Effectiveness of biatrial pacing in reducing early postoperative atrial fibrillation after the maze procedure†

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Abstract

OBJECTIVES: Interraial conduction abnormalities have an important role in the initiation of recurrent atrial fibrillation (AF) after the maze procedure. Biatrial pacing or single atrial pacing alters the site and timing of atrial depolarization and may improve restoration of sinus rhythm after the maze procedure. To further evaluate whether biatrial pacing is superior to single atrial or no pacing, we performed a randomized prospective study on 240 patients with a full maze procedure to compare the effectiveness with different pacing approaches in the postoperative period.

METHODS: Between 2002 and 2010, 240 patients undergoing mitral ± tricuspid valve surgery concomitant with the maze procedure were randomized into three equal groups: Group I using overdrive biatrial pacing, Group II utilizing single atrial pacing and Group III without pacing. The atria were paced continuously in Atrium paced, Atrium sensed, and pacemaker Inhibited in response to sensed beat (AAI) mode at a rate of 80 pulses per minute or 10 pulses above the underlying rate for 5 days. The endpoints were the onset of AF or discharge.

RESULTS: The incidence of recurrent postoperative atrial fibrillation was significantly less in Group I with 9 of 80 patients (11%) incurring atrial fibrillation compared with 23 of 80 patients (28%) in Group II (P < 0.01) and 29 of 80 patients in Group III (P < 0.01). The length of hospital stay and the mean costs of hospital stay were significantly lower in the biatrial pacing group (P < 0.05).

CONCLUSIONS: Biatrial overdrive pacing is well tolerated and more effective in preventing the early recurrence of atrial fibrillation after the maze procedure. The impacts of the long-term results with the maze procedure require further study.

Keywords: Atrial fibrillation • maze procedure • Atrial pacing

INTRODUCTION

Early postoperative recurrent atrial fibrillation (AF) is the most common clinically encountered arrhythmia after mitral valve surgery concomitant with the maze procedure. Up to 43% of the cases present with AF during postoperative days 2–5 [1–4]. These tachyarrhythmias are recognized as a major cause of perioperative morbidity. They can cause hypotension, congestive heart failure and significant symptoms that include palpitations or shortness of breath. Moreover, the management of these arrhythmias has been shown to significantly extend the length of hospitalization and associated cost [5–7]. Pharmacological control is the first line of therapy, but AF may be associated with low success rates, high recurrence rates or patient intolerance. Thus, there is considerable interest in non-pharmacological therapy as a way to maintain sinus rhythm. Continuous overdrive biatrial pacing was found to be effective in promoting sinus rhythm and reducing the incidence of AF after open-heart surgery [6, 7].

The pathogenesis of early postoperative recurrent AF remains unclear and is presumably multifactorial, but the mechanism of these tachyarrhythmias may be different from that of other preoperative AFs. A variety of abnormalities of atrial electrophysiology are found in patients susceptible to recurrent AF in addition to incomplete ablation during the maze procedure [8, 9]. Interatrial conduction block due to ablation in particular results in delayed activation of the atria. Atrial inflammatory response, atrial ischaemia during surgery, atrial premature complexes and sinus bradycardia all play a major role as triggers for AF [10, 11].

The purpose of this prospective study is to evaluate the efficacy of biatrial pacing as a prophylactic measure against early recurrent AF after the maze procedure when compared with single atrial pacing and no pacing (control). The impact of therapy on length of hospitalization was also examined.

PATIENTS AND METHODS

After Institutional Review Board and institution ethical research committee approval, 240 patients from January 2002 to
After the operation, all patients were monitored continuously for arrhythmias. They received an intraoperative intravenous loading dose of amiodarone (150 mg) followed by a 12-h postoperative infusion, aggressive postoperative diuresis and intravenous administration of Nesiritide. Upon endotracheal tube removal, oral amiodarone of 400 mg twice daily and Viagra 50 mg daily were administered as tolerated and continued until hospital discharge. Electrical cardioversion was performed prior to hospital discharge in any patient who was not in normal sinus rhythm or if they postoperatively developed significant events such as cardiogenic shock or ventricular tachyarrhythmias.

