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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Myocardial injury biomarkers after radiofrequency catheter and cryoballoon ablation for atrial fibrillation and their impact on recurrence

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Abstract

Background: Myocardial injury induced by catheter ablation (CA) for atrial fibrillation (AF) leads to elevated biomarker levels.

Aim: This prospective study examined levels of myocardial injury biomarkers (creatinine kinase [CK], myocardial bound for CK [CK-MB], and troponin I [TnI]) and their impact on AF recurrence following two different ablation strategies, namely: cryoballoon ablation (CBA) and radiofrequency ablation (RFA). We also aimed to evaluate the relationship between AF recurrence after CA and other clinical, echocardiographic and procedural parameters.

Methods: We enrolled 98 patients with AF, 21% of whom had persistent AF and 79% had paroxysmal AF. 58% of patients underwent CBA, and 42% underwent RFA. CK, CK-MB, and TnI levels were measured before and 6 h after the procedure. Patients had follow-up visits three, six, and nine months after the index procedure. Biomarker levels were compared between the patients with and without AF recurrence.

Results: Post-ablation CK (postCK), post-ablation CK-MB (postCKMB), and post-ablation TnI (postTnI) levels were significantly high in the CBA and RFA groups ($p < 0.001$ for all). TnI elevation (ΔTnI) was correlated with age ($p = 0.033$) and median temperature reached during ablation ($p < 0.005$) in the CBA group, while it was correlated with application time in the RFA group ($p < 0.001$). Multivariate analysis in the CBA group revealed age and left atrium diameter as positive independent predictors ($p = 0.029$ and $p = 0.046$), and ΔTnI as a negative independent predictor for AF recurrence ($p = 0.001$). Elevated cardiac biomarkers were not associated with AF recurrence in the RFA group ($p > 0.05$).

Conclusions: The levels of all cardiac biomarkers were elevated after CBA and RFA. Elevated TnI levels after CBA were independent negative predictors of AF recurrence. Measurement of TnI levels after CBA may be useful for the prediction of better clinical outcome.

Key words: catheter ablation, atrial fibrillation, myocardial injury biomarkers

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INTRODUCTION

Catheter ablation (CA) is an established therapy for patients with drug-refractory atrial fibrillation (AF) [1]. Pulmonary vein (PV) isolation is the cornerstone of ablation strategies for AF. PV isolation may be established via point-by-point radiofrequency ablation (RFA) or balloon-based cryoballoon ablation (CBA).

Various markers of myocardial injury are released into systemic circulation due to myocardial necrosis induced by CA. Markers including creatinine kinase (CK), myocardial bound for CK (CK-MB), and cardiac troponin I (TnI) have been previously used as surrogates for effective ablation lesion formation [2, 3]. Conflicting results were obtained in studies investigating myocardial injury markers following CBA and RFA [4–6].

In this study, we aimed to analyse myocardial cell injury markers measured after RFA and CBA procedures. We also aimed to evaluate the relationship of these markers and other clinical, echocardiographic, procedural parameters with AF recurrence after CA.

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METHODS

Study population

The study comprised a total of 98 patients with AF refractory or intolerant to antiarrhythmic therapy. Twenty-one (21%) patients had persistent AF and 77 (79%) patients had paroxysmal AF. A 256-slice computed tomography (CT) and three-dimensional reconstruction of the left atrium-PV was performed in order to visualise the PV anatomy and variation before the procedure. Complex PV anatomy was defined as the presence of two more PV ostia on each side (right or left). RFA was scheduled for patients with complex PV anatomy, and CBA was scheduled for the remaining patients.

Patients with severe anaemia, renal failure (creatinine > 2 g/dL), moderate or severe valvular disease, active infection, malignancy, acute coronary syndrome, and those undergoing electrical cardioversion were excluded from the study.

Echocardiographic measurements

All echocardiographic measurements were performed according to the American Society of Echocardiography Guidelines [7].

Ablation procedure

The cryoballoon procedure was performed similarly to the CBA technique described elsewhere [8, 9]. Right femoral vein, left femoral vein, and left femoral artery punctures were performed with Seldinger technique in patients who had CBA. A 6 French (F) decapolar catheter was placed in the coronary sinus (CS) via the left femoral vein. A diagnostic catheter was advanced to the aortic root via the left femoral artery in order to mark the aorta during transseptal puncture. A 7 F long-sheath was advanced to the superior vena cava over a 0.38-inch guidewire from the right femoral vein. Transseptal puncture was performed with a Brockenbrough needle (St. Jude Medical) under fluoroscopic guidance. Transoesophageal echocardiography was used for selected patients with difficult puncture. A steerable 12 F sheath (FlexCath, Medtronic) was advanced to the left atrium.

