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RESEARCH ARTICLE

A Prospective Randomized Study Comparing Patients with Morbid Obesity Submitted to Laparotomic Gastric Bypass with or without Omentectomy

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Abstract
Background Visceral fat, especially the greater omentum, seems to be an important factor in the development of some metabolic disturbances such as insulin resistance, hyperglycemia, and dyslipidemia. Therefore, we wanted to evaluate the influence of resecting or leaving in situ the greater omentum in a group of patients with morbid obesity.
Methods Seventy patients with morbid obesity were submitted to laparotomic resectional gastric bypass and an omentectomy was randomly performed in some patients. Body mass index (BMI), serum levels of sugar, insulin, total cholesterol, and triglycerides were determined prior to surgery and followed up on for 2 years afterwards.
Results Two years after surgery, no differences were seen in BMI levels in either group. Blood sugar levels, serum insulin, total cholesterol levels, and serum triglycerides had similar values in both groups. Arterial hypertension had similar behavior.
Conclusions Based on these results, omentectomy is not justified as part of bariatric surgery. Its theoretical advantages are not reflected in this prospective random trial.

Keywords Morbid obesity · Gastric bypass · Omentectomy

The worldwide increase in obesity has been extensively documented. This condition is associated with a number of adverse health effects. Several studies have suggested that the increase in visceral fat seems to be an important factor for developing several metabolic comorbidities such as insulin resistance, hyperglycemia, and dyslipidemia [1–6].

Different types of bariatric surgery have been employed in these patients in order to decrease weight, improve comorbidities, and improve their quality of life. Among these options, gastric bypass is, up to now, the "gold standard" as the surgical treatment of choice for patients with morbid obesity [7–9]. There is evidence that visceral adipose tissue is particularly pernicious to health [6]. Therefore, our hypothesis was that the removal of the greater omentum during gastric bypass may have an additional beneficial effect on the metabolic comorbidities associated to morbid obesity. Consequently, we performed a prospective random study evaluating the influence of the removal of the omentum or leaving it in situ, in a group of patients with morbid obesity evaluated prior to surgery and followed up on for 2 years afterwards.

Material and Methods

1. Patients studied: In this prospective and random study, a total of 70 patients with morbid obesity were included. All gave their written consent to be included in this study, which lasted between August 2000 and January 2003. None had previous abdominal surgery. Patients with arterial hypertension, diabetes, hyperinsulinemia, and dyslipidemia were included in this study. All were evaluated prior to surgery and followed up on for 2 years afterwards.
2. Method of randomization: After a laparotomy, and if the patient was completely suitable for any type of surgical procedure, a small card was taken out blindly from an envelope which contained 35 cards marked

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Table 1 Body mass index (kg/m^2) prior to surgery and for 24 months afterwards

	With omentectomy n=35		Without omentectomy n=35	
Before operation	A	43.3±4.5	B	43.2±4.7
After operation	C	27.9±3.8	D	28.9±4.0

Statistical significance: A vs. B>0.9, C vs. D>0.3, A vs. C<0.000, B vs. D<0.000

"yes" and 35 cards marked "no". Therefore, omentectomy was added or not according to this randomization.

3. Surgical procedure: All patients were submitted to laparotomic resectional gastric bypass, as previously described in detail [10]. Omentectomy was performed in similar way as we have done for gastric carcinoma in a great number of patients [11]. The entire great omentum was resected, and its weight was immediately measured after its resection.
4. Evaluated parameters: The following parameters were evaluated prior to surgery and for 24 months afterwards:
   (a) Weight: expressed as body mass index (BMI) in kilogram per meter.
   (b) Arterial hypertension: taking 130/80 mmHg as the maximum normal value.
   (c) Blood sugar: taking 70 to 110 mg/dl as the normal range.
   (d) Insulinemia: considering 20 uL/ml as the maximum normal value.
   (e) Serum cholesterol: with normal values ranging between 130 and 200 mg/dl.
   (f) Serum triglycerides: with a normal range between 35 to 165 mg/dl.
5. Statistical evaluation: For statistical significance, the Fisher exact test and the chi square test were employed, taking a $p<0.05$ as significant.

Results

Group I (with omentectomy) consisted of 35 patients, 24 women (68.6%), and 11 men (31.4%) with a mean age of 37.8±10.9 years (range 23–59). Group II (without omentectomy) consisted of 29 women (82.9%) and six men (17.1%) with a mean age of 36.9±11.6 years (range 15–57). There was no operative mortality, and five patients (7.1%) presented some postoperative morbidity. Among patients in Group I (with omentectomy), three patients (8.6%) developed the following complications: one case of evisceration, one case of gastrojejunal leakage that was treated conservatively, and one case of upper gastrointestinal hemorrhage managed by endoscopy. Two patients in Group II (5.7%) presented a perisplenic collection that was treated conservatively and a deep venous thrombosis managed with high doses of heparin. The mean hospital stay for both groups was 6 days. The resected great omentum had a mean weight of 864.7±370 gr (range 353–1,500).

