Effects of radiofrequency ablation on levels of cardiac biochemical markers in patients with atrioventricular nodal re-entry tachycardia

Atriyoventriküler nodal reentran taşikardili hastalarda radyofrekans ablasyonun kardiyak biyokimyasal belirteçlerin seviyelerine etkisi

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Atrioventricular nodal reentry tachycardia (AVNRT) is a rhythm disorder, which makes up 60% of paroxysmal supraventricular tachycardia except atrial fibrillation and flutter (1, 2). Radiofrequency ablation (RFA) method has started a new era in AVNRT treatment is extremely efficient and with low complication rate (3). Currently proposed RFA of AVNRT is performed by ablating the slow pathway, which have led to tachycardia, so that it would not let tachycardia. Moreover, myocardial damage occurs inevitably at the contact place of catheter on cardiac tissue during RFA procedure (4). In many studies, creatine kinase (CK), creatine kinase MB isoform (CK-MB), troponin I (TnI) and plasma B- type natriuretic peptide (BNP) levels were shown to be increased in this myocardial damage (5-7). We aimed to define the myocardial damage during RFA procedure in patients with AVNRT by measuring cardiac damage specific biochemical marker levels.

This study designed as prospective cohort study on 46 sequential patients (34 female, 12 male), who had RFA because of symptomatic AVNRT. Blood samples were collected from patients 30 minutes before and 6 and 12 hours after the first RFA current was given.

Radiofrequency energy with the test dose of 10-20 Watt was applied to the target area by using a radiofrequency generator for 10 seconds. Then power was increased up to 50 Watt, and the temperature was increased to 40-60 centigrade degrees (°C) in a stepwise manner. If the current failed in 10 seconds after the targeted speed was reached, then the application was stopped. We turned to the region where arrhythmia induced, RFA procedure with the power of 50 Watt was applied 40-60 seconds more on this area. RFA accepted as successful if dual nodal physiology completely disappeared, tachycardia could not induced and not observed more than one echo current. Electrophysiological study was repeated 20-30 minutes after the successful ablation and after the IV atropine application for increasing the cardiac rate by 20% if tachycardia not induced.

The Statistical Package for the Social Sciences (SPSS Inc, Chicago, IL, USA) 18.0 was used for statistical analysis. Quantitative variables were presented as arithmetic mean±standard deviation (SD). In repetitive measurements, while comparing ANOVA and two or more variables related to each other, Friedman test was used to define whether there was significant difference between the distributions. Pearson correlation analyses was used for biochemical markers, temperature degree and duration of the current. Statistical level of significance was defined at $p<0.05$.

There was statistically significant difference between CK, CK-MB, TnI and BNP values in at least one blood sample, which were collected 30 minutes before and 6-12 hours after RFA procedure in patients underwent AVNRT ablation ($p<0.05$) (Table 1).

There was statistically significant difference between CK-MB and BNP values, which were measured 30 minutes before and 6-12 hours after the RFA procedure ($p<0.05$). Additionally, there was a statistically significant increase between CK, CK-MB, TnI and BNP values, which were measured before and 12 hours after the procedure ($p<0.05$). Statistically significant increase was also defined between TnI and BNP values, which were measured before and 6 hours after the procedure ($p<0.05$). A significant positive correlation was also defined between mean TnI and heat grades, which were measured 6 hours and 12 hours after the procedure ($r=0.69$, and

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Table 1. Mean marker concentrations before and after the procedure

Variables	Before the procedure	At hour 6	At hour 12
CK, U/L	80.90±36.14	82.35±34.09	89.34±38.05*
CK-MB, U/L	18.52±7.83	23.78±10.82	28.21±17.36 *
TnI, µg/mL	0.03±0.02	0.16±0.14*	0.22±0.15*
BNP, Pg/mL	33.31±45.85	39.83±52.86*	43.05±59.75*

Results are shown as mean±standard deviation.
*ANOVA test, p< 0.05
BNP - brain natriuretic peptide, CK - creatine kinase, CK-MB - creatine kinase myocardial band, TnI-troponin I

r=0.84, respectively). There was no positive correlation between mean values of CK, CK-MB and BNP and heat grades measured 6 and 12 hours after the procedure. There was a significant and weak correlation between duration of the current and TnI values measured 6 and 12 hours after the procedure (Table 2).

RFA procedure was applied at the mean grade of 51°C, and mean duration of 86 seconds. RF heat grade was evaluated as it was grouped above and below 51°C, whereas duration of the current was grouped above and below 70 seconds. In the measurements of 6 and 12 hours after the procedure, there was a significant difference in mean values of TnI, CK, and CK-MB between the groups with values above and below 70 seconds (p=0.001, p=0.035, and p=0.001, respectively). No statistically significant difference was present in BNP values (p=0.51). Mean TnI, CK, CK-MB and BNP concentrations, which were measured 6-12 hours after the procedure in the group above 51°C, were significantly different when compared their counterparts with below 51°C (p=0.001, p=0.032, p=0.001, and p=0.046, respectively).

RFA is based on transmission of heat produced by radiofrequency energy to target tissue by the catheter contact. Extent of myocardial thermal damage depends on electrode diameter, size of the electrode tip, power and duration of RF energy. Heat should be reached up to approximately 50°C to cause the irreversible tissue damage (8, 9). Reaching appropriate heat and stable heat level during the procedure is quite important both for the procedure success and decreased complications. Similar design to our study, changes in cardiac biomarkers related to myocardial damage as the result of RF energy have been investigated in various studies (10). Small sample size and selection of arrhythmia patients, who were technically easy and uncomplicated, might be considered the limitations of our study.

In our study, TnI measurement was defined as a high sensitive method to evaluate myocardial damage caused by radiofrequency energy, but CK, CK-MB and BNP measurements were not sensitive enough. Significant positive correlation was defined between TnI concentration and RFA parameters (grade and duration of heat). Our study proposed suggestions about the ideal duration and grade for the applied heat should be used in RFA procedure.

Table 2. Correlation between mean marker concentrations and RFA procedural parameters

Variables	RFA parameters	
	Temperature degree	Duration of the current
TnI[1]	r=0.69 p<0.001	r=0.18 p<0.05
TnI[2]	r=0.84 p<0.001	r=0.36 p<0.05
CK[1]	r=0.22 p=0.13	r=-0.18 p=0.22
CK[2]	r=0.26 p=0.07	r=-0.15 p=0.31
CK-MB[1]	r=0.16 p=0.26	r=0.21 p=0.15
CK-MB[2]	r=0.06 p=0.68	r=-0.02 p=0.81
BNP[1]	r=0.05 p=0.73	r=0.05 p=0.72
BNP[2]	r=0.01 p=0.90	r=0.08 p=0.95

Pearson correlation analyses
[1]-Enzyme concentration at 6 hours after RFA. [2]-Enzyme concentration at 12 hours after RFA
BNP - brain natriuretic peptide, CK - creatine kinase, CK-MB - creatine kinase myocardial band, RFA - radiofrequency ablation, TnI-troponin I

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