We used a 28-mm cryoballoon (Arctic FrontTM Medtronic Cryocath and Aortic Front Advance) for the ablation procedure. The balloon was introduced into the PV ostium over the Achieve guidewire (Medtronic Ablation Frontiers, LLC, Carlsbad, CA), which is utilised for mapping PV potentials before, during, and after cryo applications. Contrast medium was injected to the distal site of the balloon in order to visualise occlusion through the Arctic Front catheter. Cryoapplication was delivered for 4 min per application, and two applications were done for each PV. If PV potentials were still present, one extra cryoballoon application was attempted as needed. Before targeting the right PVs, the decapolar CS catheter was positioned in the superior cava for continuous phrenic nerve stimulation during cryoapplication. After the procedure, exit and entrance block of all PVs was confirmed by pacing manoeuvres.

The RFA procedure was performed similarly to the RFA technique described elsewhere [10, 11]. Two right femoral vein, one left femoral vein, and one left femoral artery punctures were performed with Seldinger technique in patients who had RFA. A 6 F decapolar catheter was placed in the CS via the left femoral vein. A diagnostic catheter was advanced to aortic root via left femoral vein in order to mark the aorta during transseptal puncture. The transseptal puncture was performed with a Brockenbrough needle (St. Jude Medical) under fluoroscopic guidance. Transoesophageal echocardiography was used for selected patients with difficult puncture. Two catheters were introduced via a transseptal puncture into the left atrium; a circumferential PV mapping catheter (Lasso TM, Biosense and Webster, Inc., CA, USA) and a 4-mm cooled-tip ablation catheter (ThermoCool Navi-Star, Biosense-Webster, Inc., CA, USA or Medtronic SPRINKLR). An electro-anatomic mapping system was used to guide the ablation (NavX; St. Jude Medical, St. Paul, MN, USA and CARTO; Biosense Webster, Diamond Bar, CA, USA). The circular mapping catheter was positioned close to the PV ostium, and point-by-point RFA was performed to encircle the right and left PVs. Radiofrequency energy was applied in a power-controlled mode with a power limit of 35 W (30 W at the posterior wall) and a maximal temperature of 45°C. At each point, a radiofrequency current was applied until a voltage of < 0.1 mV was achieved, with a maximum of 30 s per point. The endpoint of PV isolation was confirmed using entrance and exit blocks. Reconfirmation of PV isolation was performed 20 min after ablation for each PV.

For both procedures, as soon as transseptal puncture was achieved, bolus heparin (100 U/kg) was administered. Throughout the procedure, the activated clotting time was monitored every 30 min, and additional heparin boluses were given to maintain activation clotting time between 275 and 300 s.

Blood sampling and Biomarker measurements

Blood samples (pre-ablation CK [preCK], pre-ablation CK-MB [preCKMB], pre-ablation troponin I [preTnI]) were obtained on admission one day before the index procedure. Post-procedural blood samples (post-ablation CK [postCK], post-ablation CK-MB [postCKMB], and post-ablation TnI [postTnI]) were collected 6 h after the index procedure. Blood samples were centrifuged within 30 min. CK was determined with Cobas 6000 device (Roche) by photometric method, and CK-MB and TnI were determined with an AQT90 device (Radiometer) by immunoassay method. Cut-off values for CK, CK-MB, and TnI were 192 U/L, 7.2 μg/L, and 0.023 μg/L, respectively.

Follow-up

Patients were scheduled for follow-up visits at three, six, and nine months after CA. AF recurrence was defined as the presence of any AF episode lasting more than 30 s on 12-lead electrocardiogram (ECG) or 24-h ambulatory ECG monitor-

Table 1. Comparison of clinical and laboratory characteristics of cryoballoon ablation (CBA) and radiofrequency ablation (RFA) groups

