

# Single-center Experience of AAIR Pacemakers for Sinus Node Dysfunction

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Received on: 17 November 2021; Accepted on: 23 November 2021; Published on: 31 August 2022

## ABSTRACT

**Introduction:** The choice of pacing mode in sinus node dysfunction in patients is still up for debate. Patients with atrial pacing (AAI/AAIR) in comparison to ventricular pacing (VVI/VVIR) have fewer chances of developing atrial fibrillation, stroke, and heart failure. Dual-chamber pacing (DDD/DDDR) is also associated with significantly less atrial fibrillation and less heart failure hospitalization, but various trials have failed to show a survival benefit in relation to ventricular pacing alone. We report about the use of AAIR pacemaker implantation for sinus node dysfunction in 15 adult patients and analyze the clinical characteristics and short-term outcomes of these patients.

**Materials and methods:** All adult patients (18 years or above) who underwent AAIR pacemaker implantation for sinus node dysfunction at the Department of Cardiology, Mahatma Gandhi Hospital, Jaipur between 1st June 2018 and 31st August 2021 were included in the study for retrospective analysis of clinical characteristics and short-term outcome of these patients. This was a retrospective observational study. Prior approval was taken before the start of the study from the Institute Ethics Committee.

**Results:** In our study, the mean age was 63 years and 66% of patients were females. Hypertension was present in 46% of patients and diabetes was seen in 33% of patients. About 26% of patients were having coronary artery disease (CAD). The mean LVEF in the study was 54%. Regarding the indication of AAIR pacemaker, 26% had inappropriate sinus bradycardia, 53% had significant sinus pause, and 20% had bradycardia-tachycardia syndrome. The procedure-related complication was not reported in our study. No change in the pacing mode was required in all 15 patients. Two patients developed episodes of paroxysmal AF on follow-up. No deaths were reported on short-term follow-up.

**Conclusion:** The development of AV blocks is rare in sinus node dysfunction patients. The optimal choice of pacing in these patients is the atrial (AAI/AAIR) pacemaker. It is the safest and provides the best cost-to-benefit ratio when compared to a dual-chamber pacemaker. Hence, atrial pacing should be preferred in sinus node dysfunction patients in the absence of atrioventricular blocks.

**Keywords:** AAIR, Pacemaker, Sinus node dysfunction.

*Journal of Mahatma Gandhi University of Medical Sciences and Technology* (2022); 10.5005/jp-journals-10057-0192

## INTRODUCTION

Sinus node dysfunction includes a group of diseases related to abnormal conduction and propagation of electrical impulses at the sinoatrial node. It is often secondary to senescence of the sinoatrial (SA) node and surrounding atrial myocardium. It includes inappropriate sinus bradycardia, bradycardia-tachycardia syndrome, sinus pause or arrest, and SA exit block.

The choice of pacing mode in these patients is still up for debate. Patients with atrial pacing (AAI/AAIR) in comparison to ventricular pacing (VVI/VVIR) have fewer chances of developing atrial fibrillation, stroke, and heart failure. Dual-chamber pacing (DDD/DDDR) is also associated with significantly less atrial fibrillation and less heart failure hospitalization but various trials have failed to show a survival benefit in relation to ventricular pacing alone.

There is still controversy about the most effective pacing mode in sinus node dysfunction. Various studies have shown that physiological pacing (atrial and dual-chamber pacemaker) improves hemodynamic patterns in comparison with ventricular stimulation (VVI/VVIR) alone. The cost factor also play role in decision making as double chamber pacemakers are significantly costlier than single-chamber pacemakers.

We report about the use of AAIR pacemaker implantation for sinus node dysfunction in 15 adult patients and analyze the clinical characteristics and short-term outcomes of these patients.

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**How to cite this article:** Sharma R, Dahiya A, Thakur M, et al. Single-center Experience of AAIR Pacemakers for Sinus Node Dysfunction. *J Mahatma Gandhi Univ Med Sci Tech* 2022;7(1):4-6.

