Atrioventricular Conduction Disturbance Characterization in Transcatheter Aortic Valve Implantation With the CoreValve Prosthesis

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Background—Atrioventricular (AV) block is one of the most frequent complications of CoreValve transcatheter aortic valve implantation (TAVI). The aim of this study was to analyze the effects of CoreValve implantation on AV conduction.

Methods and Results—Electrophysiological study was performed immediately before and after CoreValve implantation in 18 consecutive, permanent pacemaker-free patients. An electrode was placed on the His bundle during valve implantation, and data were continuously recorded during the procedure. With surface ECG, a median (first, third quartile) QRS width of 96 (84, 116) to 150 (121, 164) ms ($P=0.001$) and PR interval of 180 (159, 216) to 210 (190, 240) ms ($P=0.008$) were significantly prolonged, and QRS axis was left deviated $30^\circ$ ($20^\circ$, $60^\circ$, $2^\circ$) ($P=0.005$). With intracardiac electrograms, the AH (97 [70, 123] to 115 [96, 135] ms, $P=0.021$) and HV (52 [42, 55] to 60 [50, 70] ms, $P=0.002$) intervals were increased. At the end of the procedure, we observed significant ECG- or electrophysiological study-persistent conduction disturbances in 14 (78%) patients. Five patients experienced transient changes (2 AV blocks and 3 left bundle branch blocks).

Conclusions—CoreValve implantation worsens AV conduction in most patients, either transiently or permanently. This worsening is the result of direct damage either on the His bundle or on the AV node. (Circ Cardiovasc Interv. 2011; 4:280-286.)

Key Words: aortic valve ■ heart valve prosthesis implantation ■ stenosis ■ atrioventricular block ■ electrophysiology ■ pacemakers

Transcatheter aortic valve implantation (TAVI) is an emerging technique for the treatment of severe aortic stenosis in high-surgical-risk patients. More than 10 000 implants worldwide have proven its technical feasibility and safety, as described in several reports.1–5 However, because of the proximity of the aortic valve to the atrioventricular (AV) node and His bundle, AV block has been reported as one of the most frequent complications of CoreValve (Medtronic; Minneapolis, MN) implantation, and the need for permanent pacing has been reported in 18% to 35% of patients.4–8 Although some clinical and electrocardiographic predictors of AV block have already been reported, there is no available information regarding electrophysiological changes on AV conduction. In the present study, we analyzed the acute effect of TAVI with the CoreValve prosthesis on the AV node.

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Methods

Patients

From December 2009 to August 2010, a total of 18 permanent pacemaker-free patients with symptomatic, severe aortic stenosis were referred to our institution for CoreValve implantation (Table 1). All underwent implantation of the third generation CoreValve prosthesis as described previously.5 A transient pacemaker was positioned through the right jugular vein in all patients before CoreValve implantation and for the next 48 hours. Patients were continuously monitored, and electrocardiography was performed daily until discharge and the end of follow-up. The study was approved by the hospital ethics committee, and all patients gave consent.

Electrophysiological Study

Baseline and postprocedure electrophysiological studies (EPSs) were performed in the catheterization room immediately before the initial
balloon valvuloplasty and immediately after CoreValve prosthesis implantation. None of the patients were taking medication that could potentially affect the conduction system. Hemodynamic status was similar during both EPSs. The portable EP Tracer electrophysiology system (CardioTek; Maastricht, The Netherlands) was used for the procedure, and 2 quadripole catheters were positioned in the right atrium or ventricle and across the tricuspid annulus to record His bundle activation. In the 13 patients in sinus rhythm, corrected sinus node recovery time, sinoatrial conduction time, and antegrade and retrograde AV node function were assessed using atrial and ventricular pacing and extrastimuli. Measurements of atrial and ventricular refractory periods were not performed because of the risk of inducing arrhythmias. Arterial access then was achieved, and aortic valvuloplasty and CoreValve implantation was performed; intracardiac electrograms and local conduction intervals were monitored continuously and stored during the whole procedure in all patients. We considered normal the following parameters: PA interval, ≤55 ms; corrected sinus node recovery time, <500 ms; sinoatrial conduction time, <150 ms; AH interval, <125 ms; HV interval, ≤55 ms; effective refractory period of AV node, <425 ms; functional refractory period of AV node, <525 ms; Wenckebach AV block point, ≤450 ms; and 2:1 AV block point, ≤400 ms.

