**Rhythm course over 5 years following surgical ablation for atrial fibrillation**

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Abstract

OBJECTIVES: Reporting methods for surgical ablation (SA) of atrial fibrillation (AF) were standardized by the Heart Rhythm Society Guidelines, stating that results should be reported only for the first 2 years following SA. The purpose of this study was to assess the outcome of SA over 5 years and determine predictors for success over that period.

METHODS: Data were collected prospectively for all SA (n = 787). Rhythm was verified by electrocardiogram and Holter monitoring at 3, 6, 9, 12, 18 and 24 months and yearly thereafter. Patients with rhythm status available at 2 and 5 years were included in the main analyses (n = 137). Multivariate logistic regression was used for predictors of normal sinus rhythm (NSR). Receiver operating curves compared 2- and 5-year predicted probability against observed rhythm status by year.

RESULTS: Return to NSR at 2 years was 88% (80% off antiarrhythmic drugs) and at 5 years was 85% (71% off antiarrhythmic drugs). The majority of patients (64%) had stable NSR over 5 years. The only predictor for 2-year NSR was smaller left atrial size (odds ratio [OR] = 0.40, P = 0.04)). Predictors for 5-year NSR were smaller left atrial size (OR = 0.28, P = 0.002), age (OR = 0.91, P = 0.031) and length of hospital stay (OR = 0.85, P = 0.026).

CONCLUSIONS: This study demonstrated stable results of SA for AF over time with somewhat different predictors for 2- and 5-year NSR in a group of patients with complete follow-up at both time points. Accurate models to determine predictors for success of SA more than 2 years after surgery are essential to better understand long-term outcome for patients with AF.

Keywords: Surgical ablation • Rhythm • Long-term follow-up • Atrial fibrillation

BACKGROUND

The Cox-maze III/IV procedure has met with great success in returning patients’ cardiac rhythm to sinus rhythm [1–4]. The procedure has also been associated with a significant reduction in cerebrovascular accidents and transient ischaemic events due to the relatively high success rate in ablating atrial fibrillation (AF) and the exclusion of the left atrial appendage (LAA). In addition, the procedure results in fewer implantation of pacemakers, improved atrial transport and sinus node function, and an increase in survival over time [3–7].

Despite the reported success of the procedure, surgical ablation (SA) is still underutilized. Recent studies have found that only 38% of patients who present for cardiac surgery with AF are actually ablated [8, 9]. Part of the reason this may be the case is that there are very few reports of the long-term outcomes of patients after SA for AF [10, 11]. At present, the Heart Rhythm Society (HRS)/European Heart Rhythm Association/European Cardiac Arrhythmia Society guidelines recommend only 2 years of follow-up for procedures involving AF ablation [12]. However, despite the challenges involved with long-term follow-up, it is important to learn more about the outcome beyond 2 years following the surgical procedure. Therefore, the purpose of this study was to report a single centre’s outcomes for the same group of patients for whom complete follow-up data at both 2 and 5 years were available after SA of their AF.

METHODS

All patients with SA for AF at our centre (n = 787) were followed up prospectively. All consecutive SA patients from January 2005 through June 2008 with complete follow-up data at 2 and 5 years after surgery were eligible for inclusion in the present analysis (n = 137; Fig. 1). Of all patients operated on 5 or more years ago (n = 300), 32 patients withdrew before 5 years, 42 patients died before 5 years, 82 patients had incomplete rhythm follow-up data for the entire 5 years and 7 patients did not have 2-year follow-up information. The study was approved by our Institutional Review Board (IRB #06.095 and IRB #12.055). SA patients at our institution

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were followed up longitudinally with rhythm and clinical status information collected at 3, 6, 9, 12 and 18 months and then yearly thereafter. Rhythm status was verified by electrocardiogram (EKG) and 24-h Holter monitoring at all follow-up time points. The HRS definition of failure (all documented atrial arrhythmias lasting for >30 s) was used to determine return to sinus rhythm [12]. The data in this unique AF registry were then merged with data from our local Society of Thoracic Surgeons (STS) database.

