The implementation of a comprehensive clinical protocol improves long-term success after surgical treatment of atrial fibrillation

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Objective: Surgical ablation for the treatment of atrial fibrillation is now being performed routinely in centers throughout the world. After the hospital stay, patients' care is usually delivered by cardiologists who are often unfamiliar with the nuances of the procedure, as well as the management of patients' medical regimens and atrial arrhythmia recurrence. We sought to determine the effectiveness of a postdischarge protocol designed not only to capture patients' rhythm status but also to coordinate their clinical management when required for all patients undergoing surgical ablation in our institution.

Methods: A unique, computer-based atrial fibrillation registry was developed to comply with the Heart Rhythm Society guidelines. An extensive follow-up program to track patients' preoperative characteristics and operative and postoperative courses was established. The required long-term clinical follow-up and interventions were based on a simple clinical algorithm-driven protocol that was developed and recommended by us to be used. All available patients were followed at each respective time point and were evaluated for protocol implementation as determined by the algorithm. Stepwise logistic regression was used to determine whether being on the protocol was a significant predictor for being in sinus rhythm at 18 and 24 months.

Results: At the time of the study, we had 391 patients (multiple surgeons) in our registry with more than 2000 clinical records and follow-up rhythm status information. Overall, the return to sinus rhythm was 88%, 87%, and 84% at 6, 12, and 24 months, respectively. Significantly higher rates of sinus rhythm were documented for patients whose care was managed according to the algorithm, with a return to sinus rhythm rate of 92% versus 72%, 91% versus 62%, and 89% versus 40% at 6, 12, and 24 months, respectively. Fifty-one percent of the patients in atrial fibrillation at 12 months did not receive treatment as indicated by the algorithm, with the most common deviations being a change in antiarrhythmic drug treatment, any attempt of cardioversion, and premature placement of patients on a rate-control regimen. The odds of being in sinus rhythm at 24 months was significantly increased when a patient's care was managed according to the protocol (on protocol: odds ratio, 8.066; 95% confidence interval, 1.085–59.940; $P = .041$).

Conclusion: This study describes a new concept in which a clinical algorithm is being used to manage patients after surgical ablation. Our findings suggest that the success rate of the surgical ablation procedure was significantly better in patients who were followed and treated according to the clinical algorithm. These findings suggest that coordination of patients' treatment with cardiologists is challenging but essential to enhance the long-term success rate of the surgical ablation procedure. (*J Thorac Cardiovasc Surg* 2010;139:1146-52)

The Cox maze III procedure is a well-established approach and offers patients with medical refractory atrial fibrillation (AF) an alternative treatment option.¹⁻⁸ However, the advent of this surgical intervention also requires clinicians to develop an understanding of the unique, long-term medical care issues required to determine a successful outcome. In May 2007, the Heart Rhythm Society, in conjunction with the Society for Thoracic Surgeons, the European Heart

Rhythm Association, and the European Cardiac Arrhythmia Society, developed a consensus statement on catheter and surgical ablation of AF.⁹ The purpose of the consensus statement was to provide recommendations for ablation programs that included: (1) guidelines for personnel training, (2) patient selection criteria, and (3) necessary components of a follow-up program to determine the success of the ablation program.

The guidelines are also unique in recommending the necessary components for follow-up after an ablation to include the following: (1) the importance of follow-up for patients every 6 months for at least 2 years after the initial follow-up at 3 months after ablation; (2) use of an event monitor to screen for recurrent AF/atrial tachycardia/atrial flutter in patients complaining of palpitations; (3) discontinuation of warfarin only after patients had some type of continuous monitoring to screen for asymptomatic AF/atrial tachycardia or atrial flutter; (4) avoidance of a repeat procedure for at

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Abbreviations and Acronyms

AF	= atrial fibrillation
ECG	= electrocardiography
SR	= sinus rhythm

least 3 months if patients' symptoms are controlled with medical therapy; and (5) definition of success being no monitored atrial arrhythmia of greater than 30 seconds while off antiarrhythmic drugs. Although these guidelines have provided a very good beginning as to how to follow patients after an ablation, they lack clear details on what to do when patients are experiencing problems after an ablation, as well as how to address patients who are doing well in regard to the timing of stopping antiarrhythmic drugs and possibly anticoagulation therapy. These nuances of care are especially lacking when caring for a patient after the Cox maze procedure, despite the fact that the surgical ablation to treat AF is now performed routinely.

