

The Use of Auto Mode Switching in Patients with Sick Sinus Syndrome

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ABSTRACT

Background. At present the dual chamber pacing, originally developed for patients with AV blockades, is widely used also for patients with sick sinus syndrome (tachycardia-bradycardia type). But these patients often cause therapeutical problems to their physicians. In these cases either antiarrhythmic (AA) therapy is necessary to prevent recurrent supraventricular tachycardias (which are cause of rapid ventricular pacing) or in the case of failure of AA therapy the pacing mode has to be changed to DDI/R, which excludes physiological VAT pacing. The Auto Mode Switching (AMS) function ensures adequate ventricular pacing rate in the time of SV arrhythmias.

Methods and Results. Effects of dual chamber pacemakers equipped with AMS were studied in a group of patients with paroxysmal atrial fibrillation and/or atrial flutter.

Conclusions. Therapy brings effects in lower expenses due to less frequent visits at the physician, lower rate of rehospitalisations and lower need for powerful AA therapy.

Key words: Auto mode switching, sick sinus syndrome, supraventricular tachycardia.

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Patients with sick sinus syndrome (SSS) represent the majority of today's indications for pacemaker (PM) implantation. These patients with tachycardia-bradycardia syndrome have hemodynamically significant bradycardias and concurrent paroxysms of supraventricular tachycardias, the most frequent being atrial fibrillation with rapid ventricular response. Dual chamber pacemakers, providing most physiological form of stimulation, have always been implanted in these patients with the fear that sensing atrial arrhythmia in VAT pacing (ventricular pacing triggered by atrial activation) may lead to rapid stimulation of the ventricles and thus to serious problems.

Dual chamber pacemakers in DDD/R mode are secured against supraventricular dysrhythmias by having programmable threshold for maximal atrial rate, so-called "tracking".

The rate that is set up in this function is an upper rate limit for ventricular stimulation triggered by atrial activity. Above this rate limit, the pacemaker works in the pattern of Wenckebach's periods. In pacemakers equipped with AMS function, there is an automatic switch from DDD/R pacing to DDI/R mode, if the atrial rate reaches or exceeds the detection limit for atrial tachycardia (Fig. 1).

This function is switched on if there are 5 – 10 seconds of atrial rate higher or equal to the detection border for atrial tachycardia. A delay time is established to secure the pacemaker against changes of mode during short-lasting supraventricular tachycardias. As soon as the atrial rate drops under the preset rate for atrial tachycardia, the switch from DDI/R back to DDD/R takes place (Fig. 2). The goal of our study was to find the significance of the AMS function for patients with SSS with paroxysms of atrial fibrillation (1-3).

STUDY POPULATION AND METHODS USED

The study population consists of 30 patients, 18 females and 12 males aged 40 – 70 years, with an average age 57 years. The indication for PM implantation was SSS with paroxysms of atrial fibrillation or atrial flutter. All patients were treated with antiarrhythmics; 12 patients (40%) used beta-blockers, 10 patients (i.e. 33%) used propafenone and 8 patients (27%) had amiodarone (Tab.1).

These patients were indicated for implantation of pacemaker Trilogi DR+ equipped with AMS function. After implantation, the patients were followed up in usual intervals of 1, 3 and 6 months or as needed in case of difficulties. On follow-ups, we used recording functions of pacemaker "switch mode histogram" and "event histogram" that store records of events of supraventricular dysrhythmias in the device memory, both according to the character of an event and according to the total proportion of paroxysms in the monitored interval.

We performed 24-hour ECG Holter monitoring or monitoring by R-test in selected patients. In the patients with subjective complaints, such as palpitations, we used the function "patient triggered event recordings", when a magnet placed over PM for at least 5 seconds causes a symptomatic event to be stored in device's memory for later medical analysis of the particular event. At the most 3 events may be stored in the memory, and during the recording of the next event the oldest record is automatically deleted.