In addition to data collection at our institution, we also have an intensive follow-up centre to assist patients and medical professionals in treating patients postablation to address any issues related to rhythm and anticoagulation management. Our efforts are guided by a specific postoperative protocol regarding management following SA, which has been described in detail in our previous work [13].

Operative approach

SA was performed by a number of different surgeons. In 88% of 2- and 5-year sample patients, the complete Cox-maze III/IV lesion set was performed as described previously [14, 15]. Pulmonary vein isolation or limited left-sided SA (12%) was applied to patients who presented with intermittent AF (paroxysmal or persistent AF as defined by the HRS). The LAA was managed in all patients. The surgical approach to manage the LAA was left to the surgeon’s discretion. There were four different techniques used: complete excision, epicardial suturing, endocardial suturing and, more recently, application of an AtriClip [16]. All patients left the operating theatre with transesophageal echocardiogram (TEE) verification that the LAA was well managed. No left atrial (LA) size reduction procedures are being performed in our centre. Cryothermia only (Medtronic, Minneapolis, MN, USA) was used as the sole energy source in 31% of patients, bipolar radiofrequency in 8% of patients and a combination of cryothermia and bipolar radiofrequency (Atricure, West Chester, OH, USA) in the remaining 61% of patients.

Statistical analysis

Continuous data are presented as mean ± standard deviation (SD) and categorical data are presented as frequency (percent) unless otherwise noted. Group comparisons for categorical variables were conducted with \( \chi^2 \) or Fisher’s exact test, and comparisons for continuous variables were conducted with Student’s t-test or Mann–Whitney U-test, as appropriate, based on test assumptions. McNemar’s test was used to evaluate the proportion in sinus rhythm at each time point in comparison to the proportion in sinus rhythm at the previous time point, as well as the comparison of 2- and 5-year sinus rhythm proportions. The McNemar’s tests were case-complete analyses, so the sample sizes varied slightly for the comparisons involving 3- and 4-year rhythm status. Kaplan–Meier survival analysis was conducted to examine event-free survival during the follow-up. Statistical significance was
considered to be $P < 0.05$, two-tailed. All analyses were conducted using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA).

Predictors for sinus rhythm at 2 and 5 years after SA were assessed using multivariate logistic regression. The model mainly examined AF-specific factors as predictors of sinus rhythm with some pertinent clinical and surgical factors as well. The factors in the model were determined a priori and included age, gender, additive European System for Cardiac Operative Risk Evaluation (EuroSCORE), length of hospital stay (LOS) (days), type of AF (long-standing persistent versus all others), duration of AF (months), LA size (cm), prior intervention (ablation or cardioversion), perioperative AF, full Cox-maze III/IV versus limited SA procedure, stand-alone procedure and energy source (cryotherapy only versus bipolar radiofrequency as a stand-alone or combined with cryotherapy). Following completion of these multivariate models, receiver operating curve (ROC) analysis compared 2- and 5-year predicted probability of sinus rhythm against observed rhythm status by year of follow-up, and the ROCs were used to calculate the area under the curve (AUC). Therefore, these ROC analyses served to examine the applicability of the multivariate models predicting sinus rhythm at 2 and 5 years to observed sinus rhythm at each time point across 5 years of follow-up.

RESULTS

Preoperative characteristics

There were 383 SA patients at our centre who had at least 2 years of follow-up after surgery, and a subset of these patients with the complete 2- and 5-year follow-up ($n = 137$) were examined in the present analyses (Fig. 1). Preoperative and intraoperative characteristics of the patient sample with the complete 2- and 5-year follow-up ($n = 137$) are presented in Table 1. The mean age of this group was $63.7 \pm 10.1$ years, 28% of patients were female, and the mean additive EuroSCORE was $5.5 \pm 2.6$. Patients included in this 2- and 5-year sample ($n = 137$) were similar to the rest of the SA patients with at least 2 years of follow-up, but without the complete 2- and 5-year follow-up ($n = 246$). The similarities on AF-related and surgical factors included age, duration of AF, minimally invasive approach, stand-alone procedure, full Cox-maze III/IV procedure and AF during hospital stay. The group without complete 2- and 5-year follow-up did have a larger LA size (5.1 ± 1.0 cm vs 4.8 ± 1.0 cm, $P = 0.018$).