After completion of valve surgery concomitant with the maze procedure and with the heart in junctional rhythm or sinus rhythm, Bipolar pacing wires (Bipolar Coaxial 6495; Medtronic, Inc., Minneapolis, MN, USA) were attached to each atrium. One atrial bipolar wire was assigned as the anode, and the other was attached to the Bachmann bundle. The pacing and sensing thresholds were tested during and after surgery. The external temporary pacemaker (Medtronic dual-chamber temporary pacemaker model 5388; Medtronic, Inc.) was then programmed to the AAI mode. The rate was set at a maximum of 120 pulses per minute. The pacing protocol started with output programmed at three times the capture thresholds. Sensitivity was set at 1 mV. Serum potassium levels were maintained between 4.5 and 5.0 mmol/L. Overdrive pacing was continued for 5 days, with continuous telemetry monitoring. The pacing and sensing thresholds were checked daily, and the output was adjusted accordingly. The 12-lead electrocardiogram was performed daily for 5 days at baseline and during pacing. The pacing wires were removed by simple transcutaneous retraction by day 6 in the absence of a clinical endpoint. The primary endpoint was AF lasting >10 min or the requirement for urgent intervention because the patient became symptomatic or haemodynamically unstable.

After the operation, all patients were monitored continuously for arrhythmias. They received an intraoperative intravenous loading dose of amiodarone (150 mg) followed by a 12-h postoperative infusion, aggressive postoperative diuresis and intravenous administration of Nesiritide. Upon endotracheal tube removal, oral amiodarone of 400 mg twice daily and Viagra 50 mg daily were administered as tolerated and continued until hospital discharge. Electrical cardioversion was performed prior to hospital discharge in any patient who was not in normal sinus rhythm or if they postoperatively developed significant events such as cardiogenic shock or ventricular tachyarrhythmias.

All patients underwent triple radio frequency (RF) pulmonary vein epicardial circumferential isolation, multiple RF pulmonary vein epicardial–endocardial longitudinal ablation, left atrial wall box lesions, left atrial isthmus ablation and bilateral atrial appendage resection in conjunction with their primary cardiac surgical procedure. Biatrial reduction with reef imbricate suture technique concomitant with the maze procedure was performed if the left atrial diameter was >65 mm. The following methods of assessment were used: left atrial dimensions were measured by transoesophageal echo cardiogram (TEE) or transthoracic echocardiography (TTE) and serum brain natriuretic peptide (BNP) levels were measured pre- and postoperatively. Severity of tricuspid regurgitation was classified as 0 (none), 1 (trivial), 2 (mild), 3 (moderate), 3.5 (moderate-severe) and 4 (severe) by 2D and Doppler echocardiographic evaluation before surgery and postoperative follow-up at discharge, 6 months and 1 year (Table 1).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Biatrial pacing</th>
<th>Single atrial pacing</th>
<th>Control group</th>
<th>Total value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient (n)</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>240</td>
</tr>
<tr>
<td>Male/female</td>
<td>37/43</td>
<td>35/45</td>
<td>36/44</td>
<td>-</td>
</tr>
<tr>
<td>Age (years)</td>
<td>56 ± 10.4</td>
<td>54 ± 7.3</td>
<td>57 ± 9.6</td>
<td>-</td>
</tr>
<tr>
<td>NYHA class</td>
<td>2.1 ± 0.7</td>
<td>2.3 ± 0.9</td>
<td>2.4 ± 0.8</td>
<td>-</td>
</tr>
<tr>
<td>Hx of stroke, n (%)</td>
<td>3 (3)</td>
<td>4 (5)</td>
<td>2 (2)</td>
<td>-</td>
</tr>
<tr>
<td>Atrial appendage clot</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Mitral stenosis and insufficiency</td>
<td>71</td>
<td>70</td>
<td>75</td>
<td>216</td>
</tr>
<tr>
<td>Mitral insufficiency</td>
<td>8</td>
<td>10</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>Aortic stenosis and insufficiency</td>
<td>11</td>
<td>14</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>Tricuspid insufficiency</td>
<td>64</td>
<td>67</td>
<td>64</td>
<td>195</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>48 ± 8</td>
<td>46 ± 11</td>
<td>48 ± 9</td>
<td>-</td>
</tr>
<tr>
<td>Duration of atrial fibrillation (months)</td>
<td>51 ± 23</td>
<td>47 ± 19</td>
<td>48 ± 15</td>
<td>-</td>
</tr>
<tr>
<td>Left atrial diameter (mm)</td>
<td>62 ± 13</td>
<td>61 ± 11</td>
<td>62 ± 16</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 1: Sites of biatrial pacing wires placement. SVC: superior vena cava; LA: left atrium; RAA: right atrial appendage; AA: ascending aorta; LAA: left atrial appendage; LCX: left circumflex artery.

