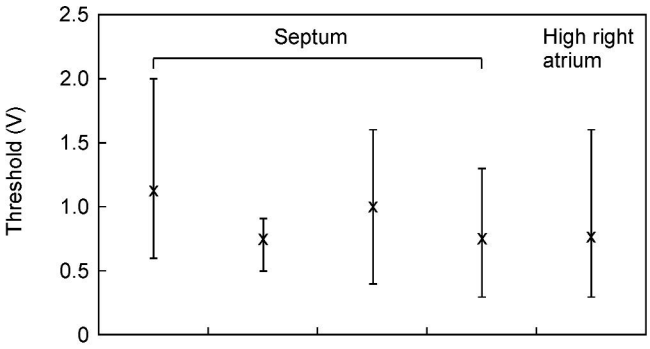


Figure 2. Postoperative X-ray after septal implantation of the atrial lead.

Discussion

Septal pacing was shown to be safe and feasible after a test period. The intraoperative threshold values were similar to those in other investigations and do not differ from those for the conventional pacing sites. Only the sensing values tend to have lower levels at the septum, with 2.6 mV in comparison to 4.0 mV for conventional atrial lead placement. The use of screw-in leads with narrow tip-to-ring spacing is recommended for septal pacing; a guiding stylet is also recommended to facilitate the placement of the lead.

The programming of the pacemaker during follow-up is crucial because of the different interatrial conduction time for septal pacing, which results in changes to the atrioventricular (AV)-delay for the left ventricle. Chevalier [5] showed an interatrial activation time of 118 ± 20 ms after stimulation of the right atrial appendage; pacing the atrial septum shortens the interatrial activation time to 79 ± 15 ms. With a given, unchanged, interventricular activation time of 125 ± 21 ms, the AV-delay for the left ventricle has to be shortened by about 40 ms. The influence on hemodynamics in patients with normal left-ventricular function was negligible in this report. The stroke volume was unchanged for pacing sites and AV-delay. Kindermann [6] performed an AV-delay optimization by echocardiography, resulting in similar findings, with an opti-



Investigator	Spencer [2]	Katsivas [3]	Padeletti [1]	Anelli-Monti	Anelli-Monti
Number	4	7	34	12	36
Lead	4058 Medtronic USA	4068 Medtronic USA	Varia	TendrilSDX Pacesetter USA	TendrilSDX Pacesetter USA

Figure 3. Intraoperative threshold measurements for septal lead positioning of different investigators in comparison with our patients for septal versus non-septal.

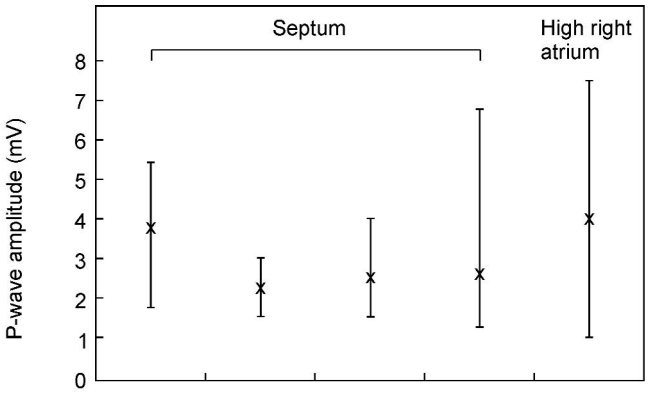


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Figure 4. Intraoperative P-wave amplitudes for septal leads of different investigators in comparison with our patients for both septal and non-septal.

mal AV-delay for the left ventricle of 152 ± 33 ms for non-septal and 108 ± 38 ms for septal atrial pacing. Based on these findings, we programmed the AV-delay 40 ms shorter in patients with septal atrial pacing.

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