We always believed that a follow-up program to focus only on rhythm and disregarding the clinical approach might be limited. After the first assessment of the postdischarge clinical data from our initial 142 patients undergoing operations during 2005–2006, it was clear to us that a clinical algorithm-driven protocol was required to improve our understanding and delivery of care. The first assessment demonstrated that of the 119 patients who had the surgical ablation procedure either as a stand-alone procedure or combined with other cardiac surgical interventions and at least 3 months' follow-up information, normal sinus rhythm (SR) was documented in 108 (91%). AF or atrial flutter was documented in the other 11 (9%) patients. To our surprise, 44 (40%) of the patients in SR were found to be managed pharmacologically with antiarrhythmic drugs we believed were unnecessary. For the 11 patients who remained in AF/atrial flutter, only 3 (27%) were followed with any antiarrhythmic protocol with regard to modification of their antiarrhythmic drug therapy, as well as consideration for electrical cardioversion.

Our initial assessment clearly demonstrated that an acceptable outcome could be anticipated after the surgical ablation procedure. However, we determined that a comprehensive postdischarge protocol was necessary to better address recurrence of atrial arrhythmias and reduce the use of antiarrhythmic drugs and warfarin after SR was restored. Our thought was that the written protocol would also provide a means of collaboration between cardiologists and surgeons after ablation surgery for this selected group of patients. The purpose of this study was to describe and perform an initial assessment of whether such a protocol can be implemented in a community-based hospital and whether such a postdischarge protocol is effective in enhancing the success rate of the surgical ablation procedure.

MATERIALS AND METHODS

The follow-up program was adjusted in October 2006 and then refined in May 2007 to adhere to the Heart Rhythm Society guidelines.⁹ The forum we currently use is a unique AF registry operated through a statistical platform that interacts with and compliments the Society of Thoracic Surgeons database (Figure 1). The AF registry tracks all patients' preoperative, operative, and postoperative characteristics not captured in the Society of Thoracic Surgeons database, as well as patients' health-related quality of life (the SF-12 health survey).¹⁰ Clinical information and patients' algorithm-driven protocol status is used as a mechanism for comprehensive interpretation of the clinical data, as well as a forum to communicate our recommendations to the respective cardiologists. Our current clinical structure is that all our institution's cardiologists are part of private practices, and therefore we did not randomize patients. Rather, we conducted this study to determine the initial effect of a clinically driven algorithm on patients' outcomes in a real-world scenario in a large community hospital.

All patients who underwent a Cox maze procedure or other surgical ablation with either cryothermal energy alone or in combination with bipolar radiofrequency were entered into our AF registry. Subsequent clinical status information and health-related quality of life data were then obtained at 3, 6, 12, and 24 months after surgical intervention and then yearly thereafter. The clinical information collected included (1) patients' self-reported rhythm, (2) current medications, (3) any readmissions and cardiac intervention that had taken place during the interim, and (4) the date of the last visit to the cardiologist. Diagnostic (electrocardiography [ECG], Holter monitoring, 1-week monitoring, or pacemaker interrogation) rhythm information was obtained from the patients' last visit to their cardiologists to assist in determining the patients' current rhythm (Figure 2).

The algorithm/protocol used to interpret and guide our follow-up program was developed through a compilation of the literature and interviews with experts in the field (Figure 3).^{11–17} The protocol recommends that all patients be discharged and maintained on an arrhythmic drug, such as amiodarone or sotalol, during the first 3 months after the operation (the blanking period). Patients are also started on warfarin regardless of their rhythm at discharge because their rhythm might be unstable for the first 3 months after the operation.^{9,18–20} After the blanking period, all patients are recommended to undergo 12-lead ECG, 24-hour Holter monitoring, or both to confirm their current rhythm status. If the patients' ECG/Holter monitoring results demonstrate SR, the discontinuation of the patients' antiarrhythmic drug is recommended, but warfarin is continued.^{1,18–20} Approximately 4 to 12 weeks (depending on the antiarrhythmic drug taken) after the discontinuation of patients' antiarrhythmic drug, the patients should undergo at least 5 days of rhythm monitoring to determine their respective rhythm without antiarrhythmic drugs. This is to ensure that patients are not experiencing any silent episodes of clinically significant AF (>30 seconds).⁹ At this time, if the results of the long-term monitoring demonstrate SR and the left atrial appendage is confirmed to be not communicating after it was surgically excluded or amputated, we recommend re-evaluation for the continuation of warfarin. Patients with no indication for the continuation of warfarin are started on aspirin postoperatively.

