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EHRA SURVEY

Management of conduction disorders after transcatheter aortic valve implantation: results of the EHRA survey

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Abstract

Conduction disorders such as left bundle branch block (LBBB) are common after transcatheter aortic valve implantation (TAVI). Consensus regarding a reasonable strategy to manage conduction disturbances after TAVI has been elusive. The European Heart Rhythm Association (EHRA) conducted a survey to capture contemporary clinical practice for conduction disorders after TAVI. A 25-item online questionnaire was developed and distributed among the EHRA electrophysiology (EP) research network centres. Of 117 respondents, 44% were affiliated with university hospitals. A standardized management protocol for advanced conduction disorders such as LBBB or atrioventricular block (AVB) after TAVI was available in 63% of participating centres. Telemetry after TAVI was chosen as the most frequent management strategy for patients with new-onset or pre-existing LBBB (79% and 70%, respectively). Duration of telemetry in patients with new-onset LBBB varied, with a 48-h period being the most frequently chosen, but almost half monitoring continued for at least 72 h. Similarly, in patients undergoing EP study due to new-onset LBBB, the HV interval cut-off point leading to pacemaker implantation was heterogeneous among European centres, although an HV >75 ms threshold was the most common. Conduction system pacing was chosen as a preferred approach by 3.7% of respondents for patients with LBBB and normal left ventricular ejection fraction (LVEF), and by 5.6% for patients with LBBB and reduced LVEF. This survey suggests some heterogenity in the management of conduction disorders after TAVI across European centres. The risk stratification strategies vary substantially. Conduction system pacing in patients with LBBB after TAVI is still underused.

Keywords Transcatheter aortic valve replacement • Bradyarrhythmia • Conduction disorders • Remote monitoring • Permanent pacemaker • Complication • EHRA survey

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Introduction

Transcatheter aortic valve replacement (TAVI) has become a well-established treatment option for patients with symptomatic aortic stenosis with an intermediate-to-high surgical risk[1,2] and has been expanded to include strata with lower surgical risk.[3] The occurrence of left bundle branch block (LBBB) post-TAVI remains the most frequent complication of the procedure and has been shown to be associated with a much greater rate of high-grade atrioventricular block (HAVB, 5–34%)[4–7] and syncope (16%) during the first year after TAVI compared with patients without LBBB (<1%).[8] Consensus regarding the reasonable strategy to manage cardiac conduction disturbances after TAVI has been elusive. Different protocols have been used in the current clinical practice, including the following: placement of temporary pacemakers (PM), prolonged monitoring, electrophysiological study using different HV interval cut-offs for recommending pacemaker implantation or implantation of loop recorders (ILR).[9–12] Currently, there are no randomized controlled trials available.

The aim of this European Heart Rhythm Association (EHRA) survey was to gather data on the management of conduction disorders after TAVI in European electrophysiology (EP) centres.

Methods

Online questionnaire

The questionnaire was developed by the EHRA Scientific Initiatives Committee. The survey electronic link was sent to the members of EHRA, EHRA Young EP, between 4 October 2021 and 5 November 2021, and promoted via social media. The online questionnaire was constructed to collect information regarding current clinical management of conduction disturbances after TAVI. The online-based questionnaire consisted of single- and multiple-choice questions assessing physicians' knowledge and perception of differences between new-onset vs. pre-existing LBBB, the duration and type of telemetric monitoring, the role of EP testing, the presumed risk factors for AVB, the treatment of conduction disturbances other than LBBB, and the preferred approaches for device implantation. The full questionnaire was approved by all investigators and is provided in Supplementary material online, *Appendix*. The response was voluntary, anonymous, and GDPR compliant.

Statistical analysis

Continuous variables are presented as mean ± standard deviation (SD) or median and interquartile range (IQR). Categorical variables are expressed as numbers and percentages. Test for normality was performed using the Kolmogorov–Smirnov test. Student's *t*-test or Mann–Whitney *U* test was applied for comparison of continuous variables and categorical variables were compared by Pearson χ^2 test and Fisher's exact test, as appropriate. All analyses were performed using SPSS (version 22.0, SPSS Inc., Chicago, IL, USA) and a *P*-value <0.05 was considered statistically significant.