	CBA (n = 57)	RFA (n = 41)	P
Age [years]	53 ± 12	56 ± 10	0.199
Gender (male)	28 (49.1%)	22 (53.7%)	0.812
Hypertension	25 (43.9%)	25 (61%)	0.142
DM	17.5%	5 (12.2%)	0.575
CAD	10.5%	8 (19.5%)	0.249
LAD [cm]	3.7 ± 0.4	4 ± 0.5	**0.022**
LVEF [%]	64 ± 2	63 ± 6.7	0.098
Persistent AF	5 (8.8%)	17 (41.5%)	**< 0.001**
Recurrence	8 (14%)	18 (43.9%)	**0.001**
Ablation procedure			
Procedure time [min]	73 [91–61]	136 [152–77]	**< 0.001**
Fluoroscopic time [min]	20 ± 6.4	37 ± 7.3	**< 0.001**
Application time [min]	42 ± 6.9	44 ± 6.2	0.113
Application number	8 ± 0.8	35.7 ± 7.9	**< 0.001**
Temperature [°C]	–42.5 ± 1.7	42.6 ± 1.3	
Laboratory			
PreCK [U/L]	112.65 ± 67.45	115.58 ± 92.09	0.856
PreCKMB [μg/L]	13.23 ± 13.39	9.61 ±9.07	0.138
PreTnI [μg/L]	0.1 ± 0.29	0,09 ± 0.27	0.847
Medications			
Beta-blocker	39 (68.4%)	30 (73.2%)	0.777
ACEI	6 (10.5%)	6 (14.6%)	0.550
ARB	10 (17.5%)	9 (22%)	0.613
CCB	6 (10.5%)	9 (22%)	0.158
Amiodarone	8 (14%)	8 (19.5%)	0.582
Propafenone	18 (31.6%)	12 (29.3%)	0.982
OAD	7 (12.3%)	4 (9.8%)	0.757
Warfarin	5 (8.8%)	10 (24.4%)	**0.047**
Dabigatran	12 (21.1%)	12 (29.3%)	0.487
Rivaroxaban	0 (0%)	2 (4.0%)	0.173
Balloon type			
Arctic FrontTM Medtronic Cryocath	22 (38.6%)		
Aortic Front Advance	35 (61.4%)		

ACEI — angiotensin converting enzyme inhibitors; AF — atrial fibrillation; ARB — angiotensin receptor blockers; CAD — coronary artery disease; CCB — calcium channel blockers; DM — diabetes mellitus; LAD — left atrium diameter; LVEF — left ventricular ejection fraction; OAD — oral anti-diabetic; PreCK — pre-ablation creatinine kinase; PreCKMB — pre-ablation myocardial bound for creatinine kinase; PreTnI — pre-ablation troponin I

ing at each visit. Patients were treated with propafenone or amiodarone for six weeks following ablation. All patients were orally anticoagulated for three months following ablation, and those with a CHA_2DS_2VASc score ≥ two received continuous oral-anticoagulant therapy. Procedural success was defined as the absence of any atrial arrhythmia lasting longer than 30 s at six weeks after discontinuing after antiarrhythmic drug therapy.

Statistical analysis

SPSS 17.0 statistical software (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Continuous variables were expressed as mean ± standard deviation or median and interquartile range as appropriate. Categorical variables were expressed as percentages. The Kolmogorov-Smirnov test was used to test normality of distribution of continuous variables. Group means for continuous variables were compared with the use of Student's t-test or the Mann-Whitney U test, as appropriate. Pearson or Spearman correlation analysis was used for assessing correlation between ΔTnI (postTnI-preTnI) and continuous variables depending on Gaussian distributions. The χ^2 test examined the correlation between categorical variables and continuous variables. To account for the non-Gaussian

Table 2. Post-procedural changing of cardiac biomarkers

	Pre-ablation levels	Post-ablation levels	p
Cryballoon ablation group			
CK [U/L]	112.65 ± 67.45	464.15 ± 185.42	< 0.001
CK-MB [μg/L]	13.23 ± 13.39	71.72 ± 35.34	< 0.001
TnI [μg/L]	0.10 ± 0.29	6.85 ± 5.35	< 0.001
Radiofrequency ablation group			
CK [U/L]	115.58 ± 92.09	212.36 ± 87.20	< 0.001
CK-MB [μg/L]	9.61 ± 9.07	24.18 ± 11.96	< 0.001
TnI [μg/L]	0.09 ± 0.27	2.64 ± 2.28	< 0.001

CK — creatinine kinase; CK-MB — myocardial bound for creatinine kinase; TnI — troponin I

