

Inflammatory Response Measured By Body Temperature, C-Reactive Protein and White Blood Cell Count 1, 3, and 5 Days After Laparotomic or Laparoscopic Gastric Bypass Surgery

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Abstract

Background Morbid obesity is a chronic inflammatory condition due to the production of several cytokines from the adipose tissue. However, what happens with some of these parameters the first days after surgery is unknown. Therefore, the objective of the present study was to determine, through a prospective and descriptive study, the behavior of the C-reactive protein (CRP), the white blood cell count, and the body temperature prior to a gastric bypass and for 5 days afterwards.

Methods A total of 156 patients with morbid obesity were included in this prospective study. There were 120 women and 36 men, with a mean age of 41 years and a body mass index of 43 kg/m². They were submitted either to a laparotomic resectional gastric bypass or to a laparoscopic gastric bypass. Body temperature was measured every 8 h during 5 days. CPR and white blood cells were measured at the first, third, and fifth day after surgery.

Results All patients had a normal postoperative course. Body temperature showed no change. White blood cells increased significantly at the first and third day after surgery but normalized by the fifth day. However, the third day after surgery, laparotomic gastric bypass patients

showed a significantly greater increase in the total white blood cell count as well as in segmented neutrophil cells compared to laparoscopic surgery patients. CRP exhibited a similar increase and was more pronounced after a laparotomic approach.

Conclusion During the 5 days after gastric bypass, a significant increase in white blood cells and CRP was observed. The increase was significantly greater after a laparotomic bypass compared to the laparoscopic approach.

Keywords Gastric bypass · C-reactive protein · White blood cells · Morbid obesity

Introduction

C-reactive protein (CRP) was first described by Tillet and Francis in 1930, as a special protein found in the serum of patients with an acute phase of pneumonia [1]. Today, it is considered an excellent method for evaluating inflammation or infection. After a special stimulus, activated macrophages produce interleukin 6, which induces the synthesis of CRP in the liver. Therefore, after any type of surgery [2–4], a sudden increase in CRP plasmatic levels is observed. The maximum level is obtained 2 or 3 days after surgery and then it progressively decreases.

If CRP is used as a diagnostic tool for postoperative complications after gastric bypass surgery in morbidly obese patients, it is fundamental to know the normal or usual behavior of CRP levels after a noncomplicated elective surgery.

The purpose of the present prospective study was to establish the “normal” or “physiological” plasmatic levels of

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CRP in patients with morbid obesity submitted to laparotomic or laparoscopic gastric bypass, correlated to the levels of white blood cell count and body temperature during the same period after surgery.

Material and Methods

1. Patients studied

This is a prospective and descriptive study, performed between October 2005 and October 2006. A total of 156 patients were included: 120 women (76.9%) and 36 men (23.1%) with a mean age of 41.3 years and a mean body mass index of 42.9 kg/m². They were divided into two groups, based on the patient's election concerning the surgical approach:

Group I: laparotomic gastric bypass: 117 patients (75%).

Group II: laparoscopic gastric bypass: 39 patients (29%).

All patients gave their informed consent to be included in the present investigation. Patients with any postoperative complication were excluded from this study, as well as those who refused to participate or who had incomplete data in their clinical record.

2. Serum determination of CRP

All samples were measured by the enzymatic immunoassay method with a VITRO® 5,1 FS Chemistry System, with a normal value range from 0 to 10 mg/l.

3. White blood cells or leukocytes

These were determined by the impedancy and cytometry method with an ABX Pentra 80 hematology analyzer, with a normal value range from 4,000 to 10,000 leukocytes per cubic millimeter. Following the white blood cell number, the white cells were analyzed to find the percentage of each white blood cell type by doing a differential leukocyte count:

a. Segmented neutrophils with a normal value range from 60% to 70%.

b. Band cells with a normal value range from 0% to 3%.

4. Body temperature

After surgery, each patient's body temperature was measured in degree Celsius every 8 h for 5 days after surgery.

5. Surgical procedure

The details of laparotomic gastric bypass surgery have been extensively published elsewhere [5]. In the case of laparoscopic approach, six trocars were used and the procedure described by Schauer et al. [6] was employed. The first surgical step is to perform an enteroenterostomy 50 cm distal to the Treitz's angle. Then, the small gastric pouch is constructed and the gastrojejunostomy was manually performed. The distal excluded gastric segment was left *in situ*.

6. Statistical analysis

For statistical evaluation, the Epi Info and the Microsoft Excel program were employed, taking a $p < 0.05$ as significant.

