A NEW MODEL OF GLOBAL ISCHAEMIA FOR THE ASSESSMENT OF MYOCARDIAL FUNCTION AFTER DIETARY FAT SUPPLEMENTATION

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In order to precisely measure metabolic and haemodynamic ventricular function, we have developed an isolated working heart preparation in which global ischaemia is induced by lowering coronary perfusion pressure (CPP) without altering cardiac afterload or atrial perfusion pressure (Pepe and McLennan, 1989). Washed porcine erythrocytes in a modified Krebs-Henseleit solution (40% hematocrit) were used for optimal oxygen delivery. A one way-microvalve, placed above the aorta allowed anterograde flow in systole but prevented diastolic perfusion of the coronary blood vessels. Between this valve and the aorta, an inlet from a reservoir allowed perfusate to flow to the coronaries during diastole. A second valve placed at this inlet permitted perfusion during diastole and was closed by systolic pressure. The coronary reservoir was lowered to reduce CPP to 35 mmHg and induce ischaemia while the workload remained at 75 mmHg.

Four month old Hooded-Wistar rats were fed standard rat chow (REF) alone or supplemented with saturated fat (SF) or polyunsaturated fish oil (FO) for a further 4 months (n=10). The composition and preparation of the diets have been previously described (McLennan, et al., 1988). During normal coronary perfusion (75 mmHg), external work and cardiac output did not differ between dietary groups. The pressure-time integral of SF hearts was significantly decreased while coronary flow was increased compared with REF and FO hearts. O_2 consumption was elevated in SF. O_2 extraction did not differ between the groups.

After 15 min of ischaemia coronary flow was decreased and oxygen extraction increased in all groups. O2 consumption was significantly elevated in REF and FO but not SF despite O_2 extraction being highest in SF hearts. Ischemic acidosis was greatest in SF but was reduced in FO hearts compared to REF. Creatine kinase and K^+ release during ischaemia was higher in SF than REF or FO hearts. Ischaemic and reperfusion arrhythmias were significantly reduced in FO and increased in SF.

The increased O_2 consumption in SF hearts in normo-perfusion reduces the reserve capacity for increased O_2 consumption during ischaemia and reperfusion compared to REF and FO. This study demonstrates the detrimental effects of dietary saturated fat on cardiac performance and O_2 metabolism, especially during ischaemia, while fish oil improved cardiac function and provided protection during ischaemia. These findings support and elaborate previous dietary fat supplement studies conducted in this laboratory that utilized isolated papillary muscle and whole animal/ coronary ligation experiments. This is the first isolated working heart model that permits low pressure coronary perfusion with maintained workload and transient measures of venous and aortic pH, PO_2, and PCO_2 to be made during the progression of global ischaemia, while the heart continues to perform work and reflects the contrasting oxygen demand differences between pre- and post-ischaemia.

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