Pacemaker dependency after isolated aortic valve replacement: do conductance disorders recover over time?†

Hassina Baraki*, Ammar Al Ahmad, Stefan Jeng-Singh, Shunsuke Saito, Jan Dieter Schmitto, Bernhard Fleischer, Axel Haverich and Ingo Kutschka

Department of Cardio-Thoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany

* Corresponding author. Department of Cardio-Thoracic, Transplantation and Vascular Surgery, Hannover Medical School, Carl-Neuberg-Str. 1, 30625 Hannover, Germany. Tel: +49-511-5326581; fax: +49-511-5325404; e-mail: baraki.hassina@mh-hannover.de (H. Baraki).

Received 14 September 2013; received in revised form 29 November 2012; accepted 7 December 2012.

Abstract

OBJECTIVES: Permanent pacemaker (PPM) implantation is required in 3–8% of all patients undergoing aortic valve replacement (AVR). Our aim was to evaluate long-term PPM dependency and recovery of atrioventricular (AV) conduction disorders during follow-up in these patients.

METHODS: Since January 1997, a total of 2106 consecutive patients underwent isolated AVR at our institution. Of these, 138 patients (6.6%, 72 female, median age 71 (37–89) years) developed significant conduction disorders leading to PPM implantation postoperatively. Preoperative ECG showed normal sinus rhythm (n = 64), first degree AV block (n = 19), left bundle branch block (n = 13), right bundle branch block (n = 16), left anterior hemiblock (n = 14) and AV block with ventricular escape rhythm (n = 10). Atrial fibrillation was present in 23 patients. Pacemakers were implanted after a median of 7 (1–30) days following AVR. PPM dependency was analysed by ECG and pacemaker check during follow-up.

RESULTS: A total of 45 of 138 patients with postoperative PPM Implantation died during a mean follow-up time of 5.3 ± 4.7 years. A further 9 patients were lost to follow-up. Long-term survivals at 1, 5 and 10 years were 88%, 79% and 59%, respectively. Only 8 (10%) of 84 survivors were no longer pacemaker-dependent. The majority of patients (n = 66, 75%) required permanent ventricular stimulation, and the remaining 10 (13%) showed intermittent stimulation with a mean ventricular stimulation fraction of 73% (22–98%).

CONCLUSIONS: The majority of patients do not recover from AV conduction disorders after AVR. Since higher-grade AV blocks expose patients to a high risk of sudden death after surgery, we recommend early implantation of permanent pacemaker.

Keywords: Aortic valve replacement • Pacemaker dependency • Conductance disturbances

INTRODUCTION

The incidence of permanent pacemaker (PPM) implantation after cardiac surgery varies between 0.8 and 34%, depending on the specific surgical procedure [1–4]. Early postoperative PPM implantation after isolated aortic valve replacement (AVR) is reported to be 3–8.5% [5–10]. Only few studies analysed the long-term PPM dependency rate of patients who required PPM implantation following cardiac surgery [2, 8, 11, 12].

In this study, we focussed on patients who received isolated AVR and early postoperative PPM implantation due to conduction disturbances in our institution. We aimed to determine the long-term outcome and the long-term PPM dependency of these patients.

Furthermore, we aimed to identify the predictors of long-term pacemaker dependency in order to avoid unnecessary PPM implantations and to decide on early PPM implantation in selected patients. Liberal PPM implantation is cost-intensive and may expose patients to an avoidable risk of pacemaker complications [13]. On the other hand, a delayed implantation increases morbidity by immobilization and the risk of sudden death caused by unpredictable conduction disorders without sufficient ventricular escape rhythm.

MATERIALS AND METHODS

Between January 1997 and September 2011, a total of 2106 consecutive patients underwent isolated AVR at our institution (including 92 patients with Sutureless Perceval S Aortic Valve [Sorin Group, Saluggia, Italy] and 75 patients with Edwards Sapien Transapical Aortic Valve [Edwards Lifescience, Irvine, CA, USA]). Our database was reviewed for AVR patients who underwent PPM implantation during the same hospital stay due to postoperative significant conduction disorders. Patients with preexisting PPM, implantable defibrillators or cardiac resynchronization therapy devices (CRTDs) were excluded. A total of
138 (6.6%) patients could be identified and included in the study. Their clinical data were extracted from patients' charts recorded in the hospital's computer database.

