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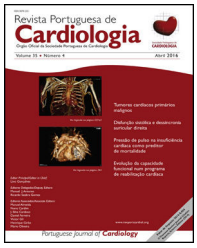

EDITORIAL COMMENT

''MZ was here!'' The importance of an implantable cardioverter-defibrillator monitoring zone in the primary prevention of sudden death

«MZ was here» A importância da programação de uma zona de monitorização em cardioversores-desfibrilhadores implantados para prevenção primária de morte súbita

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It is a long time since the concept of the 'shock box' was popular. This device was proposed in the late 1990s for certain types of primary rhythm disturbances, such as Brugada syndrome. The rationale of this concept was that highly sophisticated implantable cardioverter-defibrillator (ICD) programming was not required to treat very fast polymorphic ventricular tachycardia (VT) or ventricular fibrillation (VF). A single detection zone and shock-only therapy would be sufficient to treat these patients with high efficacy. An important reason for this proposal at that time was certainly the high price and short lifetime of ICDs, and the intention was to make the ICD a cheaper and consequently more cost-effective therapy. The concept was widely discussed but was never put into practice.

Looking back over the last 20 years, knowledge of the underlying diseases and arrhythmogenic mechanisms are now much improved. Once again, a good example is Brugada syndrome: the possibility of monomorphic VT and fast atrial fibrillation (AF), and not only polymorphic VT, justifies additional programming beyond the shock box. We need at least a monitoring zone (MZ) to obtain some additional input on the patient's arrhythmic burden, particularly in patients suffering inappropriate therapies.

In the late 1990s, the ICD underwent significant technological advances, taking on many of the features of currently available systems. New developments included significant reductions in size and the advent of implantation in a subcutaneous pectoral pocket with intracavitary leads, which led to the widespread use of this therapy.[1]

Three main developments occurred early in this century. First was improvement in the quality of batteries and capacitors, leading to increased device longevity. This was an essential factor in improving the cost-effectiveness of the ICD, by reducing the need for generator replacements. The Multicenter Automatic Defibrillator Implantation Trial (MADIT) II[2] found a significant reduction in mortality in patients with ischemic heart disease and left ventricular ejection fraction <30% over a 20-month follow-up in primary prevention, but when follow-up was extended to 96 months this benefit was more marked,[3] with relative mortality reduction rising from 31% to 37% and the number needed to treat to save one life decreasing from 17 to 6. Furthermore, the costs of the therapy have decreased substantially over the past 16 years: from 19.4 euros per day of treatment in 2002 to 2.96 euros in 2018. Second, ICDs have become more technologically advanced, including better detection algorithms and the ability to store intracardiac electrograms (EGMs). Stored intracardiac EGMs are

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the most valuable source of telemetric information for use in troubleshooting and in gaining insight into the mechanisms of onset of VT/VF.[1] The MZ takes advantage of this storage capability, with a low cutoff zone allowing EGM storage without therapy delivery. Third is remote monitoring, a tool that has made follow-up more efficient for patients and physicians[4] and may improve patient survival.[5] It enables immediate assessment of alerts, stored EGMs and ICD therapy behavior.

Unpublished data from the Portuguese Registry on Cardiac Electrophysiology for 2016 reveal that a primary prevention indication accounted for 78% of ICD or cardiac resynchronization therapy-defibrillator (CRT-D) implantations. This proportion is similar to that found in the Spanish ICD registry for 2015, in which 59.1% of patients had no previously documented arrhythmia at the time of device implantation.[6]

In this issue of the *Journal*, Rosa et al. retrospectively analyze their single-center population of patients who underwent ICD or CRT-D implantation for primary prevention between 2006 and 2015, with an MZ programmed and under remote monitoring.[7]

In view of the increasing number of patients who receive an ICD or CRT-D for primary prevention, I consider the lessons to be drawn from this study to be of the utmost importance.

The aim of the study was to assess the benefit of programming an MZ in clinical practice and its impact on treatment. In patients with arrhythmic events documented in the MZ, the decision of the physician in the outpatient clinic regarding the treatment approach was analyzed by reviewing patient files. A second analysis of MZ reports was performed through RM systems to determine the impact of changes in medication or invasive strategy on the recurrence of arrhythmic events.[7]

The MZ was programmed according to heart rate (140-170 bpm) and arrhythmia persistence (number of consecutive cycles >50). The therapy zones were programmed for 170-200 bpm for 30 out of 40 cycles (ATP attempts or shock), and >200 bpm for 12 out of 18 cycles (ATP during charge or shock). The authors found arrhythmic events in the MZ in 62.9% of patients. Supraventricular arrhythmias accounted for almost half of all findings (49.4%), with a similar incidence of supraventricular tachycardia and AF/atrial flutter. Non-sustained ventricular tachycardia (NSVT) occurred in 74 patients (42.5% of all events) in the MZ, and only five events were due to noise.