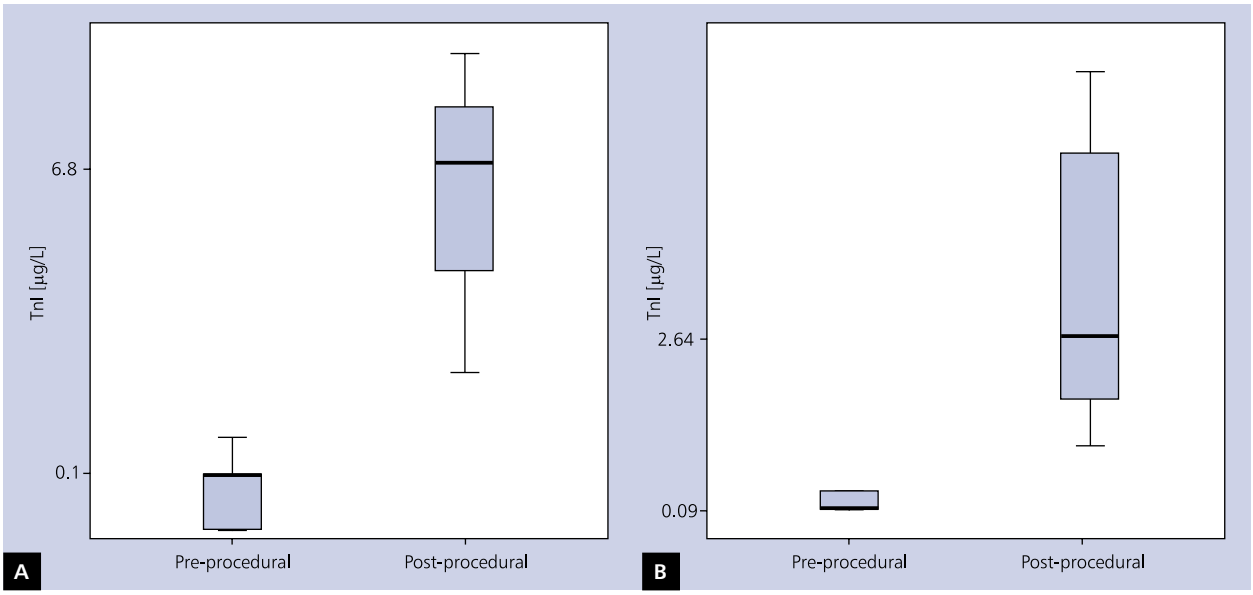

Figure 1. **A.** Post-procedural changes in troponin I (TnI) levels after cryoballoon ablation; **B.** Post-procedural in TnI levels after radiofrequency ablation

distribution of ΔTnI, a log10 {x+1} transformation was made. Variables with a p value ≤ 0.05 and those that were previously shown to be associated with AF recurrence including age, left atrium diameter (LAD), persistent AF, hypertension (HT), diabetes mellitus (DM), and fluoroscopic time were selected for logistic regression analysis. Logistic regression analysis was performed to find independent associates of recurrence. A p value ≤ 0.05 was considered statistically significant.

RESULTS

Table 1 shows a comparison of clinical and laboratory characteristics of CBA and RFA groups. The CBA and RFA groups were similar in terms of age, gender, HT, DM, coronary artery disease, and ejection fraction. LAD and persistent AF frequency were significantly higher in the RFA group than in the CBA group. Similarly, the AF recurrence rate was significantly higher in the RFA group compared to the CBA group. Procedural time, fluoroscopic time, and application number were significantly lower in the CBA group than in the RFA group. The levels of post-CK, post-CKMB, and post-TnI were higher in the CBA group compared to the RFA group. Plasma levels of CK, CK-MB, and TnI measured after ablation in the CBA and RFA groups were higher than pre-procedural levels, respectively (Table 2). Figure 1 shows post-procedural changes in TnI levels after CBA and RFA.

Table 3 shows correlation analysis of ΔTnI with clinical and laboratory parameters in the CBA and RFA groups, showing that only age and procedural temperature were significantly correlated with ΔTnI in the CBA group. Figure 2A, B shows the relationship between ΔTnI and temperature. In the RFA group, correlation analysis of ΔTnI with clinical and procedural variables revealed only application time in correlation with ΔTnI ($p < 0.001$). Figure 2B shows the relationship between ΔTnI and application time.

Table 3. Association between troponin I elevation (ΔTnI) and clinical, procedural variables in the cryoballoon ablation (CBA) and radiofrequency ablation (RFA) groups

Variables	r (correlation coefficient)	P
CBA group		
Age [years]	+0.282	**0.033**
LAD [cm]	+0.036	0.791
Procedure time [min]	+0.104	0.440
Fluoroscopic time [min]	+0.209	0.119
Application time [min]	+0.193	0.150
Application number	+0.094	0.489
Temperature [°C]	+0.364	**0.005**
RFA group		
Age [years]	+0.063	0.696
LAD [cm]	+0.008	0.962
Procedure time [min]	+0.012	0.943
Fluoroscopic time [min]	+0.110	0.495
Application time [min]	+0.545	**< 0.001**
Application number	+0.073	0.652
Temperature [°C]	+0.297	0.167

LAD — left atrium diameter

Table 4 shows clinical and laboratory characteristics and a comparison of patients with and without recurrence in the CBA and RFA groups. The AF recurrence rate in CBA group was 14 (24%). When patients with and without recurrence in CBA group were compared, LAD, ΔCK, ΔCKMB, and ΔTnI parameters were significantly different while other parameters were not. The AF recurrence rate in the RFA group was found to be 43%. When patients with and without AF recurrence in the RFA group were compared, there was no difference with regard to all parameters, including elevated cardiac biomarkers.

