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## RESEARCH LETTER

## Laparoscopic sleeve gastrectomy modifies cholesterol synthesis but not cholesterol absorption

## KEYWORDS

Morbid obesity;  
Sleeve gastrectomy;  
Cholesterol synthesis;  
Cholesterol  
absorption;  
Non cholesterol  
sterols;  
Bariatric surgery

## Summary

**Background and aims:** Each bariatric surgery procedure impacts differently on cholesterol synthesis and absorption. Although a restrictive procedure, sleeve gastrectomy resolves diabetes mellitus and, like mixed-type procedures, induces early changes in gastrointestinal hormones. To our knowledge the present study is the first to assess the effects of sleeve gastrectomy on cholesterol synthesis and absorption. **Methods and results:** 42 consecutive subjects with obesity and sleeve gastrectomy candidates were included in the study together with a control group of 20 subjects without obesity. Before sleeve gastrectomy and 10 months afterwards, all subjects underwent a clinical examination, blood tests, ultrasound visceral fat area estimation and determination of plasma lathosterol, campesterol and sitosterol concentrations.

After sleeve gastrectomy, significant decreases were observed in BMI, waist circumference, visceral and subcutaneous fat, blood pressure, triglycerides, insulin and glucose levels, lathosterol and HOMA-IR. HDL-C and apolipoprotein AI levels increased significantly. No significant differences emerged in LDL-C, apolipoprotein B levels or cholesterol absorption markers. Lathosterol levels correlated significantly with BMI, visceral fat area and HOMA-IR. Differences in cholesterol intake after surgery were not significantly associated with differences in lathosterol, campesterol and sitosterol concentrations.

**Conclusions:** Sleeve gastrectomy reduced the markers of cholesterol synthesis but did not modify cholesterol absorption. Changes in cholesterol synthesis and absorption were independent of variations in cholesterol intake, suggesting a specific sleeve gastrectomy-related effect.

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## Introduction

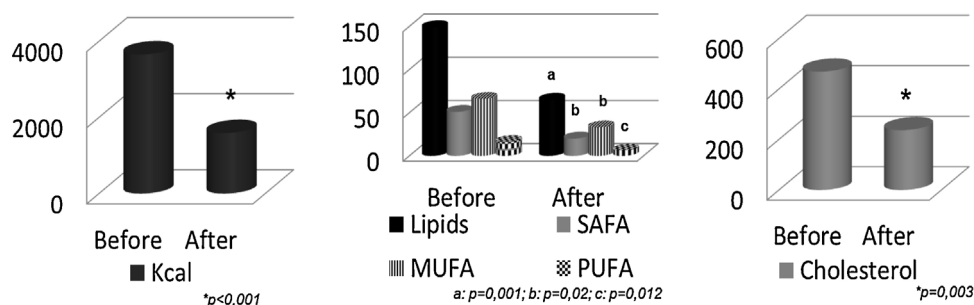
The rising prevalence of morbid obesity [1] bolstered the demand for bariatric or “metabolic” surgery which seems to be more effective than conventional therapies.

Each bariatric surgery procedure, besides improving lipid profile [2,3], can impact differently on non-cholesterol sterols, currently used to estimate cholesterol synthesis and absorption and also useful markers of lipid absorption. Gastric banding reduces cholesterol synthesis and increases cholesterol absorption [4]; the Roux-en-Y gastric bypass

<http://dx.doi.org/10.1016/j.orcp.2016.12.004>

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Please cite this article in press as: De Vuono S, et al. Laparoscopic sleeve gastrectomy modifies cholesterol synthesis but not cholesterol absorption. *Obes Res Clin Pract* (2016), <http://dx.doi.org/10.1016/j.orcp.2016.12.004>



**Figure 1** Intake modifications before and after sleeve gastrectomy.

SAFA: saturated fatty acids

MUFA: monounsaturated fatty acids

PUFA: polyunsaturated fatty acid

**Table 1** Characteristics of the population before surgery.

	Obese (n.42)	Controls (n.20)	<i>p</i>
Age (years)	45 ± 13	54 ± 16	0.026
SBP (mmHg)	138 ± 16	126 ± 10	0.001
DBP (mmHg)	84 ± 8	80 ± 6	ns
Weight (kg)	122 ± 27	68 ± 7	<0.001
BMI (kg/m <sup>2</sup> )	44 ± 7	25 ± 2	<0.001
Waist circumference (cm)	130 ± 18	90 ± 8	<0.001
VFA (cm <sup>2</sup> )	249 ± 74	152 ± 36	<0.001
Subcutaneous fat (cm)	28 ± 8	15 ± 6	<0.001
Triglycerides (mg/dl)	146 ± 107	138 ± 46	ns
HDL-C (mg/dl)	50 ± 14	48 ± 15	ns
LDL-C (mg/dl)	117 ± 35	127 ± 23	ns
Glycemia (mg/dl)	102 ± 33	87 ± 7	ns
Insulinemia (μIU/ml)	18 ± 16	6 ± 5	<0.001
HOMA-IR	4.7 ± 4.1	1.4 ± 1.3	<0.001
Apolipoprotein AI (mg/dl)	133 ± 25	163 ± 27	<0.001
Apolipoprotein B (mg/dl)	98 ± 23	107 ± 21	ns
Lathosterol (μmol/mmol)	194 (151–270)	76 (57–95)	<0.001
Campesterol (μmol/mmol)	49 (28–71)	54 (27–95)	ns
Sitosterol (μmol/mmol)	45 (25–71)	83 (63–116)	<0.001

SBP = systolic blood pressure; DBP = diastolic blood pressure; BMI = body mass index.

VFA = visceral fat area; HOMA-IR = H0meostasis Model Assessment of Insulin Resistance.

decreases cholesterol synthesis and absorption [4]; after biliopancreatic diversion, cholesterol absorption drops while cholesterol synthesis rises [3].

To our knowledge no studies have, as yet, evaluated cholesterol synthesis/absorption patterns after laparoscopic sleeve gastrectomy (LSG). LSG provides significant weight loss, similar early changes in gastrointestinal hormones as mixed-type procedures and marked improvements in, or remission of, co-morbidities like diabetes mellitus [5,6]. Sleeve gastrectomy is also effective in reducing the prevalence of the metabolic syndrome was well documented by Péquignot et al. [7].

The present study evaluated cholesterol synthesis and absorption modifications in subjects with

morbid obesity before and after sleeve gastrectomy.

## Subjects, materials and methods

We retrospectively enrolled 42 subjects with obesity (13 males, 29 females), referred to Perugia University Internal Medicine Unit, from November 2011 to December 2013 for cardiovascular and metabolic assessment, one month before and ten months after sleeve gastrectomy. A control group of 20 subjects without obesity (10 males and 10 females) was also included in the study. Data were collected on computer database.

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