Heart Rhythm Disorder

Long-Term Efficacy of Cryo Catheter Ablation for the Treatment of Atrial Flutter

Results From a Repeat Electrophysiologic Study

Annibale S. Montenero, MD,* Nicola Bruno, MD,* Andrea Antonelli, MD,* Daniele Mangiameli, MD,* Luca Barbieri, MD,* Peter Andrew, MMEDSCI, PhD,† Olive Murphy, MSC,‡ Stephen O’Connor, PhD,‡ Francesco Zumbo, MD*

Milan, Italy; and Kirkland, Canada

OBJECTIVES

We investigated the long-term efficacy of cryo ablation for treatment of atrial flutter. To our knowledge, no study has assessed the long-term efficacy of cryo ablation by assessing both symptom and conduction recurrence.

BACKGROUND

A total of 45 consecutive patients with symptomatic atrial flutter were ablated with a 7-F, 6-mm-tip, quadripolar cryo catheter (Freezor Xtra, CryoCath Technologies Inc., Kirkland, Canada). Electrophysiologic studies (EPS) were performed with diagnostic catheters. Cryo ablation was at −75°C for 4 min, beginning at the inferior rim of the coronary sinus os and creating a posterior line to the Eustachian ridge. Safety, bi-directional isthmus block at intervention, and recurrence at three, six, and nine months post procedure were assessed.

RESULTS

There were no adverse events reported. All patients were free of discomfort on cryo energy delivery. The acute success rate at intervention was 87%. Follow-up data from 39 acutely successful patients showed 27 (69%) without conduction recurrence on repeat EPS at three months, and none (0%) had symptom recurrence documented by Holter monitoring, electrocardiogram, and/or patient diary records at three, six, and nine months follow-up.

CONCLUSIONS

Our experience with a new 7-F, 6-mm-tip, quadripolar cryo catheter yielded a fairly high success rate at intervention, an excellent safety profile, and a good chronic success rate in terms of symptom recurrence. However, further monitoring is necessary to determine whether all asymptomatic patients continue to remain free of symptoms, given the small pool of patients demonstrated to have conduction recurrence. (J Am Coll Cardiol 2005;45: 573–80) © 2005 by the American College of Cardiology Foundation

Radiofrequency (RF) ablation of the isthmus between the tricuspid annulus and the inferior vena cava is commonly used to treat atrial flutter (1). This well-established target is known as the cavotricuspid isthmus (CTI) (2,3). The feasibility of using a hand-held catheter to deliver cryo energy to successfully ablate the CTI was first demonstrated by Dubuc et al. in a series of experiments in dogs (4), and more recently there has been an accumulation of clinical experience with cryo ablation catheters in the treatment of patients with both common and atypical atrial flutter (5–8).

Our experience, as well as that of others, is that the focal lesions produced by cryo ablation are effective in creating permanent bi-directional isthmus block (5–7). Recurrence rates after RF ablation treatment for atrial flutter are between 0% and 31% over follow-up periods ranging from 6 to 68 months (8–11). The wide variation in recurrence rates reported by these studies may be due in part to different methods of recording recurrence—some studies have documented recurrence primarily by electrocardiogram (ECG) and/or patient diary records, whereas others have performed invasive repeat electrophysiologic study (EPS) post ablation. A recent study involving cryo ablation treatment for atrial flutter reported a symptom recurrence rate of 11% over a mean follow-up period of approximately 18 months (5). Although this study demonstrated the long-term efficacy of cryo ablation treatment for atrial flutter, the method of recording recurrence did not involve a repeat EPS, and consequently some patients categorized as asymptomatic may have had conduction recurrence demonstrated with repeat EPS. Such patients are a potential reservoir of individuals who could eventually become symptomatic.

The aim of this study was to document our experience with a new 7-F, 6-mm-tip, quadripolar cryo catheter in the treatment of patients with atrial flutter. Apart from safety and acute efficacy data, we sought to assess long-term efficacy by performing a follow-up assessment of arrhythmia recurrence using repeat EPS as well as ECG, patient diary records, and Holter monitoring.