The authors conclude that these findings had a significant impact on clinical practice, since in half of the patients outpatient medication was changed and/or ablation was performed. This optimization in patient management resulted in a considerable reduction in arrhythmic events reported in the MZ.[7]

Evidence that shocks administered by an ICD may be deleterious has recently influenced the type of programming adopted. Internal electric shocks decrease quality of life,[8] may cause depression and anxiety, are known to be proarrhythmic,[9] and may be associated with increased mortality.[10]

During the time span of the recruitment for this study, various relevant papers were published assessing high-rate ICD therapy or prolonged detection.

One of the most important was the MADIT-RIT study by Moss et al.,[11] published in 2012, some years after the beginning of patient recruitment for the present retrospective analysis. The detection zones used in the present study, which also match our clinical practice, resemble the conventional arm in MADIT-RIT. In the latter, there was a fast-rate arm (Arm B) and a duration-delay arm (Arm C). The MZ was programmed in the fast-rate arm (zone 1: monitor only >170 bpm, zone 2: $\geq$200 bpm ATP during charge and shock with a delay of 2.5 s) but not in the extended arm (here, the first zone was programmed for $\geq$170 bpm with ATP and shocks and a long delay of 60 s).

Similar programming was used in a study by Clementy et al.,[12] with an MZ programmed between 170 and 220 bpm and only one therapy zone, at >220 bpm. When a ventricular episode was detected in the monitoring zone, baseline programming was only modified in the event of concomitant symptoms, regardless of whether the episode was sustained. The modification then usually consisted of three bursts of ATP followed by shocks (lower energy for the first attempt, then at maximum output) between 170 and 220 bpm. Some traces of the old concept of the 'shock box' persisted, albeit with a programmed MZ, which was of particular importance for reprogramming after inappropriate therapy. Ventricular episodes long enough to be detected in the MZ were recorded in 44 patients (12%). Thirty-seven of these (84%) remained completely asymptomatic, so device programming was not altered. In the other seven patients, ATP followed by shocks was programmed in the VT zone (170-220 bpm), replacing the MZ. Four patients were hospitalized during follow-up for symptomatic prolonged slow VT episodes below the monitoring zone (<170 bpm). For these, a slow VT zone with multiple ATP therapies was added.

The main reason for the use of an MZ in these circumstances was undoubtedly concern about arrhythmias under treatment. In patients with ischemic heart disease or dilated cardiomyopathy and impaired left ventricular systolic function in whom no arrhythmia has been previously documented, it is not possible to predict how a ventricular arrhythmia will present – sustained or non-sustained, rapid or slow, well or poorly tolerated – as this depends not only on the myocardial substrate but also on the patient's clinical condition and medication.

The aforementioned studies demonstrated reductions in inappropriate or unnecessary therapies in primary prevention with new schemes of delayed detection or higher detection zones, without compromising safety. However, the utility of the MZ is also demonstrated in not only a high but also in a low MZ, as used in the article that is the subject of this editorial.

When to perform VT ablation is currently the subject of debate: certainly in patients with an arrhythmic storm, but whether to perform it after the first or multiple shocks remains in dispute. In my opinion, the MZ has a role to play. If antiarrhythmic therapy such as amiodarone is the first choice (and this drug often slows down the clinical VT), the MZ could then be used to identify patients who should be referred for VT ablation to prevent future ICD therapies. Thus, the MZ is an important tool for modifying the empirical detection zones and therapies programmed just after implantation to those more tailored to the patient's specific arrhythmias.

As pointed out by Rosa et al., the occurrence of NSVT is associated with increased risk of death in both ischemic and non-ischemic cardiomyopathy, and thus its detection in the MZ followed by treatment, particularly ablation of the VT substrate, could potentially reduce mortality. The survival benefit may be the result of reductions in ICD shocks, which are known to be deleterious,[9] or simply of a reduction in VT burden, but additional mechanisms may also be at work. It is crucial to program ICDs so as to minimize the risk of ICD shocks, and the MZ may be particularly helpful for this purpose.

In the present study, the incidence of ICD therapies in patients with events in the MZ was similar to that of patients without (16.1% vs. 15.5%, respectively), suggesting that programming an MZ did not negatively impact the occurrence of appropriate therapies. This was expected because the MZ was programmed independently of therapy zones.