### Patient characteristics

A total of 138 patients with a mean age of 71 (range 37–89) years were included in this study. The preoperative patients' characteristics and echocardiographic findings are listed in Table 1. The indications for AVR were isolated valve stenosis (n = 82, 59%), isolated valve insufficiency (n = 7, 5%), and combined aortic valve defects (n = 27, 20%). A total of 18 patients (13%) suffered from native or prosthetic valve endocarditis, and 27 cases (20%) were performed as redo surgery (Table 1).

Preoperative ECG revealed different conductance disorders in 53% of patients: first degree AV block (n = 19, 14%), left bundle branch block (n = 13, 9%), right bundle branch block (n = 16, 12%), left anterior hemiblock (n = 14, 10%), intermittent atrial fibrillation (n = 6, 4%), chronic atrial fibrillation (n = 17, 12%), higher AV block with ventricular escape rhythm (n = 10, 7%). The remaining patients (n = 64, 47%) had a normal sinus rhythm. All patients with higher degree AV block and ventricular escape rhythm had sufficient cardiac frequency >50 beats/min at the time point of surgery. Perioperative data, types and sizes of the implanted aortic valve prostheses are given in Tables 2 and 3.

### Follow-up

Follow-up was performed by telephone interviews contacting patients and their cardiologists.

### Table 1: Patients' characteristics and preoperative data.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n = 138</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years, range)</td>
<td>71 (37–89)</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>72 (52%)</td>
</tr>
<tr>
<td>NYHA class (range)</td>
<td>2.9 (2–4)</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>27 (20%)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>11 (8%)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>31 (23%)</td>
</tr>
<tr>
<td>Renal impairment (serum creatinine &gt;200 μmol/l)</td>
<td>33 (24%)</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>15 (11%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>87 (63%)</td>
</tr>
<tr>
<td>Body mass index (kg/m²) (range)</td>
<td>27 (17–42)</td>
</tr>
<tr>
<td>Beta blocker</td>
<td>34 (25%)</td>
</tr>
<tr>
<td>Amiodaron</td>
<td>11 (8%)</td>
</tr>
<tr>
<td>Echocardiographic data</td>
<td></td>
</tr>
<tr>
<td>Aortic valve stenosis</td>
<td>82 (59%)</td>
</tr>
<tr>
<td>Aortic valve insufficiency</td>
<td>7 (5%)</td>
</tr>
<tr>
<td>Combined aortic valve stenosis and insufficiency</td>
<td>27 (20%)</td>
</tr>
<tr>
<td>Endocarditis (native valve)</td>
<td>13 (19%)</td>
</tr>
<tr>
<td>Endocarditis (prosthetic valve)</td>
<td>5 (4%)</td>
</tr>
<tr>
<td>Prosthetic valve degeneration</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>Slight to moderate mitral valve insufficiency</td>
<td>75 (54%)</td>
</tr>
<tr>
<td>Pulmonary hypertension (mean &gt;40 mmHg)</td>
<td>34 (25%)</td>
</tr>
<tr>
<td>Left ventricular ejection fraction</td>
<td></td>
</tr>
<tr>
<td>&gt;50%</td>
<td>86 (62%)</td>
</tr>
<tr>
<td>30–50%</td>
<td>30 (22%)</td>
</tr>
<tr>
<td>&lt;30%</td>
<td>22 (16%)</td>
</tr>
</tbody>
</table>


### Table 2: Perioperative data

<table>
<thead>
<tr>
<th>Variable</th>
<th>n = 138</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic ring enlargement by annuloplasty</td>
<td>9 (7%)</td>
</tr>
<tr>
<td>Cardiopulmonary bypass time (min range)</td>
<td>104 (41–241)</td>
</tr>
<tr>
<td>Aortic cross clamp time (min)</td>
<td>67 (0–181)</td>
</tr>
<tr>
<td>Intubation time (h) (range)</td>
<td>44 (0–1051)</td>
</tr>
<tr>
<td>Reoperation for bleeding</td>
<td>2 (1.4%)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>2 (1.4%)</td>
</tr>
<tr>
<td>Low output syndrome</td>
<td>6 (4%)</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>3 (2%)</td>
</tr>
</tbody>
</table>

