*Bratisl Lek Listy 2010; 111 (2)*
90 – 92

CLINICAL STUDY

# Cryothermal ablation of typical atrial flutter

Misikova S, Stancak B

*Eastern Slovakia Institute of Cardiac and Vascular Diseases, Kosice, Slovakia.* **misikova_s@mediclub.sk**

**Abstract:** *Objectives:* To evaluate the efficacy and safety of cryoablation compared with the radiofrequency (RF) method in the treatment of typical atrial flutter (AFL).
*Methods:* 12 patients with typical counterclockwise AFL underwent cryoablation of the cavotricuspid isthmus. Cryoablation was performed with a 9F catheter with an 8 mm tip electrode. Applications were delivered by point-by-point technique to create the ablation line. The end point of the procedure was achievment of bidirectional isthmus conduction block. Control group consisted of 12 consecutive patients who underwent the ablation by means of RF method.
*Results:* We found no differences in the duration of transisthmic conduction after ablation in both groups and in the fluoroscopy time. We found significant differences in the procedural time (187±81 vs 110±35 minutes, p<0.01) and in the analgesic use (0/12 vs 12/12, p<0.01). After a 3 month follow-up all patients in both groups were free from the recurrence of AFL, 1 pacient in cryoablation group had paroxysm of atrial fibrillation.
*Conclusions:* Efficacy and safety profile of cryoablation are similiar with RF ablation. Procedural time in the cryoablation group is significantly longer but the use of analgesics can be completely avoided *(Tab. 2, Ref. 20).*
Full Text (Free, PDF) *www.bmj.sk.*
Key words: cryoablation, catheter, atrial flutter.

Catheter ablation of typical atrial flutter (AFL) is at present time the standard therapeutical approach (1). In the last years after the successful surgical experience (2, 3) and due to the technical progress in the development of the catheters, the cryothermal energy was introduced into the clinical practice (4, 5). The principle of cryoablation is freezing the tissue to -75 degrees of Celsius mediated by specially constructed cryoablation catheter. Fluid nitrous oxide is delivered under pressure to the catheter tip through a hollow injection tube, which runs internally through the whole length of the catheter. In a small chamber inside the tip electrode, nitrous oxid expands and liquid to gas phase change takes place with heat extraction from the electrode-to tissue interface. The temperature of the tip is constantly monitored by the console (6, 7, 8). The aim of the study is to evaluate the efficacy and safety of cryoablation method and to compare it with the RF method.

## Patients and method

Cryoablation of typical AFL was performed in 12 patients (7 men and 5 women) with mean age 59±12 years. All patients gave informed consent for the procedure. Oral antiarrhythmic drugs were stopped at least 5 biological half-times before the procedure. All patients had typical counterclockwise AFL, in 5 patients was also documented atrial fibrillation (AFIB) or atypical left AFL. The follow-up after the ablation was done in 3–6 month intervals. The recurrence of AFL was ruled out with 24 hours Holter monitoring during the follow-up visits. The control group consisted of 12 following patients who underwent the RF ablation of typical AFL. The details of the patients group are shown in Table 1.

Under local anesthesia by the puncture of v. subclavia 6 F decapolar catheter was inserted into the coronary sinus and via the puncture of femoral vein we inserted Halo catheter and 7 F cryoablation catheter Freezor Max with 8 mm tip. In the RF ablation we used 8 mm tip 7 F ablation catheter. The Halo catheter was positioned near the tricuspid anulus to map the atrial activation. In patients with persistent AFL we used the entrainment to verify the istmus dependence of AFL. In patients on sinus rhythm we measured the transisthmic conduction in both directions before the ablation. The three-dimentional nonfluoroscopy system LocaLisa was used for localization of catheters. We used the technique of a point-by-point application of energy starting at tricuspid anulus and proceeding to the ostium of the inferior vena cava. The application of the cryoenergy lasted at least 4 minutes. If we were not able to achieve sufficient double potentials, or if the flutter was not interrupted after the completion of ablation line, or bidirectional block was not achieved, we continued the ablation by searching for the gaps in the ablation line. The data are expressed as the arithmetical mean ± standard deviation. Student•s *t* test for continuous variables, and the chi-square test with Yates correction for ordinal variables were used. As a level of statistical significance was considered 5 %.

