

Abstract Hilmar Stolte Preis 2019

Title: Influence of triolein and tripalmitin enriched western diets on cardiac carbohydrate metabolism

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Background: High-fat, high-sucrose western diet (WD) has been shown to impact cardiac metabolism. Furthermore, it has been reported that different fatty acid species such as oleic and palmitic acid exert distinct metabolic effects on cardiomyocytes. Potential effects of western diets enriched with either oleic or palmitic acid on carbohydrate or fatty acid utilization have not been characterized. A better understanding of fatty acid-dependent regulation of cardiac metabolism may have implications for dietary interventions to combat the increasing threat of cardiac disease.

Methods: Male Wistar rats were subjected to standard or western diet exclusively enriched with triolein or tripalmitin as dietary fat. After 14 weeks, isolated heart perfusions were performed using ^{13}C -labeled substrates. ^1H and ^{13}C NMR spectroscopy were applied to estimate the fractional contribution of carbohydrates to acetyl-CoA formation. Cardiac metabolite and glycogen content were determined using spectrophotometric methods. The gene expression of several key players of cardiac carbohydrate and fatty acid metabolism was quantified by qPCR. Cardiac triacylglyceride and ceramide profiles were obtained by LC/MS/MS experiments.

Results: The fractional contribution of carbohydrates to the citric acid cycle was significantly reduced in rats subjected to western diet enriched with triolein (WDO). The suppression of carbohydrate oxidation was accompanied by elevated levels of citrate, decreased glycogen content and an up-regulation of pyruvate dehydrogenase kinase 4 expression. These findings were not observed in animals fed a western diet enriched with tripalmitin (WDP). Cardiac function assessed during isolated heart perfusions was not affected by the dietary protocol. LC/MS/MS experiments suggested diet-specific lipid profiles with preferential incorporation of oleic acid into triacylglyceride depots.

Conclusion: The effects of high-fat, high-sucrose western diets on cardiac carbohydrate metabolism depend on dietary fat composition. Future experiments focusing on more severe models of cardiac disease will reveal whether the metabolic alterations found in WDO are rather beneficial or detrimental.