Perioperative results

Perioperative morbidities for SA patients at our centre ($n = 787$) were stroke ($n = 6$) or transient ischaemic attack ($n = 4$) in 1.3%, pneumonia in 3.8%, renal failure requiring dialysis in 1.7% and operative mortality (<30 days) of 2.5%. The frequency of morbidity in the 2- and 5-year sample ($n = 137$) was comparable to that of the full cohort, including permanent strokes or transient ischaemic attack in 0.7% ($n = 1$), pneumonia in 2.9% ($n = 4$) and renal failure requiring dialysis in 1.5% ($n = 2$).

Sinus rhythm and follow-up

The proportion of patients in sinus rhythm at 2 years after SA was 88% (120/137), and 80% of patients were in sinus rhythm off class I/III antiarrhythmic drugs (109/137). The proportion of patients in sinus rhythm was consistent throughout the follow-up time points as well (Fig. 2). Specifically, at 5 years after SA, 85% of patients were in sinus rhythm (117/137) and 71% were in sinus rhythm off antiarrhythmic drugs (97/137). The majority of patients (64%) remained in stable sinus rhythm throughout the
Table 2: Results of McNemar’s test comparing proportions in sinus rhythm across 5 years of rhythm follow-up (data presented are frequency in normal sinus rhythm/potential patients; P-values for each comparison)

<table>
<thead>
<tr>
<th>Time</th>
<th>SR</th>
<th>SR off antiarrhythmic drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3 years</td>
<td>87% (114/131)–82% (108/131)</td>
<td>78% (102/130)–75% (97/130)</td>
</tr>
<tr>
<td>3-4 years</td>
<td>83% (97/117)–84% (98/117)</td>
<td>76% (88/116)–73% (85/116)</td>
</tr>
<tr>
<td>4-5 years</td>
<td>84% (102/122)–85% (104/122)</td>
<td>72% (88/122)–72% (88/122)</td>
</tr>
<tr>
<td>2-5 years</td>
<td>88% (120/137)–85% (117/137)</td>
<td>80% (109/137)–71% (97/137)</td>
</tr>
</tbody>
</table>

Multivariate models

In the multivariate model for the complete 2- and 5-year rhythm sample (Table 3), the only significant predictor for sinus rhythm at 2 years after SA was left atrial size (odds ratio [OR] = 0.40, P = 0.044) such that greater LA size was associated with reduced likelihood to be in sinus rhythm. Sinus rhythm at the 5-year post-SA time point was also significantly predicted by LA size (OR = 0.28, P = 0.002), as well as by length of hospital stay (LOS) (OR = 0.85, P = 0.026) and age (OR = 0.91, P = 0.031); longer LOS and older age were associated with reduced likelihood to be in sinus rhythm. The only significant predictors of being in sinus rhythm at both 2 and 5 years after SA were LA size (OR = 0.34, P = 0.003) and LOS (OR = 0.80, P = 0.011). Reviewing the effect of LA size on the odds to be in sinus rhythm from the multivariate analyses indicated that for every 1-cm increase in LA size, there was a 72% reduced likelihood of being in sinus rhythm at 2 years, and for every 1-cm increase in LA size, there was a 72% reduced likelihood of being in sinus rhythm at 5 years.