### Table 3: Types and sizes of the implanted aortic valve prostheses with the corresponding postoperative day of pacemaker implantation

<table>
<thead>
<tr>
<th>Prosthesis type</th>
<th>n = 138</th>
<th>Time to PPM implantation in days (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stented</td>
<td>67 (49%)</td>
<td>7 (1–30)</td>
</tr>
<tr>
<td>Stentless</td>
<td>6 (4%)</td>
<td>9 (1–18)</td>
</tr>
<tr>
<td>Sutureless Perceval S Aortic Valve (Sorin)</td>
<td>11 (8%)</td>
<td>5 (1–14)</td>
</tr>
<tr>
<td>Edwards Sapien Transapical Aortic Valve (Edwards Lifescience)</td>
<td>9 (7%)</td>
<td>7 (1–30)</td>
</tr>
<tr>
<td>Mechanical</td>
<td>35 (25%)</td>
<td>10 (1–30)</td>
</tr>
<tr>
<td>Homograft</td>
<td>10 (7%)</td>
<td>6 (1–30)</td>
</tr>
<tr>
<td>Prosthesis size (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>31 (22%)</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>60 (44%)</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>32 (23%)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>5 (4%)</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>7 (5%)</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>3 (2%)</td>
<td></td>
</tr>
</tbody>
</table>

Patients were asked about their activity level (NYHA, New York Heart Association classification, NY, USA), cardiac reoperations and PPM-associated complications. The cardiologist was asked to perform an actual ECG and PPM check in order to determine the PPM dependency of the patient during the last check-up period (6 months). Patient's pacemaker dependency was categorized as dependent, non-dependent or intermittent dependent. Dependent patients showed a continuous ventricular stimulation without any pacemaker inhibition by spontaneous cardiac activity. Non-dependent patients did not show any pacemaker activity, and a pacemaker check revealed sinus rhythm or atrial fibrillation with adequate heart rate. Patients with intermittent dependency showed temporary pacemaker activity quantified as percentage of pacemaker stimulation throughout the entire check-up period. All pre- and perioperative parameters (Tables 1–3) were included in univariate analysis for association with PPM dependency. The study was performed according to the Declaration of Helsinki. The local medical ethics committee approved the study and all patients or their close relatives provided an informed consent for the data collection and the anonymous use of their data for research purposes.
Statistical analysis

Statistical analyses were performed using the SPSS software (SPSS 19, Inc., Chicago, IL, USA). Continuous variables were expressed as median and range. For comparisons of categorical variables, the χ² test was used. The Mann–Whitney U test was applied for comparisons of continuous variables. P-values of ≤0.05 were considered significant. Survival was analysed by the Kaplan–Meier method.

RESULTS

Perioperative data

Types and sizes of the implanted prostheses as well as the perioperative outcome are listed in Table 3. The standard surgical approach was a median sternotomy. Only 9 of 138 patients received a left lateral thoracotomy for transapical valve implantation. In 10 cases (7%), a homograft was implanted in the aortic position for treatment of acute endocarditis. Nine patients (7%) required an aortic ring enlargement in order to avoid a patient-prosthesis mismatch. We included only patients who developed significant postoperative bradyarrhythmias requiring the implantation of PPM (Table 4). The leading indication for pacemaker implantation was AV block III in 103 patients (75%), followed by low-rate atrial fibrillation in 22 cases (16%). One patient presented with an asystolic syncope 1 week postoperatively and was resuscitated successfully. PPMs were implanted after a median of 7 (range 1–30) days following AVR. Timing of pacemaker implantation was based on the surgeon’s judgement, the clinical status of the patient and the threshold of the epicardial temporary pacemaker. PPMs were implanted when the threshold of the temporary pacemaker increased >10 V.

The different PPM implantation times depending on indication and prosthesis type are presented in Tables 3 and 4 (Fig. 1).