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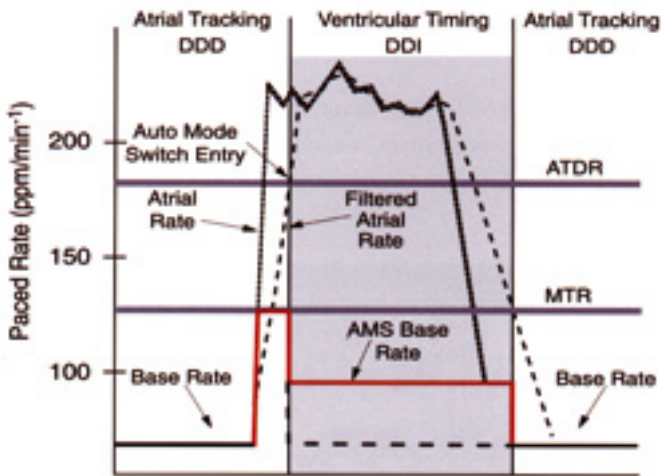


Fig. 1. Graphical representation of "auto mode switching" function – taken from user guide for Pacemaker
The lower unbroken line shows maximum ventricular rate in the patient with SSS with paroxysm of SVT, with switch of pacemaker from DDD mode to DDI mode and back after termination of arrhythmia.

RESULTS

On follow-up after half a year, our study population was divided into three groups. In group A there were 7 patients who had no records on "switch mode histogram" and who had no complaints. In group B there were 18 patients who had a record on "switch mode histogram", but had no subjective complaints. 5 patients were included in group C; they had palpitations and concurrently had a record on "switch mode histogram". After the examination of these patients we concluded that in group A, that is in 23% of patients, successful antiarrhythmic treatment was administered. In these patients, supraventricular arrhythmias do not occur any more. In group B - 60% of patients - there was effective combination of antiarrhythmic treatment with AMS function. In the last group C, that is in 17% of patients in whom paroxysms of supraventricular tachycardias were detected and who had complaints such as palpitations, we gave out magnets for recording their symptomatic events (Tab. 2).

Tab. 1. Study population

	Number (n)	Age	Average age
Males	12	40–65	55
Females	18	47–70	61

Tab. 2. Distribution of patients according to subjective complaints and records on histogram

Group	A	B	C
Number of patients	7	18	5
Record	–	+	+
Complaints	–	–	+

After assessment of these patient-triggered recordings we found that not a single one of these 5 patients had problems caused by a paroxysm of ventricular tachycardia, but all the patients had an unpleasant sensation during the switch of VAT pacing into DDD mode, in fact the beginning of atrial stimulation. The patients' complaints disappeared after reprogramming the pacemaker to lower rates with preference of their own rhythm. This change of setting removed the patients' subjective difficulties.

DISCUSSION

Patients with tachycardia-bradycardia syndrome have significant bradycardias with MAS paroxysms or their equivalents on one hand, and supraventricular tachycardias - most frequently atrial fibrillation that can also be hemodynamically significant - on the other hand. These patients are indicated for PM implantation on account of prevention from complications caused by bradycardia, and concurrently they are indicated for antiarrhythmic therapy of tachycardic events.

Nevertheless, uncertainty often exists about optimal choice of pacing mode. The pacing modes at SSS have been investigated in numerous randomized trials. For example, in the Eldery study, where paroxysms of atrial fibrillation and strokes were followed up, the results clearly support DDD pacing as opposed to non-physiological VVI.