Table 1: Patient demographics
a patient was unable to tolerate amiodarone postoperatively, then sotalol was used for the same duration. All patients in the study group underwent overdrive biatrial pacing throughout their hospitalization and the endpoints were either the onset of recurrent AF or discharge home.

Anticoagulation therapy was determined by the valve surgery performed and postoperative diameter of left atrium (LA). If a mechanical prosthesis was implanted, warfarin therapy was initiated on the third postoperative day and continued permanently. For patients with a postoperative LA diameter >60 mm, anticoagulation with Coumadin was used for the first 3 postoperative months.

All values are expressed as the mean ± standard deviation. Statistical analysis comparing the data between three groups was performed with the \( \chi^2 \) test for categorical variables. Continuous variables were compared by means of two-tailed Student’s \( t \)-tests and Kruskal-Wallis test where appropriate. Data collected were analysed using the number cruncher statistical systems software (NCSS, Kaysville, UT, USA). A \( P \) value of <0.05 was considered statistically significant.

**RESULTS**

The study population involved 240 patients consisting of 108 male and 132 female patients with a mean age of 58 ± 6.3 years and the mean duration of AF was 48.4 ± 18.9 months. The pre-operative mean atrial size was 61 ± 12 mm. Baseline characteristics of both groups are compared in Table 1; there were no statistically significant differences in any of the parameters.

Operative data of both groups are shown in Table 2; again, there were no statistically significant differences between the two groups.

A total of 61 patients developed early recurrent AF after the maze procedure, with an overall incidence of 25%. There were 9 (11%) patients in the biatrial pacing group, 23 of 80 (28%) patients in the single atrial pacing group and 29 of 80 (36%) patients in the control group, respectively. The prevalence of postoperative recurrence of AF was significantly less in Group I, 9 of 80 (11%) patients compared with 23 of 80 (28%) in Group II and 29 of 80 (36%) in the control group \( (P = 0.0079) \). The peak incidence of early postoperative AF occurred within the first 4 postoperative days. The first postoperative episode of AF occurred 2.3 ± 1.6 days after surgery in the control group, 2.5 ± 0.9 days in the single atrial pacing group and 2.9 ± 0.7 days after surgery in the biatrial pacing group \( (P = 0.044) \). The mean duration of AF was 12 ± 1.2 h in the biatrial pacing group, 14 ± 1.8 h in the single atrial pacing group and 18 ± 1.6 h in the control group \( (P = 0.0085) \). If AF was not converted spontaneously to sinus rhythm (SR) in 48 h, either pharmacological means or electrical cardioversion was used to restore SR before discharge.

A progressive increase in pacing thresholds and a decrease in atrial sensing amplitude occurred with time, but adequate pacing was possible in all patients during the study period. Atrial pacing was discontinued prematurely in 4 patients (5%) of the biatrial pacing group because of diaphragmatic pacing. Two patients (2%) in the study group required open pericardial drainage due to cardiac tamponade after removal of the epicardial pacing wires.

The mean length of hospital stay was 7.2 ± 1.7 days; the median stay was 5.6 days. The length of hospital stay was most significantly reduced in the biatrial pacing group \( (6.1 ± 1.2 \text{ vs } 8.7 ± 4.1 \text{ days in the other two groups}; \ P = 0.0094) \). The mean length of stay in the intensive care unit was also significantly reduced in the biatrial pacing group \( (2.1 ± 0.6 \text{ vs } 3.6 ± 2.5 \text{ days in the other two groups}; \ P = 0.047) \). The median hospital charges in the biatrial pacing group was significantly reduced by 14% compared with the median charges in the other two groups \( (P = 0.049) \).

