High-degree atrioventricular block in patients with preexisting bundle branch block or bundle branch block occurring during transcatheter aortic valve implantation

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BACKGROUND Transcatheter aortic valve implantation (TAVI) has become the standard therapy for high-risk and non-operable patients with severe aortic stenosis. However, the procedure involves several adverse effects, such as rhythm and conduction disturbances. Patients with postprocedural left bundle branch block may have an increased mortality risk, whereas patients with preprocedural right bundle branch block display a higher rate of postinterventional bradyarrhythmias.

OBJECTIVE The purpose of this study was to investigate the occurrence of high-degree atrioventricular block (AVB) in patients with preexisting bundle branch block (BBB) or BBB occurring during TAVI.

METHODS In this prospective single-center study, 50 consecutive patients undergoing TAVI with the Medtronic CoreValve Revalving System were included. Of these patients, 17 with preexisting BBB or BBB occurring during TAVI received a primary prophylactic permanent DDD pacemaker, programmed to the SafeR-mode and featuring dual-channel event counters as well as stored intracardiac electrograms. Pacemaker readouts and intracardiac electrograms were analyzed for the occurrence of high-degree AVB.

RESULTS Ten of 17 patients (58.8%) with preexisting BBB or BBB occurring during TAVI developed episodes of high-degree AVB that were immediately terminated due to switch into DDD backup pacing. In 5 of the cases (29.4%), the first documented episode of high-degree AVB occurred after hospital discharge. Mean follow-up period was 578.1 ± 294.9 days.

CONCLUSION Development of high-degree AVB is a common complication in patients with preexisting BBB or BBB occurring during TAVI. Accordingly, intensified monitoring might be reasonable, especially in patients treated with the self-expandable Medtronic CoreValve Revalving System.

KEYWORDS Transcatheter aortic valve implantation; Pacemaker; Bundle branch block; Atrioventricular block

ABBREVIATIONS **AS** = aortic stenosis; **AV** = atrioventricular; **AVB** = atrioventricular block; **BARC** = Bleeding Academic Research Consortium; **BBB** = bundle branch block; **EGM** = electrogram; **EuroSCORE** = European System for Cardiac Operative Risk Evaluation Score; **LAFB** = left anterior fascicular block; **LBBB** = left bundle branch block; **PM** = pacemaker; **TAVI** = transcatheter aortic valve implantation; **VARC** = Vascular Academic Research Consortium

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Introduction

Transcatheter aortic valve implantation (TAVI) is a procedure being increasingly offered to high-risk nonoperable patients with severe aortic stenosis (AS).[1] TAVI has enabled access to aortic valve replacement for patients who until now have not been accepted for surgery because of the high perioperative risk. Despite the benefits, this procedure involves several undesirable side effects, such as stroke, vascular access site complications, and acute kidney injury.[2,3]

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Among the patients treated with the self-expandable Medtronic CoreValve Revalving System, some of the most frequent complications are rhythm and conduction disturbances.[4,5] As a consequence, permanent pacemaker (PM) implantation is performed, with reported rates between 18% and 49%.[6–8] According to the current ACC/AHA/HRS guidelines, permanent PM implantation is only recommended in cases of symptomatic and/or high-degree AVB.[9] Except for these established indications, there is no generally accepted strategy for PM implantation in patients with preexisting or periprocedurally acquired conduction disturbances. However, recent publications show that new-onset left bundle branch block (LBBB) especially but also QRS prolongation in general are important and independent risk factors for all-cause mortality after TAVI.[10,11] Moreover, patients with preexisting right bundle branch block have an increased risk for the occurrence of postprocedural bradyarrhythmia and episodes of high-degree AVB necessitating permanent PM implantation.[12,13]

Cardiac asynchrony, which has been thoroughly investigated in animal models and in patients with heart failure, could be responsible for the negative influence of QRS prolongation on survival.[10,14–16] In addition, the occurrence of high-degree AVB might have a negative impact on the outcome of these patients. Conduction abnormalities occurring in the context of TAVI procedures are conceivably caused by mechanical trauma of the cardiac conduction system. Recent data show a distinct correlation between positioning of the valve prosthesis and the prevalence of LBBB.[17,18] However, a "progression" from bundle branch block (BBB) to high-degree AVB has not yet been examined. Therefore, we investigated the incidence of high-degree AVB (type 2 second-degree AVB and complete AVB) in patients with preexisting BBB or BBB occurring during TAVI.

