

White Blood Cells in Obesity and Diabetes

Effects of weight loss and normalization of glucose metabolism

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White blood cell (WBC) count is elevated in obesity (1) and is a risk factor for atherosclerosis (2). An elevated WBC count is present in impaired glucose tolerance (IGT) (3), and WBC count is associated with macro- and microangiopathic complications in type 2 diabetes (4). In both of these studies, the effect was more marked in obese patients. In morbid obesity, bariatric surgery in many cases (gastric bypass or laparoscopic adjustable gastric banding [LAGB]) is able to induce, together with a sustained and durable weight loss, the disappearance of comorbidities, such as type 2 diabetes (5,6). The aim of this study was to compare the effect of LAGB and of conventional diet on WBC count in patients with morbid obesity that is simple or complicated by IGT or type 2 diabetes.

RESEARCH DESIGN AND METHODS

— According to the protocol approved by the local ethics committee, all patients underwent a full diagnostic evaluation completed by psychological-psychiatric assessment (6). Patients who were suitable for surgery at the end of the diagnostic workup, but refused LAGB for personal reasons, underwent conventional treatment. Patients were studied under basal conditions and after

1–3 years of follow-up. Table 1 shows the clinical and laboratory variables of patients. Laboratory methods used in this study have already been published (6,7). For each variable, differences between basal conditions and follow-up were assessed using the Student's *t* test for paired data. Pairwise regression analysis between change in WBC count and change in clinical and metabolic variables was calculated. Stepwise regression analysis was further carried out to estimate the independent contribution of selected variables (variables significant at linear regression plus age and sex) on change in WBC count. *P* values <0.05 were considered statistically significant.

RESULTS — Table 1 shows that under basal conditions the two groups were not different as to clinical and metabolic variables. At follow-up, BMI, fasting blood glucose and insulin, homeostasis model assessment (HOMA) index, and WBC count decreased significantly with LAGB, not in the other group. HbA_{1c} decreased significantly in both groups. Glucose tolerance improved with LAGB, not in the other group. Change in WBC count correlated with change in BMI ($r = 0.342$, $P = 0.0016$), in insulin ($r = 0.278$, $P = 0.0126$), and in HOMA ($r = 0.283$, $P = 0.0132$) but not with change in glucose

tolerance. At stepwise regression analysis (age, sex, change in BMI, and change in HOMA [or change in insulin] were the variables in the model), BMI change was the only predictor of WBC count change ($P = 0.01$).

CONCLUSIONS — These data indicate the importance of weight loss in reducing WBC count in morbid obesity, simple or complicated by IGT or type 2 diabetes. This finding agrees with a previous report indicating that adhesion molecules (intercellular adhesion molecule-1 and E-selectin) decrease in morbidly obese patients after significant weight loss, not after normalization of glucose metabolism (7).

The mechanism through which weight loss is associated with a decrease in WBC count is a matter of speculation, and one hypothesis is that leptin might be involved in the decrease in WBC count. In fact, leptin stimulates myeloid differentiation (8) and decreases after weight loss (9). On the other hand, insulin decreases after weight loss as well, but the available evidence indicates that insulin has an antiapoptotic effect only on myocytes (10). IGF-1 has an antiapoptotic effect on WBC count (11), but IGF-1 levels are not increased in obese subjects and do not change after weight loss (12).

Another aspect of interest is the potential value of a decrease of 1,000 WBCs/ μ l (–11%) within the normal range. According to Tong et al. (2), an increase of 1,000 WBCs/ μ l is associated with an increased 15.8% risk of macrovascular complications and with an increased 12.3% risk of microvascular complications. Cavalot et al. (13) have shown a linear regression between WBC count, within the normal range, and albumin excretion rate. Leukocytes participate in the inflammation process, are recruited at the site of endothelial injury, and form foam cells in the plaque (14). Interleukins and tumor necrosis factor- α are released from activated leukocytes and cause endothelial dysfunction (15).

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Abbreviations: HOMA, homeostasis model assessment; IGT, impaired glucose tolerance; LAGB, laparoscopic adjustable gastric banding; WBC, white blood cell.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—Clinical and metabolic variables of subjects in the study

	LAGB		No LAGB	
	Basal	At follow-up	Basal	At follow-up
n (M/F)	67 (18/49)	—	34 (8/26)	—
Age (years)	42.4 ± 1.07	—	45.6 ± 1.93	—
BMI (kg/m ²)	45.1 ± 0.78	36.9 ± 0.66*	44.7 ± 1.52	44.9 ± 1.78
Glucose tolerance (NGT/IGT/diabetes)	34/24/9	60/6/1*	18/9/7	19/6/9
Fasting blood glucose (mmol/l)	6.3 ± 0.18	5.3 ± 0.11*	6.3 ± 0.49	6.2 ± 0.76
Fasting insulin (μU/ml)	17.3 ± 1.14	9.7 ± 0.61*	12.9 ± 1.22	15.3 ± 1.61
HOMA [(glucose × insulin)/22.5]	4.8 ± 0.34	2.3 ± 0.16*	3.6 ± 0.42	3.7 ± 0.46
HbA _{1c} (%)	6.5 ± 0.15	5.6 ± 0.09*	6.7 ± 0.31	5.9 ± 0.30*
WBCs (no./μl)	7,783 ± 238	6,909 ± 237*	7,635 ± 313	7,649 ± 210

Data are means ± SE. *Significant versus basal. NGT, normal glucose tolerance.

In line with these data, sustained weight loss is accompanied by a decrease in interleukins and in tumor necrosis factor- α and by improvement of endothelial dysfunction (16).

A longer follow-up is required to verify whether sustained and long-lasting weight loss decreases the risk for macrovascular complications in obesity and diabetes.

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