Eastern Slovakia Institute of Cardiac and Vascular Diseases, Košice, Slovakia

**Address for correspondence:** S. Misikova, MD, Bukova 5, SK-040 14, Kosice, Slovakia.
Phone: +421.903.102171, Fax: +421.55.7891313

**Tab. 1. Basic characteristics and echocardiography parameters in both groups.**

| | Cryo group | RF group | p |
|---|---|---|---|
| patients | 12 | 12 | |
| m/w | 7/5 | 8/4 | |
| age | 59±12 | 59±11 | NS |
| BMI (kg/m$^2$) | 29.4±4.4 | 33.1±8.9 | NS |
| lasting of AFL (</>) than 1 year | 8/4 | 5/7 | NS |
| appearance of AFIB | 4 | 9 | NS |
| ECHOCG | | | |
| LA (μm) | 41±7 | 40±6 | NS |
| LV (mm) | 50±9 | 53±8 | NS |
| EF (%) | 51±5 | 48±8 | NS |
| treatment | | | |
| amiodarone | 4 | 6 | |
| propafenone | 2 | 3 | |
| beta-blocker | 6 | 9 | |
| structural heart disease | | | |
| AH | 9 | 9 | |
| CAD | 3 | 2 | |
| other | 6 | 2 | |

Cryo group – cryothermal ablation group, RF group – radiofrequency ablation grup, BMI – body mass index, AFL – atrial flutter, AFIB – atrial fibrillation, ECHOCG – echocardiography, LA – left atrium, LV – left ventricle, EF – ejection fraction, AH – arterial hypertension, CAD – coronary artery disease

**Tab. 2. Electrophysiological and procedure parameters in both groups.**

| | Cryo group | RF group | p |
|---|---|---|---|
| CL AFL (ms) | 245±30 | 249±26 | NS |
| fluoroscopic time (seconds) | 429±316 | 553±168 | NS |
| procedure time (minutes) | 187±81 | 110±35 | <0.01 |
| transisthmic conduction after ablation(ms) | 155±32 | 148±19 | NS |
| bi/unidirectional block | 10/2 | 12/0 | NS |
| analgaesia (fentanyl) | 0 | 12 | <0.01 |
| appearance of AFL/AFIB after 3 months | 0/1 | 0/0 | NS |

Cryo group – cryothermal ablation group, RF group – radiofrequency ablation grup, CL AFL – cycle length of atrial flutter, AFL – atrial flutter, AFIB – atrial fibrillation

## Results

The results are summarized in Table 2. Clinical characteristics in cryoablation and RF ablation groups presented no differences in age, sex or the surface area and morphometric parameters in echocardiography. The cycle lenth of AFL did not differ in both. The mean fluoroscopy time was similar in both groups. We found no differences in the duration of transisthmic conduction after ablation in both groups. In cryothermal ablation group the procedural time was significantly longer due to longer application of cryoenergy to achieve the conduction block. On the other hand, this application is not accompanied with the pain. The significant difference was found in analgaesia medication, because this was not used in the cryoablation group. On the contrary, the RF energy application in the vicinity of inferior vena cava was in all patients perceived as painfull and administration of analgethics was needed in all patients. Periprocedural complications did not occure in any group. Relapse of AFL after three months was not reported or documented in any patient in both groups except for one patient with paroxysmal AFIB requiring electrical cardioversion in the cryoablation group.

## Discussion

Cryothermal energy represents an alternative source of energy which can be used in catheter ablation. Cryoablation causes lesion of the target tissue by dual mechanisms: through the direct effect to the cell and indirectly due to the damage of the underlying vessels bed. The direct cellular injury is mediated by the formation of ice. By cooling to the temperature of -30 °C the ice develops only extracellularly. Consequently, extracellular environment becomes hyperosmotic and intracellular to extracellular water shift occurs. This causes cellular shrinkage and damage to the membrane. The damage is reversible, if the application of energy lasts a short time. In the clinical use, the option of producing a functionally reversible lesion is quite attractive to test the effect of cryoablation without producing permanent lesion (cryomapping). Conversely, by cooling down to -40 °C and less, intracellular water freezing of results in major and irreversible disruption of organelles and cell membrane followed by cellular death. Cooling the tissue leads also to vasoconstriction, which completely stops the circulation. These changes result into the ischemic necrosis. The lesion becomes well circumscribed from the neighbouroughing tissue by fibrotic border (7).

Endothelial damage is only a little thrombogenic, and low is also the risk of the damage of coronary vessels (9). The risk of thromboembolic complication is 5.6 x lower than during the RF ablation (10, 11). The depth of the lesion is comparable by that occurring during RF ablation, but the volume and surface of the lesion are smaller. When the tip of catheter is freezed up to the target tissue, resulting damage is more focal and spreads more to the depth of the tissue. Due to slower formation of the lesion longer application of energy is needed. On the other hand, the slower damaging of the target tissue allows premature stopping of the energy application in the suboptimal position without an irreversible loss of conduction properties (12, 13, 14). The big advantage of the cryoablation of AFL is painless procedure. RF isthmus ablation in the vicinity of the inferior vena cava is in majority of patients accompanied with pain caused by irritation of the pericardium adjacent to the thin right atrial wall and vena cava inferior. Timmermans (15) found in the group of 125 patients with the cryoablation, that the application of energy was percepted as painfull in one patient, compared to the RF where all 94 patients sensed at least 1 application of energy as painfull. Literature data show the average procedural success during the cryoablation of AFL about 87–100 %. The recurrence of conduction through the isthmus after the 3 month post ablation is between 30–44 % and recurrence of sympthoms during the follow-up 3–18 month about 0–25 % (16, 17). The majority of

authors use the classical application point-by-point throughout the isthmus. Montenero [18] preferes the hot-spot application of energy in which the energy is applied at the site of the optimal intracardiac electrogram with the prolongation of conduction of about 30–40 ms. Kuniss (19) utilized the so called sigmoid curvature which can improve the cryoadhesion of catheter to the tissue under the Eustachian valve and to the site of tricuspid valve ridge. Only few studies compared cryoablation and RF ablation of AFL. Collins (20) found comparable acute success in both methods, approximately 11 % of clinical recurrence after 3-month follow-up in cryoablation group and significantly lower pain perception in cryoablation group compared to RF ablation.