METHODS

Demographics. The study population consisted of 45 consecutive patients with symptomatic atrial flutter who were referred to our institute to undergo ablation for recurrent

From the *Cardiology Department and Arrhythmia Center of Policlinico Multi-Medica, Sesto S.Giovanni, Milan, Italy; †Atlas Medical Science Writers Inc., Montreal, Canada; and ‡CryoCath Technologies Inc., Kirkland, Canada. Dr. Fred Morady acted as Guest Editor for this paper.

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atrial flutter between May 2002 and May 2003. The local ethics committee approved the protocol, and patient informed consent was obtained from all patients before the procedure. All patients had previously been treated for atrial flutter with two or more drug regimens at the time of the ablation. No patient had previous RF ablation or cryo ablation. Eligibility for ablation required that all patients had at least two documented symptomatic episodes of atrial flutter recorded either by ECG or Holter monitoring. All patients received an echocardiogram to ascertain the existence of cardiac pathology, underlying cardiac disease, and to measure left ventricular ejection fraction (LVEF). Anti-arrhythmic drugs were withdrawn in all patients at least one week before ablation, with the exception of amiodarone that was withdrawn eight weeks before intervention. The anti-anxiety drug diazepam was administered to a few patients at the discretion of the investigator. Patients were not anticoagulated as part of the ablation procedure. Three month follow-up data were available from 39 patients, all of whom were successfully ablated at intervention.

End points. Bi-directional conduction block at intervention was assessed by the following two steps: 1) Pacing the atrium at the coronary sinus (CS) immediately adjacent to the line of block (e.g., CS os) and recording at the lateral free wall (AL1) (Fig. 1). If the resultant atrial activation on the opposite side of the line of block at AL1 is late, this indicated that the wave of depolarization must proceed around the entire right atrium in a counterclockwise direction to the opposite side of the line of block. 2) Pacing from AL1 on the lateral free wall and recording at the CS os. This confirmed that the resultant atrial activation at the CS os is late, indicating that the wave of depolarization must proceed around the entire right atrium in a clockwise direction to the opposite side of the line of block.

At three-month follow-up, a repeat EPS was performed to determine whether conduction recurrence could be demonstrated. Catheters were positioned as for the ablation procedure. Atrial flutter inducibility and bi-directional conduction were evaluated. The programmed atrial stimulation involved a basic drive cycle length of 600 ms and a single extrastimulus at 400 ms with 20-ms decrements. If this was ineffective, a second extrastimulus at 300 ms with 20-ms decrements was delivered. Bi-directional block was assessed by pacing from the CS os and AL1 (Fig. 1).

Symptom recurrence rate at three, six, and nine months post procedure was documented by Holter monitoring, ECG, and/or patient diary records. Holter monitoring was performed on a monthly basis for all patients, and two patients had an implantable loop recorder implanted that was checked weekly.

Adverse events and patient reporting of discomfort with cryo energy delivery were recorded.

Catheters. Diagnostic. A 7-F, 24-pole catheter (Orbiter, USCI-Bard Inc., Bellerica, Massachusetts) with alternating 2-14-2-mm interelectrode distance was placed, via the right femoral vein, into the trabeculated right atrium to simultaneously record electrical activity in the right atrial free wall, the atrial roof, and the anterior septum. A 10-pole catheter (USCI-Bard Inc.) was placed in the CS via the left subclavian vein for recording the left atrium and part of the infero-posterior atrial septum. A 10-pole catheter with 2-mm inter-electrode spacing was inserted via the right femoral vein and positioned along the atrial septum in the His bundle region.

Ablation. In all cases, a commercially available 7-F deflectable, quadripolar catheter with a 6-mm-tip electrode (Freezor Xtra, CryoCath Technologies Inc., Kirkland, Canada) available with a large reach was used (7).

Electrogram recordings. Bipolar intracardiac electrograms filtered between 30 and 250 Hz were digitally recorded and stored on a Lab System 3.57 (USCI-Bard Inc., Bellerica, Massachusetts). A three-lead surface ECG was used simultaneously. Digital calipers were used to calculate atrial activation times in sinus rhythm and the atrial flutter cycle length (F-F intervals).

