AAI pacing for sick sinus syndrome: first choice on all counts

The British Pacing and Electrophysiology Group guidelines for pacemaker prescription recommend single chamber atrial pacing as the most appropriate pacing mode for sinus node disease in the absence of atrioventricular conduction disturbance. As such it offers a rare combination of maximum clinical effectiveness for the minimum cost and a good training opportunity. However, it seems that this message has yet to be translated into pacing practice in the UK.

In this issue of Heart, Clarke et al retrospectively analyses the pacing activity for sinus node disease in a tertiary pacing centre over five years. They conclude that in their centre £103 000 per year could have been saved by more judicious use of AAI pacing, largely by reducing the DDD implant rate. It seems likely that these potential savings are equally applicable to the rest of the UK. Current pacemaker prescribing for sinus node disease is frequently illogical, ignores current evidence, and misses out on training opportunities for junior staff.

The evidence to support atrial based pacing for sinus node disease, rather than single chamber ventricular pacing, is very strong. Numerous retrospective studies have demonstrated that mortality and morbidity are greater in ventricular only paced patients, and that the progression to chronic atrial fibrillation (AF) is less common in patients with atrial based pacing. Although these data may be criticised for the potential biases inherent in retrospective studies, since 1994 data have been available from the first prospective randomised study. Andersen et al were able to demonstrate a reduction in the frequency of AF and incidence of thromboembolism (5% v 18%) with atrial pacing after three years of follow up. The most recent analysis of this study (at 5.5 years of follow up) has also shown a significant reduction in all cause mortality (35.5% v 49.6%) and the degree of heart failure in patients with AAI pacing. Another small prospective randomised study recently compared “physiological” (AAI, DDD, DDDR or VDD) pacing with “non-physiological” (VVI or VVIR) pacing. This also showed a significant reduction in the incidence of chronic AF (8% v 22%) and stroke (10% v 22%) when patients received a physiological pacing system. To support this message, the first results of the PASE study (pacemaker selection in the elderly) show a non-significant reduction in mortality (6% v 12%), stroke (2% v 4%), and all cardiac events (10% v 19%) at one year of follow up. The authors of this study hope that further follow up will allow these trends to reach significance.

Despite this evidence to support the use of AAI pacing, the latest British Pacing and Electrophysiology Group registry data reveal that of 2700 patients paced in the UK in 1995 for sinus node disease (codes E1–E5), 44% received ventricular only pacing systems, 45% received dual chamber devices, and only 11% received atrial only devices (UK National Pacemaker Database). This raises two important questions. Why do we implant dual chamber devices when a single chamber atrial device may provide the same benefits at a greatly reduced cost and, more importantly, why are so many patients still receiving inappropriate pacing systems?

With reference to the implantation of dual chamber devices, one explanation might be that cardiologists are afraid of the development of complete heart block in patients without a ventricular lead. However, the evidence to date suggests that with no evidence of atrioventricular (AV) nodal or His-Purkinje dysfunction at implantation, the subsequent incidence of symptomatic AV block is small. In Clarke et al’s series, 5.8% of AAI paced patients developed high grade AV block over the follow up period (1% each year). None of these patients suffered any significant morbidity. These findings are in keeping with other retrospective studies where the incidence of AV block varies from 0.6–2% per annum. Of these, the studies reporting a high incidence include either only very small numbers or do not exclude patients at high risk. Indeed, Brandt and colleagues (who reported a rate of 1.8% per annum) subsequently showed that the development of AV block was predicted by pre-existing bundle branch block or bifascicular block, and the incidence of AV block in patients without these findings was much lower. Many of the other studies selected patients for AAI pacing with the additional criteria of the absence of first degree heart block and a Wenckebach point of greater than 120 beats/min. Although neither has been shown to predict progression to AV block, their use as inclusion criteria in these studies has led to their widespread acceptance in clinical practice.

