

Cardiac implantable electronic device procedure history as the most important predictor of poor 2-year survival after transcatheter aortic valve replacement

Michał Stegienta¹, Anita Korczak¹, Izabela Adamowicz¹, Anna Ceranka¹, Milena Jakuszczonek¹, Andrzej Walczak², Michał Krejca², Aleksandra Ryk³, Jacek Burzyński, Jarosław Drożdż¹

¹2nd Department of Cardiology, Central University Hospital, Medical University of Lodz, Łódź, Poland

²Department of Cardiac Surgery, Central University Hospital, Medical University of Lodz, Łódź, Poland

³Department of Biostatistics and Translational Medicine, Medical University of Lodz, Łódź, Poland

Correspondence to:

Michał Stegienta, MD,
2nd Department of Cardiology,
Medical University of Lodz,
Pomorska 251, 92–213 Łódź,
Poland,
phone: +48 42 201 43 08,
e-mail:
michal.stegienta@umed.lodz.pl
Copyright by the Author(s), 2023
DOI: 10.33963/KPa2023.0058

Received:

October 10, 2022

Accepted:

January 3, 2023

Early publication date:

March 5, 2023

INTRODUCTION

Aortic valve stenosis is an increasingly common cause of heart failure in the aging population in highly developed countries. Over time, the development of the transcatheter aortic valve replacement (TAVR) procedure extended this technique to intermediate and low surgical-risk patients, and this indication was recently approved by US Food and Drug Administration [1]. Our study aimed to assess survival of patients undergoing TAVR over a 2-year follow-up and to identify preoperative risk factors for a poor 2-year prognosis.

METHODS

Study population

This retrospective observational study was conducted at the Central Clinical Hospital of the Medical University of Lodz — a tertiary regional academic care center. The study included symptomatic patients suffering from severe aortic stenosis who were scheduled for TAVR by a local Heart Team between March 2015 and February 2020 following the applicable guidelines [2]. A total of 130 patients after the TAVR procedure were assessed. The full exclusion criteria were as follows: incomplete medical documentation and lack of consent for the proposed invasive treatment. The characteristics of the patients included in the study are summarized in Supplementary material, *Table S1*.

Analyzed parameters

Source data included in the analysis were obtained from the electronic database of the

hospital. The pre-procedure characteristics of the patients were analyzed, including demographics, previous history of comorbidities, basic laboratory parameters assessed on admission to the hospital, echocardiographic findings, and surgical risk assessed using appropriate scales. Patients were also classified according to age and surgical risk assessment following the algorithm from the latest recommendations of the European Society of Cardiology for the management of valvular disease [3].

Procedural details

Based on the medical history, previous echocardiographic assessment, and multislice computed tomography analysis, the patients were qualified for a procedure with appropriate vascular access.

Follow-up and study endpoints

All collected data were assessed for correlation with 2-year survival. One patient was excluded from the 2-year survival analysis due to death on the day of surgery related to the surgery itself. Survival data were based on the status in the central register of citizens. We collected follow-up data from all patients included in the study.

Statistical analysis

Qualitative variables were presented as numbers with the appropriate percentage. Continuous variables were presented as median and interquartile range (IQR). Univariable Cox regression was performed to identify

factors associated with the occurrence of death in the 2-year follow-up period. Then, statistically significant variables (as identified by univariable analysis) and other variables (identified as important in a literature search) were included in the multivariable model, and forward stepwise Cox regression was performed. Survival probability over time was presented using the Kaplan-Meier curve. The log-rank test was used to compare survival between groups. A *P*-value below the level of 0.05 was considered statistically significant. All calculations were carried out in STATISTICA 13.3 software.