**DISCUSSION**

The pathogenesis of early postoperative recurrent AF remains unclear and is presumably multifactorial, but the mechanism of early postoperative recurrent AF may be different from that of preoperative AF. The increased dispersion of atrial refractoriness is one proposed mechanism that facilitates the initiation of re-entry in the atria after the maze procedure. Previous animal studies demonstrated that dispersion of refractoriness and anisotropic conduction are two essential elements for sustaining atrial arrhythmia, [12, 13] and both have been implicated in the pathogenesis of postoperative AF. The maze procedure requires extensive ablation, incision and suture lines on both atria. These caused interstitial conduction block, atrial inflammatory response, atrial ischaemia, atrial premature complexes and sinus bradycardia [14]. The multiple atrial ablations likely cause a robust inflammatory response and may contribute not only to abnormal refractoriness but also increase the frequency of triggering events. The slow conduction in either atrium with

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Biatrial pacing</th>
<th>Single atrial pacing</th>
<th>Control group</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV repair only</td>
<td>12</td>
<td>9</td>
<td>11</td>
<td>22 (9)</td>
</tr>
<tr>
<td>MVR only</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>36 (15)</td>
</tr>
<tr>
<td>MVR + TV repair</td>
<td>53</td>
<td>57</td>
<td>51</td>
<td>161 (67)</td>
</tr>
<tr>
<td>MVR + TV repair + LAR</td>
<td>24</td>
<td>21</td>
<td>28</td>
<td>73 (30)</td>
</tr>
<tr>
<td>MVR + TV repair + LATE</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>31 (12)</td>
</tr>
<tr>
<td>MVR + TV repair + AVR</td>
<td>14</td>
<td>8</td>
<td>6</td>
<td>28 (11)</td>
</tr>
<tr>
<td>MVR + TV repair + PFOC</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>14 (6)</td>
</tr>
</tbody>
</table>

subsequent retrograde activation resulted in greatly delayed and inhomogeneous activation of the contralateral atrium and major intra-atrial and interatrial asynchrony with prolonged regional refractoriness. The site of atrial pacing influences atrial activation patterns. It is believed that disparities in atrial activation and repolarization are contributors to the development and recurrence of atrial arrhythmias. Atrial pacing from Bachmann’s Bundle reduces intra-atrial conduction time, improves synchronization of left and right atrial contraction, and may reduce the risk of AF compared with conventional pacing from the right atrial appendage.

This study demonstrated that biatrial overdrive pacing can prolong arrhythmia-free intervals in patients with drug-refractory AF after the maze procedure. The antifibrillatory effects of biatrial pacing may be explained by several different electrophysiological mechanisms as follows: (i) biatrial overdrive pacing at a higher rate can suppress bradyarrhythmia-induced irregular heart rate and may reduce the dispersion of refractory periods. (ii) Biatrial overdrive suppression of atrial premature beats may contribute to AF prevention though the suppression of automatic foci. (iii) Biatrial overdrive pacing corrects asynchrony and nonuniform activation resulting from organic or functional blocks, thereby improving local excitability and reducing the window of opportunity for AF initiation [10, 11].

In patients undergoing the maze procedure, all had preoperative AF, usually of long duration, and had already developed the appropriate substrate required to sustain this arrhythmia. In patients with giant atria, failure to anatomically isolate the entire posterior left atrium and severe atrial myocardial fibrosis, early postoperative recurrent AF was considered to be a continuation of preoperative AF. Biatrial overdrive pacing for this group of patients is not productive [2, 15].

The failure of biatrial overdrive pacing to prevent AF after cardiac surgery has been reported previously [16]. One of the possible reasons was the failure of the temporary pacemaker to sense the atrial electrical activity; in particular, sensing threshold could lead to asynchronous pacing of the atria. This may directly relate to either temporary pacing wire dysfunction or pacing wire site [17]. This study demonstrated that the left atrial Bachmann’s bundle area and right atrial crista terminalis area are suitable sites to attach the temporary pacing wires. It decreased in pacing thresholds and increased in atrial sensing amplitude. The possible explanation may be analogous to optimizing the capture and depolarization of the largest volume of atrial myocardium within the smallest possible time.