In Andersen et al’s prospective study, the incidence of AV block was 0.6% per annum in patients receiving AAI pacemakers. While this study excluded patients with ventricular conduction disturbance, first degree AV block, and a low Wenckebach rate, only 30% of patients evaluated were excluded on these grounds. This is in keeping with other data that suggest that the incidence of AV conduction disturbance in patients with sinus node disease is about 30%.

A recent paper by Hildick-Smith et al has raised concerns that pacemaker upgrade itself may result in a high complication rate. This paper retrospectively reviewed the complications associated with upgrading ventricular single chamber pacemakers to DDD systems and concluded that 45% of patients experienced a “complication”. However, included in the definition of complications was a “prolonged procedure” (> 102 minutes), which accounted for 42% of the complications. While this is not desirable, it probably does not constitute a major complication, it adds little to the cost of the procedure, and in this study it was not associated with other complications. Also included was “atrial lead reposition within six weeks”, which accounted for a further 33% of the complications. Obviously, this cannot be applied to the upgrade of AAI pacemakers where the atrial lead is already in situ and stable. Omitting these complications would reduce the complication rate to 14%. The authors also note that the complication rate was more than halved when the operator was an experienced upgrader (more than two previous procedures). Therefore, in experienced hands, upgrade of an AAI pacing system does not carry an exceptionally high complication rate.

In contrast to the perceived reasons for implanting DDD devices, there can be no logical reason for having implanted 44% (1188) VVI pacemakers for sinus node disease in 1995. The evidence for the low incidence of AV block applies as for DDD pacing but the financial arguments against VVI pacing...
are even stronger. Sutton and Bourgeois analysed the literature on the effects of different pacing modes for sick sinus syndrome to produce a model for cost–benefit analysis.\textsuperscript{7} This model establishes the cost of various factors such as implantation, follow up, and complications (for example, AF stroke and heart failure) in arbitrary units (100 = the cost of a single chamber pulse generator). Applying this model to the UK in 1995, of 2700 patients paced for sinus node disease, 45\% received dual chamber devices, 44\% received ventricular only pacing systems, and 11\% received atrial only devices (UK National Pacemaker Database). Using the evidence described above, it could be argued that only 30\% should have received DDD systems (because of concurrent AV conduction disturbance) and 70\% should have received AAI systems. Assuming the cost of single chamber pulse generator to be £900 (+VAT), the potential saving in 1995 would have been £380 700 in hardware costs alone. The reduced implantation and follow up costs of AAI \textless DDD pacing would have saved a further £125 478 over the first year. Therefore, the reduced yearly costs of follow up approximately balance the potential cost of upgrading patients who develop AV block. However, the elimination of VVI pacing for sinus node disease would have resulted in even greater savings. Essentially the cost of implanting a single chamber device is the same whether it be atrial or ventricular. Using the same model,\textsuperscript{24} the health care savings from the reduction in AF, heart failure, stroke, and subsequent disability seen with AAI pacing would amount to £835 797 per annum for patients paced in 1995 (again allowing for upgrades). This is in addition to any reduction in mortality.\textsuperscript{12}

Why are so many patients given inappropriate devices? It seems likely that any reasons proffered are merely excuses for ignorance or lack of interest in pacing at a senior level. Certainly, pacing appears to be predominantly a junior staff activity in many UK centres. Fear of the atrium as a site for permanent pacing leads may also be to blame. This is perhaps understandable for the inexperienced junior, as lead displacement is said to be more common in the atrium than the ventricle.\textsuperscript{3,27} This is only true, however, for inexperienced operators\textsuperscript{3,27} — the obvious solution is improved training. AAI pacing provides the ideal setting to learn atrial lead positioning as it is free from the additional complexities associated with dual chamber pacing. Combined with a greater senior input, increased use of AAI pacing should enable all junior cardiologists to become competent at placing atrial leads, even in non-specialist centres.

AAI should be the default pacing mode for sinus node disease (as recommended by BPEG)\textsuperscript{2} in the absence of AV conduction disturbance. It is almost the ideal treatment — simple and yet elegant, it combines an excellent training opportunity with maximum clinical benefit for the lowest feasible cost.

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