Baseline EPS. A baseline EPS was done with all patients in sinus rhythm and a non-sedated state. All patients received local anesthesia with lidocaine. Pacing was delivered via the Orbiter catheter placed close to the right atrial auricula at twice the diastolic threshold with a 2-ms pulse width.

Induction of atrial flutter. During the baseline EPS, sustained or non-sustained atrial flutter was induced by programmed atrial stimulation to identify patterns of activation consistent with atypical forms of atrial flutter or rapid atrial tachycardia. It was possible to induce atrial flutter in approximately 90% of our patient group. Thereafter, atrial pacing at a cycle length 20% shorter than the atrial flutter cycle length was used to perform concealed entrainment and terminate atrial flutter. In the remaining 10% of patients in whom atrial flutter could not be induced, we moved directly to isthmus site evaluation and subsequent ablation; all patients received ablation in the CS os with pacing after conversion to sinus rhythm to assess conduction block across the isthmus.

Initial positioning of the ablation catheter. In all procedures, the ablation catheter was initially placed under fluoroscopic guidance (45° left anterior oblique and right anterior oblique projections) at the posterior isthmus close to the CS os (Fig. 1). The ablation catheter was positioned to ensure stability plus good electrode-endocardium contact. This was confirmed by stable intracardiac electrograms.
Determining the target site for ablation. Previous ablation experience suggested that specific electrogram characteristics differentiated successful from unsuccessful target sites (7). Essentially, a successful target site exhibited a time to effect, defined as the length of time required to observe an electrophysiologic change in the area being ablated, of approximately 20 s after 60 s of cryo energy delivery at $-75^\circ$C. Hence, after initial fluoroscopic positioning of the ablation catheter at the posterior isthmus close to the CS os, all subsequent catheter repositioning was done with the aid of anatomic (fluoroscopic) and electrophysiologic (EPS) guidance. Having anatomically positioned the ablation catheter at a site, a cryo test (e.g., cryo energy delivery for up to 60 s at $-75^\circ$C) was performed in an attempt to create an electrophysiologic change (e.g., transient reversible conduction block); 60 s of cryo energy delivery at $-75^\circ$C was used on the basis of investigator experience that delay of conduction at the isthmus appears at $-60$ s of cryoapplication (7). Pacing was performed during cryo testing.

Figure 1. Fluorographic images of anatomic placement of the new 7-F, 6-mm-tip, quadripolar cryo catheter for the treatment of atrial flutter. (Top) Left anterior oblique view of right atrium. (Bottom) Right anterior oblique view of right atrium. ABI = cryo ablation catheter; AL 1 = anterolateral right atrial wall electrode; CS 1 = distal coronary sinus electrode; CS os = proximal electrode at coronary sinus os; HIS = His bundle catheter; MS 12 = midseptal electrode.
to identify bi-directional block. Generally, successful cryo testing prolonged conduction by 30 to 40 ms. If prolongation of conduction was not achieved, the cryo test was halted, the target tissue was allowed to re-warm and regain its electrophysiologic properties, and the ablation catheter was slightly repositioned. This ability to create transient reversible conduction block using cryo energy has been discussed elsewhere under the guise of cryo or ice mapping (12).

Ablation protocol to create permanent bi-directional block. When an electrogram showed that a cryo test at a specific target site caused the desired electrophysiologic perturbation (e.g., complete bi-directional block of conduction over the CTI), cryo energy delivery to this target was maintained for 4 min at −75°C. This created a permanent cryo lesion. Some patients exhibited flutter that was terminated during the ablation procedure. However, flutter interruption per se did not mean successful ablation; recovery of sinus rhythm was necessary to pace the heart from the CS os to assess conduction across the isthmus in these (and other) patients. Double potentials were demonstrated at the end of the ablation (Fig. 2). Bi-directional conduction block defined the end point of the ablation procedure. Assessment of whether bi-directional block was achieved was by pacing the atrium from the CS os and sensing on the lateral wall, and vice-versa as described earlier. Once bi-directional block was achieved, no additional cryoapplications were delivered to complete a lesion line across the CTI. Isoproterenol was not used to test completeness of the conduction block after the ablation, and a pacing cycle length of 600 and 400 ms was used to assess conduction block; current levels were 15 mA amplitude for 5 ms duration. A 30-min wait period occurred between the initial successful ablation and subsequent re-testing to ensure bi-directional block remained; a 30-min wait period was selected based on investigator experience with ablation procedures for atrial flutter as well as evidence from published data (3). Patients were asked to report any discomfort they felt throughout the ablation procedure; their comments were recorded on a patient chart.