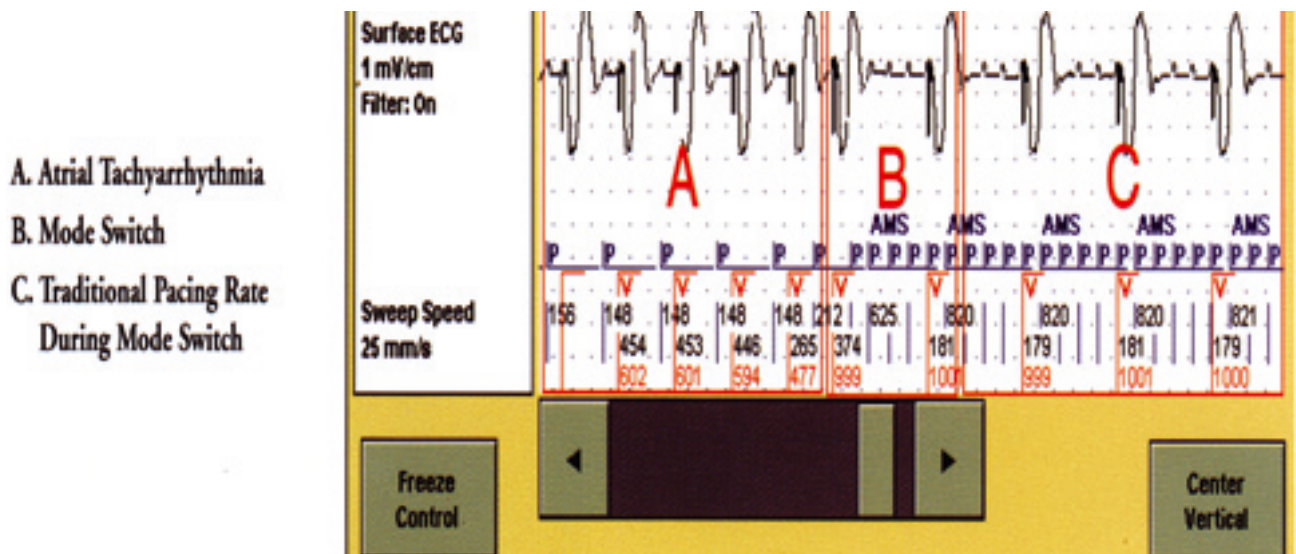


Fig. 2. Demonstration of AMS function on intracardial ECG – taken from user guide for Pacemaker
A – atrial triggered tachycardia, B – initiation of function "auto mode switching", C – ventricular pacing with exclusion of atrial sensing (DDI)

In patients with paroxysmal atrial fibrillation, permanent ventricular pacing expedites the development of chronic atrial fibrillation.

It was necessary to rely on effectivity of antiarrhythmic medication during dual chamber physiological pacing.

If antiarrhythmic drugs are not effective, then in case of SV tachycardia the patient is threatened by triggering of pacemaker tachycardia with all the consequences brought about by this condition. That is why in case of failure of antiarrhythmic medication, in most of these patients the pacemaker is reprogrammed to DDI mode without the possibility of physiological VAT.

In patients whose PM is equipped with AMS function, each episode of atrial tachycardia that exceeds the rate limit for detection of atrial tachycardia and whose duration is longer than 5 – 10 seconds, causes mode rate-dependent on atria to be switched automatically to the rate-independent mode (4–6).

In our experience these patients do not have subjective feelings such as palpitation. Because of the frequent occurrence of paroxysms of SV dysrhythmias in our study, one group of the patients was submitted to anticoagulation therapy. In these patients, combination of antiarrhythmic medication and AMS function is effective. During antiarrhythmic therapy it is possible in these patients to administer less aggressive treatment than in patients with PM without AMS function, where we always try to keep sinus rhythm (7–9).

Higher doses of antiarrhythmic drugs, or combined treatment, may bring about many adverse effects. In some patients we perform electrical cardioversion that brings a certain risk of damage of pacemaker and unfortunately involves hospitalization for the patient (10–12).

CONCLUSION

It follows from the data described above that pacemakers equipped with AMS function may be conveniently used in patients with SSS with paroxysms of atrial fibrillation or atrial flutter.

A pacemaker with AMS function provides a higher degree of comfort, and its economic advantage is undeniable. Therapy brings effects with far less frequent visits at the physician, as well as lower rate of rehospitalisations, and it is possible to prescribe less aggressive antiarrhythmic therapy.

The question remains whether anticoagulation therapy should be administered to these patients.

Abbreviations

AMS	– Auto Mode Switching
DDD/R, DDI/R, VVI	– (D – dual, R - rate responsive, I – inhibited, V – ventricle, T – triggered)
MAS	– Morgagni-Adams-Stokes syncope
PM	– pacemaker
SSS	– sick sinus syndrome
SV	– supraventricular
VAT	– ventricular pacing triggered by atrial activation

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On the Article by J. Vlašínová: “The Use of Auto Mode Switching in Patients with Sick Sinus Syndrome”

The introduction of **Auto Mode Switching (AMS)** in case of occurrence of supraventricular tachycardias (SVT) in AV sequential pacing in the first half of the 1990s represented important progress. Previously, in case of occurrence of atrial fibrillation (AF), atrial flutter or other SVT, stimulation had been effected in fixed-rate mode - with various consequences for the patient: the occurrence of palpitations owing to numerous fusion beats, worsening of mitral and tricuspidal regurgitation, and deterioration of the left ventricle filling. In the long term, left ventricle remodeling, left atrium dilation and manifestation of heart failure may develop (1). As a consequence, some pathophysiological mechanisms were activated, leading to maintenance of atrial fibrillation and its transition into permanent form without possibility of sinus rhythm restoration (2).