Single chamber ventricular PPMs were implanted in 32 (23%) patients, dual chamber PPMs in 105 (76%) and only 1 patient received a biventricular CRTD. The timing of transvenous PPM implantation was based on the judgment of the attending surgeon, the clinical status of the patient and the pacing threshold of the temporary epicardial pacemaker. Only 3 patients died within the first 30 postoperative days due to sepsis (n = 1) and low cardiac output (n = 2). All patients received systemic anticoagulation with coumadin for at least 3 months postoperatively. Patients with additional indications for long-term anticoagulation such as mechanical prostheses and atrial fibrillation continued with anticoagulation.

Long-term results

Follow-up was completed in 129 (93%) patients. Nine patients were lost for evaluation. Mean time of follow-up was 5.3 ± 4.7 (range 0.1–15) years. During this time period 45 (33%) patients died. In 20 patients, death was related to cardiac cause. Overall survival at 1, 5 and 10 years was 88%, 79% and 59%, respectively (Fig. 2). The survivors improved their NYHA status by 1.5 (range 1–3). During follow-up, 4 patients required a pacemaker battery change and 1 had to be reoperated due to re-endocarditis. Two atrial leads had to be revised due to dislocation. No other PPM-related complications were observed. More than half of the patients (n = 48, 57%) received coumadin for anticoagulation, and 25 due to mechanical valve prosthesis. Three two-chamber PPMs were reprogrammed to the VVI mode due to persistent atrial tachyarrhythmias.
Sufficient heart rhythm was not recovered in 90% of all surviving patients (Table 5). According to our criteria, 66 (79%) patients were completely PPM dependent with permanent ventricular stimulation. Only 8 (9%) patients were classified as non-dependent as they did not show any PPM activity. Their ECG revealed sinus rhythm or atrial fibrillation with continuous adequate heart rate. The remaining 10 (12%) patients were considered as intermittent dependent. Their PPM activity showed intermittent stimulation with a mean ventricular stimulation fraction of 73% (range 22–98%).

The univariate analyses did not identify any association of pre- or perioperative parameters with long-term PPM dependency.

**DISCUSSION**

The rate of PPM implantation after cardiac surgery is reported to be 0.8–8% [2, 5, 6]. Roten et al. [3] reported an implantation rate of PPM in 34% of cases after transcatheter AVR. In the present study, we observed a total of 6.6% pacemaker implantations following isolated AVR. Nardi et al. [7] described a PPM implantation rate of only 3% within the first 30 days after AVR. Other studies that reported even lower incidences of early postoperative PPM dependency included a variety of valve procedures and coronary artery bypass grafting [2, 11, 14]. The higher incidence in our study might be explained by the selection of isolated AVR procedures and the inclusion of patients with transapical and sutureless AVR. The rate of PPM implantation following transapical or sutureless AVR was 12% each in our cohort, which was lower than that reported in the literature. Both procedures are well known to increase PPM need due to a relevant tension stress on the conduction system [3, 15, 16]. Additionally, the high rate of redo surgery and infective endocarditis may also have influenced the number of patients with postoperative PPM need in our study [17, 18].

To our knowledge, the current study is the first to analyse long-term PPM dependency after isolated AVR. The majority of our patients (90%) remained PPM dependent. This is in contrast to the findings of Glikson et al. [2] who reported a heart rhythm recovery rate of 41% after cardiac surgery. Their higher recovery rate might be explained by their selection criteria and a different definition of PPM dependency. They included several cardiac procedures with only 23% of patients who underwent isolated AVR. Pacemaker dependency was detected by down-regulation of the pacing frequency to the lowest programmable rate for 15 min. Merin et al. [14] also analysed patients with different surgical procedures. In their cohort, only 14% underwent isolated AVR and 63% remained PPM dependent after a mean follow-up of 72 months. In this study, PPM dependency was detected by lowering the pacing rate to 40 beats/min (bpm) for a very short duration of 10 s. Patients without pacing activity during this time period were considered as non-dependent. Huynh et al. [8] observed patients with aortic and mitral valve surgery who required postoperative PPM and found that 15 of 207 patients required PPM implantation postoperatively. Seven patients (70%) were PPM dependent during a mean follow-up period of 32 months. PPM dependency was defined as lacking escape rhythm at a pacing rate of 30 bpm for 30 s. In contrast, Onalan et al. [11] reported 77% long-term recovery from postoperative pacemaker dependency. PPM dependency was defined as any PPM activity in the VVI mode with a pacing rate of 30 bpm. In our opinion, short-term pacing rate down-regulation might be inadequate to classify these patients into dependent or non-dependent. For example, patients with ventricular escape rhythm rates <50 bpm and an absent heart rate increase during exercise should be considered PPM dependent. Some of our patients showed only intermittent pacemaker activity, which ranged between 22 and 98%. Unfortunately, pacemaker check records were not appropriate to determine whether the natural heart rate of these patients would have been sufficient during the intermittent stimulation periods. We believe that the above-mentioned studies underestimate clinically relevant pacemaker dependency by short-term evaluations. On the other hand, we might have overestimated PPM dependency in our study by permanent or intermittent over-pacing of a marginally sufficient natural heart rate.