**Pacemaker Implantation**

Implantation of a permanent pacemaker was indicated immediately after TAVI in patients with newly developed complete AV block that persisted at the end of the procedure. At follow-up, a permanent pacemaker was indicated after demonstrated paroxysmal or persistent second- or third-degree AV block.

**Statistical Analysis**

Discrete variables are expressed as percentages and continuous variables as mean±SD or median and first and third quartiles as appropriate. Differences between variables before and after the procedure were analyzed with McNemar and Wilcoxon signed rank 2 related samples tests. Logistic regression was used to assess the univariate associations between continuous baseline characteristics and the probability of pacemaker implantation, and \( \chi^2 \) testing was used for discrete variables. Tests were conducted using \( P=0.05 \) as the level of significance. SPSS version 17.0 statistical software (SPSS Inc; Chicago, IL) was used for all calculations.

**Results**

**Baseline Findings**

**Surface ECG**

Thirteen patients were in sinus rhythm of whom 4 had first-degree AV block (Table 2). Seven had a left-axis deviation. Intraventricular conduction was abnormal in 6 patients (3 left anterior hemiblock, 2 left bundle branch block [LBBB], and 1 bifascicular block).

**EPS and Intracardiac Electrograms**

All parameters of sinoatrial node function were normal except in 1 patient with increased PA interval. AH interval was prolonged in 3 patients, and HV interval in 2. Wenckebach and 2:1 block points were prolonged in 6 patients and refractory periods in 7. Retrograde conduction was present in 5 patients.

**Effect of TAVI on ECG and EPS Parameters**

**Surface ECG**

At the end of the procedure, new ECG anomalies were detected in 14 (78%) patients (4 first AV blocks, 3 complete AV blocks with wide QRS and 25 beats/minute mean escape rhythm, and 9 LBBB) (Tables 2 through 4). QRS axis was left deviated in 10 patients (\( P=0.005 \)), and the width was increased in 13 (\( P=0.001 \)). All these changes were related to initial valvuloplasty (6 cases) or valve deployment (8 cases). The continuous trace recording analysis of procedure data revealed 5 transient changes that had gone unnoticed: 3 LBBB (lasting 6, 45, and 70 seconds) and 2 complete AV blocks (lasting 4 and 7 seconds). One was caused by valvuloplasty and 4 by prosthesis deployment.

**EPS and Intracardiac Electrograms**

Sinus function parameters were similar after the procedure. A significant increase of AH (\( P=0.021 \)) and HV (\( P=0.002 \)) intervals was detected (Tables 2 and 3). Functional refractory period of AV node (\( P=0.012 \)) and Wenckebach block point (\( P=0.005 \)) were also significantly increased. Of the 3 complete AV blocks, 1 was intra-Hisian and 2 infra-Hisian. In these 3 patients, a permanent pacemaker was implanted immediately after the procedure (2 DDD and 1 VVI). In the 3 patients who experienced transient LBBBs, HV increased to 55, 58, and 63 ms. The 2 cases of transient third AV block were infra-Hisian. Atrial stimulation did not reveal any infra-Hisian block. Retrograde conduction also was affected after valve implantation, but none of these changes reached statistical significance. Including both transient and permanent changes in the analysis, TAVI with the CoreValve prosthesis caused AV conduction disturbances in all but 1 patient with previous atrial fibrillation and LBBB, which represents a total affection rate of 94%.

**Follow-Up**

One of the 3 patients with postprocedural complete AV block and permanent pacemaker implantation also had mitral regurgitation and severe pulmonary hypertension and died 24 hours...
<table>
<thead>
<tr>
<th>Pt No.</th>
<th>Rhythm</th>
<th>Intraventricular or AV Conduction Disease and PM Implant, ms</th>
<th>QRS Duration, ms</th>
<th>QRS Axis, °</th>
<th>PR, ms</th>
<th>PA, ms</th>
<th>AH, ms</th>
<th>HV, ms</th>
<th>cSNRT, ms</th>
<th>SACT, ms</th>
<th>ERPAVN, ms</th>
<th>FRPAVN, ms</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Pre Post PM Implant, ms</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
<td>Pre Post</td>
</tr>
<tr>
<td>1</td>
<td>SR</td>
<td>No</td>
<td>1st AVB+LBBB</td>
<td>Yes*</td>
<td>90</td>
<td>164</td>
<td>45</td>
<td>-10</td>
<td>190</td>
<td>270</td>
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<td>30</td>
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<td>1st AVB+LBBB</td>
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<td>-60</td>
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<td>LBBB</td>
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<tr>
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<td>85</td>
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<td>1st AVB</td>
<td>1st AVB+LBBB</td>
<td>90</td>
<td>180</td>
<td>50</td>
<td>-70</td>
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<td>116</td>
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<td>LAFB</td>
<td>112</td>
<td>130</td>
<td>-30</td>
<td>-70</td>
<td>150</td>
<td>160</td>
<td>55</td>
<td>53</td>
<td>59</td>
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<td>1st AVB</td>
<td>LBBB</td>
<td>72</td>
<td>130</td>
<td>30</td>
<td>0</td>
<td>180</td>
<td>230</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