Three-, six-, and nine-month follow-up. All patients kept a diary record of symptoms experienced after the ablation procedure. These records were collected at our out-patient clinic every month. A general cardiovascular check-up and ECG were also performed as part of the clinical follow-up. A follow-up invasive repeat EPS was performed on all consenting patients at approximately three months post ablation; bi-directional block was assessed in exactly the same way it was at intervention. The same
induction protocol was used for the repeat EPS as was previously used in the ablation procedure; a second ablation was scheduled for any patient who had conduction recurrence demonstrated on repeat EPS, and an identical induction protocol was employed as previously described.

**Statistical analysis.** STATISTICA version 6.0 (StatSoft Inc., Tulsa, Oklahoma) was used for all statistical analysis. An unpaired *t* test was generally used to compare the number of cryo tests performed, ablations delivered, and cryoapplication times between acute success patients versus acute failure patients, as well as for those conduction recurrent patients versus non-conduction recurrent patients. When normality and equal variance analyses failed, a Mann–Whitney rank sum test was used instead of an unpaired *t* test. The significance level was set at *p* < 0.05.

**RESULTS**

**Demographics.** The study population consisted of 45 patients with symptomatic atrial flutter; 43 patients had common atrial flutter and 2 had atypical atrial flutter. The mean ± SD age and arrhythmia duration were 62 ± 12 years and 33 ± 40 months, respectively. One (2.2%) patient had a previous pacemaker implant and implantable cardiac defibrillator. The LVEF was >60% in 34 (75.6%) patients, between 35% and 60% in 7 (15.6%) patients, between 25% and 34% in 2 (4.4%) patients, and <25% in 1 (2.2%) patient; LVEF data were unknown in 1 (2.2%) patient.

**Procedure characteristics.** There was no statistically significant difference between acute success patients versus acute failure patients in terms of the number of cryo tests performed (27 ± 21 vs. 22 ± 9) and cryoapplication time (44 ± 22 min vs. 58 ± 36 min) (Table 1). However, there was a significant difference between these two groups in terms of the number of cryo ablations delivered (9 ± 17 vs. 10 ± 15; *p* = 0.003); about four times as many cryo ablations were delivered to non-conduction recurrent patients than conduction recurrent patients (Table 2). There were no marked differences in procedure and fluoroscopy times between conduction recurrent patients and non-conduction recurrent patients (Table 2). Moreover, there were no major differences between these two groups in terms of patient characteristics such as age, arrhythmia duration, and LVEF (Table 2).

**Safety: acute and follow-up data.** There were no reported adverse events during or post ablation procedure before discharge from hospital (Table 3). There was no incidence of cryo-induced permanent atrioventricular block. None (0%) of the 45 patients who were treated with cryo experienced discomfort on cryo energy delivery. No adverse events were reported in any patient between hospital discharge and nine-month follow-up, or at the repeat EPS.

