POLISH HEART JOURNAL

Kardiologia Polska
The Official Peer-reviewed Journal of the Polish Cardiac Society since 1957

Online first
This is a provisional PDF only. Copyedited and fully formatted version will be made available soon

ISSN 0022–9032 e-ISSN 1897–4279

First experience in simultaneous use of the extravascular implantable cardioverter-defibrillator and the leadless atrioventricular pacemaker

Authors: Maciej Sterliński, Ewa Świerżyńska-Wodarska, Joanna Zakrzewska-Koperska, Krystyna Guzek, Anna Drohomirecka, Łukasz Szumowski

Article type: Clinical vignette

Received: September 6, 2024

Accepted: September 6, 2024

Early publication date: September 6, 2024

First experience in simultaneous use of the extravascular implantable cardioverter-defibrillator and the leadless atrioventricular pacemaker

Maciej Sterliński[1]*, Ewa Świerżyńska-Wodarska[1, 2]*, Joanna Zakrzewska-Koperska[1], Krystyna Guzek[1], Anna Drohomirecka[3], Łukasz Szumowski[1]

[1]1st Department of Arrhythmia, National Institute of Cardiology, Warszawa, Poland
[2]Doctoral School, Medical University of Warsaw, Warszawa, Poland
[3]Department of Heart Failure and Transplantation, National Institute of Cardiology, Warszawa, Poland
*Both authors equally contributed to the study.

Correspondence to:
Ewa Świerżyńska-Wodarska, MD,
1st Department of Arrhythmia,
National Institute of Cardiology,
Alpejska 42, 04–628, Warszawa, Poland,
phone: +48 22 343 46 19,
e-mail: eswierzynska@ikard.pl

The extravascular implantable cardioverter-defibrillator (EV-ICD) was introduced into clinical practice in 2023. EV-ICD uses a substernal lead location to provide both defibrillation and anti-tachycardia pacing therapy [1] for patients who do not present with chronic bradycardia, do not have indications for multichamber pacing, and have not undergone a previous sternotomy. Currently, an implanted or added device is acceptable only when ventricular bipolar single-chamber pacing is used. Although various device combinations with leadless pacemakers have been described before [2, 3], the leadless Micra™ Transcatheter Pacing System is officially contraindicated with any another active cardiac device that may interfere with the sensing performance of the Micra device [4, 5]. Both Micra and an EV-ICD may offer benefits in patients with limitations or contraindications to transvenous devices, but their simultaneous use has not been clinically tested before. This article presents a first report in the literature on the unprecedented simultaneous application of a leadless Micra AV pacemaker and a EV-ICD, representing a novel and previously undocumented approach in clinical practice.

Both devices, a Micra AV™ Transcatheter Pacing System and an Aurora EV-ICD™ SureScan MRI model DVEA3E4, were implanted in a 19-year-old female with fulminant postinfectious Ebstein-Barr virus cardiomyopathy. A detailed description of the patient's history of non-invasive treatment in the Heart Failure and Transplant Unit, although very educational, is beyond the scope of this case presentation. After the first month of the onset of symptoms, the patient developed a complete atrioventricular block. In view of the disseminated venous occlusion after intensive care (Figure 1A) and to avoid further vascular complications during a possible heart transplantation, it was decided to implant a leadless pacemaker instead of a transvenous device. A Micra AV was implanted in December 2023 (Figure 1B), and the patient was discharged home with an left ventricular ejection fraction of 15%–20%, optimal pharmacotherapy, and a wearable cardioverter-defibrillator as a bridge to recovery or decision about heart transplantation. As no significant improvement in cardiac function was observed, an EV-ICD was implanted uneventfully in March 2024 following limitations with the transvenous approach and vector test failures with the subcutaneous ICD (Figure 1C–D; Supplementary material, *Figure S1–S2*). Both devices were tested robustly and programmed with the manufacturer's consultation. Micra pacing capture threshold was checked following intraprocedural EV-ICD defibrillation testing. EV-ICD sensitivity was programmed to 0.15 mV with Post-Shock Pacing and Pause Prevention pacing algorithms OFF, and ATP turned OFF for all zones to avoid unintentional cross-talk pacing inhibition, while Wavelet was permanently OFF (parameters of both devices are presented in Supplementary material, *Figure S3*).

The proper functioning of both devices was confirmed in subsequent interrogations performed during the 3-month follow-up. (Supplementary material, *Figure S4*) The programming applied resulted in continuous effective pacing in this pacemaker-dependent patient, and no tachyarrhythmic events were recorded, as might be due to ventricular pacing counting. Both systems were explanted on May 31 2024, during sternotomy, when heart transplantation was performed due to rapid progression to end-stage heart failure.

The combination of devices described above became the only viable option in our robust review and has been proven to be safe and effective.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/polish_heart_journal.

Article information

Acknowledgments: The authors would like to thank Ilona Michałowska, MD, PhD, Paweł Syska, MD, PhD, and Anna Maraszek, MD, for their medical contributions, and Medtronic employees Alison Graves-Calhoun, Alfonso Hernandez, Elise Higgins, Thomas Holmes, Oktawian Kopka, and Sarah Willey for their technical consultations and review of the case study.

Conflict of interest: MS received investigational, consulting, or lecturer fees from Biotronik, HammerMed, Medtronic and Zoll. The other authors have not declared any conflict of interest.

Funding: None.