*PM was implanted at 10th day.
†PM was implanted immediately.

1st AVB indicates first-degree atrioventricular block; 3rd AVB, complete atrioventricular block; AF, atrial fibrillation; cSNRT, corrected sinus node recovery time; ERPAVN, effective refractory period of atrioventricular node; FRPAVN, functional refractory period of atrioventricular node; LAFB, left anterior fascicular block; LBBB, left bundle branch block; PM, pacemaker; RBBB, right bundle branch block; SACT, sinoatrial conduction time; SR, sinus rhythm.
after the procedure as a result of heart failure and cardiogenic shock (Table 4). One patient who developed a new LBBB after TAVI and had a prolonged HV interval of 76 ms in postprocedural EPS experienced recurrent syncope after discharge. Paroxysmal complete AV block was documented in this patient 10 days after TAVI, and a permanent pacemaker was implanted. After a median follow-up of 20 weeks (17–22 weeks) the 3 patients who required permanent pacemaker implantation continued as pacemaker dependent on complete AV block with an escape rhythm of \( \frac{30}{120} \) beats/minute, and they were 100% paced.

At a median follow-up of 16 weeks (7–28 weeks), no other disorders were detected among the remaining pacemaker-free patients, including those who experienced a complete transitory AV block during the procedure.

### Predictors of AV Block

Among the 4 patients who developed complete AV block (3 patients during TAVI and 1 patient 10 days after the procedure), 3 had a normal ECG before the procedure, and the other showed bifascicular block. Initial EPS was normal in all

### Table 3. ECG and EPS Parameters Before and After TAVI and Distribution of the Change

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before TAVI</th>
<th>After TAVI</th>
<th>( P^* )</th>
<th>Delta†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate, beats/min</td>
<td>64 (61–68)</td>
<td>64 (55–72)</td>
<td>0.462</td>
<td>0 (0–4.7)</td>
</tr>
<tr>
<td>QRS axis, °</td>
<td>30 (32–46)</td>
<td>20 (60–2)</td>
<td>0.005</td>
<td>−15 (−57–0)</td>
</tr>
<tr>
<td>QRS duration, ms</td>
<td>96 (84–114)</td>
<td>150 (121–164)</td>
<td>0.001</td>
<td>34.5 (0–71)</td>
</tr>
<tr>
<td>PR, ms</td>
<td>180 (159–216)</td>
<td>210 (190–240)</td>
<td>0.008</td>
<td>18 (12–30)</td>
</tr>
<tr>
<td>PA, ms</td>
<td>48 (36–55)</td>
<td>48 (34–55)</td>
<td>0.829</td>
<td>0 (−2–0)</td>
</tr>
<tr>
<td>AH, ms</td>
<td>97 (70–123)</td>
<td>115 (96–135)</td>
<td>0.021</td>
<td>15 (3–20)</td>
</tr>
<tr>
<td>HV, ms</td>
<td>52 (42–55)</td>
<td>60 (50–70)</td>
<td>0.002</td>
<td>10 (4–16)</td>
</tr>
<tr>
<td>cSNRT, ms</td>
<td>200 (138–285)</td>
<td>210 (148–290)</td>
<td>0.345</td>
<td>0 (0–20)</td>
</tr>
<tr>
<td>SACT, ms</td>
<td>80 (62–99)</td>
<td>80 (70–115)</td>
<td>0.138</td>
<td>0 (0–20)</td>
</tr>
<tr>
<td>ERPNAV, ms</td>
<td>440 (270–505)</td>
<td>470 (320–580)</td>
<td>0.059</td>
<td>50 (10–60)</td>
</tr>
<tr>
<td>FRPAVN, ms</td>
<td>520 (415–586)</td>
<td>570 (450–691)</td>
<td>0.012</td>
<td>36 (0–76)</td>
</tr>
<tr>
<td>Antegrade Wenckebach point, ms</td>
<td>440 (380–500)</td>
<td>507 (460–580)</td>
<td>0.005</td>
<td>40 (20–40)</td>
</tr>
<tr>
<td>RERPAVN, ms</td>
<td>400 (335–475)</td>
<td>440 (420–540)</td>
<td>0.06</td>
<td>30 (20–40)</td>
</tr>
<tr>
<td>RFRPAVN, ms</td>
<td>290 (244–365)</td>
<td>400 (315–434)</td>
<td>0.1</td>
<td>168 (0–174)</td>
</tr>
<tr>
<td>Retrograde Wenckebach point, ms</td>
<td>403 (380–478)</td>
<td>462 (380–517)</td>
<td>0.1</td>
<td>59 (0–76)</td>
</tr>
</tbody>
</table>