Table 1 shows the mean BMI prior to surgery and for 2 years afterwards. There was a significant decrease of BMI in both groups, without differences among them. Table 2 shows the behavior of BMI prior to surgery and for 2 years afterwards in accordance with the degree of obesity. Aside from the preoperative BMI, the decrease of weight was significant and similar when comparing both groups in each category of obesity. Table 3 shows the behavior of arterial hypertension prior to surgery and for 2 years afterwards. In the group with omentectomy, 12 patients (34.3%) had hypertension. This was regulated back to normal in ten patients, and two patients improved, meaning that they needed less medication. In the group without omentectomy, from a total of seven patients with hypertension, five normalized their pressure and two improved considerably. This was not significant. Table 4 shows the changes in blood sugar levels before and late after surgery in both groups. It can be seen that in every patient with hyperglycemia before operation, blood sugar levels

Table 2 Mean body mass index (kg/m^2) prior to surgery and for 24 months afterwards, separated in three categories

	Body mass index (kg/m^2)					
	35–39.9 kg/m^2		40–49.9 kg/m^2		>50 kg/m^2	
	Before op	After op	Before op	After op	Before op	After op
With omentectomy	n=10		n=22		n=3	
n=35	(A) 37.4±1.5	(B) 24.9±3.5	(A) 45.1±2.4	(B) 28.6±3.0	(A) 51.4±1.9	(B) 32.9±3.2
Without omentectomy	n=8		n=26		n=1	
n=35	(C) 37.2±1.8	(D) 26.5±3.7	(C) 44.5±3.0	(D) 29.5±38	(C) 56.1	(D) 35

Significance: A vs. B<0.000 A vs. C>0.8 A vs. B<0.000 A vs. C>0.46 A vs. B<0.002, C vs. D<0.000 B vs. D>0.36 C vs. D<0.000 B vs. D>0.34

Table 3 Evolution of arterial blood pressure prior to surgery and for 2 years afterwards

	Before operation	After operation
With omentectomy n=35	With hypertension n=12 (34.3%)	10 Pts without hypertension 2 pt improved
Without omentectomy n=35	With hypertension n=7(20%)	5 Pts without hypertension 2 pts improved

pts Patients, *improved* needs less medication

returned to normal values. Similar findings are shown in Table 5, evaluating serum levels of insulin before and after surgery. In all patients, hyperinsulinemia returned to normal values. Table 6 shows the mean values of total serum cholesterol only in those patients who had abnormally high values before surgery. Among 12 patients with hypercholesterolemia submitted to omentectomy, in 11 of them, cholesterol values returned to normal levels and only one patient still had abnormal values. Similar findings were observed in patients without omentectomy. There were no differences after surgery when comparing both groups. Table 7 shows the results of serum triglycerides before and after surgery in only those patients with abnormally high values before surgery. In the group with omentectomy, 13 patients (37.1%) had high levels of triglycerides. Eleven patients showed decreased levels of triglycerides resulting to normal values, and two patients decreased their levels of triglycerides but not to normal values. Among the group without omentectomy, seven out of 11 returned to normal values, three patients showed decreased values but not within the normal range, and one patient showed an increase in serum levels of triglycerides. However, there were no significant differences after surgery comparing both groups.

Table 4 Evolution of the levels of blood sugar in patients with hyperglycemia prior to surgery and for 2 years afterwards

	Blood sugar (mg/dl)	
	Before operation	2 years after surgery
With omentectomy		
n=35	Hyperglicemia n=4(11.4%)	n=0
	224	95
	229	95
	181	88
	149	92
Without omentectomy		
n=35	Hyperglicemia n=6(17.1%)	n=0
	127	100
	135	97
	141	90
	130	83
	153	88
	207	89

Discussion

The results of the present study suggest that patients with morbid obesity who had gastric bypass surgery, as well as the complete resection of the greater omentum, showed similar values compared to gastric bypass patients without omentectomy, in terms of weight loss and changes in comorbidities.

The idea of resecting the great omentum in patients with morbid obesity seems attractive. It has been shown that the mean adipocyte surface area of morbidly obese patients increases two- to fourfold compared to nonobese patients [11]. Furthermore, the adipocyte recruitment in the omental adipose tissue has been suggested as the underlying defect in obesity-induced insulin resistance [12]. It has also been suggested that omentectomy by resection of visceral fat reduces the source of plasminogen activator inhibitor-1, which is a procoagulant factor that reduces the risk of atherothrombosis [13]. It also provides a decrease in the

Table 5 Evolution of serum levels of insulin in patients with hyperinsulinemia prior to surgery and for 2 years afterwards

	Insulinemia uLl/ml	
	Before operation	2 years after surgery
With omentectomy		
n=35	Hyperinsulinemia	
	n=7 (20%)	n=0
	27	11
	37	13
	40	3
	37	8
	31	5
	48	20
	54	9
Without omentectomy		
n=35	Hyperinsulinemia	
	n=9 (25%)	n=0
	36	5
	54	11
	43	6
	33	9
	38	18
	25	12
	24	7
	43	5
	58	11