Multivariate analysis performed among variables including age, LAD, fluoroscopic time, persistent AF, HT, DM, and ΔTnI in the CBA group detected LAD and age as positive independent predictors, and ΔTnI as a negative independent predictor for AF recurrence (Table 5).

Figure 3 shows pre-ablation and post-ablation values of ΔTnI in the CBA group with and without recurrence.

The optimal cut-off value of ΔTnI for predicting CBA efficacy was > 10.8, yielding a specificity of 90.7% and a sensitivity of 64.3% (AUC: 0.816, 95% CI 0.691–0.906) (Fig. 4).

DISCUSSION

Our study demonstrated elevated levels of CK, CK-MB, and TnI in both groups following CA. Among procedural parameters, median temperature reached during CBA was correlated with ΔTnI. The increase in CK, CK-MB, and TnI levels following CA was associated with lower AF recurrence rate in CBA group. This relationship was also supported in the multivariate analysis.

In the RFA group, application time, which was one of the procedural parameters, correlated with ΔTnI. The increase in CK, CK-MB, and TnI levels after RFA was not associated with AF recurrence. Catheter ablation causes the release of myocardial injury markers into systemic circulation [12, 13]. There are many studies investigating the alterations in plasma levels of these markers in the literature so far. One of these studies reported at least a 20-fold increase in troponin T (TnT) levels in all patients after RFA, but TnT levels after CA were not

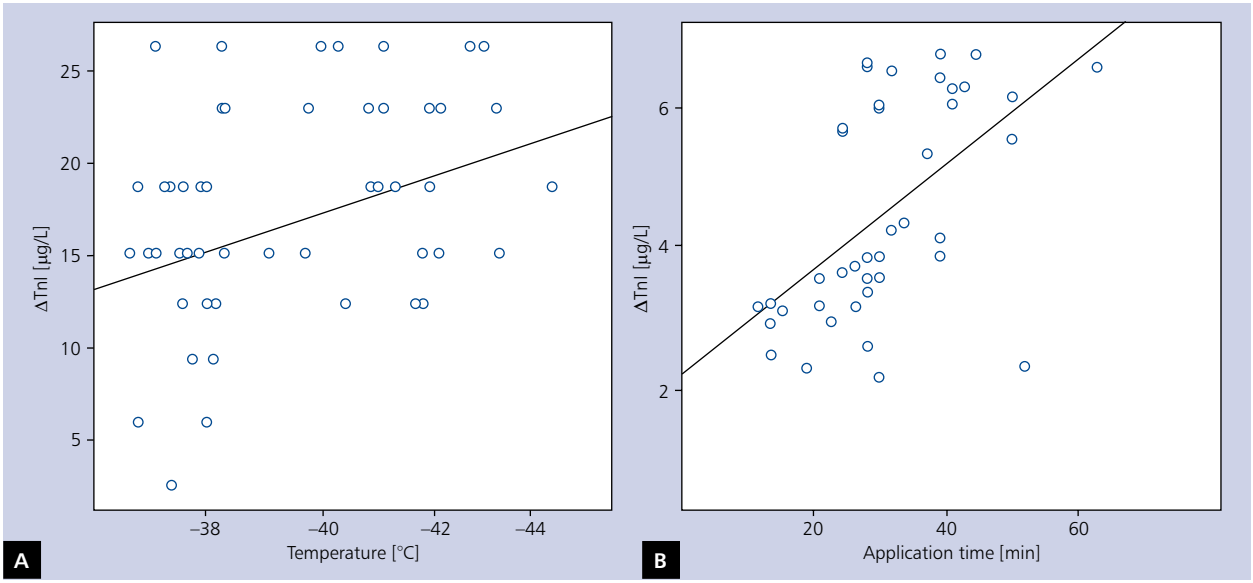

Figure 2. **A.** The relationship between troponin I elevation (ΔTnI) and temperature in the cryoballoon ablation group; **B.** The relationship between ΔTnI and application time in the radiofrequency ablation (RFA) group

Table 4. Clinical and laboratory characteristics and comparison of patients with and without recurrence in the cryoballoon ablation (CBA) and radiofrequency ablation (RFA) groups