Results

We received 117 responses to the survey (mean age 45 years, 85% male). Most responses came from Switzerland (32%) and France (28%) (Supplementary material online, *Appendix Table S1*). Participants were affiliated to university hospitals (44%) or to private hospitals (33%) and non-university hospitals (25%). The majority (63%) of the participants identified themselves as cardiac electrophysiologists, while 31% were general cardiologists, and 6% fellows in training.

The mean number of annually performed TAVIs per centre was 189. The most frequent used prosthetic valve was the self-expandable Evolut PRO/R (40% of respondents) followed by the balloon expandable Edwards SAPIEN 3/Ultra (33%). A standardized management protocol for advanced conduction disorders such as LBBB or HAVB after TAVI was available in 63% of centres.

New-onset vs. pre-existing left bundle branch block after transcatheter aortic valve replacement

Respondents were asked to select the management strategy (or strategies) adopted in their centres for new-onset LBBB after TAVI among the alternatives shown in *Figure 1*. Most respondents selected telemetry (79%), followed by temporary PM (32%), EP study (27%), 'first intention PM implantation' (16%), implantation of an ILR (5.4%), and no specific strategy (3.6%). For patients with new-onset, but delayed LBBB (>24 h post-procedure), the adopted strategies are similar: telemetry in 61%, EP study in 22%, 'first intention PM implantation' in 13%, and an implantable loop recorder (ILR) in 1.9%.

Responses differed when participants were asked about their management strategy in patients with pre-existing LBBB (*Figure 1*): first intention PM implantation was chosen significantly less often compared with patients with new-onset LBBB (1.8% vs. 16%, $P = 0.009$), while 'no specific strategy' was chosen more often (16% vs. 3.6%, $P = 0.03$).

Type and duration of monitoring

Participants were asked regarding the optimal duration of acute telemetry in patients with new-onset LBBB, pre-existing LBBB or right bundle branch block (RBBB) (*Figure 2*). For patients with new-onset or pre-existing LBBB, a telemetry duration of 48 h was the most frequent choice (35% and 38%), followed by 72 h in new-onset LBBB (27%), and 24 h in patients with pre-existing LBBB (29%). Telemetry duration > 72 h was deemed necessary in patients with new-onset LBBB by 20% of respondents and in patients with pre-existing LBBB in 7.1%. In patients with pre-existing RBBB, all options were chosen with similar frequency.

For standard mid-/long-term follow-up in post-TAVI patients with LBBB, an Holter electrocardiogram (ECG) is the most frequent strategy (50%), although 28% mentioned having no specific protocol, and 15% use 12-lead ECGs only.

Role of electrophysiology study

Participants were asked which parameters should be measured during an EP study in patients with LBBB after TAVI (*Figure 3*). HV interval measurements were chosen by 84% of respondents, whereas atrioventricular node Wenckebach cycle length is measured by 68% and the atrioventricular node effective refractory period by 50%. An HV interval ≥ 75 ms was selected by 44% of the respondents as the cut-off point for recommending PM implantation in patients with new-onset LBBB, while an HV interval ≥65 ms and ≥55 ms cut-off points were chosen by 28% and 7.4% of the participants, respectively.