Data are presented as median (Q1–Q3). EPS indicates electrophysiological study; RERPAVN, retrograde effective refractory period of atrioventricular node; RFRPAVN, retrograde functional refractory period of atrioventricular node; TAVI, transcatheter aortic valve implantation; SACT, sinoatrial conduction time; cSNRT, corrected sinus node recovery time; ERPNAV, effective refractory period of atrioventricular node; FRPAVN, functional refractory period of atrioventricular node.

*Wilcoxon signed ranks test.
†Delta stands for the difference between postprocedural and preprocedural parameters.

### Table 4. Changes in ECG Parameters of Cardiac Conduction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre</th>
<th>( P )</th>
<th>Immediate Post</th>
<th>( P )</th>
<th>Predischarge (Median, 3 d)</th>
<th>( P )</th>
<th>Follow-Up (Median, 18 wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBBB</td>
<td>2/18</td>
<td>0.004</td>
<td>11/15*</td>
<td>0.25</td>
<td>8/15†</td>
<td>1</td>
<td>6/14‡</td>
</tr>
<tr>
<td>LAFB</td>
<td>3/18</td>
<td>0.625</td>
<td>1/15*</td>
<td>0.5</td>
<td>2/15†</td>
<td>1</td>
<td>2/14‡</td>
</tr>
<tr>
<td>RBBB + LAFB</td>
<td>1/18</td>
<td>1</td>
<td>0/15*</td>
<td>1</td>
<td>0/15†</td>
<td>1</td>
<td>0/14‡</td>
</tr>
<tr>
<td>1st AVB</td>
<td>4/13§</td>
<td>0.125</td>
<td>8/11*</td>
<td>0.5</td>
<td>6/11†</td>
<td>1</td>
<td>5/10‡</td>
</tr>
<tr>
<td>3rd AVB</td>
<td>0/18</td>
<td>0.25</td>
<td>3/18</td>
<td>1</td>
<td>2/17†</td>
<td>0.5</td>
<td>3/17‡</td>
</tr>
<tr>
<td>Left axis</td>
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<td>0.125</td>
<td>10/15*</td>
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<td>11/15†</td>
<td>1</td>
<td>9/14‡</td>
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<tr>
<td>QRS duration, ms</td>
<td>96 (84–116)</td>
<td>0.001</td>
<td>150 (121–164)</td>
<td>0.25</td>
<td>130 (92–150)</td>
<td>0.32</td>
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<tr>
<td>QRS axis, °</td>
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<td>0.005</td>
<td>–20 (–60–2)</td>
<td>0.7</td>
<td>–15 (–50–7)</td>
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<td>–20 (–52–15)</td>
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<tr>
<td>PR interval, ms</td>
<td>180 (159–216)</td>
<td>0.008</td>
<td>210 (190–240)</td>
<td>0.5</td>
<td>220 (192–27)</td>
<td>0.11</td>
<td>205 (182–222)</td>
</tr>
</tbody>
</table>

Data are expressed as n/N or median (Q1–Q3). \( P \) values denote significance of McNemar test (qualitative variables) and of Wilcoxon signed ranks test (quantitative variables) for differences between adjacent time points for each variable. SACT indicates sinoatrial conduction time; cSNRT, corrected sinus node recovery time; ERPNAV, effective refractory period of atrioventricular node; FRPAVN, functional refractory period of atrioventricular node.

