

Fatty acid composition of red blood cell membranes as a marker of human heart membrane phospholipid fatty acids

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Background. Regular intakes of fish or fish oil are associated with low cardiovascular disease morbidity and mortality. A major effect is in reducing sudden cardiac death (Marchioli *et al.*, 2002). Studies using animals, suggest that the long-chain omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have antiarrhythmic and other cardiac effects which are dependent on their incorporation into myocardial membranes (Pepe & McLennan, 1996). The red blood cell (RBC) EPA+DHA content correlates inversely with adverse cardiovascular outcomes and is proposed as a new cardiovascular disease risk factor (Omega-3 Index) (Harris & von Schacky, 2004) on the premise that it reflects the composition of cardiac cells. Animal studies indicate large differences in membrane fatty acid compositions of different tissues.

Objective. To characterise the membrane phospholipid fatty acid composition of human RBC in relation to heart.

Design. Membrane phospholipid fatty acids were extracted from atrial biopsy samples and red blood cells, obtained from cardiac surgery patients (n=10). Mixed venous blood samples were obtained pre-operatively. Biopsy samples were taken from an atrial appendage during open chest surgery. Phospholipid fatty acids were determined by gas chromatography against known standards.

Outcomes. Polyunsaturated fatty acid (PUFA) content of atrial cell membranes was higher ($51.13 \pm 0.75\%$, values are means \pm SE) than RBC ($34.88 \pm 0.39\%$), with PUFA replacing saturated fatty acids. The levels of omega-6 PUFA linoleic acid (LA, 18:2 n-6) $18.89 \pm 1.01\%$ and arachidonic acid (AA, 20:4 n-6) $21.32 \pm 0.61\%$ were higher in atria than RBC (LA, $6.79 \pm 0.34\%$ and AA, $13.96 \pm 0.64\%$). In both atria and RBC, DHA was the major omega-3 fatty acid. Both total omega-3 PUFA and DHA in the atria was highly correlated with RBC EPA+DHA ($9.60 \pm 1.14\%$ (range 4.71-11.45%)). Some patients were supplemented with fish oil prior to surgery and had correspondingly higher omega-3 content in both RBC and atria.

Conclusion. The long-chain omega-3 fatty acids EPA and DHA, found in high amounts in fish oil, represent a marker of human atrial omega-3 fatty acid composition and the Omega-3 Index in red blood cells may be a valid marker for human heart composition.

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