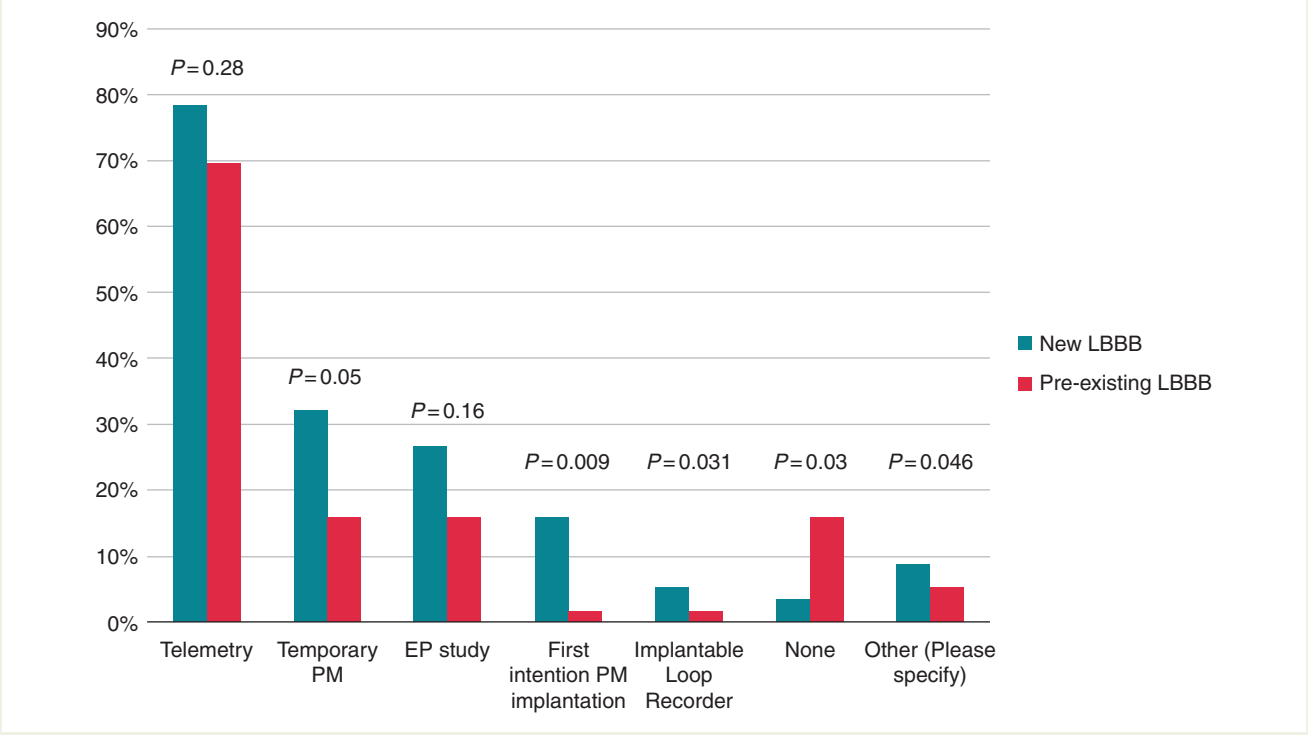

Figure 1 How do you manage new-onset vs. pre-existing LBBB after TAVI? LBBB, left bundle branch block; TAVI, transcatheter aortic valve implantation.

Twenty percent of respondents indicated that 'PM indication should not be based on HV interval'. Similar HV interval cut-offs were selected for patients with pre-existing LBBB.

Risk factors associated with atrioventricular block

QRS duration > 150 ms (78%), PR > 240 ms (74%), and transient periprocedural AV block (78%) were risk factors most frequently identified by respondents. Additional risk factors included PR prolongation post-TAVI > 20 ms (selected by 41%), periprocedural junctional rhythm (9%), and a high burden of aortic calcification (33%).

Atrioventricular block and pre-existing bifascicular block

In case of persistent HAVB or complete heart block immediately after TAVI, a 24-h observation period before PM implantation was the most utilized option (52%), followed by immediate PM implantation (24%), 48-h observation (20%), and a waiting period of >72 h (3.7%).

In patients with pre-existing bifascicular block [RBBB and left anterior/posterior fascicular block (LAFB/LPFB)], no specific management strategy was the most frequently selected option (65%), followed by prophylactic PM implantation before TAVI (20%) and EP study after TAVI (14%).

Type of implanted pacemaker

A dual chamber pacemaker was chosen by 82% of respondents for patients in sinus rhythm with LBBB after TAVI and normal left ventricular ejection fraction (LVEF), while 3.7% received conduction system pacing (His/LBB pacing). In patients in sinus rhythm with LBBB after TAVI and reduced LVEF, cardiac resynchronization therapy was chosen by 72% of respondents, followed by a dual chamber pacemaker in 17% of cases and conduction system pacing (His/LBB pacing) by 5.6% of respondents.

Discussion

This survey provides insight into the current clinical management of conductions disorders after TAVI in European centres. Our main findings are as follows.