REFERENCES

1. Friedman P, Murgatroyd F, Boersma LVA, et al. Efficacy and safety of an extravascular implantable cardioverter-defibrillator. N Engl J Med. 2022; 387(14): 1292–1302, doi: 10.1056/NEJMoa2206485, indexed in Pubmed: 36036522.
2. Mondésert B, Dubuc M, Khairy P, et al. Combination of a leadless pacemaker and subcutaneous defibrillator: First in-human report. HeartRhythm Case Rep. 2015; 1(6): 469–471, doi: 10.1016/j.hrcr.2015.07.009, indexed in Pubmed: 28491609.
3. Montgomery JA, Orton JM, Ellis CR. Feasibility of defibrillation and pacing without transvenous leads in a combined MICRA and S-ICD system following lead extraction. J Cardiovasc Electrophysiol. 2017; 28(2): 233–234, doi: 10.1111/jce.13111, indexed in Pubmed: 27763694.
4. https://wwwp.medtronic.com/crsupload/letters/401/401_Micra_AV_Implant_Manual_with_Medical_Procedure_and_EMI_Precautions.pdf (accessed: July 2, 20224).
5. Katarzyńska-Szymańska A, Chmielewska-Michalak L, Grymuza M, et al. Effectiveness of atrioventricular synchrony in a patient with Micra AV after the first implantation in Central Eastern Europe. Kardiol Pol. 2022; 80(12): 1268–1269, doi: 10.33963/KP.a2022.0231, indexed in Pubmed: 36183272.

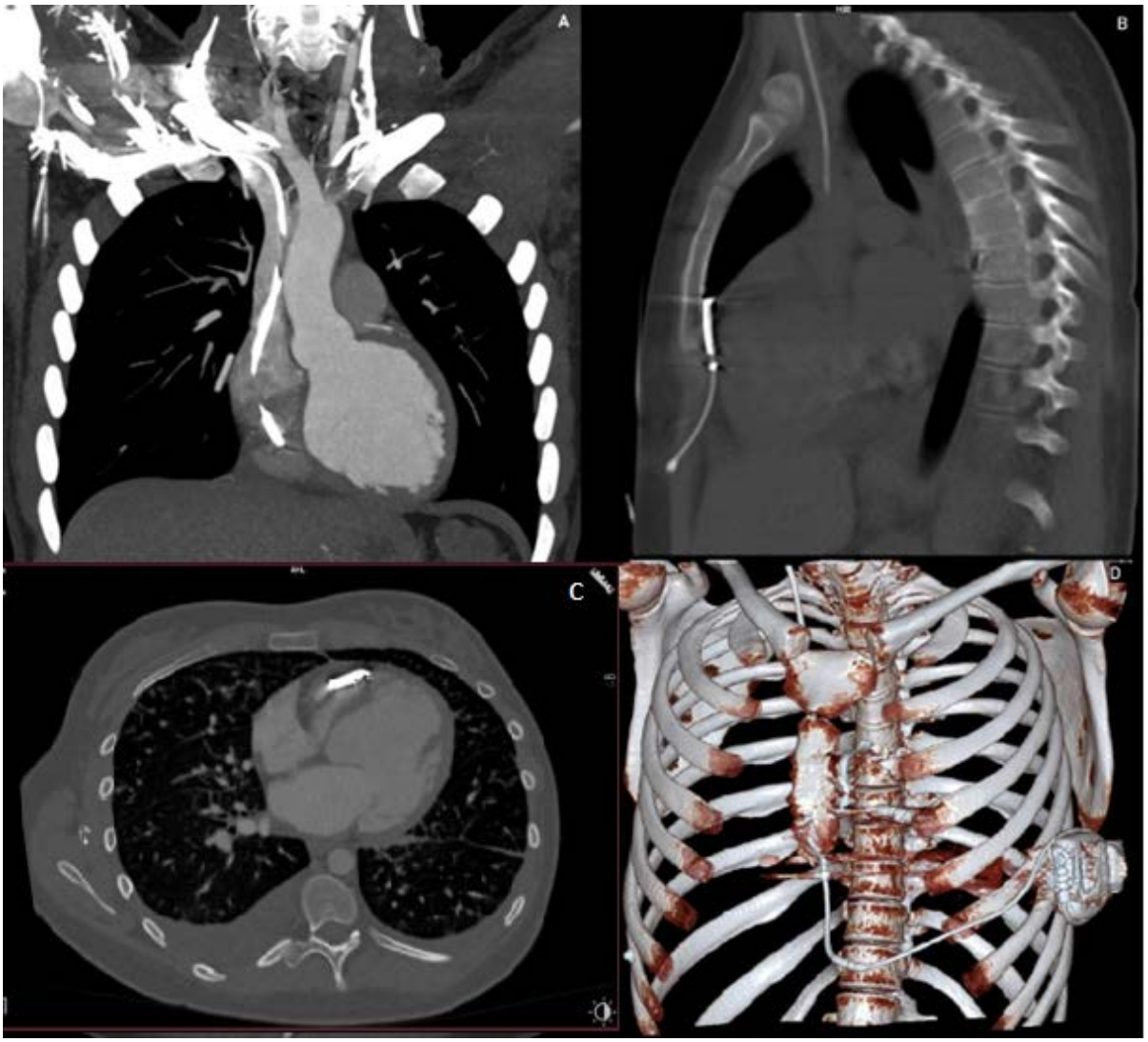

Figure 1. A. Angio-CT chest scan performed before electrotherapy procedures. Coronal plane. Diffuse white areas represent sub-occlusion of the subclavian veins and superior vena cava, which is a contraindication for transvenous system implantation. **B.** CT chest scan; axial plane, after Micra AV TPS implantation — the device is located in a septal/apical position in the right ventricle. **C.** CT chest scan; axial plane. Micra AV TPS is seen in the exact location as on Panel 1.B. Reflection of substernal lead of EV ICD implanted 3 months after LP is marked with an arrow. **D.** Rendered 3D reconstruction made upon chest CT scan. LP and EV ICD systems topographic locations