



EDITORIAL COMMENT

Enhanced pacing modalities in bradycardia patients: Can technology reduce costs?



Aperfeiçoamento das modalidades de *pacing* nos doentes com bradicardia: poderão as tecnologias reduzir os custos?

Mário Martins Oliveira ^{a,b,c}

^a *Unidade de Arritmologia, Pacing e Eletrofisiologia (UNAPE), Centro Hospitalar Universitário Lisboa Central, Hospital de Santa Marta, Lisboa, Portugal*

^b *Centro do Coração, Hospital CUF Infante Santo, Lisboa, Portugal*

^c *Instituto de Fisiologia, Faculdade de Medicina de Lisboa, Lisboa, Portugal*

Several studies have demonstrated the deleterious impact of conventional right ventricular apical pacing on cardiac performance, particularly regarding the induction of ventricular dyssynchrony, deterioration of left ventricular function and development of heart failure. There is also a strong association with increased incidence of atrial fibrillation (AF) in patients requiring implantation of permanent pacemakers for sinus node disease (SND) or atrioventricular block (AVB), with or without prior paroxysmal AF.^{1–4}

The ideal pacing mode in patients with SND is still the subject of debate. Despite previous studies showing that atrial-based pacing, compared with ventricular pacing, may reduce the occurrence of AF, these patients may subsequently develop advanced AVB, requiring ventricular pacing. Also, although atrial antitachycardia pacing (ATP) therapies have been associated with long-term reduction of the atrial tachyarrhythmias burden in patients with pacemakers, the real clinical benefits of algorithms using ATP to prevent AF initiation are still under discussion.⁵

The MINimize Right Ventricular pacing to prevent Atrial fibrillation and heart failure (MINERVA) multicenter international randomized trial examined whether a combined

pacing modality, including atrial preventive pacing, ATP and the managed ventricular pacing (MVP) algorithm, designed to give priority to intrinsic ventricular activation and thereby minimize ventricular pacing, reduced mortality, morbidity, or progression to permanent AF when compared with standard dual-chamber pacing.⁶ The main results showed that this combination of algorithms was associated with a statistically and clinically significant lower risk of a composite endpoint of death, cardiovascular hospitalizations, or progression to permanent AF at two-year follow-up, compared with standard DDDR pacing in patients with bradycardia and paroxysmal or persistent atrial tachyarrhythmias.

Another study, by Padeletti et al., analyzed the MINERVA algorithm for the prevention of AF progression by randomly assigning patients to DDDR (n=385), MVP (n=398), or DDDR with ATP + MVP (n=383).⁷ The best results were obtained using the combined algorithm of ATP + MVP. Permanent or persistent AF was significantly reduced in patients with high ATP efficacy (hazard ratio [HR] 0.32; 95% confidence interval [CI] 0.13-0.78; p=0.012) and in those with high atrial pacing (HR 0.98; 95% CI 0.97-0.99; p=0.011); conversely, a higher risk of permanent or persistent AF was associated with higher ventricular pacing (HR 1.03; 95% CI 1.02-1.05; p<0.001).

In this issue of the *Journal*, Sousa et al. present the results of a complementary study in which they performed a healthcare cost analysis of enhanced pacing modalities in a

DOI of original article: <https://doi.org/10.1016/j.repc.2018.01.013>

E-mail address: m.martinsoliveira@gmail.com

Portuguese population, based on the results of the MINERVA trial.⁸ Previously, Boriani et al. also performed a healthcare cost analysis focused on MINERVA, with data from the USA, Italy, Spain and the UK.⁹ They demonstrated significant savings using this algorithm regarding utilization of AF-related health resources, resulting in significant cost reductions in medical practice across these diverse healthcare systems.

The present study calculated the cost impact of the ATP+MVP algorithm, using the same methodology as in Boriani et al.,⁹ with an analysis of the Portuguese tariffs for AF-related hospitalizations and for emergency department and unscheduled outpatient visits. According to the authors, the cost saving associated with the use of this combined algorithm could be 17 118 euros per 100 patients over a 10-year period (the estimated lifetime of the device).