**Source of support:** Nil

**Conflict of interest:** None

## MATERIALS AND METHODS

All adult patients (18 years or above) who underwent AAIR pacemaker implantation for sinus node dysfunction at the Department of Cardiology, Mahatma Gandhi Hospital, Jaipur between 1st June 2018 and 31st August 2021 were included in the study for retrospective analysis of clinical characteristics and short-term outcome of these patients. This was a retrospective observational study. Prior approval was taken before the start of the study from the Institute Ethics Committee.

### Aim and Objective

To do a retrospective analysis of clinical characteristics of patients and short-term outcomes with AAIR pacemakers.

## Inclusion Criteria

- Age  $\geq$ 18 years.
- Patients with sinus node dysfunction treated with AAIR pacemaker.
- Patient giving consent for the study.

## Exclusion Criteria

- Age <18 years.
- Patient not giving consent.

We performed a retrospective analysis of all the patients in the sample and we evaluated the clinical characteristics (age, sex, cardiopathy, type of SND) and the parameters during the implantation (threshold of atrial detection and capture). During follow-up, we evaluated the complications resulting from the electrodes (problems with detection and displacement), the development of paroxysmal or chronic AF, development of second or third degree AVB, the need for a change in stimulation mode, and death.

## RESULTS

In our study, the mean age was 63 years and 66% of patients were females. Hypertension was present in 46% patients and diabetes was seen in 33% patients. About 26% patients were having coronary artery disease (CAD). The mean LVEF in the study was 54%. Regarding the indication of AAIR pacemaker, 26% had inappropriate sinus bradycardia, 53% had significant sinus pause, and 20% had bradycardia-tachycardia syndrome (Table 1).

Procedure-related complication was not reported in our study (Table 2). No change in the pacing mode was required in all 15 patients. Two patients developed episodes of paroxysmal AF on follow-up. No deaths were reported on short-term follow-up.

## DISCUSSION

Sinus node dysfunction affects mainly older patients, especially those with another cardiac disorder or diabetes. Clinical symptoms result from the hypoperfusion of end organs and about 50% of patients present with cerebral hypoperfusion symptoms like syncope, presyncope, lightheadedness, and cerebrovascular

accident. Other symptoms include palpitations, decreased physical activity, angina, muscular fatigue, and oliguria.

Various studies have shown that physiological pacing (atrial or both atrial and ventricular pacing) improves hemodynamic patterns in comparison with ventricular pacing alone. Also, it has been shown that VVI mode produces a greater number of complications in the short and long term than other forms of cardiac stimulation.<sup>1-4</sup> It is still a matter of debate whether the most effective pacing mode in sinus node dysfunction is the dual-chamber or the isolated atrial mode.<sup>5,6</sup>

The safety and stability of atrial pacing in sinus node dysfunction is already reported in various studies.<sup>7</sup> However, there is a slightly higher risk of atrial lead dislocation in comparison to ventricular lead.<sup>8</sup> In our study, we did not observe any pacemaker-related problem requiring changes in pacing or any lead dislocation requiring relocation.

As some of the arrhythmias like paroxysmal atrial fibrillation or flutter are related to the presence of bradycardia or vagal stimulation, the presence of these arrhythmias is not a contraindication for the implantation of an AAIR pacemaker. Studies comparing AAIR vs DDDR pacemakers in sinus node dysfunction have repeatedly shown that incidence of atrial arrhythmias reduces with atrial stimulation alone.<sup>2</sup> In some cases, chronic atrial fibrillation may require changing the pacing mode.<sup>9-11</sup>

Dual-chamber pacemakers are not only costlier but also have other disadvantages. The procedure-related issues include a longer duration and the need for another subclavian puncture. These devices are comparatively bulkier than single chamber pacemakers and can result in some discomfort to the patient. As battery depletion is more in these devices, the time elapsed before elective replacement is shorter. Various trials have not shown any benefit of

**Table 2:** Clinical events

|                                | No. of patients |
|--------------------------------|-----------------|
| Atrial fibrillation            | 2               |
| Heart failure                  | 1               |
| Stroke                         | 0               |
| Procedure related complication | 0               |
| Death                          | 0               |

