

# Myocardial Injury After Radiofrequency Catheter Ablation

CHARN SRIRATANASATHAVORN, M.D.\*, WATTANA LEOWATTANA, M.D.\*\*,  
ONGKARN RAUNGRATANAAMPORN, M.D.\*, RUNGROJ KRITTAYAPHONG, M.D.\*\*\*,  
KIERTIJAI BHURIPANYO, M.D.\*, CHARUWAN KANGKAGATE, M.S. (Biostat)\*,  
SANSERN CHARERNTHAI, M.D.\*, SASIKANT POKUM, B.Sc.\*\*,  
SUPHACHAI CHAITHIRAPHAN, M.D.\*

## Abstract

Radiofrequency catheter ablation has been a good treatment option for various types of cardiac arrhythmia. However there is concern about myocardial injury associated with radiofrequency catheter ablation. We studied myocardial injury with biochemical markers and echocardiogram in 41 consecutive patients who underwent electrophysiology study (EP study) and radiofrequency catheter ablation (RFCA) at our institute from April to July 2000. The concentration of biochemical markers (CK-MB mass, troponin T and myoglobin) and result of the echocardiograms were analyzed with other characteristics. In 41 patients subjected to EP study with possible RFCA, abnormal levels of troponin T, CK-MB mass and myoglobin were found in 46 per cent, 15 per cent and 44 per cent immediately after procedure, which went up to 64 per cent, 22 per cent and 2 per cent at twenty four hours. Compare to the group with normal troponin T level, the patients with abnormal level at 24 hours after RFCA had a longer procedure time ( $119 \pm 44$  min. vs  $90 \pm 22$  min.), more frequent use of impedance ablation catheters (65% vs 27%), more RF applications ( $9 \pm 8$  vs  $18 \pm 16$ ) and more ventricular ablation sites (69% vs 9%). The echocardiogram results showed no remarkable abnormality in any patients.

Troponin T was the most sensitive marker to detect thermal myocardial injury associated with radiofrequency catheter ablation. Prolonged procedure time, RF applications, the use of impedance ablation catheter and ventricular ablation site were associated with elevated troponin T concentration after RFCA.

**Key word :** Myocardial Injury, Radiofrequency Catheter Ablation

SRIRATANASATHAVORN C, LEOWWATTANA W, RAUNGRATANAAMPORN O, et al  
J Med Assoc Thai 2000; 83 (Suppl. 2): S214-S217

\* Her Majesty Cardiac Center,

\*\* Department of Clinical Pathology,

\*\*\* Division of Cardiology, Department of Medicine Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

The treatment of cardiac tachyarrhythmia has been evolving in the last two decades. Radiofrequency catheter ablation (RFCA) has been accepted as a viable treatment option, with curative result, high success rate and low complications (1,2). However there was concern regarding thermal myocardial injury associated with RFCA(3). Previous studies showed small myocardial damage after RFCA, detected by different biochemical markers such as creatine kinase (CK), CK-MB isoenzyme and troponin T level(4-7). The purpose of this study was to evaluate the pattern of biochemical markers and associated factors for such injury. This information may help to define the optimal way to detect and possibly minimize this damage.

## MATERIAL AND METHOD

The study population consisted of 41 consecutive patients who were referred for electrophysiologic study (EP study) with possible radiofrequency catheter ablation at our hospital from April to July 2000. For each patient, the blood samples were collected three times. The first two samples were taken at the beginning and the end of the procedure. The third sample was collected 20-24 hours after the procedure. The concentrations of troponin-T, CK-MB mass and myoglobin were measured in each blood sample. The day after each procedure, an echocardiogram was performed on every patient before discharge.

## Laboratory

Myoglobin, troponin T (TnT) and CK-MB mass concentrations were measured by the electrochemiluminescence immunoassay (ECLIA) which was based on the "sandwich principle", using two different monoclonal antibodies. The immunoassay analyzer was the Roche Diagnostic Elecsys 1010 and 2010.

## Statistical Analysis

Measured variables were presented in mean  $\pm$  standard deviation. Categorical variables were presented in frequency and percentage. Differences between groups were analyzed with Student's *t* or Chi square test when appropriated. Binary logistic regression was used to analyze the associated factors.

## RESULTS

The characteristics of patients was shown in Table 1. RFCA was not performed in 4 patients because the target of ablation could not be defined. The most common arrhythmia subjected to RFCA was atrioventricular accessory pathway 46.3 per cent (19 patients) followed by atrioventricular nodal reentry tachycardia 14.6 per cent (6 patients) and symptomatic right ventricular out flow tract ectopy 14.6 per cent.

