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CARDEC MRI ASSESSMENT OF THE EFFECTS OF DIETARY EICOSAPENTAENOIC ACID (EPA) ON THE ADVERSE CONSEQUENCES OF SEPSIS

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Aim

Severe sepsis is a serious syndrome requiring adequate medical care. It results from multi-organ damage with a significant toxicity during the early phase of sepsis, cardiac mechanical activity is increased, but it progressively declines until cardiac failure. In the Western societies, the consumption of omega6 (=6) polyunsaturated fatty acids (PUFA) is too high whereas that of omega3 (=3) PUFA is too low. Yet the consequences of sepsis could be altered by PUFA-based dietary which modulate the inflammatory process. The aim of this study was to determine the effects of a dietary based on eicosapentaenoic acid (EPA, C20:5 =3) a fatty of the n-3 series, on the adverse cardiac consequences of sepsis in a newly developed rat model of early onset sepsis induced by cecal ligation and puncture.

Material and Method

**Cardiac MRI**

One MR imaging was carried out at 1.17T (500MHz) with a 72-mm inner diameter volume coil. Ten to 12 contiguous 1-mm slices were acquired to cover the heart from the base to the apex using short-axis left ventricular (LV) bright blood imaging protocol based on the navigator self-gated FLASH sequence (TR/TE = 6/2.5 ms, FA = 8°, FOV = 5x5 cm, 256x256 matrix, slice thickness 1 mm, oversampling 408 → reconstruction of 16 movies frames per slice.

After imaging session, rats were euthanized and the heart removed for analysis of mitochondrial function.

**Image analysis**

After semi-automated segmentation of the LV (Fig. 1), using Segment software1, the time evolution of EDV (Fig. 2) was obtained. From this curve, morphological and functional parameters, i.e., end diastolic volume (EDV), end systolic volume (ESV), ejection fraction (EF), heart rate (HR) and cardiac output (CO), along with the contraction and relaxation rates, were then derived.

**Results**

![Figure 1: To determine the time evolution of the epicardium (green) and endocardium (red) volumes, each slice was segmented. The images show 5 slices for both the End-diastolic (left) and End systolic (right).](image1.png)

![Figure 2: Example of the evolution of the left ventricular ejection fraction (green) and end-diastolic volume (red) in one cardiac cycle. The contraction and relaxation rates were respectively derived from the ascending and descending slope changes of the endocardium.](image2.png)

![Figure 3: Left ventricular functional parameters for control (sham operated) (n=10) and septic (n=10) rats. In each group, rats were fed without (n=5) and with EPA based dietary (n=5). Data are mean and the bars are standard deviation of the mean.](image3.png)

![Table 1: Summary of the main results of the myocardial energy metabolism. Mitochondrial ATP production from malate and glutamate substrates is significantly (*) reduced by sepsis in deficient rats. Sepsis also induced an increase of the myocardial ratio between lactate production (anaerobic glycolysis) and oxygen consumption (aerobic metabolism). No modification was observed in the EPA groups.](table1.png)

**Discussion and conclusion**

That sepsis tended to increase the rate of contraction indicates that the pathology was in its early hyperdynamic phase with an activation of cardiac function. Since in omega3 deficient animals, early sepsis increased levels of mitochondrial respiration (p <0.001) compared to control rats, with no difference observed in EPA animals, the absence of difference in MRI global cardiac function in septic rats may be attributed to the activation of the anaerobic ATP production in the deficient group compensating the decrease in mitochondrial activity and maintaining the cardiac mechanical activity.

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