	Recurrence (–)	Recurrence (+)	p
CBA group	N = 43 (76%)	N = 14 (24%)	
Age [years]	52 ± 11	54 ± 13	0.510
Gender (male)	21 (48.8%)	7 (50%)	0.940
Hypertension	18 (41.9%)	7 (50%)	0.758
DM	8 (18.6%)	2 (14.3%)	0.712
CAD	5 (11.6%)	1 (7.1%)	0.635
LAD [cm]	3.8 ± 0.44	4.1 ± 0.25	**0.012**
LVEF [%]	64 ± 2.3	65 ± 0	0.416
Persistent AF	4 (9.3%)	1 (7.1%)	0.804
Procedure time [min]	73 ± 7.5	72 ± 8.6	0.731
Fluoroscopic time [min]	20 ± 6.3	20 ± 7.1	0.970
Application time [min]	42 ± 6.8	41 ± 7.3	0.546
ΔCK [U/L]	536 ± 162	298 ± 116	**< 0.001**
ΔCKMB [μg/L]	81 ± 50	51 ± 27	**0.032**
ΔTnI [μg/L]	11.7 ± 5.4	5.1 ± 4.2	**< 0.001**
Beta-blocker	30 (69.8%)	9 (64.3%)	0.747
ACEI	4 (9.3%)	2 (14.3%)	0.629
ARB	7 (16.3%)	3 (21.4%)	0.694
CCB	3 (7%)	3 (21.4%)	0.151
Amiodarone	4 (9.3%)	4 (28.6%)	0.091
Propafenone	15 (34.9%)	3 (21.4%)	0.511
OAD	6 (14%)	1 (7.1%)	0.669
Warfarin	2 (4.7%)	3 (21.4%)	0.89
Dabigatran	10 (23.3%)	2 (14.3%)	0.710
Rivaroxaban	0 (0%)	0 (0%)	1
RFA group	N = 29 (71%)	N = 12 (29%)	
Age [years]	57 ± 9	52 ± 12	0.144
Gender (male)	13 (44%)	9 (75%)	0.078
Hypertension	20 (69%)	5 (41%)	0.103
DM	5 (17%)	0 (0%)	0.125
CAD	6 (20%)	2 (16%)	0.767
LAD [cm]	3.9 ± 0.5	4.2 ± 0.4	0.103
LVEF [%]	63 ± 3	60 ± 11	0.182
Persistent AF	13 (44%)	4 (33%)	0.497
Procedure time [min]	130 ± 19	132 ± 17	0.782
Fluoroscopic time [min]	37.9 ± 6.9	37.4 ± 8.5	0.831
Application time [min]	44.4 ± 5.7	44.8 ± 7.4	0.860
Post-CK [U/L]	201 ± 84	238 ± 91	0.230
Post-CKMB [μg/L]	21.9 ± 7.8	29.5 ± 17.8	0.064
Post-TnI [μg/L]	2,6 ± 2.2	2.2 ± 2.5	0.938
Beta-blocker	21 (72%)	9 (75%)	0.865
ACEI	5 (17%)	1 (8%)	0.463
ARB	8 (27%)	1 (8%)	0.175
CCB	7 (24%)	2 (16%)	0.599
Amiodarone	6 (20%)	2 (16%)	0.767
Propafenone	8 (27%)	4 (33%)	0.713
OAD	4 (13%)	0 (0%)	0.176
Warfarin	7 (24%)	3 (25%)	0.953
Dabigatran	9 (31%)	3 (25%)	0.699
Rivaroxaban	2 (6.9%)	0 (0%)	0.351

ACEI — angiotensin converting enzyme inhibitors; AF — atrial fibrillation; ARBs — angiotensin receptor blockers; CAD — coronary artery disease; CCB — calcium channel blockers; DM — diabetes mellitus; LAD — left atrium diameter; LVEF — left ventricular ejection fraction; OAD — oral antidiabetic; PreCK — pre-ablation creatinine kinase; PreCKMB — pre-ablation myocardial bound for creatinine kinase; PreTnI — pre-ablation troponin I

Table 5. Multivariate analysis of independent predictors of atrial fibrillation (AF) recurrence in cryoballoon ablation group

	P	Odds ratio	95% CI
Age	**0.029**	1.125	1.012–1.251
LAD	**0.046**	15.665	1.046–234.575
Fluoroscopic time	0.116	1.185	0.954–1.463
Persistent AF	0.188	0.091	0.03–3.230
Hypertension	0.571	1.953	0.192–19.827
DM	0.969	1.059	0.057–19.747
ΔTnI	**0.001**	1.668	1.233–2.255

CI — confidence interval; DM — diabetes mellitus; LAD — left atrium diameter; ΔTnI — troponin I elevation