For patients who are still experiencing AF 4 to 6 weeks after surgical ablation, the patient should be evaluated for cardioversion according to the standard guidelines for cardioversion.²¹ The use of a different antiarrhythmic drug should also be considered at this time.

This pattern of intervention was used at each patient's follow-up visit every 3 months for at least the first year (Figure 3). Starting the patient on rate-control medication after the surgical ablation procedure was only considered after attempting cardioversion 3 times and the use of several different antiarrhythmic drugs without successful conversion of the patient's AF rhythm to SR. A letter was sent to the patients' cardiologists after the patients' follow-up surgical visits to assist in the collaborative relationship between the cardiac surgeon and the cardiologist. The letter had specific recommendations for the patients' follow-up care, irrespective of whether the patient was in SR or AF. A follow-on letter with protocol-driven recommendations

IHVI Research Data Process and Characteristics

FIGURE 1. Picture of the registry process. STS, Society of Thoracic Surgeons.

was also generated to the patients' respective cardiologists if we found that a patient was not following the protocol during our clinical follow-up.

Descriptive statistics and frequencies were used to describe the patients and SR by time point. Mantel-Haenszel χ^2 tests were used to determine whether there were differences in SR rates at 6 and 12 months by surgical group. To determine whether the algorithm-driven protocol had an effect on the outcome of SR at 24 months, we divided the patients into 2 groups: those patients who were on the protocol at their 6-, 12-, and 18-month follow-up time points (on-protocol group) versus all others (off-protocol group). A multiple logistic regression model was then constructed. In the first step of the model, we entered the type of surgical ablation (Cox maze procedure vs limited left atrial ablation) and variables known to be associated with the development of AF after the surgical ablation procedure, which were age, duration of AF before the surgical intervention, and left atrial size. Duration and type of AF were highly associated, and therefore only duration was selected to be a part of the model. In the second step we entered the newly formed protocol status variable (on-protocol group vs off-protocol group). All analysis was completed with SAS version 9.1.3 software (SAS Institute, Inc, Cary, NC) and SPSS version 17 (SPSS, Inc, Chicago, Ill).

RESULTS

Since our program inception in 2005, 391 patients have undergone surgical ablation procedures performed by multiple surgeons at our institute. The average time to follow-up

was 29.42 ± 16.27 months. Three hundred forty-two (87%) patients underwent the Cox maze procedure with or without concomitant surgical intervention; 49 (13%) patients underwent a left-sided ablation only with concomitant surgical intervention. The patients' average age was 63.3 ± 12.1 years, with an average time from first diagnosis of onset of AF of 42 ± 57.8 months.

The return to SR at 6, 12, 18, and 24 months for all patients (overall) was 88%, 87%, 82%, and 84%, respectively. There were no significant differences between surgical (full maze procedure vs left-sided ablation) groups on the return to SR at these respective time points ($P > .05$); however, left-sided ablation only was found to be an independent predictor for failure (Table 1), and this fact is well established in the literature.²² Of note, patients on the protocol maintained a fairly constant rate of SR, whereas patients off the protocol did not (Figure 4). There was a significant difference between patients in SR and those experiencing AF occurrences in the duration of AF before the surgical intervention. Patients experiencing recurrence of atrial arrhythmia at 12 months ($n = 25$) had a significantly longer duration of AF before the operation

Post Surgical Ablation Patient Follow-Up

	D/C	3 Mon	6 Mon	9 Mon	12 Mon	18 Mon	24 Mon	Yearly Thereafter
Patient Self-Report For Follow-Up From Previous Time Point								
Health-Related Quality of Life		✓	✓		✓		✓	✓
Cardiac Procedure		✓	✓	✓	✓	✓	✓	✓
Hospital Admission		✓	✓	✓	✓	✓	✓	✓
Infection		✓	✓	✓	✓	✓	✓	✓
Stroke		✓	✓	✓	✓	✓	✓	✓
Bleeding		✓	✓	✓	✓	✓	✓	✓
Atrial Fibrillation/Arrhythmia		✓	✓	✓	✓	✓	✓	✓
Patient Self-Report on Current Date of Follow-Up								
Current Cardiac Rhythm		✓	✓	✓	✓	✓	✓	✓
Current Atrial Fibrillation Medications		✓	✓	✓	✓	✓	✓	✓
Nurse Coordinator Activities								
Reconciliation of Missing Data		✓	✓	✓	✓	✓	✓	✓
Verification of Cardiac Rhythm		✓	✓	✓	✓	✓	✓	✓
Protocol Status		✓	✓	✓	✓	✓	✓	✓
Other Clinical Follow-Up		As information becomes available, which are outside the standard time points, they are listed as "Follow-Up" - Most recent F/U can then be extracted.						

