Review paper

AAI – the forgotten pacing mode

AAI – zapomniany tryb stymulacji

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Słowa kluczowe: stymulacja serca, zespół chorej zatoki, AAI, DDD.

Abstract

For a long time the AAI pacing mode was commonly used in patients with sick sinus syndrome, who were treated with pacemaker. After the guideline recommendations were updated in 2013 the AAI mode was displaced by the DDDR mode, especially with atrioventricular delay management. The most important argument for this change was the risk of the development of advanced atrioventricular block in long-term observation. This situation may require changing the pacing mode to DDD and implanting a ventricular lead. However, the AAI pacing mode has many forgotten advantages and it could still be successfully used in well selected patients with sick sinus syndrome.

Streszczenie

Przez wiele lat tryb stymulacji AAI był powszechnie używany u pacjentów z zespołem chorej zatoki, którzy wymagali implantacji kardiostymulatora. Po zmianie wytycznych w 2013 r. rozruszniki AAI zostały niemal całkowicie wyparte przez DDD, zwłaszcza z programowanym czasem opóźnienia przedsionkowo-komorowego. Argumentem za taką zmianą postępowania było głównie ryzyko rozwoju zaawansowanego bloku przedsionkowo-komorowego w długoterminowej obserwacji. Taka sytuacja może skutkować koniecznością zmiany trybu stymulacji, a co za tym idzie – koniecznością implantacji elektrody komorowej. Należy jednak pamiętać, że stymulacja w trybie AAI ma także wiele zapomnianych korzyści, które powodują, że nadal może ona być z powodzeniem stosowana w dobrze dobranej grupie pacjentów z objawową chorobą węzła zatokowego.

Two decades ago a small randomised trial showed better overall survival with AAIR pacing than with single-lead ventricular pacing [1]. Patients with sick sinus syndrome (SSS) managed by atrial pacing (AAI) had lower rates of atrial fibrillation [1–4], arterial thromboembolism [1–3], and mortality [1, 3–5] compared with those treated by ventricular pacing (VVI). It was also reported that patients with SSS benefited more from dual-chamber pacing (DDD) than from VVI [6–8]. The comparison of AAIR pacing with DDDR pacing showed no difference in survival. However, AAIR pacing was associated with a higher incidence of paroxysmal atrial fibrillation [9].

For a long time it was controversial which pacing mode, AAI or DDD, was more favourable for patients with SSS and normal AV conduction. Therefore, both modes were commonly used.

ESC Guidelines on cardiac pacing and cardiac resynchronisation therapy, published in 2013, changed the management of patients with SSS. DDD pacing became the preferred mode in this indication. The AAI mode has stayed as a second or third choice of therapy and has an indefinite class of recommendations [10]. The most important reason for this recommendation was the result of the DANPACE trial. The study demonstrated that in patients with SSS there is no statistically significant difference in death from any cause between AAIR pacing and DDDR pacing programmed with a moderately prolonged atrioventricular interval. The most important conclusion of this trial was that the risk of the development of advanced AV block was estimated to be 1.7% per year in the AAI group [9]. The consequence of this situation could be the need for changing the pacing mode and implantation of a ventricular lead. Any pacemaker reoperation is associated with a 2% risk of device infection, with a potential need to extract the complete pacemaker system [11, 12]. Some studies showed