Using predicted probability of sinus rhythm at 2 years from the multivariate model compared with observed rhythm status at each time point, the ROC analyses indicated that the AUC was 0.84 at 2 years, 0.77 at 3 years, 0.86 at 4 years and 0.80 at 5 years. In comparison, predicted probability of sinus rhythm at 5 years from the model revealed AUC of 0.88 at 5 years, 0.92 at 4 years, 0.82 at 3 years and 0.76 at 2 years. These results indicate that in the same group of patients with 2- and 5-year rhythm status, predicted probability of sinus rhythm modelled at 5 years is better at discrimination at each time point that rhythm was assessed, except for 2 years after SA. This finding may suggest that there is value in monitoring and developing prediction models in a consistent group of patients for rhythm beyond the traditional 2-year follow-up mark recommended by the HRS.

Spline curves demonstrating visually the univariate effect of LA size on probability to be in sinus rhythm are shown in Fig. 4. Although the multivariate model found LA size to be a significant predictor of rhythm at 2 years, the univariate association of LA size to sinus rhythm was not significant (OR = 0.66, 95% confidence interval [CI]: 0.38–1.15, P = 0.142). At 5 years, the univariate association was significant (OR = 0.53, 95% CI: 0.32–0.89, P = 0.016).
years following the procedure. This observation requires special attention to understand it more fully. The overall atrial arrhythmia recurrence-free survival at 5 years was acceptable at 63.5% for this series in which the majority of patients presented to surgery with non-paroxysmal AF (96%) and significant comorbidity (average additive EuroSCORE of 5.5 ± 2.6, indicating moderate to high risk for mortality). In addition, 42% of the patients with recurrence (n = 50) returned to sinus rhythm before the 5-year follow-up. The recurrence-free rate is significantly higher than that associated with percutaneous catheter ablation. In a recent report by one of the premier groups, the arrhythmia-free survival rate at 5 years following catheter ablation was only 29%. It is also important to recognize that the catheter ablation patients were healthier, the majority being noted to have paroxysmal AF, less substrate changes, smaller LA size and fewer prior interventions [19].

This study, like others before it, also demonstrated a high rate of event-free survival from embolic stroke of 98.5%, despite the fact that 62% of all patients were off anticoagulation therapy at 5 years and only 5% remained on anticoagulation while in sinus rhythm. That 62% of all patients were off anticoagulation has remained consistent since our first report on our programme’s stroke incidence rate after SA [21]. In that study, we demonstrated that the CHADS2 score was not reliable in determining the need for anticoagulation following SA and in fact was a better predictor for those who would experience significant bleeding [21]. The low incidence of thromboembolic events in general and of stroke/transient ischaemic attack in particular documented following SA is attributed to the attenuation of the LAA, the relatively high rate of return to sinus rhythm over time, a vigorous follow-up programme in which we work closely with the patients’ cardiologists to maintain a patient’s sinus rhythm or obtain sinus rhythm in patients encountering issues after surgery, and anticoagulation medication management [13]. Currently, our management strategy for patients after SA is that, once sinus rhythm has been achieved (through long-term monitoring) in patients off antiarrhythmic drugs and echocardiography has demonstrated that the LAA is well managed with no smoke in the LA, we support that anticoagulation therapy should be discontinued as long as there is no other indication for the anticoagulation.

### DISCUSSION

In this study, we present 5-year results for patients who have undergone an SA procedure for AF by a number of different surgeons. Several very interesting results were found. First, for patients who had reached both their second and fifth anniversary after surgery (n = 137), the overall return to sinus rhythm was 85% and 71% off antiarrhythmic drugs at 5 years. The predictors for sinus rhythm at 5 years were as one would expect and included a smaller LA size, younger age and shorter LOS (a potential marker for healthier or less complicated patients), all of which have been reported previously in the literature [10, 17-18]. This group of patients experienced a fairly stable rhythm course following surgery; 64% remained in sinus rhythm over the entire 5-year follow-up. In addition, the highest rate of relapses to atrial arrhythmia peaked either around 18–24 months or at 3 years following the procedure. This observation requires special