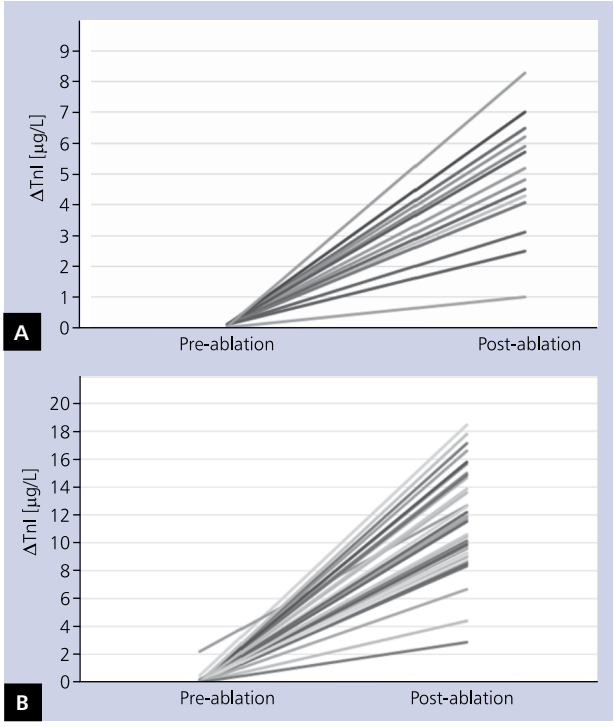

Figure 3. Pre-ablation and post-ablation values of cardiac troponin I (TnI) in the cryoballoon ablation group with (**A**) and without (**B**) recurrence

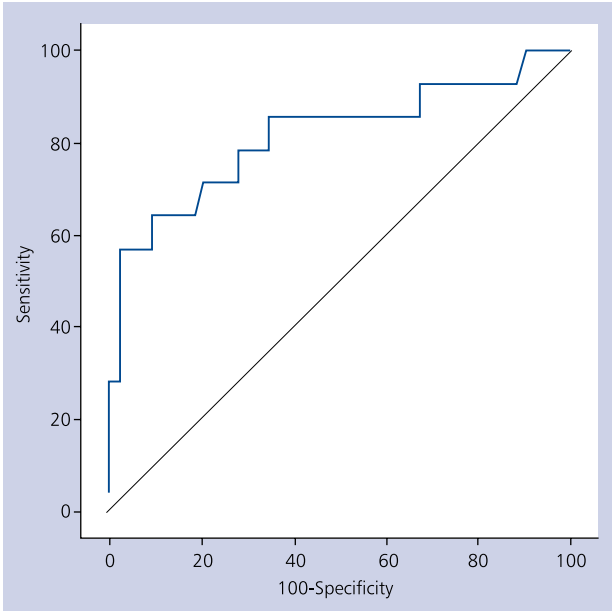

Figure 4. Receiver operating *characteristic* curve analysis for troponin I elevation (ΔTnI) in the detection of post-ablation recurrence

associated with the number of radiofrequency lesions, radiofrequency time, and procedural time [12]. Wójcik et al. [13] detected correlation between median temperature reached during CBA and post-procedural maximum levels of CK and CK-MB ($p < 0.05$). In addition, they detected correlation between CK-MB and total cryoapplication time ($p < 0.03$). The present study demonstrated that increased levels of TnI after CA were correlated with median temperature in the CBA group and application time in the RFA group. Interruption or reduction of blood flow between cryoballoon and myocardial tissue due to improved contact force by cryoballoon might have led to lower temperatures. Improved contact of cryoballoon and lower temperatures are thought to result in increased myocardial injury and TnI levels. Increased application time in the RFA group indicates greater lesion size and thus greater myocardial injury.

Several parameters are associated with AF recurrence following CA. Previous studies did not demonstrate a clear association between levels of myocardial injury biomarkers measured after ablation and AF recurrence. The study by Lim et al. [14] has shown that post-ablation TnT levels were associated with early AF recurrence occurring within the first three days after ablation whereas there was no association with AF recurrence in three and six months. Casella et al. [6] found no association between post-CA levels of CK-MB and TnI with AF recurrence during the follow-up visits at one, three, six, and 12 months. In our study, we demonstrated that elevated levels of biomarkers were associated with lower recurrence rate in the CBA group.

However, elevated cardiac biomarkers were not associated with AF recurrence in the RFA group. The different results in the CBA and RFA groups can be explained by differences in techniques and patient characteristics. Good contact of the cryoballoon catheter with myocardial tissue during CBA increases lesion size, and thus increased levels of myocardial injury biomarkers may suggest more effective ablation. Furthermore, more complex PV anatomy of patients in the RFA group than in the CBA group may have had a significant effect on recurrence rates. The degree of complexity in patients with complex PV anatomy may be associated with recurrence, and elevated levels of cardiac biomarkers may indicate effective ablation in patients without complex PV anatomy.