Immediately after the procedure, there were elevations of troponin T, CK-MB mass, myoglobin levels in 46 per cent, 15 per cent and 44 per cent respectively. At 24 hours after procedure, troponin T, CK-MB mass and myoglobin were found elevated above the normal range in 64 per cent, 22 per cent and 2 per cent respectively. The blood samples with elevated troponin T concentrations at the end and after 24 hours covered almost all samples with abnormal CK-MB mass and myoglobin levels except for one elevated myoglobin

Table 1. Characteristics of the patients.

Age (year)	39 $\pm$ 14
Sex (male)	18 (43%)
Procedure time (min)	106 $\pm$ 41
Fluoroscopy time (min)	34 $\pm$ 30.8
RF application (times)	15.7 $\pm$ 11

Table 2. Characteristics of patients with normal and elevated troponin T level at 24 hours after radiofrequency catheter ablation.

	Normal	Elevated troponin T	p-value
Age (year)	43 $\pm$ 16	39 $\pm$ 14	0.22
RF application (times)	9 $\pm$ 8	18 $\pm$ 16	0.003
Impedance catheter	3(27%)	17(65%)	0.03
Ventricular ablation site	1(9%)	18(69%)	0.001
Procedure time (min)	90 $\pm$ 22	119 $\pm$ 44	0.01
Fluoroscopy time (min)	17 $\pm$ 10	46 $\pm$ 32	<0.001

detected at the end of RFCA. The factors that were significantly associated with abnormal troponin T level at 24 hours were procedure time, fluoroscopy time, RF application, the use of impedance ablation catheter and the ablation performed on ventricular site as shown in Table 2.

Cardioversions were performed in 6 patients (5 for atrial fibrillation and one for ventricular fibrillation). There was no elevation of any biochemical markers in patients who had cardioversion and EP study without RFCA. Echocardiograms before discharge did not reveal any significant injury to cardiac structure.

## DISCUSSION

Thermal injury would be unavoidable in RFCA. The elevation pattern of these three biochemical markers would favor troponin T as the most sensitive to detect myocardial injury, giving the sensitivity up to 70 per cent at 24 hours. We did not study the level of troponin T between the end and 24 hours after the procedure. However troponin T level has been shown to peak at eight hours in other studies CK-MB mass indicated a low sensitivity reading in the first 24 hours. Information beyond this point was lacking and impractical since most patients were discharged the following day after RFCA.

Few patients had and electrophysiology study without RF ablation. This reflected the practice pattern since most patients were referred to our hospital for combined EP study and possible RF ablation in the same setting<sup>(8)</sup>. However RFCA would be performed only if the arrhythmia was documented and able to be targeted. We did not find any abnormal markers in any of the patients who had only an EP study, even with cardioversion.

The factors associated with detectable myocardial injury, represented as the abnormal troponin T concentrations in this study, may have some clinical implications. Using temperature controlled ablation catheter rather than an impedance monitor catheter, targeting at atrial site when possible, improvement in mapping technique to limit RF applications and shortening procedure times may minimize such injury.

## SUMMARY

Troponin T was the most sensitive marker to detect myocardial injury associated with radiofrequency catheter ablation, with a sensitivity of up to 70 per cent at 24 hours post RFCA. Prolonged procedure time, RF applications, the use of an impedance ablation catheter and the ventricular ablation site were associated with elevated troponin T concentration after RFCA.

---

(Received for publication on October 18, 2000)

## REFERENCES

1. Kay GN, Epstein AE, Daily SM, Plum VJ. Role of radiofrequency ablation in the management of supraventricular arrhythmias: experience in 760 consecutive patients. *J Cardiovasc Electrophysiol* 1993; 4:371-89.
2. Morady F. Radiofrequency ablation as treatment for cardiac arrhythmias. *N Engl J Med* 1999;340: 534-44.
3. Man KC, Kalbfleisch SJ, Hummel JD, et al. Safety and cost of outpatient radiofrequency ablation of the slow pathways with atrioventricular nodal reentrant tachycardia. *Am J Cardiol* 1993;72:1323-4.
4. Sribhen K, Bhuripanyo K, Raungratanaamporn O, Kiartivich S, Leowattana W, Chaithiraphan S. Improved detection of radiofrequency current-induced minor myocardial injury by cardiac troponin T measurement. *J Med Assoc Thai* 1999;82: 256-62.
5. Katritsis DG, Hossein-Nia M, Anastasakis A, et al. Myocardial injury induced by radiofrequency and low energy ablation: a quantitative study of CK isoforms, CK-MB, and troponin-T concentrations. *Pacing Clin Electrophysiol* 1998;21:1410-6.
6. Katritsis D, Hossein-Nia M, Anastasakis A, et al. Use of troponin-T concentration and kinase isoforms for quantitation of myocardial injury induced by radiofrequency catheter ablation. *Eur Heart J* 1997;18:1007-13.
7. Shyu KG, Lin JL, Chen JJ, Chang H. Use of cardiac troponin T, creatine kinase and its isoform to monitor myocardial injury during radiofrequency ablation for supraventricular tachycardia. *Cardiology* 1996;87:392-5.