Several studies have already analysed the risk factors for early postoperative need for PPM [2, 7, 14]. So far, not a single preoperative variable could be identified that reliably predicts the need for postoperative PPM implantation. Nardi et al. [7] did not observe any correlations to pre-existing conducting system disorders. According to their publication, the only predictors of PPM need following isolated AVR were the preoperative end-diastolic diameter and a septal hypertrophy. Several predictors for long-term PPM dependency such as AV block III, left bundle branch block, BMI >28.5, syncope, poor ejection fraction as well as prolonged cross-clamp and bypass time have been described before [2, 11, 14, 19]. In contrast to these findings, our statistical analysis in isolated AVR patients did not reveal any risk factor associated with long-term PPM dependency, which might be explained by the low number of patients in the ‘non-dependent’ subgroup.

As reported in the literature, the timing of PPM implantation varies between 6 and 13 days after cardiac surgery [2, 6, 8, 11]. In our institution, the decision regarding PPM implantation was based on the surgeon’s judgment, the clinical status of the patient and the threshold of the temporary epicardial pacemaker. At our institution, a PPM was implanted when the threshold of the temporary pacemaker increased >10 V. Kim et al. [20] reported that patients who developed complete atrioventricular (AV) block within 24 h postoperatively, which then persisted for >48 h, were unlikely to recover. In the long-term follow-up, 56% of these patients remained pacemaker-dependent. Our findings of long-term PPM dependency after AVR support the recommendations of Kim et al. for early implantation of PPM in patients with >48 h persisting conduction disorders after valve surgery. The main benefits of early PPM implantation include

**Table 5: Pacemaker dependency and permanent pacemaker (PPM) stimulation mode in follow-up**

<table>
<thead>
<tr>
<th>PPM dependency in follow-up</th>
<th>PPM mode at implantation time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VVI (n = 15)</td>
</tr>
<tr>
<td>Non-dependent (n = 8)</td>
<td>1</td>
</tr>
<tr>
<td>Dependent (n = 68)</td>
<td>12</td>
</tr>
<tr>
<td>Intermittent dependent (n = 10)</td>
<td>2</td>
</tr>
<tr>
<td>Stimulation mode in follow-up</td>
<td></td>
</tr>
<tr>
<td>No stimulation (n = 8)</td>
<td>1</td>
</tr>
<tr>
<td>VVI (n = 17)</td>
<td>14</td>
</tr>
<tr>
<td>DDD (n = 59)</td>
<td>0</td>
</tr>
</tbody>
</table>
early mobilization and recovery, shorter ICU stay as well as
earlier discharge from hospital. Furthermore, the risk of sudden
death due to asystole, AV block or drug-induced arrhythmias in
the early postoperative period could be considerably reduced. In
our study, 11 patients were readmitted in the first postoperative
year due to symptomatic bradyarrhythmias and required PPM
implantation in our hospital. We expect a significant number of
unreported cases that received PPM in other institutions or died
from bradyarrhythmias. Based on the above-mentioned reasons,
we would consider an early PPM implantation as justified.

Furthermore, early PPM implantation could also have eco-
nomical benefits due to faster recovery and shorter ICU and
hospital stay of these patients.

Limitations
The focus of the study was to identify potential recovery from
postoperative conduction disorders following AVR. For this
purpose, we analysed only patients that required PPM implant-
ation and did not observe all patients after AVR. Due to this
study design, we were not able to perform a risk-factor analysis
for pacemaker need after AVR. Furthermore, we were not
capable of identifying those AVR patients that did not receive a
PPM during the initial hospital stay who either died or required
a PPM implantation due to secondary conductance disturbances
during follow-up.