### Table 3: Multivariate logistic regression models predicting sinus rhythm at 2 and 5 years after surgery

<table>
<thead>
<tr>
<th></th>
<th>2 yearsa</th>
<th></th>
<th></th>
<th>5 yearsb</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>P-value</td>
<td>OR</td>
<td>95% CI</td>
<td>P-value</td>
</tr>
<tr>
<td>Age</td>
<td>0.97</td>
<td>0.89-1.05</td>
<td>0.443</td>
<td>0.91</td>
<td>0.83-0.99</td>
<td>0.031</td>
</tr>
<tr>
<td>Additive EuroSCORE</td>
<td>0.89</td>
<td>0.61-1.28</td>
<td>0.523</td>
<td>1.00</td>
<td>0.70-1.41</td>
<td>0.982</td>
</tr>
<tr>
<td>Female</td>
<td>3.13</td>
<td>0.52-18.71</td>
<td>0.211</td>
<td>1.96</td>
<td>0.42-8.67</td>
<td>0.404</td>
</tr>
<tr>
<td>Long-standing AF</td>
<td>0.12</td>
<td>0.01-1.04</td>
<td>0.054</td>
<td>0.40</td>
<td>0.07-2.32</td>
<td>0.308</td>
</tr>
<tr>
<td>Duration of AF (months)</td>
<td>1.00</td>
<td>0.99-1.01</td>
<td>0.770</td>
<td>1.01</td>
<td>0.99-1.02</td>
<td>0.306</td>
</tr>
<tr>
<td>Full Cox-maze</td>
<td>1.91</td>
<td>0.25-14.68</td>
<td>0.535</td>
<td>0.30</td>
<td>0.02-3.80</td>
<td>0.351</td>
</tr>
<tr>
<td>Left atrial size (cm)</td>
<td>0.40</td>
<td>0.16-0.97</td>
<td>0.044</td>
<td>0.28</td>
<td>0.13-0.62</td>
<td>0.002</td>
</tr>
<tr>
<td>Cryothermia energy</td>
<td>4.07</td>
<td>0.39-42.04</td>
<td>0.239</td>
<td>4.64</td>
<td>0.76-28.25</td>
<td>0.096</td>
</tr>
<tr>
<td>Stand-alone</td>
<td>2.14</td>
<td>0.18-25.27</td>
<td>0.547</td>
<td>0.47</td>
<td>0.07-3.07</td>
<td>0.430</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
<td>0.91</td>
<td>0.82-1.01</td>
<td>0.080</td>
<td>0.85</td>
<td>0.74-0.98</td>
<td>0.026</td>
</tr>
<tr>
<td>Prior Intervention</td>
<td>1.58</td>
<td>0.29-8.63</td>
<td>0.596</td>
<td>1.69</td>
<td>0.35-8.11</td>
<td>0.514</td>
</tr>
<tr>
<td>Perioperative AF</td>
<td>0.57</td>
<td>0.11-3.02</td>
<td>0.513</td>
<td>1.36</td>
<td>0.31-5.91</td>
<td>0.684</td>
</tr>
</tbody>
</table>

*aOmnibus test: \( \chi^2 = 22.70, P = 0.030 \); Hosmer-Lemeshow: \( \chi^2 = 9.10, P = 0.866 \).

*bOmnibus test: \( \chi^2 = 32.31, P = 0.001 \); Hosmer–Lemeshow: \( \chi^2 = 3.91, P = 0.866 \).
The HRS recommends only a 2-year period of follow-up. However, based on our experience, if a patient encounters an atrial arrhythmia issue (usually atrial flutter or atrial tachycardia following SA), the arrhythmia usually occurs around one of either two time points (between 18 and 24 months and then again at 3 years). However, as noted in our previous manuscript, patients found to have a recurrence of an atrial arrhythmia respond exceptionally well to cardioversion and medication interventions and, when necessary, percutaneous catheter ablation procedures for restoration of sinus rhythm [22]. The fact that our patients are followed so closely over a long-term follow-up allows any atrial arrhythmias to be addressed almost immediately, and this appears to be reflected in the low embolic stroke rate we have documented. Therefore, based on these findings, we have concluded that the information gained with additional follow-up is invaluable in expanding practitioners’ knowledge on the long-term success of an SA procedure, but it is essential to monitor patients for any changes in rhythm so that these issues can be dealt with in a timely, efficient, effective and collaborative manner [10, 11, 19, 22].