**Efficacy: acute and follow-up data.** The overall acute success rate associated with this catheter was 87% (39 of 45 patients). There were 6 (13%) of 45 patients who were acute failures. Three-month repeat EPS data were available from

### Table 1. Procedure Characteristics Associated With Particular Groups of Patients

<table>
<thead>
<tr>
<th>Group</th>
<th>Cryo Tests (Mean ± SD; Range)</th>
<th>Cryo Ablations (Mean ± SD; Range)</th>
<th>Procedure Time (min) (Mean ± SD; Range)</th>
<th>Fluoroscopy Time (min) (Mean ± SD; Range)</th>
<th>Cryoapplication Time (min) (Mean ± SD; Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients (n = 45)*</td>
<td>27 ± 20; 2–98</td>
<td>12 ± 18; 1–78</td>
<td>88 ± 48; 20–250</td>
<td>24 ± 10; 7–47</td>
<td>45 ± 24; 10–101</td>
</tr>
<tr>
<td>Patients who were acute successes (n = 39)*</td>
<td>27 ± 21; 2–98</td>
<td>9 ± 13; 1–73</td>
<td>77 ± 36; 20–180</td>
<td>23 ± 10; 7–47</td>
<td>44 ± 22; 10–101</td>
</tr>
<tr>
<td>Patients who were acute failures (n = 6)</td>
<td>22 ± 9; 15–28</td>
<td>34 ± 31; 2–78</td>
<td>156 ± 61; 70–250</td>
<td>29 ± 9; 13–39</td>
<td>58 ± 36; 10–94</td>
</tr>
</tbody>
</table>

*One patient had a pacemaker implant and implantable cardiac defibrillator.

### Table 2. Characteristics Associated With Acutely Successful Patients With and Without Conduction Recurrence Demonstrated on Repeat EPS at Three-Month Follow-up

<table>
<thead>
<tr>
<th>Parameters</th>
<th>With Conduction Recurrence (n = 12)</th>
<th>Without Conduction Recurrence (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>57 ± 13</td>
<td>66 ± 10</td>
</tr>
<tr>
<td>Arrhythmia duration (months)</td>
<td>33 ± 37</td>
<td>34 ± 42</td>
</tr>
<tr>
<td>LVEF (n)</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>&gt;60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35%-60%</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>25%-34%</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>&lt;25%</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cryo tests, mean ± SD; range</td>
<td>34 ± 25; 4–98</td>
<td>23 ± 17; 2–50</td>
</tr>
<tr>
<td>Cryo ablations, mean ± SD; range</td>
<td>3 ± 2; 1–8</td>
<td>12 ± 15; 1–73</td>
</tr>
<tr>
<td>Cryoapplication time (min), mean ± SD; range</td>
<td>44 ± 22; 16–98</td>
<td>43 ± 22; 10–101</td>
</tr>
<tr>
<td>Procedure time (min), mean ± SD; range</td>
<td>79 ± 41; 20–180</td>
<td>77 ± 34; 25–144</td>
</tr>
<tr>
<td>Fluoroscopy time (min), mean ± SD; range</td>
<td>24 ± 9; 9–36</td>
<td>23 ± 11; 7–47</td>
</tr>
</tbody>
</table>

EPS = electrophysiologic study; LVEF = left ventricular ejection fraction.
three months or less, and assessment of long-term efficacy factors such as small sample size, a follow-up period of only studies have been limited by a combination of various recurrence as measured end points. Other cryo ablation the long-term efficacy of cryo ablation in a large number of To our knowledge, this is the first study that has reported on DISCUSSION

Table 3. Safety and Efficacy Outcomes Derived From Acutely Successful Patients at 3-, 6-, and 9-Month Follow-up*

<table>
<thead>
<tr>
<th>Parameters</th>
<th>3-Month Follow-Up</th>
<th>6-Month Follow-Up</th>
<th>9-Month Follow-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients without conduction recurrence on repeat EPS, n (%)</td>
<td>27 (69)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Patients with conduction recurrence on repeat EPS, n (%)</td>
<td>12 (31)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Patients without symptom recurrence documented by monthly Holter monitoring, ECG, and/or patient diary records, n (%)</td>
<td>39 (100)</td>
<td>39 (100)</td>
<td>39 (100)</td>
</tr>
<tr>
<td>Patients with symptom recurrence documented by monthly Holter monitoring, ECG, and/or patient diary records, n (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Adverse events reported</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*There were 39 acutely successful patients consenting to repeat EPS at three-month follow-up. ECG = electrocardiogram; EPS = electrophysiologic study.