8. Jackman WM, Beckman KJ, McClelland JH, et al. Treatment of supraventricular tachycardia due to atrioventricular nodal reentry by radiofrequency catheter ablation of slow-pathway conduction. N Engl J Med 1992;327:13-8.
9. Calkins H, Sousa J, El-Atassi R, et al. Diagnosis and cure of the Wolff-Parkinson-White syndrome or paroxysmal supraventricular tachycardias during a single electrophysiologic test. N Engl J Med 1991; 324:1612-8.

## ความเสียหายต่อหัวใจจากการรักษาภาวะหัวใจเต้นผิดปกติด้วยการใช้คลื่นไฟฟ้าความถี่สูง

ชาญ ศรีรัตนสถาวร, พ.บ.\*, วัฒนา เลี้ยววัฒนา, พ.บ.\*\*, องค์การ เรืองรัตนอัมพร, พ.บ.\*, รุ่งโรจน์ กฤตยพงษ์, พ.บ.\*\*\*, เกียรติชัย ภูมิปัญญา, พ.บ.\*, จารุวรรณ คังคะเกตุ, วท.ม. (ชีวสถิติ)\*, สรรเสริญ เจริญไทย, พ.บ.\*, ศศิกานต์ โพธิ์คำ, วท.บ.\*\*, ศุภชัย ไชยธีระพันธ์, พ.บ.\*

คณะผู้วิจัยได้ทำการศึกษาความเสียหายต่อหัวใจ ในผู้ป่วย 41 ราย ที่ได้รับการส่งตัวมาที่โรงพยาบาลศิริราช เพื่อรักษาภาวะหัวใจเต้นผิดปกติด้วยการใช้คลื่นไฟฟ้าความถี่สูง การประเมินความเสียหายต่อหัวใจทำโดยการหาระดับของ troponin T, CK-MB mass และ myoglobin ก่อน, หลัง และที่ 24 ชม. หลังทำการรักษาด้วยการจี้หัวใจด้วยคลื่นไฟฟ้าความถี่สูง ผู้ป่วยทุกรายจะได้รับการตรวจ echocardiogram ก่อนออกจากโรงพยาบาลหลังการจี้ไฟฟ้าหัวใจ

พบระดับที่ผิดปกติของ troponin T, myoglobin และ CK-MB mass หลังการจี้ไฟฟ้าหัวใจทันทีในผู้ป่วย 46%, 44% และ 15% ตามลำดับ ที่ 24 ชั่วโมง พบภาวะผิดปกติของ biochemical markers ดังกล่าวใน 64%, 22% และ 2% ตามลำดับ เกือบทั้งหมดของผู้ป่วยที่มีความผิดปกติของ CK-MB mass และ myoglobin จะพบความผิดปกติของ troponin T ด้วยเสมอ ปัจจัยที่พบว่ามีความสัมพันธ์กับความผิดปกติของค่า troponin T ที่ 24 ชม. ได้แก่ ระยะเวลาในการทำหัตถการที่นาน การใช้สายจี้แบบ impedance monitor, จำนวนครั้งของการจี้หัวใจด้วยคลื่นไฟฟ้าความถี่สูง และการจี้หัวใจบริเวณห้องล่าง ไม่พบความผิดปกติโดยการตรวจ echocardiogram ในคนไข้ทุกรายในการศึกษานี้

**คำสำคัญ :** ความเสียหายต่อหัวใจ, ภาวะหัวใจเต้นผิดปกติ, การรักษาด้วยการใช้คลื่นไฟฟ้าความถี่สูง

ชาญ ศรีรัตนสถาวร, วัฒนา เลี้ยววัฒนา, องค์การ เรืองรัตนอัมพร, และคณะ  
จดหมายเหตุนานาชาติ 4 2543; 83 (ฉบับพิเศษ 2): S214-S217

\* สำนักงานศูนย์โรคหัวใจสมเด็จพระบรมราชินีนาถ,

\*\* ภาควิชาพยาธิวิทยาคลินิก,

\*\*\* สาขาหทัยวิทยา, ภาควิชาอายุรศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพฯ 10700