*Three patients developed atrioventricular block requiring PM implantation.
†One patient with complete atrioventricular block died 24 hours after the procedure.
‡One patient developed atrioventricular block after discharge from hospital.
§Five patients in AF.
of them. Because with this sample size there is virtually no statistical power to identify predictors of AV block, these analyses are not presented here.

**Discussion**

To the best of our knowledge, we have studied for the first time EPS changes in TAVI procedures with the CoreValve prosthesis. We have shown that these changes are either permanent or transient in relation to valvuloplasty or valve deployment and include conduction disturbances at 2 levels: AV node and His bundle.

**Baseline Data**

Six (33%) of 18 patients in the present study had conduction disturbances in the ECG before the implantation, an incidence similar to that reported in previous studies, which varies between 12% and 35%. Baseline characteristics of patients with severe aortic stenosis have already been described. Rasmussen et al studied conduction parameters in 20 patients with calcified aortic stenosis before and after surgery. Baseline sinus function was impaired in ≈25% of their patients, and HV was prolonged in 55%. Postsurgery EPS was performed in 9 of these patients, and HV interval had increased in 6 of them. In comparison, the patients in the present study showed better baseline conduction parameters, with baseline sinus node dysfunction present in only 5% and a prolonged HV interval in 11%. Conduction parameters in our series worsened similarly. Nevertheless, methodological differences between both studies preclude direct comparison of reported data because 1 analyzed conduction disturbances after surgery and the other after TAVI.

**AV Conduction After the Procedure**

EPSs were performed immediately before and after valve implantation. No differences were found in hemodynamic parameters, such as arterial pressure and heart rate before and after the procedure, or in sinus function parameters. Therefore, an autonomic effect is unlikely responsible for the changes.

Previous series reported worsening in ECG parameters in ≈50% of the cases, and the reported rate of permanent pacemaker implantation after the procedure ranged from 18% to 35% for the CoreValve system. Reported rates for the Edward-Sapiens prosthesis are consistently lower. In the present series, conduction parameters at the end of the procedure worsened in 78% of the patients, including 3 who required permanent pacemaker implantation. These wide differences between studies may be due to baseline differences among patients or, more likely, to discrepancies in the indication for permanent pacing because these have not been defined to date. In some cases, this worsening is only transitory (5 patients in the present study) and, therefore, may go unnoticed if data are not continuously recorded and analyzed. Globally, any worsening of conduction (transient or permanent) was seen in all patients but 1 with atrial fibrillation and previous LBBB.

Most changes occur by direct effect on the infra-Hisian conduction system, probably by direct pressure of the lower area of the prosthesis on the basal portion of the ventricular septum and the area involving the His bundle. The procedure also affects the compact AV node, probably by length of prosthesis, which is consistent with the lower rate of AV block in the shorter Edward Sapiens prosthesis.

In most cases, damage to the conduction system is related to prosthesis deployment, but in 43% of the patients in the present series, it was related to the initial valvuloplasty. Older series of aortic valvuloplasty reported a 4% incidence of procedure-related AV block requiring pacing. There are no data on the ultimate effect produced by each single maneuver because both are almost invariably performed together.

**Predictors of AV Block After TAVI**

Multiple predictors of AV block have been described after TAVI, and they have varied between studies. This variation may be partly attributed to the different criteria used in each center for permanent pacemaker indication because of the absence of consensus regarding permanent pacing requirements after TAVI. In a study by Jilaihawi et al, AV block was related to baseline left-axis deviation, LBBB, increased interventricular septal dimension, and noncoronary cusp thickness. Bleiziffer et al identified anatomic predictors of AV block (small annuli) but not electrocardiographic predictors, and Baan et al described both electrocardiographic (baseline left-axis deviation) and anatomic predictors (smaller outflow tract diameter and more mitral annular calcification). Latsios et al reported the influence of left ventricular outflow tract calcification, female sex, and depressed ejection fraction on postprocedural AV block. Finally, Ferreira et al related the deeper implantation of the prosthesis into the left ventricular outflow tract with a higher incidence of AV block.