RESULTS AND DISCUSSION

The median age in the study group was 82 years (median [IQR], 82 [75–85] years). Women accounted for 63% (*n* = 82) of patients and men for 37% (*n* = 48). Most of the patients (75%, *n* = 98) were classified as class III or IV according to the New York Heart Association (NYHA). In the study population, 78% (*n* = 102) underwent TAVR using trans-femoral access, 17% (*n* = 22) with trans-apical access, and 5% (*n* = 6) with an alternative approach. The percentage of 2-year survival was 76% (*n* = 98), whereas the percentage of 1-year survival was 81% (*n* = 105). The probability of survival over time in the study population was presented in the form of the Kaplan-Meier survival curve (Figure 1A). Our results of univariable Cox regression indicated that factors such as male sex, prior cardiac implantable electronic device (CIED) history (overall and separately in the pacemaker subgroup), chronic inflammatory lung disease, reduced vs. preserved left ventricular ejection fraction (LVEF), and femoral vascular access are significantly associated with the occurrence of death during the 2-year follow-up period after TAVR (Supplementary material, Table S2). In the CIED category, 85% (*n* = 17) were cardiac pacemakers, 10% (*n* = 2) implantable cardioverter defibrillators, and 5% (*n* = 1) cardioverter defibrillators with resynchronization function. The chronic lung disease category consisted of chronic obstructive pulmonary disease (56% [*n* = 14]), asthma (16% [*n* = 4]), and other chronic lung diseases and overlapping syndromes (28% [*n* = 7]). In the next step, Cox forward stepwise regression was carried out, and its results showed a significant and independent effect of the following factors: prior CIED history (hazard ratio [HR], 3.19; 95% CI, 1.38–7.37; *P* = 0.007), reduced vs. preserved LVEF (HR, 2.95; 95% CI, 1.32–6.58; *P* = 0.008), and chronic inflammatory lung diseases (HR 2.50; 95% CI, 1.11–5.63; *P* = 0.03) on the occurrence of death in 2-year follow-up time after TAVR (Supplementary material, Figure S1). Kaplan-Meier survival curves and log-rank test were used to present differences between survival distribution at 2-year follow-up in this group (Figure 1B–D).

Compared to the largest TAVR registry which included over 275 000 patients, the population we studied was characterized by a higher risk assessed by the Society of Thoracic Surgeons (STS)/American College of Cardiology

(ACC) TAVR score (3.34% vs. 3.18%), also the median age of the patients in our study was higher (82.00 years vs. 81.00 years) [4]. The 1-year survival in non-missing patients collected in the mentioned registry was 84.38%, but it should be noted that taking into account patients without follow-up, in whom higher one-year mortality should be expected, 1-year survival in the registry was only 65.93%, which is lower than that in our center (81.40%).

CIED history proved to be the most important factor for poor prognosis in our study. We assume that it may be correlated with higher structural damage of the myocardial tissue which caused conduction disorders and was an indication for prior pacemaker therapy. Another mechanism may be related to the coexistence of device-related tricuspid regurgitation which, according to various studies, affects from 7% to 45% of patients with CIED and is associated with higher risk of mortality after TAVR in medium-term follow-up (HR/OR, 1.96; 95% CI, 1.35–2.85; *P* < 0.001) [5, 6]. Due to the small number of implantable cardioverter-defibrillator (ICD)/cardiac resynchronization therapy with defibrillator (CRT-D) devices (15%, *n* = 3) in the CIED group, the expected protective effect on survival was not observed in our analysis. To the best of our knowledge, our study is the first study to evaluate the influence of CIED history on prognosis in this group of patients, and this issue may be the subject of further research.

Results of many trials, including the Partner 2 trial, similar to our observations, confirm the importance of reduced ejection fraction as an independent factor for death from cardiovascular causes (HR, 1.42; 95% CI, 1.11–1.81; *P* = 0.005), while total mortality despite a tendency toward increased values (adjusted HR, 1.20; 95% CI, 0.99–1.47; *P* = 0.07) did not reach statistical significance [7]. In our study population, 19% (*n* = 25) of all patients were also affected by chronic inflammatory lung diseases, and it was an independent factor for increased mortality. In comparison, in the CoreValve US Pivotal Trial study, inflammatory diseases of the lungs affected as many as 55% of patients who qualified for TAVR. In the group of people with lung diseases of moderate severity, 1-year mortality was 28.1% in the Partner 2 trial and was higher than in study subjects without these burdens, where it was only 19.2% (*P* = 0.03). A similar relationship was also maintained during the three-year follow-up [8].

It must be noted that clinical parameters which are often taken into account in risk evaluation, such as NYHA functional class, level of natriuretic peptides, age, and surgical risk scores proved to be irrelevant for 2-year survival prognosis in our study [9].

Study limitations

The study was conducted as a single-center retrospective study with a relatively small group of subjects. All of these factors may have led to an increased risk of selection bias and accidental findings in relation to the factors correlated with the study endpoint.