Methods

Patient population

Between August 2010 and December 2012, 50 consecutive patients undergoing TAVI were prospectively investigated at our department. Inclusion criteria comprised an aortic valve area of $\leq 1 cm^2$ or $\leq 0.6 cm^2/m^2$ or/and a transvalvular gradient ≥ 40 mm Hg. Each patient was evaluated for TAVI by a local heart team consisting of interventional cardiologists and cardiac surgeons. Surgical risk stratification was performed using the logistic European system for cardiac operative risk evaluation score (EuroSCORE). In case of high risk or inoperability, TAVI was the offered treatment. Baseline and procedural parameters were collected for all patients. Furthermore, intracardiac electrograms (EGMs) were performed in patients with preexisting BBB or BBB occurring during TAVI and prophylactic permanent PM implantation. Patients with a preexisting permanent PM or permanent atrial fibrillation were excluded from this analysis because it was not possible to assess intracardiac EGM recordings of AVB episodes in this setting. The study was conducted in accordance with the Declaration of Helsinki and the local ethics review committee.

Procedure

Implantation of the bioprosthesis was performed in a routine manner as described elsewhere.[19] In brief, all patients received the self-expanding third-generation CoreValve Revalving System (Medtronic, Minneapolis, MN), which consists of a trileaflet porcine pericardial valve attached to a nitinol stent frame. The bioprosthesis was used in sizes of 26, 29, and 31 mm and was implanted exclusively through the transfemoral route under general anesthesia after surgical preparation of the femoral artery. Outcome parameters were assessed in accordance with the Valve Academic Research Consortium (VARC) criteria.

Superficial ECGs and intracardiac EGMs

A baseline 12-lead ECG was collected before TAVI or before prophylactic PM implantation. Rhythm, heart rate, and PR, QRS, and corrected PQ intervals were measured. Periprocedural rhythm and conduction disturbances were monitored by permanent 3-lead ECG surveillance followed by continuous rhythm monitoring for 48 hours after the intervention. All patients received a temporary right ventricular pacemaker that was removed if conduction disorders were absent 48 hours after the implantation. If episodes of high-degree AVB were detected, permanent PM implantation was performed. According to our standard operating procedures, a permanent PM (Sorin Reply/Symphony with AVB documentation in AIDA memories, Milano, Italy) was also implanted in case of preexisting BBB or BBB occurring during TAVI. All procedures were conducted under local anesthesia and dual antiplatelet therapy if performed after TAVI. The devices were programmed in the SafeR-mode, which allows intrinsic conduction and switch to DDD mode in the event of atrioventricular (AV) conduction disturbances (first- and second-degree AVB, complete AVB, and pauses >2 seconds). The unique feature of stored intracardiac EGMs of AV conduction disturbances was the main reason to implant such devices. AIDA software facilitated the documentation and analysis of stored intracardiac EGMs and allowed continuous monitoring of AV conduction.[20] In case of ventricular pacing rates below 1%, the PM software displays "$<1\%$." For calculation purposes, these values were counted as 0.9%. Two senior cardiologists (MN, PS) reviewed all ECGs and intracardiac EGMs, in order to discriminate between true high-degree AV conduction abnormalities and incidents erroneously recorded by the PM software. ECG changes were reported in accordance with the AHA/ACCF/HRS recommendations for the standardization and interpretation of the ECG.[21]

Follow-up

After an initial PM checkup within 3 months of implantation, routine follow-up visits were scheduled at least annually at our outpatient ward. At every follow-up visit, outcome and