First, this survey revealed a large variation in the management of conduction disorders after TAVI. Despite being the most frequent complication after TAVI, a standardized management protocol for advanced conduction disorders such as LBBB is only available in approximately two-third of participating centres. Second, while telemetry was chosen as the most frequent management strategy for patients with new-onset or pre-existing LBBB or RBBB after TAVI, the optimal duration of telemetry is unknown, with answers equally distributed between 24 and 72 h of monitoring. Third, while conducting EP study post-TAVI in some patients with LBBB is recommended by the latest ESC pacing guidelines, this survey exposed multiple uncertainties regarding which parameters EP study should assess or which HV interval should be chosen as cut-off point for PM indication. Fourth, adherence to guidelines is suboptimal, as one fifth of participants chose prophylactic PM implantation before TAVI in patients with bifascicular block (RBBB and LAFB/LPFB), which represents a

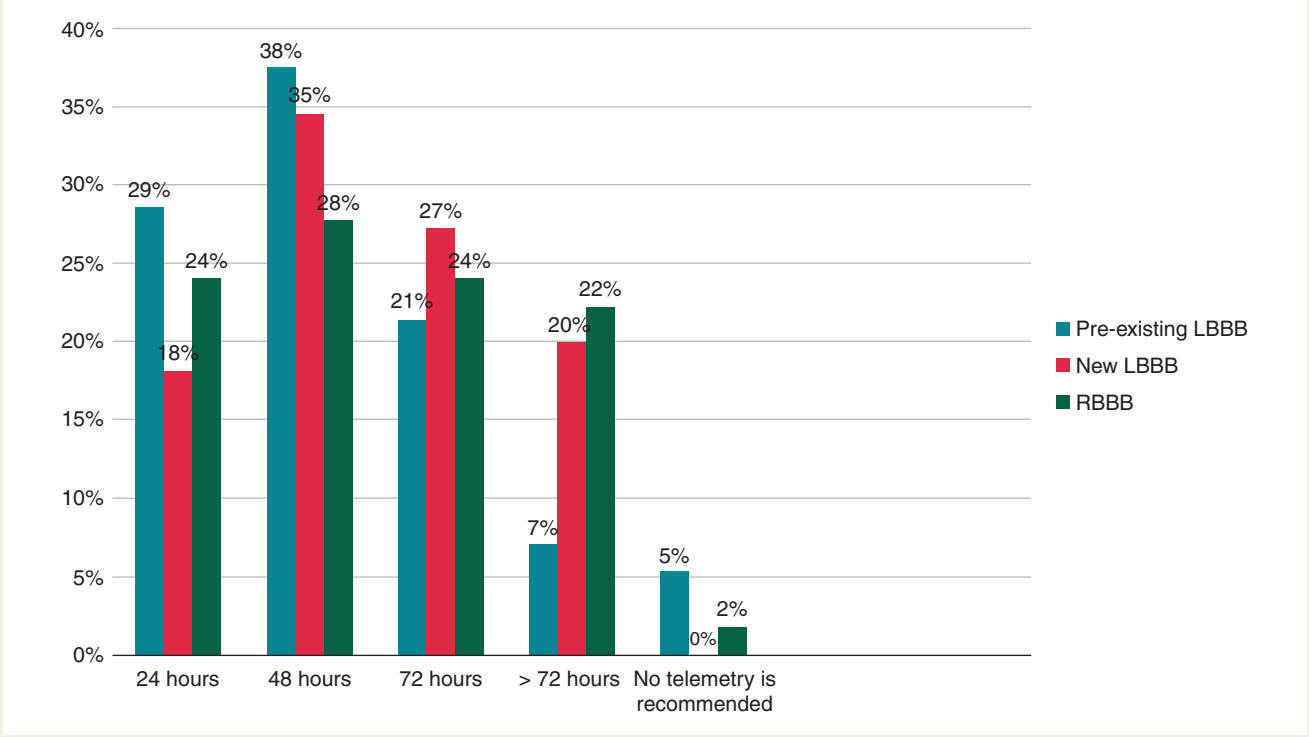

Figure 2 In patients with pre-existing, new-onset LBBB or RBBB after TAVI, telemetry is recommended for a minimum period of? LBBB, left bundle branch block; RBBB, right bundle branch block; TAVI, transcatheter aortic valve implantation.

