

# Risk factors for cardiac device-related infection during two-year follow-up: a retrospective analysis

Maciej Kempa, Grzegorz Sławiński, Ewa Lewicka, Szymon Budrejko, Grzegorz Raczak

Department of Cardiology and Electrotherapy, Medical University of Gdansk, Gdansk, Poland

## INTRODUCTION

Along with the growing number of cardiovascular implantable electronic device (CIED) implantations, an increase in the absolute number of patients in whom complications of that therapy may occur is also observed. Most serious complications include cardiac device infections (CDIs) requiring transvenous lead extraction (TLE) of the implanted system. It is estimated that such complications may affect between 0.6% and 2.4% of patients with CIEDs [1–4]. Therefore, in order to limit the incidence of CDIs, it is vital to identify their risk factors. The aim of our study was to identify retrospectively risk factors for infective complications occurring within two years from the primary procedure that required TLE.

## METHODS

Our retrospective study included all patients who had undergone TLE between the year 2012 and 2016 at our department (519 patients) and for whom it was possible to identify any procedure (i.e.: implantation, exchange, or upgrade of the device) performed up to two years before TLE. Within that group we identified patients who had undergone TLE due to CDIs (CDI group:  $n = 51$ , 42%) or other indications (non-CDI group:  $n = 70$ , 58%). The analysis included patients' demographic data, the type of preceding procedure and perioperative pharmacological treatment, concomitant diseases, and selected laboratory tests.

For all comparisons and calculations, the critical value of  $p < 0.05$  was assumed to determine the statistical significance of the results. For initial comparison of the groups in terms of binary variables, the  $\chi^2$  test was used. The ultimate analysis to determine risk factors for CDIs was based on logistic regression. The model for multivariate analysis included variables that resulted in  $p$  values  $\leq 0.1$  in the univariate analysis. Stepwise regression was used in multivariate analysis to determine independent risk factors for CDIs. Data were analysed with the use of STATISTICA 12 software, licensed for the Medical University of Gdansk, Poland.

## RESULTS

The study included 71 men and 50 women at the median age of 70 years (1<sup>st</sup>–3<sup>rd</sup> quartile: 60–79 years), of whom 56 patients had an implanted pacemaker and 65 patients had an implantable cardioverter-defibrillator (ICD). Demographic and clinical data of the study groups are presented in **Supplementary Table S1 (see journal website)**.

We did not observe any differences between the groups in terms of patients' age and sex, New York Heart Association class, number of device exchanges/revisions, or CIED upgrade procedures.

Among non-infective indications for TLE, the dominant one (50%) was lead fracture, whereas the most frequent infective indication for TLE (69%) was pocket infection of the implanted system. The remaining cases of infective complications comprised patients with infective endocarditis (**Supplementary Figure S1 — see journal website**). Fourteen per cent of patients in whom TLE was performed due to non-infective causes had the indication for TLE, defined as a change in the indications for electrotherapy. Within that group eight patients required an upgrade from the previously implanted pacemaker system to an ICD system. Two patients showed an improvement of the previously impaired left ventricular ejection fraction, and therefore an ICD was no longer required.

The mean time from the last CIED-related procedure to TLE was  $281 \pm 246$  days in the CDI group and  $298 \pm 276$  days in the non-CDI group ( $p = 0.7$ ).

We did not observe intergroup differences in inflammatory markers, such as C-reactive protein, procalcitonin, white blood cell count, or neutrophil count, obtained at the time of the last procedure preceding TLE (**Supplementary Table S2 — see journal website**).