In patients with coronary artery bypass surgery, many observational studies have investigated the timing of the onset of early postoperative recurrent AF [8, 18]. Those studies showed that the peak incidence of AF is on postoperative day (POD) 2 after coronary artery bypass surgery. In contrast, the incidence of onset of early postoperative recurrent AF was much later (POD 4) in patients after the maze procedure. Therefore, the incidence of postoperative recurrent AF significantly lengthened hospital stay after the maze procedure. The increased costs associated with the development of postoperative AF are mainly due to prolongation of hospital stay. In our study, hospital stay and hospital costs were significantly reduced by biatrial pacing compared with single site or no pacing groups.

The technique of biatrial pacing was not associated with side effects. Identifying patients at risk for developing early postoperative recurrent AF and using biatrial pacing may be the optimal cost-effective strategy. Unfortunately, at the present time, it is not possible to accurately predict early postoperative recurrent AF after the maze procedure, so we recommend prophylactic biatrial pacing in all of the patients with maze surgery. Damiano et al. [15] recently reported the predictors of late recurrence for patients with maze surgery and demonstrated three risk factors for recurrent atrial tachyarrhythmias after the maze procedure using multivariate logistic regression analysis. These include left atrial size, failure to anatomically isolate the entire posterior left atrium and early atrial tachyarrhythmias. An early aggressive attempt to prevent early ATAs would improve late success. This study demonstrated that pharmacological control and biatrial overdrive pacing may be the ideal prophylactic approach to prevent early postoperative recurrent AF. Unfortunately, we were not able to investigate the impacts of long-term results and further study needs to be conducted.

CONCLUSION

Biatrial overdrive pacing is well tolerated and more effective in preventing the early recurrence of AF after the maze procedure. This therapy also results in shortened hospital stays and decreased hospital costs. The impacts of long-term results with the maze procedure need further study.

Conflict of interest: none declared.

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[12] Spach MS, Dolber PC, Heidlage JF. Influence of the passive anisotropic properties on directional differences in propagation following modification of the sodium conductance on human atrial muscle: a model of...
We have a postoperative protocol for maze patients. Preoperatively amiodarone is not mandatory. In the operating room a bolus of 250 mg amiodarone is administered, then 1 mg IV for six hours, followed by 0.5 mg/kg IV for 18 h or until extubated. After extubation the patient can start PO with 200 mg twice daily for three months, something like that. A lot of you guys may ask, okay, amiodarone probably slows down the patient’s heart rate, but because we have the atrial pacing, we don’t worry about that. That’s number one. Number two is Viagra. The reason is that the majority of patients with mitral valve disease present with pulmonary hypertension. We thought that 25 or 50 mg of Viagra, to reduce the pulmonary hypertension, would have benefits for long-term atrial fibrillation.

Dr. M. Castella (Barcelona, Spain): When you pace two different chambers with only one pacemaker, you have the negative pole and the positive pole. The negative pole is the one that makes the impulse and the positive is the one that receives the impulse. Were you always placing the negative on the left atrium, that would be the difference between pacing the right atrium, or did you not make any difference between the positive and the negative?

Dr. Wang: That’s a very good question, because right now a lot of people are confused with this pacing. Last year I presented a paper on the same subject at the AATS, published in JTCVS, and it confused people. For example, you put one unipolar pacing wire in the Bachmann’s bundle area, which is on the dome of the left atrium, located between the ascending aorta and SVC area, and put another unipolar wire on the right atrium connected to a bipolar pacemaker. That is not called biatrial pacing, just a single atrial pacing. You have to attach one bipolar pacing wire on the dome of the left atrium which has one negative and one positive pole. Another unipolar pacing wire is placed in the right crista terminalis area. You insert one negative pole of the left pacing wire and the right unipolar pacing pole together into one of the pacemaker sockets, and you plug the positive pole of the left pacing wire to the other socket of the pacemaker. This format of pacing is biatrial pacing.

Another option you can do is to plug the unipolar right atrial wire and the unipolar left atrial pacing wire together into one socket, place another unipolar pacing wire on the skin and connect to another pacemaker socket. That also is biatrial pacing.

Dr. Castella: The two in the negative at least?

Dr. Wang: Yes. Because the two is positive and one is negative, you start biatrial pacing.

Dr. Castella: So it’s truly biatrial pacing.

Dr. Wang: Yes.

Dr. Castella: And about results, did these patients have a shorter length of stay?