Recovery from AV conduction disorders after AVR is unlikely
in the majority of patients. Since high-grade AV blocks expose
patients to a significant risk of sudden death after surgery, we
recommend early implantation of PPMs. Patients benefit from
early mobilization, faster recovery and hospital discharge and
can be protected against unpredictable, fatal bradyarrhythmias.

ACKNOWLEDGEMENTS
We gratefully acknowledge the assistance of Conny Abraham for
data acquisition.

Conflict of interest: None declared.

REFERENCES
Prolonged bradyarrhythmias after isolated coronary artery bypass graft
Indications, effectiveness, and long-term dependency in permanent
et al. Incidence and predictors of atrioventricular conduction impair-
ment after transcatheter aortic valve implantation. Am J Cardiol 2010;
[4] Van Mieghem NM, Head Sj, de Jong W, van Domburg RT, Serruys PW,
de Jaeger PP et al. Persistent annual permanent pacemaker implant-
ation rate after surgical aortic valve replacement in patients with severe
et al. Risk factors for pacemaker implantation following aortic valve re-
Permanent pacemaker implantation after isolated aortic valve
Permanent pacemaker implantation after isolated aortic valve
replacement: incidence, risk factors and surgical technical aspects. J
Permanent pacemaker implantation following aortic valve replacement:
current prevalence and clinical predictors. Pacing Clin Electrophysiol
[9] Keefe DL, Griffin JC, Harrison DC, Slinson BE. Atrioventricular conduc-
tion abnormalities in patients undergoing isolated aortic or mitral valve
Risk factors for requirement of permanent pacemaker implantation after
Determinants of pacemaker dependency after coronary and/or mitral or
aortic valve surgery with long-term follow-up. Am J Cardiol 2008;101:
203–8.
Natural history and determinants of conduction defects following coronary
Permanent pacemaker implantation following isolated aortic valve re-
placement in a large cohort of elderly patients with severe aortic sten-
pacemaker implantation following cardiac surgery: indications and long-
Early conduction disorders following percutaneous aortic valve replace-
Factors associated with cardiac conduction disorders and permanent
pacemaker implantation after percutaneous aortic valve implantation
with the CoreValve prosthesis. Am Heart J 2010;159:497–503.
need for a permanent pacemaker after reoperative cardiac surgery. J
[18] Jaeger Hj, Mathias K, Neise M, Krabb Hj. Lead dislodgment of a per-
manent pacemaker due to removal of a temporary pacing electrode.
[19] Elahi MM, Osmany KA, Bhandari M, Dhannapuneni RR. Does the type of
prosthesis influence the incidence of permanent pacemaker implant-
ation following isolated aortic valve replacement. Heart Surg Forum
2005;8:E396.
Complete atrioventricular block after valvular heart surgery and the

APPENDIX. CONFERENCE DISCUSSION

Dr C. Vicol (Munich, Germany): I think it’s a very important topic, especially
because of the explosive development of the TAVI procedure, a procedure
which, as we know, has a high incidence of post-procedural conduction dis-
turbances. So I would like to make a comment. In our institution, we wait
about one week before making the decision to implant a permanent pace-
maker. I don’t think there is any reason to hurry this if you have an accept-
able threshold of the temporary epicardial pacemaker wire. So I would like
to ask you to comment in a little bit more detail, on the indication for pace-
maker implantation in your patient population.

And a second question, don’t you think it would be interesting to build a
matched group of patients without conduction disturbances after AVR
to compare them with the patients with conduction disturbances after AVR in
order to identify factors which lead to pacemaker dependency?

Dr Baraki: Starting with the second question, I think it’s very important to
compare these two groups, pacemaker-dependent patients and patients who
did not get a pacemaker, at the same time. We are going on to perform this
analysis, but it’s a huge group of patients: there are about 2000 patients who
have to be followed up, but we are starting to do this now.
Regarding the first question, in our institution, as you saw, the mean time to implantation is seven days, as recommended by the Society. But we observed that if the patient comes out of the OR with complete AV block, grade 3, and if they have their AV block for 48 h, it is very probable that they will stay with this AV block. And there are a lot of multi-morbid, not compliant patients among these old patients. So I think the majority of our surgeons tend to implant the pacemaker a bit earlier, especially if they have complete AV block beginning with the surgery.