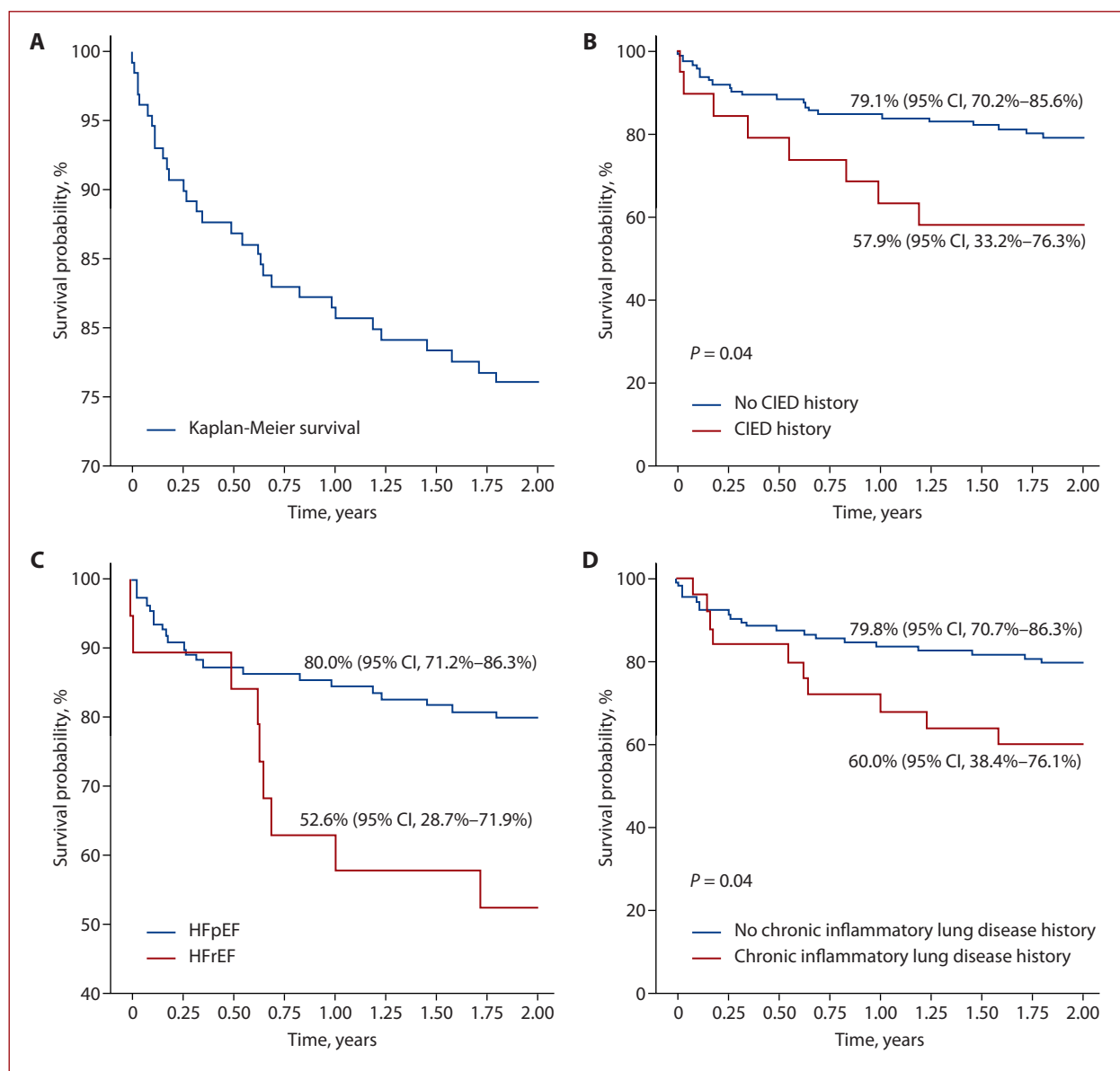


Figure 1. Two-year survival after TAVR. Kaplan-Meier curves for overall survival (A). Kaplan-Meier curves with log-rank test for comparison of 2-year survival differences after the TAVR procedure between groups with CIED vs. no CIED history (B), HFrEF vs. HFpEF (C), chronic inflammatory lung diseases vs. no chronic inflammatory lung diseases (D)

Abbreviations: CIED, cardiovascular implantable electronic device; HFrEF, heart failure with reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; TAVR, transcatheter aortic valve replacement

CONCLUSIONS

Percutaneous structural interventions are the way forward in the treatment of valvular disease, and TAVR is a procedure with an indisputable role in improving the prognosis of patients with severe aortic stenosis. In our retrospective study, CIED history was the most statistically significant factor associated with 2-year survival after TAVR.

Supplementary material

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

Article information

Conflict of interest: None declared.