39 acutely successful patients (Table 3). There was no conduction recurrence demonstrated in 27 (69%) of 39 acutely successful patients. None (0%) of the 39 patients showed symptom recurrence at three-month follow-up.

At six- and nine-month follow-up, data available from 39 acutely successful patients showed that all (100%) were asymptomatic, that is, symptom recurrence was not documented either by monthly Holter monitoring, ECG, and/or patient diary records (Table 3).

To our knowledge, this is the first study that has reported on the long-term efficacy of cryo ablation in a large number of patients using both symptom recurrence and conduction recurrence as measured end points. Other cryo ablation studies have been limited by a combination of various factors such as small sample size, a follow-up period of only three months or less, and assessment of long-term efficacy by symptom recurrence alone (5,7,8). The strengths of the current study are its reasonable sample size, a follow-up period extending to nine months to assess symptom recurrence, and the performance of a repeat EPS at three months post intervention to assess conduction recurrence.

At intervention, bi-directional conduction block was created in 39 (87%) of 45 patients. However, three-month follow-up data showed that although all (100%) acutely successful patients were asymptomatic, conduction recurrence was demonstrated in 12 (31%) patients on repeat EPS. Although six- and nine-month follow-up data showed that all (100%) acutely successful patients continued to be asymptomatic, three-month repeat EPS data suggest that there is a reservoir of asymptomatic patients who may eventually become symptomatic. The six (13%) patients who were acute failures had on average almost four times the number of ablations delivered (p = 0.032), a longer cryoapplication time, and over double the procedure time of those patients who experienced acute success with cryo at intervention (Table 1). The unsuccessful acute outcome in certain patients was primarily due to failure to localize and ablate the target site. However, the patient characteristics of those who were acute failures were not overtly different from patients who were acute successes. Consequently, possible predictors for failure at intervention could not be readily identified, although the procedure characteristics allude to the difficulty of the ablation procedure in the acute failure cases. Data concerning how many times a specific cryo test succeeded but subsequent ablation at the same site failed to create bi-directional block were not captured in this study; only data relating to the total number of cryo tests and ablations were captured for each patient. Analysis of various electrophysiologic and ablation characteristics associated with patients who were or were not recurrent on repeat EPS also failed to identify any strong predictors of conduction recurrence (Table 2), although patients without conduction recurrence had about four times as many cryo ablations delivered during the procedure (p = 0.003).

Cryo ablation has been shown to offer a number of advantages over other energy sources in terms of safety and absence of discomfort (7,8,13). Similarly, no adverse events or patient discomfort with cryo energy delivery were reported in the present study. This reflects an excellent safety profile for this new 7-F, 6-mm-tip catheter. In contrast, pain has been reported to be experienced by patients with atrial flutter who were treated with RF ablation (13), possibly because the ablation site is highly innervated and close to the CS os. The use of cryo energy allowed ablation around the CS os without causing pain in patients receiving only mild sedation.

The proof of bi-directional conduction block in the CTI remains a critical issue in the confirmation of a successfully ablated atrial flutter. Although, the literature reports unidirectional or rate-dependent conduction block in more than 31% of the patient population treated with RF ablation (3,14), this was not our experience with cryo. This suggests two possibilities. First, the area where we created lesions was more critical compared with the standard conventional isthmus lesion (7). Second, cryo energy produces a lesion more likely to result in bi-directional block. Each of these possibilities requires further investigation. Despite nearly all patients (39 of 45 patients) being demonstrated to have bi-directional block at the 30-min re-test, which followed the initial creation of conduction block at intervention, conduction recurrence was demonstrated in a number of asymptomatic patients consenting to repeat EPS at three months. The ablation technique performed at intervention may explain why a number of these asymptomatic patients were later found to have conduction recurrence—the technique may have potentially left an anterior
gap as the ablation started relatively posteriorly in the isthmus below the CS ostium. In addition, a longer period of cryo energy delivery at intervention, >4 min, may have lessened the conduction recurrence rate identified on repeat EPS post procedure. Our recent investigation of an 8-mm-tip catheter using an 8-min cryoapplication time to create permanent bi-directional block showed a 100% acute success rate, and only 2% of patients exhibited both conduction and symptom recurrence at three-month follow-up (15). This suggests that although a 4-min cryoapplication time may be effective at eliminating conduction at the time of the 30-min re-test post intervention, this length of cryoapplication may not be maximally effective at creating permanent conduction block. Moreover, a 30-min re-test period may not be a sufficient “wait time” in which to ascertain that permanent conduction has been created. There may be a reservoir of cells in the cryo lesion that are merely “stunned” and that will resume their arrhythmic activity soon after the procedure. Ultimately, a longer cryoapplication time and a catheter powerful enough to create deeper and wider lesions may have yielded a higher acute success rate and less conduction recurrence post procedure than was observed in the present study.