FIGURE 2. Post-surgical ablation follow-up. D/C, Discharge; F/U, follow-up.

than those having no problems with atrial arrhythmias ($n = 180$; 94.46 ± 88.89 vs 37.51 ± 51.1 months; $P = .0042$). Significantly higher and stable rates of SR were documented for patients whose follow-up care was managed according to the algorithm, with a return to SR rate of 92% versus 72%, 91% versus 62%, and 89% versus 40% at 6, 12, and 24 months, respectively (Figure 4).

Patients included in logistic regression who were off the protocol at 24 months ($n = 40$) were older and had a slightly higher prevalence of mild chronic lung disease than patients in the on-protocol group ($n = 54$). However, there were no differences between these groups in the other known variables associated with AF: left atrial size and type of AF. There was also no difference between groups for the type of surgical ablation performed (Table 2).

When assessing outcome at 24 months, logistic regression analysis pointed out that implementation of the clinical protocol was the most significant predictor of return to SR at 24 months (Table 1). Those on the protocol at 6, 12, and 18 months had more than 8 times the odds of being in SR as those not on the protocol at 6, 12, and 18 months (point estimate, 8.44; 95% confidence interval, 1.72–41.49) after

controlling for the type of maze procedure and variables known to be associated with return to AF (Table 2). Left atrial size and type of maze procedure were also found to be significant predictors, with patients with greater left atrial size and those undergoing the type IB maze procedure having decreased odds of being in SR.

We also determined that 51% of the patients who remained in AF and considered a “failure” by their cardiologist did not complete the protocol we had recommended. The most common deviations noted at the patients’ last known follow-up included no change in antiarrhythmic drug treatment, no attempt at cardioversion, and prematurely starting the patients on a rate-control regimen.

In addition, we noted that our follow-up system has generated more than 2000 clinical follow-up records, as well as 334 letters on behalf of 230 patients. With our follow-up system, we have also been able to identify the number and type of interventions that have been required to obtain and maintain SR after the Cox maze procedure. We have observed that 67 (18%) patients have required 107 cardioversions; 14 (4%) patients have required an ablation after the surgical ablation procedure, most commonly for atrial tachycardia;

FIGURE 3. The clinical algorithm for patients after surgical ablation. AAD, Antiarrhythmic drug; ECG, electrocardiography; ASA, aspirin.

29 (8%) patients have required a pacemaker after surgical intervention; and 37 (10%) patients have had at least 1 change of their antiarrhythmic drug. We have also seen the percentage of patients reported to be in normal SR maintained on antiarrhythmic drugs unnecessarily change over time, where at 6 months only 10% of patients were still taking what appeared to be unnecessary antiarrhythmic drugs to only 4% at 24 months.

DISCUSSION

The surgical treatment for AF is now a well-established surgical procedure that is being performed routinely. Despite the fact that it is performed routinely, there is a lack of standardization concerning the lesion set and the ablative devices in use. It is also clear from our work that there are no directions for the post-surgical ablation treatment follow-up that might be necessary for patients to maintain

SR. Patients are being followed differently and in different institutes after surgical intervention. In some cases surgeons are following patients, and in others cardiologists are following them. What was clear with our patients is that even in patients undergoing operations in the same institute, many

TABLE 1. Logistic regression to determine the effect of the protocol on the odds of being in sinus rhythm at 24 months (n = 94; on protocol: 49 vs no protocol: 36)

	Point estimate	95% CI	df	P value
Age	0.936	0.870–1.006	1	.073
Left atrial size	0.375	0.158–0.890	1	.026
Duration of atrial fibrillation	0.991	0.981–1.001	1	.068
Full Cox maze procedure	8.066	1.085–59.940	1	.041
On-protocol group	8.443	1.718–41.485	1	.009

2 Log likelihood = 56.031; Hosmer and Lemeshow goodness of fit $\chi^2 = 6.649$; P = .466. CI, Confidence interval; df, degree of freedom.