Effective management of the LAA and the use of anticoagulation medications after SA are two other important areas requiring attention if an SA programme is to be successful over time. The LAAOS (Left Atrial Appendage Occlusion Study) trial revealed that complete occlusion of the LAA was achieved in 45% (5/11) of cases using sutures and in 72% (24/33) using a stapler, with a significant increase in the success rate associated with surgeon experience. The rate of LAA occlusion by individual surgeons increased from 43% (9/21) to 87% (20/23) after performing 4 cases (P < 0.001). After a mean follow-up of 13 ± 7 months, 2.6% of patients had thromboembolic events. The authors concluded that LAA occlusion at the time of coronary artery bypass grafting is safe, and the rate of complete occlusion improved with increased surgeon experience and the use of a stapling device [23]. In a recent publication, Kanderian et al. [24] reported from echocardiograms that approximately 40% of the patients studied who had their LAA either sutured or stapled closed still showed some blood flow through the LAA area.

Based on these findings, we base our techniques of choice on surgical amputation or the use of the Atricure® AtriClip Gillinov-Cosgrove Left Atrial Appendage Exclusion system. We now use endocardial suturing only in patients having a redo procedure and in selected patients having a right minithoracotomy in whom the clip cannot be applied through the transverse sinus epicardially. We attribute our success in managing the LAA to the fact that we use TEE confirmation to confirm closure during the surgery.

A larger LA was noted to be a predictor for lower odds to be in sinus rhythm at 5 years. However, the rate of return to sinus rhythm was still significantly high such that the effect of a large LA was negligible, since 64% of the patients maintained sinus rhythm throughout the 5-year period and at 5 years, 85% were in sinus rhythm with 70% off antiarrhythmic drugs. However, the effect of a large LA is a concern as to whether a patient should undergo an ablation procedure if their atrium is too large. In a recent study by our group, we found that although a large LA (>5.5 cm) was associated with a decrease in the rate of return to sinus rhythm, the rate of return was still very acceptable; 86% at 1 year and 85% at 2 years had no increase in thromboembolic events following surgery. Therefore, we concluded that a large LA should not be a discouragement when evaluating surgical candidates with AF if patients are managed appropriately after ablation [25].

Limitations

The relatively small sample size available with both 2- and 5-year rhythm results presents a limitation for this study. Our prospective system of the follow-up data collection relies heavily on patient compliance, and it can be more difficult to maintain a large sample as the follow-up extends beyond 2 years. However, we feel that the results of this study are in agreement with prior findings, particularly for which factors predict rhythm status.

The inclusion of LOS as a factor in our multivariate models predicting sinus rhythm could be viewed as a weakness in this study, given the multifactorial nature of LOS. The fact that LOS demonstrated an independent contribution to the prediction of rhythm at 5 years, after other related measures (i.e. age, EuroSCORE and perioperative AF) were adjusted for is an intriguing finding that warrants further examination, particularly given the potential for modification of this predicting factor, when appropriate.

The rhythm monitoring used at our centre is well accepted by the HRS guidelines and includes EKG and 24-h Holter monitoring at each follow-up point. This may be perceived as an overestimation of the success rate compared with the use of continuous monitoring devices such as the Reveal XT.

Conclusions

In this study, we demonstrated that the results of SA for AF remain stable over 5 years of follow-up, with an 85% success rate and an atrial arrhythmia recurrence-free survival of 63.5% in addition to the stroke-free survival of almost 99%. Although these findings are very encouraging, work remains to be done to better understand how to address the predictors of failure: a larger LA and sicker patients. One would argue that having patients present for surgery earlier in their illness trajectory would solve these issues, but this premise needs further research, as does the role of surgeon experience in the resulting rhythm outcomes.