Study limitations. This study has limitations. First, the study was not controlled. It was a single-arm study with no randomized comparison to other smaller tipped cryo ablation catheters or RF ablation catheters. Nonetheless, this study ultimately sought to document our experience with a new 7-F, 6-mm cryo catheter for treatment of patients with symptomatic atrial flutter. Second, the study involved only two patients with atypical atrial flutter. Nonetheless, the 45 patients who were treated were representative of the general population of symptomatic patients commonly referred to expert centers for ablation of atrial flutter. Third, an anatomic approach to ablation was partially used. This may have particularly compromised the ablation procedure in patients who had atypical atrial flutter. This approach may be improved by looking for a specific electrogram to help identify a suitable site for ablation. Fourth, measurement of the conduction intervals across the isthmus before and immediately after cryo ablation and on repeat EPS to compare the intervals between patients who had complete and incomplete block would have been beneficial. Finally, three-month repeat EPS follow-up data were available from 39 patients, all of whom experienced acute success with cryo. In a number of these patients, repeat EPS demonstrated conduction recurrence even though all were asymptomatic. We postulate that perhaps a sufficient delay of conduction remained at the isthmus that did not lead to symptom recurrence but could be identified as conduction recurrence. Although this disparity between conduction and symptom recurrence may allude to the possibility of there being a critical area for ablation to eradicate symptomatic atrial flutter, alternatively those asymptomatic patients who had conduction recurrence demonstrated on repeat EPS may ultimately be a reservoir of patients who will eventually experience symptom recurrence. Although six- and nine-month data demonstrate that all acutely successful patients continued to be asymptomatic, extended follow-up would be useful to determine whether the symptom recurrence rate documented by Holter monitoring, ECG, and/or patient diary records eventually equals the conduction recurrence rate identified by repeat EPS at three months post ablation.

CONCLUSIONS

This study documents our experience with a new 7-F, 6-mm catheter for cryo ablation treatment of symptomatic atrial flutter. Neither adverse events nor discomfort with cryo energy delivery were reported with the use of this catheter. No incidence of atrioventricular block occurred. Acute success, defined as bi-directional isthmus block at intervention, was achieved in 87% of treated patients. Three-month follow-up data available from 39 acutely successful patients showed that all (100%) patients were asymptomatic. Conduction recurrence was demonstrated in 12 (31%) patients on repeat EPS at three months. Data available from 39 acutely successful patients at six- and nine-month clinical follow-up showed that all (100%) patients remained asymptomatic. The results of this study add to the growing list of studies that demonstrate cryo ablation treatment of atrial flutter to be efficacious and safe. However, further monitoring is necessary to assess whether the absence of symptom recurrence observed at nine-month clinical follow-up continues to be maintained over the long term.

Acknowledgments

All intervention and follow-up data were analyzed by an independent organization (Atlas Medical Science Writers Inc., Montreal, Canada). For disclosure purposes, this organization has previously analyzed data for CryoCath Technologies and other medical device, pharmaceutical, and biotech companies, as well as university research groups involved in arrhythmia research.

Reprint requests and correspondence: Dr. Annibale S. Montenero, Divisione di Cardiologia, Policlinico MultiMedica, Via Milanese 300, 20099, Sesto S.Giovanni (MI), Milan, Italy. E-mail: montenero@hotmail.com.

REFERENCES


