Short Communication

Effect of Medium-Chain Triglyceride Intake on Oral Glucose-Tolerance Test

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Sweeney (1) found that carbohydrate-fed healthy men had normal oral glucose-tolerance tests (OGTT), whereas fat-fed men had markedly decreased glucose tolerance. Himsworth (2) varied the carbohydrate-fat ratio and the absolute amount of dietary fat, and found that glucose tolerance changed according to carbohydrate intake. These studies used long-chain triglycerides (LCT) as dietary fat. Medium-chain triglycerides (MCT) contain fatty acid with a 6-to12-carbon chain length. Unlike normal dietary LCT, dietary MCT are rapidly absorbed and directly carried to the liver by the portal circulation.

We reassessed the effect of high fat intake on OGTT in young women by using meals containing either long-chain triglycerides (LCT) or a mixture of long-chain and medium-chain triglycerides (MCT/LCT).

Subjects and Methods

Ten healthy 19-yr-old women (body mass index 21.3 ± 0.6 SD) volunteered for this experiment. We explained the purpose and nature of the study to all individuals and obtained their

written consent before participation. The participants ate an ordinary meal 3 times/day (carbohydrate 50–60%, protein 15–20%, fat 25–30%, 1600–1900 kcal/day) for 3 days before the OGTT. At 7 pm the day before the OGTT, the participants ingested a meal containing LCT (carbohydrate 21%, protein 15%, LCT 64%, 857 kcal). Two weeks later, they had a similar normal meal regimen for 3 days, and followed by a high MCT/LCT meal (carbohydrate 23%, protein 10%, LCT 20%, MCT 47%, 859 kcal) the evening before the OGTT.

The OGTT was performed according to WHO guidelines. Plasma concentrations of glucose, insulin, free-fatty acid (FFA), triglyceride (TG), and leptin were measured.

Results and Discussion

In this study, carbohydrate and fat intake were designed to be similar for both OGTT. Plasma glucose levels before (fasting) and 2 h after the OGTT were normal in all participants, irrespective of LCT or MCT intake (fasting: 78–92 mg/dl, 2 h: 72–116 mg/dl). Fasting plasma concentrations of insulin, FFA, TG, and leptin were similar in LCT and MCT/LCT testing (Tables 1 and 2). Both glucose and insulin concentrations at 30 and 60 minutes after the OGTT were significantly lower in the MCT/LCT than in the LCT diet (Table 2), and the insulinogenic index was significantly higher in MCT/LCT (Table 1).

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Table 1 Insulinogenic index, and serum triglycerides and leptin concentrations in OGTT

	insulinogenic index [#]	triglycerides (mg/dl) ^{##}	leptin (ng/ml) ^{##}
LCT diet	1.85 ± 1.29	77.1 ± 30.8	13.0 ± 6.8
MCT diet	4.10 ± 2.42*	76.6 ± 22.1	12.7 ± 5.8

[#] ratio of change in insulin to change in the corresponding glycemic stimulus, calculated by (30 min plasma insulin-fasting plasma insulin/30 min plasma glucose-fasting plasma glucose). ^{##}Triglycerides and leptin were measured before OGTT.

*p<0.01 compared to LCT diet.

Table 2 Responses of glucose, insulin, and free fatty acids to OGTT after pretreatment with LCT or MCT

Time (min)		0	30	60	120
LCT diet	glucose (mg/dl)	85.3 ± 4.7	134.9 ± 29.3	122.9 ± 28.9	103.4 ± 30.9
	insulin (μU/ml)	8.2 ± 3.8	74.2 ± 35.2	67.1 ± 49.6	53.7 ± 32.4
	FFA (mEq/l)	0.49 ± 0.14	0.22 ± 0.10	0.14 ± 0.04	0.08 ± 0.03
MCT diet	glucose (mg/dl)	86.5 ± 6.2	105.8 ± 20.1**	99.1 ± 19.5**	98.2 ± 20.8
	insulin (μU/ml)	7.4 ± 2.8	48.7 ± 25.8*	37.5 ± 16.4*	34.4 ± 15.7*
	FFA (mEq/l)	0.43 ± 0.08	0.26 ± 0.05	0.20 ± 0.04**	0.14 ± 0.03**

* p<0.05 compared to LCT diet ** p<0.01 compared to LCT diet.

Broussolle *et al.* (3) examined changes in glucose metabolism during constant infusions of LCT or MCT/LCT and found that any effects were dependent on fatty acid chain length, since only the LCT infusion impaired glucose utilization. Eckel *et al.* (4) examined the metabolic effects of LCT and MCT/LCT with a 5-day cross-over design in patients with type 2 diabetes. On the MCT/LCT diet, the amount of glucose needed to maintain euglycemia during intravenous insulin infusion was increased by 30% in diabetic patients.

In our study, the MCT-rich diet lowered plasma glucose and increased the insulinogenic index during OGTT. These findings suggest that MCT increase insulin-mediated glucose disposal. The absorption and metabolism of MCT differ from LCT (5, 6). MCT absorbed from the gut as intact triglycerides and hydrolyzed fatty acids (FA) do not enter the lymphatics and peripheral circulation as chylomicrons but are directly

transported to the liver via the portal circulation. Unlike LCFA, MCFA do not require carnitine for entry into mitochondria and oxidation. In bypassing this major step in FA oxidation, MCT may increase insulin-mediated glucose metabolism. A lesser decrease in plasma FFA in the MCT/LCT diet after OGTT also may be related to differences between LCT and MCT.

MCT is uncommon in natural food products, but many processed foods contain MCT (cookies, powder, oil). MCT may be an effective adjunct for dietary treatment in patients with disorders of glucose tolerance.

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