Patients in the CDI group were more frequently hospitalised for any cause during the six months before the last procedure preceding TLE ( $p = 0.005$ ), they more frequently had concomitant chronic atrial fibrillation ( $p = 0.02$ ), and were treated with bridging therapy with low-molecular-weight

### Address for correspondence:

Grzegorz Sławiński, MD, Department of Cardiology and Electrotherapy, Medical University of Gdansk, ul. Dębinki 7, 80–211 Gdańsk, Poland, tel: +48 58 349 3910 / 697 336 752, fax: +48 58 349 39 20, e-mail: lek.grzegorzslawinski@gmail.com

Received: 17.10.2017 Accepted: 13.02.2018

Kardiologia Polska Copyright © Polish Cardiac Society 2018

heparin (LMWH) during the last procedure preceding TLE ( $p = 0.02$ ). The last procedure preceding TLE in patients in the non-CDI group was more frequently a de novo CIED implantation ( $p = 0.02$ ). In univariate analysis we observed that hospitalisation during the six months before the last procedure preceding TLE, chronic atrial fibrillation, bridging therapy with LMWH during the last procedure preceding TLE, and pacemaker implantation (vs. ICD implantation) as the last procedure preceding TLE were associated with a significantly higher risk of CDI (**Supplementary Table S3 — see journal website**). Bridging therapy with LMWH during the last procedure preceding TLE, history of CIED upgrade, and pacemaker implantation as the last procedure before TLE were independent risk factors for CDI in multivariate analysis.

## DISCUSSION

Well-documented risk factors for CDIs comprise the number of CIED-related procedures in a single patient [2, 5] and the complexity of these procedures [6–8]. In our analysis, the history of an upgrade of a CIED system was associated with a fourfold increase in the risk of future TLE due to CDI, which is in accordance with other reports [5]. A history of CIED system revision is another documented risk factor for CDI [2]. A similar finding was made in our univariate analysis, i.e. patients with a history of system revision had a threefold increase in the risk of CDI. However, that observation was not confirmed in the multivariate analysis.

The relation between the type of implanted device and the risk of CDI is unclear. Romeyer-Bouchard et al. [6] claimed that implantation of an ICD system, as compared with a pacemaker system, is related to higher risk of CDI in the future. In our analysis, however, the implantation of a pacemaker system was associated with a higher risk of CDI, which is in accordance with the study by Lekkerkerker et al. [5]. It is possible that the higher incidence of complications related to pacemaker implantations in our group resulted from the fact that pacemakers are implanted in a greater number of centres than ICDs, and therefore there is a greater statistical chance that the complications were caused by suboptimal quality of equipment or the limited experience of staff in some of the centres.

In our analysis, bridging therapy with LMWH during the last procedure preceding TLE was an independent risk factor for future infective complications associated with CIEDs, and the risk increase was sevenfold. Available data confirm the unfavourable consequences of perioperative LMWH use [9], but in our study that type of therapy was also associated with a higher risk of CDIs. That relationship might result from a higher incidence of CIED pocket haematoma in patients in whom LMWH bridging therapy is used [10].

We did, however, find that patients in the CDI group were more frequently hospitalised due to any cause during the six-month period before the last procedure preceding TLE. Moreover, the last procedure preceding TLE in the CDI group was less frequently a de novo implantation, compared to the non-CDI group, and that observation is in accordance with the results of Klug et al. [2].

Results confirming the existence of risk factors for CDI might raise the need to undertake appropriate measures to reduce the burden of those factors. Thus, it seems prudent to avoid — if possible — rash decisions to perform device upgrade procedures and to perform them at the time of planned device exchange. Finally, the use of LMWH is a well-known and important risk factor for not only haemorrhagic, but also infective complications, and therefore it should be avoided during the perioperative period.

The main limitation of our study is its retrospective design. Moreover, data concerning the last procedure preceding TLE may have been incomplete, because they were acquired from different centres across Poland, where patients had previously undergone surgery. Another limitation is the short time-frame of the analysis of risk factors, which only covered the period of two years preceding TLE.

In conclusion, CIED upgrade is a significant risk factor increasing two-year risk of subsequent infective complications. The risk of CDI is also increased in the case of pacemaker implantation, as compared with ICD implantation, and in patients treated perioperatively with bridging LMWH therapy.

