Ischaemia modified albumin in radiofrequency catheter ablation

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Aim Ischaemia modified albumin (IMA) is considered a marker of myocardial ischaemia, in contrast to the biomarkers of myocardial injury [creatine kinase (CK), the MB isoenzyme of CK, and cardiac troponin I (Tn-I)] that are released when cardiac necrosis occurs. Ischaemia modified albumin has been reported to increase following percutaneous coronary intervention and in acute coronary syndromes. We sought to determine whether IMA increases following radiofrequency (RF) ablation.

Methods and results We studied 40 consecutive patients who underwent RF catheter ablation; 20 were men and 20 women and their age was 47 ± 16 (16–77) years. All patients underwent electrophysiological study and subsequent RF ablation. Peripheral venous samples were collected before the procedure (baseline), immediately after the procedure, 2 h post-procedure and the following day (20 h post-procedure) and assayed for CK, the MB isoenzyme of CK, cardiac Tn-I and IMA. Ischaemia-modified albumin plasma levels did not differ significantly at all four time points, baseline, and following ablation (P = 0.5974), whereas CK, CK-MB, and Tn-I increased significantly at all time points compared with baseline (P < 0.0001). Post-ablation, all but three CK measurements were in the normal range; 14 patients had CK-MB plasma levels above the upper limit of normal; all but one patient had Tn-I elevated.

Conclusion The IMA plasma levels do not change significantly following RF ablation, unlike biomarkers of myocardial injury, implying that myocardial necrosis occurs without preceding ischaemia.

Key words Ischaemia modified albumin; Radiofrequency ablation; Biomarkers of myocardial necrosis

Introduction Ischaemia-modified albumin (IMA), as assessed by the albumin cobalt binding (ACB) test, is considered a marker of myocardial ischaemia, in contrast to biomarkers of myocardial injury [CK, the MB isoenzyme of CK, and cardiac troponin I (Tn-I)] that are released when cardiac necrosis occurs. Ischaemia, through hypoxia, acidosis, sodium, and calcium pump disruptions and free radical injury, may induce changes in the binding capacity of the NH2 terminus of albumin to bind metals such as cobalt (Co), copper (Cu), and nickel (Ni). Ischaemia modified albumin has been reported to increase following percutaneous coronary intervention (PCI), immediately post-balloon inflation and 30 min after and return to baseline in 6–12 h.1–4 Ischaemia modified albumin has also been investigated in relation to acute coronary syndromes (ACS).5–7 There are limited reports of IMA changes in association with cardioversion8 and radiofrequency (RF) ablation.9 Radiofrequency ablation induces minor myocardial injury,10–14 Our study sought to investigate whether this widely applied procedure also results in transient myocardial ischaemia, preceding minor myocyte necrosis, as assessed by IMA changes.

Methods We studied 40 consecutive patients who underwent RF catheter ablation between November 2004 and April 2005 in our unit; 20 were men and 20 women and their age was 47 ± 16 (range 16–77) years. All patients gave written informed consent and the study protocol was approved by the Ethics Committee of our Hospital.

All patients underwent electrophysiological study and subsequent RF ablation. The indication for intervention was Wolff–Parkinson–White syndrome (WPW) in 8 patients, atrioventricular nodal reentrant tachycardia (AVNRT) in 13, atrial tachycardia in 4, atrial flutter in 3, and atrial fibrillation-atrial flutter in 12. All our patients were in a fasting state and were mildly sedated. The number of applications varied greatly and was 30 ± 36 (1–151); the delivered energy was 1140 ± 1593 W (30–5000 W), for a duration of 1160 ± 1625 s (60–7320 s) and at a temperature of 56 ± 7°C (45–70°C).

Peripheral venous samples were collected before the procedure (baseline), immediately after the procedure, 2 h post-procedure and the following day (20 h post-procedure), via an indwelling catheter.

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The samples were assayed for CK, the MB isoenzyme of CK (CK-MB), cardiac Tn-I and IMA.

Creatine kinase was measured on a Cobas Integra 800 analyser (Roche, Basel, Switzerland), as was the IMA by the ACB test. Creatine kinase-MB and Troponin-I were measured by immunoassay on the Dimension system (Dade Behring, Newark, NJ, USA). We compared our results using ANOVA with repeated measures; pair comparisons were performed with the Wilcoxon test.

