The Effect of RYGB and VSG Bariatric Surgeries on Cholesterol Metabolism

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Aims/ Hypotheses: Bariatric surgery is increasing as a reliable means to treat obesity. However, in addition to weight loss, it is now clear that Roux-en-Y gastric bypass (RYGB) and vertical sleeve gastrectomy (VSG) have metabolic benefits as well. These procedures differ significantly in the alterations made to the GI tract, but in general show similar degrees of weight loss. We hypothesized that because of differences in GI anatomy, the absorption of lipid would differ between subjects with RYGB and VSG. To test this hypothesis we compared the effects of RYGB and VSG on cholesterol metabolism and fat absorption in rats. We predicted that RYGB rats would show reduced fat absorption as well as reduced cholesterol absorption and synthesis, while animals with a VSG would have no significant effect on fat absorption or cholesterol metabolism.

Methods: A cohort of RYGB (8) and VSG (13) operated animals were compared against sham operated controls. Fat absorption was tested using a sucrose polybehenate assay. Post-prandial plasma triglycerides and cholesterol were compared using an oral fat tolerance test (olive oil gavage). Plant sterol markers of cholesterol absorption and endogenous cholesterol synthesis were measured using gas chromatography-mass spectronomy analysis on 2 hr post-prandial plasma samples following a high fat challenge. Gene products of relevant enzymes involved in fat and cholesterol metabolism in liver and intestine samples were measured by qPCR (Taqman array card, Applied Biosystems).

Results: Compared to sham-surgery controls total fat absorption was significantly reduced in RYGB operated rats ($p < 0.05$), but normal in VSG rats. Following an oral fat test meal, plasma triglycerides and cholesterol were significantly reduced in both RYGB rats and VSG rats for 1 and 2 hrs post-prandial relative to the controls. Markers of cholesterol absorption (sitosterol, campesterol, avenasterol, cholestanol) were significantly reduced RYGB rats, and intermediates indicative of cholesterol synthesis (cholestenol, lathosterol, squalene) were significantly reduced in RYGB rats. These effects were more modest in VSG animals. The expression of genes involved in cholesterol absorption (Apo A4 Apo E, ScarB1, AbcA1) were reduced in both liver and intestine in RYGB rats. Genes involved in cholesterol synthesis (HMGcr , HMGcs) were also expressed in lower amounts in the liver but not intestine in RYGB rats.

Summary: Total fat absorption is reduced in RYGB rats compared to VSG rats and controls. There is also evidence for reductions in cholesterol synthesis and absorption in RYGB rats that is greater than following VSG. Despite the differences in cholesterol and lipid absorption, both surgical procedures reduced the plasma triglyceride excursion following a lipid meal, consistent with an improvement in lipid metabolism as a result of surgery.

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