Table 6 Serum levels of total cholesterol prior to surgery and for 2 years afterwards, in patients with hypercholesterolemia

	Serum cholesterol (mg/dl)	
	Before operation	After surgery
With omentectomy		
$n=35$	Hypercholesterolemia	
	$n=12$(34.2%)	
	229±19.4	169±23.8 $p<0.00$
		11 normal values
		1 abnormal value
Without omentectomy		
$n=35$	Hypercholesterolemia	
	$n=7$(20%)	
	248±38	166±39 $p<0.002$
		6 normal values
		1 abnormal value

sourcing of free acids to the portal vein and the sourcing of resistin [13], which is a hormone produced by adipocytes, reducing the sensitivity to insulin. Moreover, insulin resistance is, in part, due to the increased delivery of free fatty acids from the omental depot to the liver via the portal vein. As opponents of omentectomy, it has been argued for decades that the great omentum plays an important role as peritoneal defense mechanisms [14]. These mechanisms include translymphatic absorption of bacteria, lysis of bacteria in the peritoneal space by the component system, and phagocytosis by neutrophils and macrophages. However, it has recently been shown [14] that after resection of the omentum and in the presence of intra abdominal infection, the peripherally derived macrophages take over the defensive role as compensatory mechanisms. Therefore, the peritoneal bacterial activity against *Escherichia coli* does not change after omentectomy. Finally, in a case report of an obese patient with multiple rib fractures and increased abdominal pressure, omentectomy allowed to perform successful weaning from mechanical ventilation [15].

With all these eventual beneficial aspects of omentectomy in morbidly obese patients, the question is: why is this not a routine surgical step when performing any type of bariatric surgery? The answer can be expressed in two ways: on the one hand, omentectomy is difficult to perform during laparoscopic surgery. It increases operative time, it can increase postoperative morbidity, and it is not an easy surgical step. During open surgery, it can be performed more easily, but it requires experience in previous upper gastrointestinal surgery especially in gastric cancer surgery, in which omentectomy is a routine procedure. On the other hand, and what seems to us most important, there are very few and contradictory results when performing omentectomy. We have found only two previous reports concerning the need or not of omentectomy [16, 17]. The first came from Sweden in 2002, when in one center, a random study among 50 patients with severe obesity was performed. These patients underwent either laparotomic adjustable gastric banding or the same procedure plus total greater omentectomy. Patients were followed up on for 2 years after their procedure, exactly as we did in the present study. They found no differences in the loss of weight and changes in waist to hip and sagittal diameter among both groups. However, there was a significant improvement in oral glucose tolerance, insulin sensitivity, plasma glucose, and insulin among omectectomized patients compared to controls ($p<004$ to 0.009). The authors suggest a beneficial effect of omentectomy and proposed to perform it by laparoscopic approach. They postulated that it is an “easy and effective” procedure in selected cases, and it can be used as additional therapy for weight reduction in obese patients, particularly in those with insulin resistance. The authors did not find any difference in weight loss with or without omentectomy. Furthermore, no additional comments have been made by the authors in the literature. The second study comes from a group in Sao Paulo [14, 18]. The authors postulate a new surgical procedure by laparoscopic approach: sleeve gastrectomy, omentectomy, and enterectomy, leaving 50 cm of the proximal jejunum and 250 cm of the ileon. It is a complex procedure, in which omentectomy is a part of the procedure and there is no comparison with any control group. The authors reported good results in 100 patients, but it is very difficult to establish the real physiological action of omentectomy in these complex patients. In our study, there is an important limitation: we performed only a single analysis 2 years after surgery; therefore, it does not allow us to analyze the data from different periods such as 6, 12, and 18 months after surgery.

Table 7 Serum levels of triglycerides prior to surgery and for 2 years afterwards among patients with hipertrigliceridemia

	Serum triglycerides (mg/dl)	
	Before operation	2 years after surgery
With omentectomy		
$n=35$	Hypertriglyceridemia	
	$n=13$(37.1%)	
	284±150	115±44 $p<0.000$
		11 normal
		2 decreased
Without omentectomy		
N=35	Hypertriglyceridemia	
	$n=11$(31.4%)	
	343±206	135±47 $p<0.002$
		7 normal
		4 decreased
		1 increased

In conclusion, in the present study, we performed a prospective and random trial, but we could not demonstrate significant effects as a result of an omentectomy in terms of loss of weight and serum, glucose, and insulin levels, contrary to the results of the Swedish group. Furthermore, serum lipids showed similar behavior. Therefore, it is difficult to postulate a routine omentectomy associated to any other bariatric procedure based in these results. On the contrary, we believe in accordance to the results of our prospective random study that there is no scientific basis to propose routine omentectomy in bariatric surgery. It may have more adverse than beneficial effects through the laparoscopic approach. The theoretical advantages of omentectomy are not reflected in this clinical prospective trial.

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