In modern technology, with the recently used pacemakers and implantable cardioverter-defibrillators, there is always AMS using various algorithms or their combinations in order to increase the specificity and sensitivity of change in pacing mode. Some systems offer an individual choice of various types of AMS, depending on the origin and frequency of SVT paroxysms in the particular patient (3). In clinical practice we meet patients with implanted pacemaker with AMS - yet on ECG there is apparent atrial fibrillation and inadequate AV sequential stimulation. The most frequent cause is inactive AMS, dating back to the first implantation. It is necessary to recall that the prevalence of SVT in the patients with DDD stimulation is relatively high (up to 50%); it increases from the time of implantation (4, 5), and moreover, many episodes are quite asymptomatic (6). The next problem is the amplitude of atrial signal at the time of an atrial fibrillation episode; this may be significantly lower than in sinus rhythm at the time of implantation and is outside the limits of preset sensitivity of atrial channel. Thus AMS cannot be adequately activated, and auto mode switching does not occur.

To ensure the AMS functions correctly, at the time of implantation it is necessary:

1. to assure the stable atrial electrode not only with optimal stimulation threshold but also with the best properties of sensing (maximal amplitude of P-wave),
2. to activate AMS even in the patients with the present evidence of SVT.

Recently AMS has not been the exclusive algorithm for supraventricular tachycardias used by the modern stimulation systems. The pursuit of influencing of some mechanisms of atrial fibrillation and atrial flutter origin led to the development of **preventive pacing algorithms**, which are not employed in some pacemakers. On the basis of data analysis of AF origin (7), up to 6 preventive pacing modes are developed, which can be arbitrarily combined. But it is necessary to emphasize that the use of these algorithms (e. g. activation of all of them) without deeper analysis of the mechanisms of origin and maintenance of arrhythmia is not indicated. On the contrary, use of combination of radiofrequency ablation (RFA) of atrial fibrillation and preventive algorithms seems to be promising and may lead to a significant reduction of AF paroxysms after RFA (8).

As to permanent cardiac stimulation, the present era is characterized by a search for the most physiological approach. In addition to the alternative pacing sites, **auto mode switching of atrial stimulation to AV sequential** is one of the possibilities, depending on the condition of atrioventricular conduction. This strategy is based on the fact that the antegrade conduction is unstable in the patients with sick sinus syndrome and changes over time (9).

The AAI/R mode that is most similar to sinus rhythm is preferable during the maximal period of stimulation, and at the moment when AV conduction is prolonged over the preset limit, DDD/R is automatically activated. If AV conduction is normalized, the previous mode of atrial pacing is restored.

It can be concluded that the digital systems of the third millenium offer users many ways to improve the quality of life of the patients with sick sinus syndrome and with paroxysmal supraventricular tachycardias. The future will show whether “more physiological” modes and the pacing sites may influence mortality, or some fatal complications of permanent cardiac stimulation during long-term follow-up. It is necessary to stress that our aim should be the pursuit of causal treatment of supraventricular arrhythmias. Each patient with typical atrial flutter should be indicated for catheter ablation, and in patients with symptomatic paroxysmal atrial flutter without serious structural damage of myocardium, modification of the substrate in the left atrium by a catheter ablation should also be considered. Last but not least, we should not forget the patients indicated for cardiac surgery in whom atrial fibrillation has been detected; “Maze procedure” should be the integral part of their treatment. It is apparent that the effective and complex solution of permanent cardiac pacing and supraventricular arrhythmias is possible in large specialized centers, where patients should be referred. Today in the Czech Republic there are many centers where procedures of this kind are performed.

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