**Results**

Results (Table 1 and Figure 1) are expressed as mean ± SD (minimum–maximum). We found, using ANOVA with repeated measures, that IMA plasma levels did not differ significantly at all four time points, baseline and following ablation (P = 0.5974). Ischaemia modified albumin plasma levels were very similar to each other at all time points, with tide distribution; furthermore, they did not differ according to the number of applications or the type of the catheter used (irrigated catheters in 12 patients and non-irrigated in 28). Creatine kinase, CK-MB, and Tn-I increased significantly compared with baseline (P < 0.0001); their levels at all time points post-procedure were compared with baseline by the Wilcoxon test and were found to be significantly (P < 0.0001). Post-ablation, all but three CK measurements were in the normal range (CK < 190 mU/mL); 14 patients had CK-MB plasma levels above the upper limit of normal (CK-MB > 3.6 ng/mL); all but one patient had Tn-I elevated (Tn-I > 0.1 ng/mL).

**Discussion**

We found that IMA plasma levels did not change immediately after 2 and 20 h after RF ablation compared with baseline values, whereas CK, CK-MB, and Tn-I increased significantly compared with baseline; only 3 patients had, however, CK measurements above the normal range, less than half (14) had CK-MB measurements above the upper limit of normal but all except one patient had Tn-I elevated.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>IMA and biomarkers of myocardial necrosis before and following RF ablation</th>
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<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>IMA (U/mL)</td>
<td>96 ± 9.3 (78.9–122)</td>
</tr>
<tr>
<td>CK (mU/mL)</td>
<td>77 ± 51 (23–327)</td>
</tr>
<tr>
<td>CK-MB (ng/mL)</td>
<td>0.61 ± 0.6 (0–1.9)</td>
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<tr>
<td>Tn-I (ng/mL)</td>
<td>0.02 ± 0.04 (0–0.21)</td>
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</tbody>
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Results are expressed as mean ± SD (minimum–maximum). *P < 0.0001 vs. baseline.

![Figure 1](https://example.com/image1.png)  
**Figure 1** Mean and 95% CI of IMA, CK, CK-MB, and Tn-I at baseline, immediately post, 2 and 20 h following RF ablation.
Cardiac Tn-I is a highly specific and sensitive marker of myocardial injury; all but one patient had elevated Tn-I, implying that ablation does cause myocardial cell death. However, this myocardial necrosis is minor as the other markers (CK and CK-MB) remained within normal limits or showed only slight changes. This is in agreement with the previous studies.\textsuperscript{10-14} We found no significant changes in IMA plasma levels. There is only one published report on IMA in RF ablation, which showed that IMA significantly increases 30 min after the procedure and returns to baseline values in 8 h\textsuperscript{15}; in our study, blood sampling was performed immediately after 2 and 20 h after the procedure. The different timing may explain the contradictory findings between the latter study and ours, although the effects of ischaemia on N-terminal region of albumin which reduce the binding of cobaltium can be detectable up to 6 h after the ischaemic event.\textsuperscript{15} Thus, we think that the most likely explanation is that RF ablation induces immediate myocardial necrosis without preceding myocardial ischemia; this is in distinction from PCI and ACS where complete coronary occlusion, usually transient and repetitive, occurs and causes prolonged myocardial ischaemia which subsequently leads to myocardial necrosis. Clearly further studies are required to clarify this.

There is one study reporting that IMA plasma levels increase 1 and 6 h following cardioversion in patients with AF, but whether this reflects myocardial or skeletal ischaemia is not clear;\textsuperscript{8} CK and CK-MB rise in this setting has been attributed to skeletal muscle damage rather than myocardial necrosis.

In conclusion, IMA plasma levels do not change significantly following RF ablation, whereas biomarkers of myocardial necrosis significantly increase due to minor myocardial injury; this possibly implies that myocardial necrosis, in RF ablation, occurs without preceding ischaemia. In addition, elevated levels of IMA in the peri-ablation period may suggest incidental myocardial ischaemia.

References