## Conclusion

Our study shows that the effectivity and safety profile of cryoablation are similiar with RF ablation. Procedural time in the cryoablation group is significantly longer but the use of analgesics can be completely avoided what makes this method preferable in patients with high perception of pain.

## References

**1. Cosio FG, Arribas F, López-Gil M et al.** Radiofrequency ablation of atrial flutter. J Cardiovasc Electrophysiol 1996; 7: 60—70.

**2. Bredikis JJ, Bredikis AJ.** Surgery of tachyarrhythmias: intracardiac closed heart cryoablation. PACE 1990; 13: 1980—1984.

**3. Cox JL, Holman WL, Cain ME.** Cryosurgical treatment of atrioventricular node reentrant tachycardia. Circulation 1987; 76: 1329—1336.

**4. Dubuc M, Talajic M, Roy D et al.** Feasibility of cardiac cryoablation using a transvenous steerable electrode catheter. J Interv Card Electrophysiol 1998; 2: 285—292.

**5. Gaita F, Paperini L, Riccardi R et al.** Cryothermic ablation within the coronary sinus of an epicardial posterolateral pathway. J Cardiovasc Electrophysiol 2002; 11: 1160—1163.

**6. Friedman PL.** Catheter ablation of cardiac arrhythmias. Curr Opin Cardiol 2004; 20: 48—54.

**7. De Ponti R.** Cryothermal energy ablation of cardiac arrhythmias 2005 State of the art. Indian Pacing and electrohysiol J 2005; 5: 12—24.

**8. Khairy P, Dubuc M.** Transcatheter cryoablation Part I: Preclinical experience. PACE 2008; 31: 112—120.

**9. Rodriguez LM, Leunissen J, Hoekstra A et al.** Transvenous cold mapping and cryoablation of the AV node in dogs: observations in chronic lesions and comparison to those obtained using radiofrequency ablation. J Cardiovasc Electrophysiol 1998; 9: 1055—1061.

**10. Epstein MR, Knapp LD, Martindill M et al.** Embolic complications associated with radiofrequency catheter ablation. Amer J Cardiol 1996; 77: 655—658.

**11. Hindricks G.** The Multicentre European radiofrequency survey (MERFS): complications of radiofrequency catheter ablation of arrhythmias. Eur Heart J 1993; 14: 1644—1653.

**12. Friedman PL, Dubuc M, Green MS et al.** Catheter cryoablation of supraventricular tachycardia: Results of the multicenter prospective „frosty“ trial. Heart Rhythm 2004; 1: 129—138.

**13. Khairy P, Chauvet P, Lejmann J et al.** Lower incidence of thrombus formation with cryoenergy versus radiofrequency catheter ablation. Circulation 2003; 107: 2045—2050.

**14. Manusama R, Timmermans C, Limon F et al.** Catheter-based cryoablation permanently cures patients with common atrial flutter. Circulation 2004; 109: 1636—1639.

**15. Timmermans C, Ayers GM, Crijns HJGM et al.** Randomized study comparing radiofrequency ablation with cryoablation for the treatment of atrial flutter with emphasis on pain perception. Cicrulation 2003; 107: 1250—1252.

**16. Montenero AS, Bruno N, Antonelli A et al.** Comparison between a 7 French 6 mm tip cryothermal catheter and 9 French 8 mm tip cryothermal catheter for cryoablation treatment of common atrial flutter. J Interv Card Electrophysiol 2005; 13: 59—69.

**17. Lemola K, Dubuc M, Khairy P.** Transcatheter cryoablation Part II: Clinical utility. PACE 2008; 31: 235—244.

**18. Montenero AS, Andrew P.** Current treatment options for atrial flutter and results with cryocatheter ablation. Exprt Rev Cardiovasc Ther 2006; 4: 1—13.

**19. Kuniss M, Kurzidim K, Greiss H et al.** Acute success and persistence of bidirectional conduction block in the cavotricuspid isthmus one month post cryocatheter ablation of common atrial flutter. PACE 2006; 29: 146—152.

**20. Collins N, Barlow M, Leitch JW et al.** Cryoablation versus Radiofrequency ablation in the treatment of atrial flutter trial (CRAAFT). Heart Rhythm 2005, Scientific sessions, New Orleans, LA, USA, May 4—7, 2005.

Received January 12, 2009.
Accepted November 17, 2009.