	Not Due	Unknown
6m	41	73
9m	57	70
12m	79	69
18m	116	59
24m	154	48

We have 100% follow up as defined by each patient having at least 1 follow up

FIGURE 4. Effect of the protocol on return to sinus rhythm (SR). PO, Post-operative.

different approaches and degrees of aggressiveness were used after discharge. The deviations from the protocol might be considered trivial because the majority involved a lack of change of antiarrhythmic drugs or DC cardioversion. However, for the first time, we were able to show that protocol-guided follow-up at different time points results in a significantly higher success rate after surgical ablation.

As our program has continued to evolve, we also noted that patients were not consistently receiving any type of long-term monitoring during the initial 6 months. Based on these findings, we have developed a long-term monitoring program in which all patients reporting SR and off their antiarrhythmic drug for at least 6 to 10 weeks are started on a 5-day long-term monitor. The monitor we currently use has the ability to quantify, if present, the patients' AF burden. Currently, 110 patients have undergone long-term monitoring through our program. These results are sent to the cardiologist along with a letter with any recommendations that we might have, which continues to enhance our collaborative

TABLE 2. Demographic and clinical characteristics of patients on versus off the clinical protocol at 24 months postoperatively

	On protocol (n = 54)	Off protocol (n = 40)
Age (y)*	61.2 ± 11.3	66.2 ± 12.9
Female sex	14 (26%)	15 (38%)
Length of stay (d)†	6.4 ± 3.7	10.4 ± 7.8
AF type (m)		
Paroxysmal	1	1
Persistent	18	18
Longstanding	32	20
Left atrial size (cm)	4.9 ± 0.9	4.8 ± 0.9
Type of ablation		
Cox maze procedure	48	35
Limited left-sided ablation	6	5
Mild chronic lung disease*	0	5

AF, Atrial fibrillation. * $P < .05$. † $P < .01$.

practice environment between surgeons and cardiologists and provide optimal care to the patients.

The data collected in this study have demonstrated that patients who undergo the Cox maze procedure or other surgical ablation obtained excellent outcomes. However, the addition of a clear institutional clinical protocol has provided the ability to have a comprehensive interpretation of the data collected. We have to be aware, however, of the potential effect of certain variables and how a patient's rhythm is related to different aspects of compliance with the protocol, particularly antiarrhythmic drugs and DC cardioversion. In contrast, he or she might have been started on rate control too soon, not allowing for the full effect of the protocol to be assessed. Thus exposure to the risk of non-compliance is 2 to 3 times higher in the non-SR patients, and this, rather than the protocol, might have made it appear that noncompliance is "causing" recurrence of AF. Therefore our study is limited by the inability to address the potential effect of the type of deviation from protocol; however, this was not the intent of the study. We attempted to establish a follow-up protocol that is reproducible and results in a standardized approach in a community-based hospital. Since the program has been in place, our ability to address the potential effect of a specific deviation from the protocol on rhythm is growing with the increased number of patients enrolled, and this should serve as the basis for a future study and publication.

The protocol has also assisted in the development of a collaborative effort between cardiologists and cardiac surgeons after ablation surgery to optimize patients' outcomes and return to SR. Taken together, these efforts have translated into greater return to or maintenance of SR for all patients.

CONCLUSION

This article summarizes the implementation of a new concept of longitudinal follow-up for patients after surgical

ablation and the subsequent effect on patients' outcomes. We determined that the success of surgical ablation is significantly better in patients who were treated according to our algorithm-driven protocol. Our protocol provided the ability for us to determine the success of the operation, as well as the intended and unintended consequences of cardiac surgery. The protocol also allowed a true collaborative effort between cardiologists and surgeons after ablation surgery in which these collaborative efforts have translated into a greater return to or maintenance of SR for all patients after the procedure. Therefore it is imperative for programs that offer the surgical ablation procedure to have a follow-up system in place to optimize patients' outcomes and enhance collaboration between surgeons and cardiologists.