Analysing our data, we saw that for AV block we implanted the pacemaker after five days. For patients who had intermittent conductance disturbances, especially slow rate atrial fibrillation, we waited up to 10 days. But it’s dependent on the patient and on the surgeon. In our institution, we tend to implant it a bit earlier, especially to save the patient and I think to improve his hospital and ICU stay.

**Dr S. Benussi** (Milan, Italy): It comes to my mind that probably some difference in the management may arise in the different subsets of patients. You’ve got patients with TAVI, patients with a sutureless valve. For instance, patients with TAVI may have a different time course in the development of block and in the possible recovery of normal conduction. And I wanted you to speculate on this, as well as possibly give some insight into the different management strategies based on the fact that, for instance, TAVI patients don’t have any pacing wires so you may be inclined to place a permanent pacemaker earlier due to the fact that patients would need a transvenous external pacemaker. So to mobilize the TAVI patient, you need a pacemaker; to mobilize a surgical patient, maybe you can use the pacing wires and wait a little longer.

**Dr Baraki**: If TAVI patients get a pacemaker, an epicardial pacemaker, in OR, it would be a ventricular epicardial pacemaker in our institution. But the policy is not to mobilize the patient from the bed especially. They have to be on the ICU or in the intermediate care station and they are not mobilized and are monitored the whole time.

Concerning TAVI, 12% of the TAVI patients, of the patients receiving Percival valves, the sutureless valves, needed a pacemaker implantation in our institution. And from the eight patients who recovered, there was one patient who got a TAVI. Due to the small number of recovered patients, we could not perform any kind of statistical analysis; but TAVI patients, especially because they are multi-morbid and quite sick in our institution, they also got their pacemaker earlier and they had a higher incidence of causes.

---

**eComment. Persistent annual risk for pacemaker implantation after aortic valve replacement**

**Authors: Jamil Hajj-Chahine**
Department of Cardio-Thoracic Surgery, University Hospital of Poitiers, Poitiers, France

doi: 10.1093/icvts/ivt027
© The Author 2013. Published by Oxford University Press on behalf of the European Association for Cardio-Thoracic Surgery. All rights reserved.

This interesting study by Baraki et al. addresses the long-term pacemaker dependence of patients who required a permanent pacemaker implantation after isolated aortic valve replacement [1]. After a mean follow-up time of 5.3 years, they found that the majority of their implanted patients remained pacemaker-dependent, whereas only 10% were no longer pacemaker-dependent. Therefore, they recommended early implantation of permanent pacemaker (PPM) in patient with high-grade atrioventricular blocks. We entirely agree with their opinion. However, the theoretical advantage of early PPM should be rigorously evaluated in larger clinical studies.

Degenerative aortic stenosis is a disease affecting not only the aortic valve but also the surrounding tissue. Calcification can progress to engage the conduction system of the heart yielding electrical conduction abnormalities [2]. These degenerative changes at the level of the atrioventricular conduction system continue to progress even after aortic valve replacement especially in patient with previous conduction disturbances.

Data on late PPM implantation rates after aortic valve replacement are scarce [3]. In a recently published retrospective study [2], Van Mieghem et al. found that patients with severe calcified aortic stenosis who underwent surgical aortic valve replacement have a persistent 1% annual risk for PPM implantation, and that patients with bundle branch block (BBB) at baseline or de novo had a higher PPM implantation incidence after aortic valve replacement than patients without BBB, both within 30 days after the operation and at the late follow-up. In considering the clinical implications of their findings, the authors suggest that patients with a BBB after aortic valve replacement should be monitored closely to detect severe conduction abnormalities. This is of utmost importance to determine subsequent treatment and to avoid syncope and sudden death [4].

Further randomized controlled studies with a larger sample size and a longer follow-up period will be mandatory before shortening the period of seven days of persistent atrioventricular block prior to PPM implantation advocated by the current European Society of Cardiology guidelines [5].

**Conflict of interest**: none declared.

**References**