Funding: None.

Open access: This article is available in open access under Creative Commons Attribution-Non-Commercial-No Derivatives 4.0 International (CC BY-NC-ND 4.0) license, which allows downloading and sharing articles with others as long as they credit the authors and the publisher, but without permission to change them in any way or use them commercially. For commercial use, please contact the journal office at kardiologiapolska@ptkardio.pl.

REFERENCES

1. Wu C, Vasseur B, Maisel W. The March of Transcatheter Aortic Valve Replacement Therapy-US Food and Drug Administration Perspectives on Device Approval for Patients at Low Surgical Risk. *JAMA Cardiol.* 2020; 5(1): 5–6, doi: [10.1001/jamacardio.2019.4383](https://doi.org/10.1001/jamacardio.2019.4383), indexed in Pubmed: [31721988](https://pubmed.ncbi.nlm.nih.gov/31721988/).
2. Baumgartner H, Falk V, Bax JJ, et al. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur Heart J.* 2017; 38(36): 2739–2791, doi: [10.1093/eurheartj/ehx391](https://doi.org/10.1093/eurheartj/ehx391), indexed in Pubmed: [28886619](https://pubmed.ncbi.nlm.nih.gov/28886619/).
3. Vahanian A, Beyersdorf F, Praz F, et al. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur Heart J.* 2022; 43(7): 561–632, doi: [10.1093/eurheartj/ehab395](https://doi.org/10.1093/eurheartj/ehab395), indexed in Pubmed: [34453165](https://pubmed.ncbi.nlm.nih.gov/34453165/).
4. Carroll JD, Mack MJ, Vemulapalli S, et al. STS-ACC TVT Registry of Transcatheter Aortic Valve Replacement. *J Am Coll Cardiol.* 2020; 76(21): 2492–2516, doi: [10.1016/j.jacc.2020.09.595](https://doi.org/10.1016/j.jacc.2020.09.595), indexed in Pubmed: [33213729](https://pubmed.ncbi.nlm.nih.gov/33213729/).
5. Gelves-Meza J, Lang RM, Valderrama-Achury MD, et al. Tricuspid Regurgitation Related to Cardiac Implantable Electronic Devices: An Integrative Review. *J Am Soc Echocardiogr.* 2022; 35(11): 1107–1122, doi: [10.1016/j.echo.2022.08.004](https://doi.org/10.1016/j.echo.2022.08.004), indexed in Pubmed: [35964911](https://pubmed.ncbi.nlm.nih.gov/35964911/).
6. Takagi H, Hari Y, Kawai N, et al. Impact of concurrent tricuspid regurgitation on mortality after transcatheter aortic-valve implantation. *Catheter Cardiovasc Interv.* 2019; 93(5): 946–953, doi: [10.1002/ccd.27948](https://doi.org/10.1002/ccd.27948), indexed in Pubmed: [30474201](https://pubmed.ncbi.nlm.nih.gov/30474201/).
7. Furer A, Chen S, Redfors B, et al. Effect of Baseline Left Ventricular Ejection Fraction on 2-Year Outcomes After Transcatheter Aortic Valve Replacement: Analysis of the PARTNER 2 Trials. *Circ Heart Fail.* 2019; 12(8): e005809, doi: [10.1161/CIRCHEARTFAILURE.118.005809](https://doi.org/10.1161/CIRCHEARTFAILURE.118.005809), indexed in Pubmed: [31525069](https://pubmed.ncbi.nlm.nih.gov/31525069/).
8. Crestanello JA, Popma JJ, Adams DH, et al. Long-Term Health Benefit of Transcatheter Aortic Valve Replacement in Patients With Chronic Lung Disease. *JACC Cardiovasc Interv.* 2017; 10(22): 2283–2293, doi: [10.1016/j.jcin.2017.07.025](https://doi.org/10.1016/j.jcin.2017.07.025), indexed in Pubmed: [29102579](https://pubmed.ncbi.nlm.nih.gov/29102579/).
9. Marzec K, Jaworska-Wilczyńska M, Kowalik I, et al. Comparison of long-term outcomes and risk factors of aortic stenosis treatment in patients undergoing transcatheter aortic valve implantation and surgical aortic valve replacement. *Kardiologia Pol.* 2022; 80(7-8): 792–798, doi: [10.33963/KP.a2022.0122](https://doi.org/10.33963/KP.a2022.0122), indexed in Pubmed: [35521716](https://pubmed.ncbi.nlm.nih.gov/35521716/).