Several studies have compared AF recurrence rates following CBA and RFA. In a study, no significant difference was shown between the two ablation groups in terms of recurrence rate, whereas the CBA group had shorter fluoroscopic and procedural times [15]. Another study reported similar procedural time and AF recurrence rate in both groups; however, ablation and fluoroscopic times were longer in the CBA group [16]. In our study, patients were not randomised at the start of the trial, but those without suitable anatomy for CBA were allocated into the RFA group after PV tomography and three-dimensional reconstruction. Moreover, LAD and persistent AF frequency were significantly higher in the RFA group than in the CBA group. The comparison between the CBA and RFA groups is limited because of baseline differences in our study. Further studies are required to compare the long-term outcomes between the two ablation techniques.

Limitations of the study

Patients were not randomised into CBA or RFA groups at the beginning of the study, and randomisation of the patients into these two groups based on complex anatomy determined by PV tomography imaging and three-dimensional reconstruction is the main limitation of our study. Besides patients with complex PV anatomy in RFA group were not categorised according to the degree of complexity. This may have affected the post-CA AF recurrence rates. Post-procedural single blood sample was obtained 6 h after the procedure in each patient, and no serial measurements were performed. Serial measurements could have determined peak levels of biomarkers more accurately. Finally, the relatively small sample size may be another limitation.

CONCLUSIONS

Levels of all cardiac biomarkers were elevated after CBA and RFA. Elevated TnI levels after CBA were independent negative predictors for AF recurrence. Measurement of TnI levels after CBA may be useful for the prediction of better clinical outcome.

Conflict of interest: *none declared*

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Biomarkery uszkodzenia miokardium po przezcewnikowej ablacji prądem o wysokiej częstotliwości i krioablacji balonowej z powodu migotania przedsionków oraz ich wpływ na nawrót migotania

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Streszczenie

Wstęp: Uszkodzenie miokardium w wyniku ablacji przezcewnikowej (CA) z powodu migotania przedsionków (AF) wiąże się z podwyższonymi stężeniami biomarkerów.

Cel: W tym prospektywnym badaniu zmierzono stężenia biomarkerów uszkodzenia miokardium (kinaza kreatynowa [CK]), izoenzym sercowy kinazy kreatynowej [CK-MB], troponina I [TnI]) oraz oceniono ich wpływ na nawrót AF po zabiegu ablacji wykonanym jedną z dwóch metod: krioablacji balonowej (CBA) i ablacji prądem o wysokiej częstotliwości (RFA). Autorzy zamierzali również ocenić zależność między nawrotem AF po CA a innymi parametrami klinicznymi, echokardiograficznymi i związanymi z metodą zabiegową.

Metody: Do badania włączono 98 chorych z AF, spośród których u 21% rozpoznano przetrwałe AF, a u 79% — napadowe AF. U 58% chorych wykonano CBA, a u 42% osób — RFA. Stężenia CK, CK-MB i TnI zmierzono przed zabiegiem i 6 godzin po zabiegu. Wizyty kontrolne odbyły się 3, 6 i 9 miesięcy po ablacji. Porównano stężenia biomarkerów u pacjentów z nawrotem AF i bez nawrotu.

Wyniki: Zmierzone po ablacji stężenia CK (postCK), CK-MB (postCKMB) i TnI (postTnI) były istotnie wyższe w grupach CBA i RFA ($p < 0,001$ dla wszystkich porównań). Zwiększenie stężenia TnI (ΔTnI) w grupie CBA korelowało z wiekiem ($p = 0,033$) i medianą temperatury osiągniętej w czasie ablacji ($p < 0,005$), natomiast w grupie RFA korelowało z czasem aplikacji ($p < 0,001$). Analiza wieloczynnikowa danych pacjentów z grupy CBA wykazała, że wiek i średnica lewego przedsionka były niezależnymi czynnikami predykcyjnymi dodatnimi ($p = 0,029$ i $p = 0,046$), a ΔTnI — niezależnym czynnikiem predykcyjnym ujemnym nawrotu AF ($p = 0,001$). Podwyższone stężenia biomarkerów sercowych nie wiązały się z nawrotem AF w grupie RFA ($p > 0,05$).

Wnioski: Po CBA i RFA stężenia wszystkich biomarkerów sercowych były podwyższone. Zwiększone stężenia TnI po CBA stanowiły niezależny czynnik prognostyczny ujemny nawrotu AF. Pomiary stężeń TnI po CBA mogą być użyteczne w prognozowaniu lepszego efektu klinicznego.

Słowa kluczowe: ablacja przezcewnikowa, migotanie przedsionków, biomarkery uszkodzenia mięśnia sercowego

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