Conflict of interest: none declared.

REFERENCES


APPENDIX. CONFERENCE DISCUSSION

Dr T. Hanke (Lubeck, Germany): In your paper, you mentioned that it takes about 50 cases to get better results than you get when you do less than 50. We all know that cryoablation especially is not rocket science. Why does it take 50 cases to get good results? Is it because we are bad teachers for the others? Is it that the ones that do more than 50 cases are more interested in the AF field, and the other ones are the ones that are less interested? And what can we improve to get lower numbers in order to get good results?

Secondly, you have a superb stroke rate of 1.5%. Correct me if I’m wrong, but in your AF event-free survival, you have 62% of sinus rhythm. That means 38% do have some kind of AF recurrence. So you would expect more stroke if there is more AF. So maybe that’s kind of provocative: what do you think is more important, to resect the left atrial appendage in our procedure, or is it more important to restore sinus rhythm in order to reduce stroke?

Dr Ad: Those are excellent questions. Let me start with the first one. The number 50 is actually not unusual for almost any surgical procedure, for instance in repair of inguinal hernia. There is a lot of literature from the general surgery world that shows that around 50 is where you get into the understanding of the procedure, and inguinal hernia is also not rocket science, but yet it takes about 50 cases to get it right.

So I think, to answer the question, is that there is, as with any other procedure, a certain growth of the surgeon into the procedure, understanding repeat of a single lesion because it doesn’t look quite right, and so on. So you walk away from this into the understanding of tissue, and you develop this kind of interaction with the procedure to better understand what you do. Some atria look different than others, so you may modify it in things that you can’t really translate into a presentation or a manuscript that result in a better outcome. So I don’t know the answer. I don’t think it’s only about teaching. It’s a process that we all go through, any surgical procedure we do: CABG, mitral valve repair, so on and so forth.

For the second question, I think this is a very good question. But despite the enthusiasm of people, including my own mentor, I believe it is a combination. If you just resect the appendage in these patients in AFib, the stroke rate is going to be very high. We don’t have time to look into the time interval when we define those failures, but most of our failures are very short-lived, are not permanent. So patients may go back and forth, but when they are being monitored well, the appendage is gone in all of them, and treatment is being modified even for a short period of time. I believe that in this way you can modify the risk of stroke significantly. And our results are not unusual compared to some other big series reported that do long-term follow-up, such as reports from Japan, that show almost identical stroke rate, risk from stroke.

One important point that actually comes in between when we discuss those issues is how would you stop anticoagulation, and that’s crucial. I mean, you can’t just say: patient is in sinus rhythm, appendage is gone, so anticoagulation can be stopped. This is a significant decision, regardless of the CHADS score. You have to look at the echo and make sure they have no echogenic smoke in the atrium, stopped. This is a significant decision, regardless of the CHADS score. You have to look at the echo and make sure they have no echogenic smoke in the atrium, not too much stasis, that their appendage is indeed gone. When you analyse all this and follow your patients, you are diminishing the risk significantly.

Dr Hanke: Well, that’s true, but if you look at the PROTECT AF trial from the cardiologists, they don’t give Coumadin, never mind how much smoke there is in the atrium, how big the atrium is, and now the four-year data is out. They are doing so much better than with Coumadin. So don’t you think it is possible, just after three months, and you are sure you resected the left atrial appendage, that stopping the Coumadin is a feasible way to go?

Dr Ad: Well, there are a few ways to answer this question. The answer is no, and there is a little we can learn from the cardiologists on AF in general. I think that their work in the field with the amount of patients they have is very poor. PROTECT AF specifically, included many patients with very low risk of stroke. Our patients are different here with other risks of stroke: older patients, higher CHADS score, and their valve disease, some of them with artificial valves. So I think it is a different group of patients all together.