**Table 1:** Baseline characteristics of patients with AAIR pacemaker

|         | Age (years) | Sex    | Hypertension | Diabetes | CAD | LVEF | CKD | Indication of AAIR |
|---------|-------------|--------|--------------|----------|-----|------|-----|--------------------|
| Case 1  | 63          | Female | Yes          | Yes      | No  | 55%  | No  | SP                 |
| Case 2  | 58          | Female | No           | Yes      | Yes | 45%  | No  | ISB                |
| Case 3  | 69          | Male   | Yes          | No       | No  | 60%  | No  | BTS                |
| Case 4  | 66          | Female | No           | No       | Yes | 55%  | No  | SP                 |
| Case 5  | 72          | Male   | No           | No       | No  | 50%  | No  | ISB                |
| Case 6  | 70          | Female | Yes          | No       | No  | 55%  | No  | SP                 |
| Case 7  | 55          | Female | No           | No       | No  | 55%  | No  | SP                 |
| Case 8  | 56          | Female | No           | Yes      | No  | 50%  | No  | SP                 |
| Case 9  | 69          | Male   | Yes          | Yes      | Yes | 45%  | No  | ISB                |
| Case 10 | 73          | Male   | No           | No       | No  | 55%  | No  | SP                 |
| Case 11 | 66          | Female | No           | No       | No  | 60%  | No  | BTS                |
| Case 12 | 62          | Female | Yes          | No       | Yes | 60%  | No  | SP                 |
| Case 13 | 54          | Male   | Yes          | Yes      | No  | 45%  | Yes | ISB                |
| Case 14 | 53          | Female | No           | No       | No  | 60%  | No  | SP                 |
| Case 15 | 60          | Female | Yes          | No       | No  | 60%  | No  | BTS                |

BTS, bradycardia-tachycardia syndrome; ISB, inappropriate sinus bradycardia; SP, sinus pause

dual-chamber pacemakers over ventricular pacing alone in terms of mortality and atrial fibrillation.<sup>4</sup> This suggests that ventricular stimulation is detrimental and results in loss of physiological effect with dual-chamber pacemakers.<sup>12-16</sup>

On the other hand, atrial pacing alone in AAIR pacemakers has been shown to preserve AV synchronicity and is reported to be beneficial for sinus node dysfunction in various studies.<sup>1,9,17</sup> There is a low risk (around 1%) of the development of atrioventricular blocks in the sinus node dysfunction patients on AAIR pacemakers requiring insertion of the ventricular lead.<sup>11,18,19</sup>

In the Indian scenario, cost factors play a major role and lead to the use of single-chamber ventricular pacing in many cases resulting in non-physiological pacing and left ventricular dysfunction. Also, in patients with ventricular pacing, it is not possible to accurately diagnose acute coronary syndrome (ACS) on ECG. Whereas ACS can be easily diagnosed on ECG in patients with atrial pacing.

## CONCLUSION

The development of AV blocks is rare in sinus node dysfunction patients. The optimal choice of pacing in these patients is the atrial (AAI/AAIR) pacemaker. It is the safest and provides the best cost-to-benefit ratio when compared to dual-chamber pacemaker. Hence, atrial pacing should be preferred in sinus node dysfunction patients in the absence of atrioventricular blocks.