However, there have been concerns that an MZ may be associated with increased risk of inappropriate device therapy. Difficulties in arrhythmia redetection or confirmation, resulting in inappropriate therapies, have been reported with certain models of ICDs. This occurs when the MZ is a true tachycardia zone with therapies switched off, in combination with the use of binning. In these circumstances, the rate may remain intermittently in the MZ after an appropriate shock, for example in patients in AF, which results in the VT episode not being declared over and inappropriate shocks being triggered.[13]

During the Second World War, a Massachusetts shipyard inspector named James J. Kilroy, whose job was to inspect the riveting in the vessels which were produced by the shipyard, had a problem to solve. Initially, Kilroy put a chalk mark on items for which the riveters were to be paid. However, he discovered that riveters would then erase these marks so that they would be paid twice. So he began writing ''Kilroy was here'' next to the marks. When the ships left the shipyard, there was no time to paint over his marks, so the phrase remained visible, puzzling servicemen in the war zones. This story became part of the mythical origin of the phrase.[14,15]

Similarly, if the MZ in an ICD or a CRT-D is switched on, when the ICD is interrogated and reveals recorded unsuspected arrhythmias such as VT or AF, this should lead us to change the ICD programming and say ''MZ was here''.

Conflicts of interest

The author has no conflicts of interest to declare.

References

1. Nisam S. Technology Update: the modern implantable cardioverter defibrillator. Ann Noninvasive Electrophysiol. 1997;2:69–78.
2. Moss AJ, Zareba W, Hall WJ, et al., Multicenter Automatic Defibrillator Implantation Trial II Investigators. Prophylactic implantation of a defibrillator in patients with myocardial infarction and reduced ejection fraction. N Engl J Med. 2002;346:877–83.
3. Goldenberg I, Gillespie J, Moss A. Long-term benefit of primary prevention with an implantable cardioverter-defibrillator: an extended 8-year follow-up study of the Multicenter Automatic Defibrillator Implantation Trial II. Circulation. 2010;122:1265–71.
4. Fernandes M, Oliveira M, Primo J, et al., on behalf of the PORTLink study investigators. Remote versus In-Office Monitoring for Implantable Cardioverter Defibrillators: the PORTLink study (PORTuguese Research on Telemonitoring with CareLink) [abstract] CNM 46 Congresso Português de Cardiologia 2017; 2017.
5. Hindricks G, Taborsky M, Glikson M, et al. Implant-based multiparameter telemonitoring of patients with heart failure (IN-TIME): a randomised controlled trial. Lancet. 2014;384: 583–90.
6. Alzueta J, Fernandez-Lozano I, Barrera A. Registro Espanol de Desfibrilador Automatico Implantable. XI Informe Oficial de la Seccion de Electrofisiologıa y Arritmias de la Sociedad Española de Cardiología (2015). Rev Esp Cardiol. 2016;69: 1168–79.
7. Aguiar Rosa S, Oliveira M, Silva Cunha P. Importance of monitoring zones in the detection of arrhythmias in patients with implantable cardioverter-defibrillators under remote monitoring. Rev Port Cardiol. 2019;38:11–6.
8. Francis J, Johnson B, Niehaus M. Quality of life in patients with implantable cardioverter defibrillators. Indian Pacing Electrophysiol J. 2006;6:173–81.
9. Mitchell LB, Pineda EA, Titus JL, et al. Sudden death in patients with implantable cardioverter defibrillators: the importance of post-shock electromechanical dissociation. J Am Coll Cardiol. 2002;39:1323–8.
10. Poole JE, Johnson GW, Hellkamp AS, et al. Prognostic importance of defibrillator shocks in patients with heart failure. N Engl J Med. 2008;359:1009–17.
11. Moss AJ, Schuger C, Beck CA, MADIT-RIT Trial Investigators. Reduction in inappropriate therapy and mortality through ICD programming. N Engl J Med. 2012;367:2275–83.
12. Clementy N, Pierre B, Lallemand B, et al. Long-term follow-up on high-rate cut-off programming for implantable cardioverter defibrillators in primary prevention patients with left ventricular systolic dysfunction. Europace. 2012;14: 968–74.
13. Evertz R, Trucco E, Tolosana JM, et al. Inappropriate ICD shocks – when monitoring zones do more than monitor. Indian Pacing Electrophysiol J. 2013;13:190–3.
14. Auster P. The New York Trilogy: City of Glass. London: Faber and Faber; 1987.
15. Transit association ships a street car to shelter family of 'Kilroy Was Here'. The New York Times. 1946.