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References

- Riley M, Marrouche N. Ablation of atrial fibrillation. *Curr Probl Cardiol*. 2006; 31:361-90.
- Ad N. Surgical treatment for atrial fibrillation—the Cox-Maze procedure: past, present and future. In: Sie H, D'Anocia G, Batolozzi F, Beukema W, Doty D, editors. *Manual of surgical treatment of atrial fibrillation*. Malden, Mass: Blackwell; 2007:160-4.
- Cox JL, Scussler RB, D'Agostino HJ Jr, et al. The surgical treatment of atrial fibrillation. III. Development of a definite surgical procedure. *J Thorac Cardiovasc Surg*. 1991;101:569-83.
- Cox JL. The surgical treatment of atrial fibrillation. IV. Surgical technique. *J Thorac Cardiovasc Surg*. 1991;101:584-92.
- Cox JL, Boineau JP, Schuessler RB, et al. Modifications of the Cox-Maze procedure for atrial flutter and atrial fibrillation. I. Rationale and surgical results. *J Thorac Cardiovasc Surg*. 1995;110:473-83.
- Cox JL, Jaquiss RD, Schuessler RB, et al. Modifications of the Cox-Maze procedure for atrial flutter and atrial fibrillation. II. Surgical technique of the Cox-Maze III procedure. *J Thorac Cardiovasc Surg*. 1995;110:485-95.
- Damiano RJ Jr, Gaynor SL, Bailey M, et al. The long term outcome of patients with coronary disease and atrial fibrillation undergoing the Cox-Maze procedure. *J Thorac Cardiovasc Surg*. 2003;126:2016-21.
- Prasad SM, Maniar HS, Camillo CJ, et al. The Cox-Maze III procedure for atrial fibrillation: long term efficacy in patients undergoing lone versus concomitant procedures. *J Thorac Cardiovasc Surg*. 2003;126:1822-8.
- A report of the Heart Rhythm Society (HRS) Task Force on Catheter Ablation of Atrial Fibrillation developed in partnership with European Heart Rhythm Association (EHRA) and the European Cardiac Arrhythmia (ECAS); in collaboration with the American College of Cardiology (ACC), American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). HRS/EHRA/ECAS Expert consensus statement on catheter and surgical ablation of atrial fibrillation: recommendations for personnel, policy, procedures and follow-up. *Europace*. 2007;9: 330-79.
- Ware J, Kosinski M, Turner-Bowker D, Gandek B. How to score version 2 of the SF-12 health survey. Lincoln, RI: Quality Metric Inc; 2002.
- Ad N, Pirovic EA, Kim YD, et al. Observations on the perioperative management of patients undergoing the Cox-Maze procedure. *Semin Thorac Cardiovasc Surg*. 2000;12:63-7.
- Ad N, Barnett S, Lefrak E, et al. Impact of follow up on the success rate of cryoCox-Maze procedure in patients with rheumatic cardiac disease and enlarged atria. *J Thorac Cardiovasc Surg*. 2006;131:1073-9.
- Ad N, Tian YY, Verbalis J, Imahara SD, Cox JL. The effect of the Cox-Maze procedure on the secretion of arginine-vasopressin and aldosterone. *J Thorac Cardiovasc Surg*. 2003;126:1095-100.
- Ad N, Suyderhoud JP, Kim YD, et al. The benefits of prophylactic continuous infusion of furosemide after the Cox-Maze procedure for atrial fibrillation. *J Thorac Cardiovasc Surg*. 2002;123:232-6.
- Holonen J, Hakala T, Auvinen T, et al. Intravenous administration of metoprolol is more effective than oral administration in the prevention of atrial fibrillation after cardiac surgery. *Circulation*. 2006;114:11-4.
- Denevich S, Boci K, Reddy P. Cost effectiveness of amiodarone in cardiac surgery. *Future Drugs—Expert Review of Pharmacoeconomics and Outcomes Research*. 2007;7:19-30.
- Auer J, Weber T, Berent R, et al. A comparison between oral antiarrhythmic drugs in the prevention of atrial fibrillation after cardiac surgery: the pilot study of prevention of postoperative atrial fibrillation (SPPAF), a randomized, placebo controlled trial. *Am Heart J*. 2004;147:636-43.
- Ad N, Cox JL, Palazzo T, et al. Stroke prevention as an indication for the Cox-Maze procedure in the treatment of atrial fibrillation. *Semin Thorac Cardiovasc Surg*. 2000;12:56-62.
- Cox JL, Ad N, Palazzo T. Impact of the Cox-Maze procedure on the stroke rate in patients with atrial fibrillation. *J Thorac Cardiovasc Surg*. 1999;118:833-40.
- Division for heart disease and stroke prevention—atrial fibrillation fact sheet. Available at: http://apps.nccdc.cdc.gov/emailform/print_table.asp. Accessed October 19, 2008.
- ACC/AHA/ESC 2006 guidelines for the management of patients with atrial fibrillation—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines. Available at: content.onlinejacc.org by. Accessed August 22, 2006.
- Barnett SD, Ad N. Surgical ablation as treatment for the elimination of atrial fibrillation: a meta-analysis. *J Thorac Cardiovasc Surg*. 2006;131:1029-35.