Dr. Wang: Yes. This is a very good question. Regarding hospital stay, if there is no recurrent atrial fibrillation after the maze procedure the patients go home usually on postoperative day 5. I don’t know what happens in Barcelona, but in the United States, if patients develop postoperative recurrent atrial fibrillation, we do not advocate early conversion, we first try pharmacologic control and even discharge patients home on day 4 if they are stable. If atrial fibrillation persists, we will bring the patient back for cardioversion in the fourth postoperative week.

eComment. Is atrial pacing after maze procedure the key to a successful outcome?

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We read with great interest the article by Wang et al. on the ‘effectiveness of biatrial pacing in reducing early postoperative atrial fibrillation after the maze procedure’ [1]. The problem of postoperative atrial fibrillation (AF) after cardiac operations remains a major one, complicating up to 40% of patients [2,3]. Furthermore, our unpublished data show that AF after maze procedure can involve as many as 50% of the patients in the immediate postoperative period. Our personal experience has shown that it can take a few weeks or even months after the maze procedure to establish a sinus rhythm. It is our strong belief that every effort has to be made in order to avoid postoperative AF in order to maintain haemodynamic stability and embolic events.

Our routine protocol after a maze procedure is to pace the right atrium for 48h postoperatively, while starting aggressive beta-blocker therapy the morning after the operation regardless of the patient’s vasopressor requirements. However, this

APPENDIX. CONFERENCE DISCUSSION

Dr. S. Salzberg (Zürich, Switzerland): You summarize how biatrial pacing can actually lead to a shorter hospital stay and better short-term outcomes after the maze procedure. I would like to start with a brief comment.

A maze procedure isn’t a maze procedure, we know that. Therefore, I think it would be good if, in your manuscript, you might change the title, or even the definition, and really say what it is: it is a left atrial ablation procedure, if I understand correctly, only left-sided ablations, and therefore it is not a true Cox maze as we learned it.

My question is in regard to your pacing protocol. We know that failure of sinus rhythm at the end of an ablation procedure is a factor for a bad outcome. Were all patients paced? I understood you randomized 80 patients to biatrial pacing and 80 patients to right-sided pacing. Were all patients able to be paced?

Dr. Wang: First, I will answer your question regarding the maze procedure. I don’t know, maybe we’ll redesign my descriptor. We didn’t do the right or left maze procedure alone. For these 240 patients, it was a full maze, which is left maze plus right maze. This is a full maze. The only reason we do the left maze, for example, is for paroxysmal atrial fibrillation or in patients aged 70 and above and a long history of atrial fibrillation with coronary bypass surgery. We don’t do it if we are going to restore sinus rhythm, so we just do a left maze.

To answer your question regarding the pacing, from my experience, after completion of the maze procedure, the majority of patients, probably 80%, are in junctional rhythm in the OR; we like junctional rhythm. If the patient is in junctional rhythm, we are very happy. We know we’re going to get back to sinus rhythm. But a very small number, maybe 15%, are in sinus rhythm. So yes, you are right, maybe 10–12% of the patients, no matter what you do, are still in atrial fibrillation. We knew preoperatively the types of patients who do very poorly with the maze procedure: for example, number 1, the patients with a long history of chronic atrial fibrillation; number 2, the huge giant atrium; number 3, aortic valve combined with coronary bypass surgery. These patients do not do very well. The truly rheumatic mitral valve patients are younger and usually do very well with the maze procedure. So yes, to answer your question, probably in 12%, maybe a little more, we are not able to capture atrial pacing, we are not able to pace them.

Dr. Salzberg: Did you also look at catecholamine use, inotropic support during ICU support, how did that reflect the pacing strategies?

Dr. Wang: Yes, you are right. Basically, right now, we are going to start a clinical trial in the Scripps Memorial Hospital using a drug called Precedex by IV infusion postoperatively after the maze procedure. We are also routinely checking the BNP level and if the level is above 800, we start Natrecor IV plus Precedex IV to reduce catecholamines.

In general, postoperative inotropic usage after valve surgery is relatively low compared with coronary surgery.Probably 45–50% of our patients having concomitant valve surgery and maze did not require any inotropes. I don’t know if I answered your question or not.

Dr. Salzberg: And one last question. In the manuscript I read that all patients were treated with amiodarone and Viagra. Could you please comment on that.