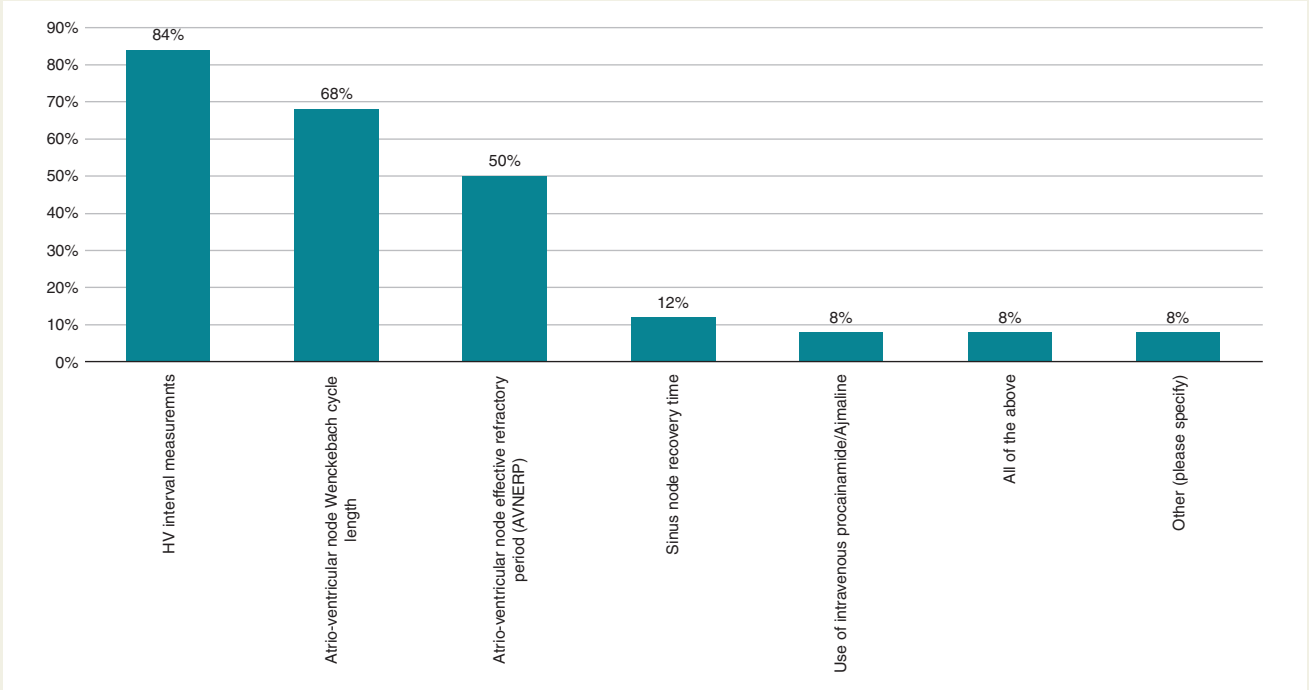

Figure 3 In patients with LBBB after TAVI, an EP study should include the following measurements. EP, electrophysiological; LBBB, left bundle branch block; TAVI, transcatheter aortic valve implantation.

Table 1 Management of conduction disorders after TAVI according to current guidelines

	Diagnosis	Treatment
	Persistent high-degree AVB or complete heart block	
Expert consensus algorithm[14]	Persistent or recurrent HAVB/CHB for 24 h	Permanent PM
ESC Guidelines 2021[13]	24–48 h post-procedural	Permanent PM (Class I)
	Pre-existing RBBB with new-onset post-procedure conduction disturbance	
Expert consensus algorithm[14]	Increase ≥20 ms PR or QRS or QRS >150 ms or PR >240 ms	i. Invasive EPS ii. Continuous ECG monitoring iii. PPM (not in patients with PR > 240 ms but QRS < 120 ms)
ESC Guidelines 2021[13]	transient high-degree AVB or PR prolongation or axis change	Permanent PM (IIa)
	Persistent new-onset LBBB	
Expert consensus algorithm[14]	At Day 2: QRS >150 ms or PR >240 ms	i. Invasive EPS ii. Continuous ECG monitoring iii. PPM
ESC Guidelines 2021[13]	QRS >150 ms or PR >240 ms with no further prolongation >48 h after procedure[a]	i. Ambulatory ECG monitoring for 7–30 days (IIa) ii. EPS (IIa), ≥70 ms may be considered positive for permanent pacing
	Pre-existing LBBB	
Expert consensus algorithm[14]	Increase ≥20 ms PR or QRS or QRS >150 ms or PR >240 ms	i. Invasive EPS ii. Continuous ECG monitoring iii. PPM (not in patients with PR > 240 ms but QRS < 120 ms)
ESC Guidelines 2021[13]	Increase >20 ms PR or QRS	i. Ambulatory ECG monitoring for 7–30 days (IIb) ii. EPS (IIb), ≥70 ms may be considered positive for permanent pacing
	No ECG changes	
Expert consensus algorithm[14]		Telemetry for 24 h or at least overnight
ESC Guidelines 2021[13]		Not available

AVB, atrioventricular block; ECG, electrocardiogram; HAVB, high-grade atrioventricular block; LBBB, left bundle branch block; PM, pacemakers; RBBB, right bundle branch block.
[a]High-risk parameters for high-degree atrioventricular block in patients with new-onset LBBB include AF; prolonged PR and LVEF <40%.

class III recommendation according to current guidelines.[13] Finally, ~30% of respondents mentioned having no specific protocol regarding mid/long-term follow-up in post-TAVI patients with LBBB.

