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Associations between ectopic fat accumulations and cardio-metabolic factors in apparently healthy subjects: assessed by 1H-magnetic resonance spectroscopy in myocardium, liver, and skeletal muscles

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Introduction: Ectopic fat accumulations have been classified into two subtypes according to their systemic or local effects. Ectopic fat, including intramyocellular lipid (IMCL), hepatic triglyceride (TG), and myocardial TG, is involved in various cardio-metabolic disorders. Previous studies, including our own report, demonstrated that cardiac steatosis is associated with cardiac dysfunction, morphology accompanied by metabolic disorders, and cardio-hemodynamic status. However, the effect of ectopic fat accumulations in various tissues has not been completely investigated, particularly in a clinical setting. There is no study simultaneously and noninvasively investigating the associations between cardio-metabolic factors and ectopic fat accumulations in the myocardium, liver, and skeletal muscles. Here we used proton magnetic resonance spectroscopy (1H-MRS) to assess TG levels in various living tissues.

Purpose: The aim of this study aimed to examine the associations between cardiometabolic factors and ectopic fat accumulations in myocardium, liver, and skeletal muscles in apparently healthy subjects.

Methods: Ectopic TG levels in the myocardium, liver, anterior tibial muscle, and soleus muscle were measured in 39 healthy male subjects using 1H-MRS by employing a 1.5T-MR scanner. Body composition, biochemical, and physiological markers, including adiponectin and oxidized LDL, were assessed in the fasting state. Other clinical parameters, including glucose tolerance assessed by 75-g oral glucose tolerance test, intima-media thickness, and vascular endothelial function, were assessed.

Results: There was no correlation between TG levels in the myocardium and IMCL, soleus muscle, liver and visceral adipose tissue (VAT) area. However, the levels of myocardial TG were significantly correlated with those of serum TG ($r = 0.37$), HDL-cholesterol ($r = -0.31$), insulin at 30 ($r = 0.33$) and 60 min ($r = 0.32$) after glucose loading, LV endo systolic volume ($r = -0.42$), and IMCL in the anterior tibial muscle ($r = 0.36$) ($P < 0.05$ in all cases). IMCL levels in the anterior tibial muscle were associated with body fat percentage ($r = 0.30$), abdominal circumference ($r = 0.36$), alanine transaminase ($r = 0.41$), oxidized LDL ($r = 0.37$), serum adiponectin ($r = 0.30$), and VAT ($r = 0.31$) levels. We divided the examined individuals into three groups according to IMCL levels in the anterior tibial muscle. Adiponectin levels were significantly lower and myocardial TG levels were significantly higher in the highest IMCL group than in the other two groups ($P < 0.05$).

Conclusion: This is the first study, which demonstrated that myocardial TG levels were significantly correlated with adiponectin levels and IMCL accumulation, particularly in the anterior tibial muscle. These results suggest that adiponectin may be associated to cardiac and skeletal muscle steatosis in apparently healthy subjects.