In the present series, all 4 patients who underwent permanent pacemaker implantation after TAVI (3 patients immediately after the implant and 1 patient 10 days later) had a normal preprocedural EPS, and 3 of them had a normal ECG. Although these good baseline conduction parameters might suggest that there is no relation between preexisting conduction anomalies and the development of complete AV block, this study has virtually no statistical power to identify predictors of AV block due to its sample size, which is the reason why we decided not to present these analyses here. Studies with a greater number of patients are essential to properly evaluate this issue. Nevertheless, the low predictive value of the EPS and particularly of the atrial stimulation maneuvers in detecting AV block in asymptomatic patients is well established; in fact, its utility is only established for symptomatic or asymptomatic patients with an HV interval duration ≥100 ms.

Bleiziffer et al found that AV block detection during the procedure was a significant predictor of permanent pacemaker implantation, with a reported odds ratio of 4.8. We could not analyze the evolution of procedural AV block in the present study because pacemaker implantation was performed straightforward in those cases in which third AV block was recorded. Nevertheless, all these patients remained pacemaker dependent at follow-up, with 100% pacing.
Preprocedural right bundle branch block also has been related to AV block after TAVI.\(^8\)\(^,\)\(^2\) Only 1 patient in the present series had this preexisting condition (with associated left anterior hemiblock), and she developed AV block, which supports previous findings.

**Follow-Up and Pacemaker Indication**

In the present study, most conduction disturbances occurred early and all but 1 during the TAVI procedure. This finding is in concordance with those of Jilaihawi et al.\(^1\)\(^1\) Nevertheless, other studies reported conduction anomalies along the first week postprocedure.\(^9\)

Most electrocardiographic disorders were definitive, as in the 3 patients with complete AV block who did not recover spontaneous AV conduction and remained pacemaker dependent at the end of follow-up, which contrasts other series that have described a progressive recovery of conduction parameters during follow-up.\(^1\)\(^1\) This finding supports pacemaker implantation early after the procedure in these patients rather than waiting a few days for AV conduction recovery.

Currently, there are no studies addressing the indications for permanent pacemaker implantation in patients with the CoreValve prosthesis. The published series are characterized by great variability in the indications. In the present series, AV blocks were early, definitive, intra-Hisian or infra-Hisian and with slow escape rhythm, indicating a severe lesion of the His bundle. One patient developed AV block on the 10th day; her postprocedural HV interval was 76 ms. Patients with transient AV block did not require pacemaker implantation.

These data could support definitive pacemaker implantation in patients with persistent AV block at the end of the procedure and diagnostic assessment (eg, EPS or insertable loop recorder) in other uncertain cases. Nevertheless, more studies are needed before setting any recommendation regarding permanent pacing requirements and optimal timing.

**Study Limitations**

The small sample size and short follow-up period limit the detection of predictors of AV block and pacemaker implantation in this study. Recovery of spontaneous AV conduction is difficult to evaluate in patients with complete AV block because pacemaker implantation is carried out immediately after the TAVI procedure. A longer follow-up is essential to analyze the evolution of transient and minor procedure-related alterations. Pacemaker implantation is the dependent variable in most studies analyzing conduction anomalies related to TAVI. Because there currently is no consensus on the indications for pacing requirements after TAVI, the great variability in the indications for permanent pacing among the different centers is one of the factors that precludes comparisons between studies.

**Conclusions**

CoreValve implantation originates transient or permanent worsening of conduction parameters in most patients. This worsening is the result of direct damage on the AV node or His bundle and is related to the initial valvuloplasty or prosthesis deployment.

**Disclosures**

Dr Morís de la Tassa is proctor for Medtronic/CoreValve. The other authors report no conflicts of interest in relation to this study.

**References**


**CLINICAL PERSPECTIVE**

Atrioventricular block is one of the most frequent complications of CoreValve transcatheter aortic valve implantation. Although several studies have analyzed the effect of transcatheter aortic valve implantation on ECG parameters, none have analyzed the electrophysiological study conduction parameters. The present study demonstrates that both the atrioventricular node and His bundle may also be affected by the procedure. Disturbances may arise from both balloon valvuloplasty and transcatheter aortic valve implantation and may be transient and go unnoticed if continuous recording is not performed. Short-term follow-up also provides insight into the evolution of these disturbances to better define the optimal timing and indications for pacemaker implantation.
Atrioventricular Conduction Disturbance Characterization in Transcatheter Aortic Valve Implantation With the CoreValve Prosthesis
José M. Rubín, Pablo Avanzas, Raquel del Valle, Alfredo Renilla, Enrique Ríos, David Calvo, Iñigo Lozano, Ignasi Anguera, Beatriz Díaz-Molina, Angel Cequier and César Morís de la Tassa

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