Two documents are currently available to provide guidance for the management of patients with conduction disorders after TAVI. An expert consensus algorithm[14] proposed in 2019 by a multidisciplinary group of interventional cardiologists, electrophysiologists, and cardiac surgeons attempted to provide a guide based on the available evidence. According to this document, patients are assigned to one of the five groups based on the presence and type of conduction disturbances on the 12-lead ECG pre- and post-TAVI. In a recent clinical validation study of the proposed algorithm in a large cohort of consecutive TAVI patients, patients with no need for a PM were identified with a negative predictive value of 97.3%.[15] Furthermore, the algorithm identified three of the four TAVI patients who are eligible for safe and early discharge without prolonged monitoring. More recently, the 2021 ESC pacing guidelines dedicated a section to the management of conduction disorders after TAVI.[13] Differences in these two documents are highlighted in *Table 1* and may partly explain the heterogeneous approach in patients with conduction disorders post-TAVI among European centres.

Given the fact that a minority of patients with LBBB will develop advanced conduction disturbances requiring PM implantation, an approach using long-term ambulatory monitoring (implantable or external) or EP study in lieu of direct PM implantation seems reasonable. There are multiple types of external ambulatory ECG monitors available. In the setting of conduction disorders, continuous monitoring devices should be preferred, and although the optimal duration is not known, prolonged monitoring up to 30 days seems preferable.[9]

Considering the EP study, multiple uncertainties remain. While the current 2021 ESC guidelines recommend performing EP testing >3 days post-procedural after the conduction abnormalities have stabilized and to use >70 ms as a cut-off point for PM implantation, the 2019 consensus document does not provide such specific information. In general, a baseline HV threshold of ≥55 ms is considered abnormal and a baseline HV ≥ 70 ms is a sign of significant infra-Hisian disease.[11,12,16] The true potential of EP study for the identification of

patients who need or do not need a PM following TAVI is unclear,[12–17] and the optimal timing and HV interval cut-offs need clarification Several studies are currently ongoing.

Due to the limitations of both prolonged continuous ECG monitoring and EP study, the third option, immediate PM implantation may still be considered for the time being. Accordingly, clinical judgement remains important when evaluating patients classified as higher risk for AV block for PM implantation post-TAVI. Additional strategies for refining the risk assessment based on ECG parameters in this group of patients are needed to improve management.

Patients requiring PM therapy after TAVI have higher rates of heart failure hospitalization and greater decline in LVEF compared with those who did not have PM.[17,18] Thus, conduction system pacing (CSP) such as his-bundle pacing or left bundle branch area pacing might be an attractive option in post-TAVI patient to potentially decrease the risk of pacing-induced cardiomyopathy. The feasibility and safety of using CSP in this patient subgroup has been already demonstrated in small studies.[19] In addition, the anatomic relationship between the prosthetic aortic valve location and the bundle of His may be used to guide physiological pacing implanters. Nevertheless, only a minority of participants in this survey currently chooses CSP in post-TAVI patients. Clearly, larger, prospective randomized trials are needed to assess the role of CSP in this patient cohort.

Limitations

This survey has some limitations. First, due to the relatively low number of respondents, mainly electrophysiologists affiliated to university hospitals, and very high representation from France and Switzerland, we should not extrapolate our results to different categories of European practitioners and all European countries. However, the hesitance of practitioners in participating in this survey may also reflect the lack of sound evidence and clear guidance on how to manage patients with conduction disorders after TAVI.

Conclusion

There is considerable room for improving the management of patients with conduction disorders after TAVI, and a clear need for dedicated management protocols in TAVI patients covering monitoring and risk assessment for HAVB based on EP studies, clinical risk factors, and/or ILR placement.

Supplementary material

Supplementary material is available at *Europace* online.

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