that bundle branch block, bifascicular block [13], or Wenckebach block point lower than 120 beats/min [14] were predictive for the development of advanced atrioventricular block. However, some other studies presented opposing results [15, 16]. This information is a decisive factor for routine implantation of DDD-mode pacemaker in SSS [10]. However, careful analysis of the results of this trial showed that the need for change of the pacing mode accounted for only one third of the reasons for reoperation. More often the indication for this procedure was battery depletion, or lead-related surgical or mechanical complication [9]. All of there elements depend on the pacing device or the technique of implantation. What is more, the study period (1999–2008) suggests that this data could be invalid and might not reflect the present situation. The reason for this is pacemaker, lead, and technique of implantation development during those years. Routine use of leads with active fixation can particularly change these statistics because their translocation should be rarer than for passive leads. There are studies that confirm this theory. The results of a comparative analysis of the effectiveness of active versus passive atrial lead fixation in Chinese patients with cardiac implantable electrical devices are very promising and might be important in the discussion on the role of AAI pacing. Active atrial lead fixation demonstrated lower mean atrial implantation times, greater stability, steady long-term thresholds, and minimal lead-related complications. What is more, there were no cases of myocardial perforation, cardiac tamponade, implantation failure, or electrode dislocation/re-fixation. Hospitalisation time was also shorter in the active fixation group in this study [17].

Lead failure is one of the most important complications during long-term follow-up after pacemaker implantation. The relative risk for lead failure in double-lead pacing is calculated to be around two-fold higher than in single-lead pacing, since twice the number of pacing leads are implanted [14, 18, 19]. This aspect of DDD implantation was not approached in the DANPACE study. Median follow-up in this trial was 5.4 years [9], which could be too short to show the scale of the problem. In one study the mean age of removed atrial and ventricular leads was reported to be 80.1 and 56.9 months, respectively [19].

The number of pacing leads remaining in the body is one of the most important factors in the development of potential stimulation complications. Multiple leads can drag or rub against each other during the heart movements in systole and diastole. That is why multiple pacing leads may be associated with a greater risk of their damage, infection, venous occlusion, or lead migration [14, 18–22]. Ventricular lead presence can be the cause of tricuspid valve regurgitation [23], which can be important for general patient condition.

Unpublished data from the Polish Transvenous Lead Extraction Registry, steered by professor Andrzej Kutarski from 2006 to 2016, showed that AAI pacemakers were related with lower complication risk. In this registry only 4% of interventions were made in the AAI group (93 of 2323 patients). What is more, non-infectious indications were the main reason for operation (66.7%). Other indications included: lead-dependent infective endocarditis (LDIE) (20.4%) and local pocket infection (12.9%). In contrast, 40% of these procedures were made in the DDD group (942 of 2323 patients). Also in this group non-infectious indications prevailed over infectious indications (55.7% vs. 44.3%). The number of LDIE cases amounted to 169 (17.4%), and local pocket infection 243 (25.8%). The conclusion was that in the AAI group non-infectious complications were more frequent, pocket infections were rarer, and LDIE were equally frequent in both groups.

Nowadays, infective complications are the most important kind of infections associated with implantable devices. Some data show that the risk of LDIE depends on the number of leads [18]. That is why the construction simplicity of the AAI pacemaker is of great additional value. But it is also true that the DANPACE trial results are contrary to this information.

All of these arguments show that the discussion about the pacing mode in SSS is still open. For many years AAI pacemakers have been used with success. For many patients it was the only kind of pacing mode they needed for their whole life. Nowadays, following new guidelines, AAI pacemakers are rarely implanted. However, this pacing mode could still be useful. Its most important advantage is the construction simplicity, which should result in lower crashworthiness, especially mechanical. We should remember that trial results are not unequivocal in this field. On the other hand, AAI pacing is associated with the risk of the development of advanced AV blocks. Yet there are no identified specific factors that can credibly predict the risk of this problem. Also, the guidelines are not clear enough to select patients with SSS for AAI implantation. This situation means that the responsibility due to the patients' claims following any complications related to the ventricular lead not being implanted could be shifted onto the physician. However, taking it all into account, the AAI mode can be an interesting alternative to the DDD mode. AAI pacemakers should be considered for implantation to avoid lead-dependent complications, especially in younger patients. What is more, active lead fixation, which is currently a standard procedure, should improve short- and long-term statistics. That is why the AAI pacing mode is still worthy of interest and should be further studied in the future.

Conflict of interest

The authors declare no conflict of interest.

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