These national tariffs, based on data published by the Central Administration of the Portuguese National Health System (ACSS), do not consider specific costs for hospital admissions due to AF, or for hospitalizations or outpatient or emergency care visits in patients with implantable pulse generators.^{10,11} This may, of course, have led to underestimation of the associated healthcare costs in such a complex population. Moreover, there are no published data on the proportion of patients undergoing pacemaker implantation presenting with previous atrial tachyarrhythmias. Portugal has one of the highest rates of pacemaker implantation in Europe (1000 per million population) (Sanfins, et al. Registo Nacional de Pacing Cardíaco; Associação Portuguesa de Arritmologia, Pacing e Eletrofisiologia; Arritmias 2018 - oral communication). Considering the growing prevalence of AF and the aging of the Portuguese population, a reduction in AF-related health resource utilization could contribute to significant savings in the healthcare system.

Interestingly, compared to the data from the USA, the UK, Italy, and Spain used by Boriani et al.,⁹ the average tariff/costs per episode in Portugal were between 38% and 72% lower for hospital admissions, and 22% to 76% lower for emergency department visits. Costs associated with outpatient visits were higher than in Italy, similar to those in Spain and lower than in the USA and the UK. An update of the costs of healthcare utilization for specific clinical situations requiring hospitalizations and emergency care visits, and costs of outpatient visits according to the type of cardiac electronic device implanted, could potentially increase the cost savings calculated by Sousa et al. In fact, the MINERVA pacing algorithm was associated with reductions of 42% and 68% in the event rates for hospitalization and emergency department visits, respectively, which may also be associated with significant benefits regarding healthcare costs.⁷

Finally, this analysis, focusing on the cost savings obtained by using a combination of ATP + MVP in patients with previous atrial arrhythmias undergoing dual-chamber

pacemaker implantation due to SND, did not take into consideration the pricing of the devices, and it should therefore be borne in mind that the potential benefits assume that prices for these devices will remain similar.

Conflicts of interest

The author has no conflicts of interest to declare.

References

1. Tops LF, Schalij MJ, Bax JJ. The effects of right ventricular apical pacing on ventricular function and dyssynchrony implications for therapy. *J Am Coll Cardiol*. 2009;54:764–76.
2. Mattioli AV, Vivoli D, Mattioli G. Influence of pacing modalities on the incidence of atrial fibrillation in patients without prior atrial fibrillation. A prospective study. *Eur Heart J*. 1998;19:282–6.
3. Sweeney M, Hellkamp A, Ellenbogen K, et al., MDe Selection Trial (MOST) Investigators. Adverse effect of ventricular pacing on heart failure and atrial fibrillation among patients with normal baseline QRS duration in a clinical trial of pacemaker therapy for sinus node dysfunction. *Circulation*. 2003;107:2932–3293.
4. Veasey R, Arya A, Silberbauer J, et al. The relationship between right ventricular pacing and atrial fibrillation burden and disease progression in patients with paroxysmal atrial fibrillation: the long-MinVPACE study. *Europace*. 2011;13:815–20.
5. Gillis AM, Koehler J, Morck M, et al. High atrial antitachycardia pacing therapy efficacy is associated with a reduction in atrial tachyarrhythmia burden in a subset of patients with sinus node dysfunction and paroxysmal atrial fibrillation. *Heart Rhythm*. 2005;2:791–6.
6. Boriani G, Tukkier R, Manolis AS, et al., on behalf of the MINERVA Investigators. Atrial antitachycardia pacing and managed ventricular pacing in bradycardia patients with paroxysmal or persistent atrial tachyarrhythmias: the MINERVA randomized multicentre international trial. *Eur Heart J*. 2014;35:2352–62.
7. Padeletti L, Pürerfellner H, Mont L, et al., on behalf of the MINERVA Investigators. New-generation atrial antitachycardia pacing (Reactive ATP) is associated with reduced risk of persistent or permanent atrial fibrillation in patients with bradycardia: results from the MINERVA randomized multicenter international trial. *Heart Rhythm*. 2015;12.
8. de Sousa J, Marques P, Martins V, et al. Health care cost analysis of enhanced pacing modalities in bradycardia patients: Portuguese case study on the results of the MINERVA trial. *Rev Port Cardiol*. 2018;37:973–8.
9. Boriani G, Manolis AS, Tukkier R, et al., on behalf of the MINERVA Investigators. Effects of enhanced pacing modalities on health care resource utilization and costs in bradycardia patients: an analysis of the randomized MINERVA trial. *Heart Rhythm*. 2015;12:1192–200.
10. Portaria no234/2015 de 7 de Agosto. Tabela Nacional dos Grupos de Diagnóstico Homogéneo; 2015.
11. ACSS (Autoridade Central do Sistema de Saúde). Base de dados dos elementos analíticos; 2009.