**Conflict of interest:** none declared

## References

1. Polyzos KA, Konstantelias AA, Falagas ME. Risk factors for cardiac implantable electronic device infection: a systematic review and meta-analysis. *Europace*. 2015; 17(5): 767–777. doi: [10.1093/europace/euv053](https://doi.org/10.1093/europace/euv053), indexed in Pubmed: 25926473.
2. Klug D, Balde M, Pavin D, et al. Risk factors related to infections of implanted pacemakers and cardioverter-defibrillators: results of a large prospective study. *Circulation*. 2007; 116(12): 1349–1355. doi: [10.1161/CIRCULATIONAHA.106.678664](https://doi.org/10.1161/CIRCULATIONAHA.106.678664), indexed in Pubmed: 17724263.
3. Chauhan A, Grace AA, Newell SA, et al. Early complications after dual chamber versus single chamber pacemaker implantation. *Pacing Clin Electrophysiol*. 1994; 17(11): 2012–2015. doi: [10.1111/j.1540-8159.1994.tb03791.x](https://doi.org/10.1111/j.1540-8159.1994.tb03791.x).
4. Greenspon AJ, Patel JD, Lau E, et al. 16-year trends in the infection burden for pacemakers and implantable cardioverter-defibrillators in the United States 1993 to 2008. *J Am Coll Cardiol*. 2011; 58(10): 1001–1006. doi: [10.1016/j.jacc.2011.04.033](https://doi.org/10.1016/j.jacc.2011.04.033), indexed in Pubmed: 21867833.
5. Lekkerkerker JC, van Nieuwkoop C, Trines SA, et al. Risk factors and time delay associated with cardiac device infections: Leiden device registry. *Heart*. 2009; 95(9): 715–720. doi: [10.1136/hrt.2008.151985](https://doi.org/10.1136/hrt.2008.151985), indexed in Pubmed: 19036758.
6. Romeyer-Bouchard C, Da Costa A, Dauphinot V, et al. Prevalence and risk factors related to infections of cardiac resynchronization therapy devices. *Eur Heart J*. 2010; 31(2): 203–210. doi: [10.1093/eurheartj/ehp421](https://doi.org/10.1093/eurheartj/ehp421), indexed in Pubmed: 19875388.
7. Margey R, McCann H, Blake G, et al. Contemporary management of and outcomes from cardiac device related infections. *Europace*. 2010; 12(1): 64–70. doi: [10.1093/europace/eup362](https://doi.org/10.1093/europace/eup362), indexed in Pubmed: 19910314.
8. Polewczyk A, Jacheć W, Polewczyk AM, et al. Infectious complications in patients with cardiac implantable electronic devices: risk factors, prevention, and prognosis. *Pol Arch Intern Med*. 2017; 127(9): 597–607. doi: [10.20452/pamw.4065](https://doi.org/10.20452/pamw.4065), indexed in Pubmed: 28724879.
9. Alturki A, Proietti R, Birnie DH, et al. Management of antithrombotic therapy during cardiac implantable device surgery. *J Arrhythm*. 2016; 32(3): 163–169. doi: [10.1016/j.joa.2015.12.003](https://doi.org/10.1016/j.joa.2015.12.003), indexed in Pubmed: 27354859.
10. Ahmed I, Gertner E, Nelson WB, et al. Continuing warfarin therapy is superior to interrupting warfarin with or without bridging anticoagulation therapy in patients undergoing pacemaker and defibrillator implantation. *Heart Rhythm*. 2010; 7(6): 745–749. doi: [10.1016/j.hrthm.2010.02.018](https://doi.org/10.1016/j.hrthm.2010.02.018), indexed in Pubmed: 20176137.

**Cite this article as:** Kempa M, Sławiński G, Lewicka E, et al. Risk factors for cardiac device-related infection during two-year follow-up: a retrospective analysis. *Kardiologia Polska*. 2018; 76(4): 800–801. doi: [10.5603/KP.2018.0079](https://doi.org/10.5603/KP.2018.0079).