## REFERENCES

- Andersen HR, Cosedis JN, Thomsen PL, et al. Long-term follow up of patients from a randomised trial of atrial versus ventricular pacing for sick-sinus syndrome. *Lancet* 1997;350(9086):1210-1216. DOI: 10.1016/S0140-6736(97)03425-9
- Santini M, Alexidou G, Ansalone G, et al. Relation of prognosis in sick sinus syndrome to age, conduction defects and modes of permanent cardiac pacing. *Am J Cardiol* 1990;65(11):729-735. DOI: 10.1016/0002-9149(90)91379-k
- Simon AB, Zloto AE. Symptomatic sinus node disease: natural history after permanent ventricular pacing. *Pacing Clin Electrophysiol* 1979;2(3):305-314. DOI: 10.1111/j.1540-8159.1979.tb03650.x
- Conolly SJ, Kerr CR, Gent M, et al. Effects of physiologic pacing versus ventricular pacing on the risk of stroke and death due to cardiovascular causes. *N Engl J Med* 2000;342(19):1385-1391. DOI: 10.1056/NEJM200005113421902
- Barold S. Permanent single chamber atrial pacing is obsolete. *Pacing Clin Electrophysiol* 2001;24(3):271-275. DOI: 10.1046/j.1460-9592.2001.00271.x
- Santini M, Ricci R. Is AAI or AAIR still a viable mode of pacing. *Pacing Clin Electrophysiol* 2001;24(3):276-281. DOI: 10.1046/j.1460-9592.2001.00276.x
- Goicolea de Oro A, López L, Pastor A, et al. Resultados a largo plazo de la estimulación auricular permanente en la enfermedad del nodo sinusal. *Rev Esp Cardiol* 1997;50(7):474-479
- Markewitz A, Hemmer W, Weinhold C. Complications in dual chamber pacing: a six year experience. *Pacing Clin Electrophysiol* 1986;9(6):1014-1018.
- Rosenqvist M, Isaaq K, Botvinick E, et al. Relative importance of activation sequence compared to AV synchrony in left ventricular function. *Am J Cardiol* 1991;67(2):148-156. DOI: 10.1016/0002-9149(91)90437-p
- Rediker DE, Eagle KA, Homma S, et al. Clinical and hemodynamic comparison of VVI versus DDD pacing in patients with DDD pacemakers. *J Am Coll Cardiol* 1986;61(4): 323-329. DOI: 10.1016/0002-9149(88)90938-1
- Kristensen L, Nielsen JC, Pedersen AK, et al. AV Block and changes in pacing mode during long term follow up of 399 consecutive patients with sick sinus syndrome treated with an AAI/AAIR pacemaker. *Pacing Clin Electrophysiol* 2001;24(3):358-365. DOI: 10.1046/j.1460-9592.2001.00358.x
- Lee MA, Dae MW, Langberg JJ, et al. Effects of long-term right ventricular apical pacing on left ventricular perfusion, innervation, function and histology. *J Am Coll Cardiol* 1994;24(1):225-232. DOI: 10.1016/0735-1097(94)90567-3
- Rosenqvist M, Bergfeldt L, Haga Y. The effect of ventricular activation sequence on cardiac performance during pacing. *Pacing Clin Electrophysiol* 1996;19(9):1279-1286. DOI: 10.1111/j.1540-8159.1996.tb04205.x
- Bedotto J, Grayburn P, Black WH, et al. Alterations in left ventricular relaxation during atrioventricular pacing in humans. *J Am Coll Cardiol* 1990;15(3):658-664. DOI: 10.1016/0735-1097(90)90642-3
- Tse H, Lau C. Long term effect of right ventricular pacing on myocardial perfusion and function. *J Am Coll Cardiol* 1997;29(4):744-749. DOI: 10.1016/s0735-1097(96)00586-4
- Nielsen JC, Bottcher M, Nielsen TT, et al. Regional myocardial blood flow in patients with sick sinus syndrome randomised to long-term single chamber atrial or dual chamber pacing. Effect of pacing mode and rate. *J Am Coll Cardiol* 2000;35(6):1453-1461. DOI: 10.1016/s0735-1097(00)00593-3
- Nielsen JC, Andersen HR, Thomsen PE, et al. Heart failure and echocardiographic changes during long-term follow up of patients with sick sinus syndrome randomised to single chamber atrial or ventricular pacing. *Circulation* 1998;97(10):987-995. DOI: 10.1161/01.cir.97.10.987
- Morinigo JL, Arribas A, Ledesma C, et al. Clinical safety and efficacy of single-chamber atrial pacing in sick sinus syndrome: long-term follow-up. *Rev Esp Cardiol* 2002;55(12):1267-1272. DOI: 10.1016/s0300-8932(02)76799-7
- Masumoto H, Ueda Y, Kato R, et al. Long-term clinical performance of AAI pacing in patients with sick sinus syndrome: a comparison with dual-chamber pacing. *Europace* 2004;6(5):444-450. DOI: 10.1016/j.eupc.2004.05.003