Results

None of the patients had any complications during the operation or in the postoperative period. The mean duration of the operation was 158 min for the laparotomic approach and 152 min for the laparoscopic approach ($p > 0.5$). The mean hospital stay was 5 days for the laparoscopic procedure and 6 days for the laparotomic approach ($p > 0.2$). Table 1 shows the mean maximum body temperature during the 5 days after surgery, measured three times per day in each patient. None of the patients had a fever after surgery ($T^{\circ} > 37.5^{\circ}\text{C}$). In Fig. 1, the total number of white blood cells is shown according to the surgical approach. As it can be seen, the first day after surgery, there is a significant increase in both groups, compared to the preoperative values ($p < 0.00$), but no difference was seen comparing both groups. On the third day after surgery, only the laparotomy group had a higher value compared to the preoperative levels ($p < 0.008$), while the laparoscopic showed no difference ($p > 0.3$). Five days after surgery, the white blood cell count was similar to the preoperative values in both groups ($p > 0.3$). When comparing the differences between both groups during the period of time, only on the third day after surgery was a significant difference seen, with a higher value for the laparotomic group ($p < 0.05$). These values normalized on the fifth day after surgery. Figure 2 shows the mean percentage of segmented neutrophils cells before and after surgery. Values in each period of time after surgery were significantly higher compared to the preoperative levels both in the laparotomic group ($p < 0.000$) as well as in the laparoscopic group ($p < 0.015$). Again, a significant difference was seen only on the third day after surgery when comparing both groups ($p < 0.05$). There was no significant difference when comparing the percentage of band cells during the 5 days after surgery. Figure 3 expresses the evolution of CRP before and after surgery. Both groups exhibited a significant

Table 1 Evolution of body temperature before and after surgery ($^{\circ}\text{C}$)

	Group I (laparotomic)	Group II (laparoscopic)
Before operation	36.4	36.2
First day postop	36.8	36.7
Third day postop	36.7	36.7
Fifth day postop	36.6	36.5

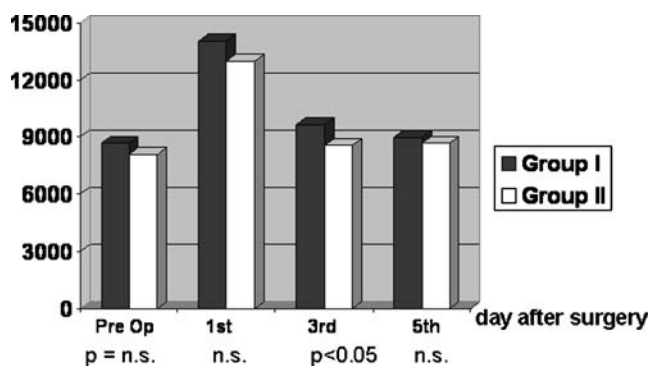


Fig. 1 Total white blood cells count per cubic millimeter before operation and the first, third, and fifth day after either laparotomic or laparoscopic gastric bypass

increase compared to the preoperative values ($p < 0.001$) in each period of time after surgery. However, a significant difference was observed when comparing both groups on the first and third day after surgery ($p < 0.05$). The increase of CRP was more than double after the laparotomic approach compared to the laparoscopic approach. On the fifth day after surgery, CRP values still remained significantly higher when compared to the preoperative values.

Discussion

It is well known and extensively described that increased body weight, especially morbid obesity, is associated to an increase in the white blood cell count and a low-grade chronic inflammatory state [6–11]. Fat tissue produces and releases inflammatory cytokines and therefore obesity, as a chronic inflammatory condition, may be responsible for some of the comorbidities and risks associated with the inflammatory aspects of the disease [12, 13]. This chronic low-grade inflammatory state may also be demonstrated by the increase of inflammatory markers such as interleukin 6, tumor necrosis factor, and C-reactive protein [14].

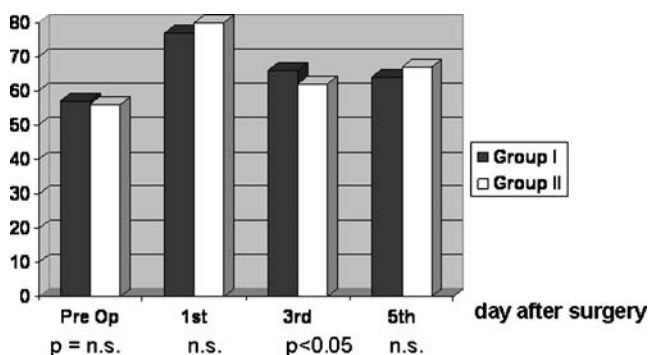


Fig. 2 Percent of segmented neutrophil cells before surgery and at the first, third, and fifth day after either laparotomic or laparoscopic gastric bypass

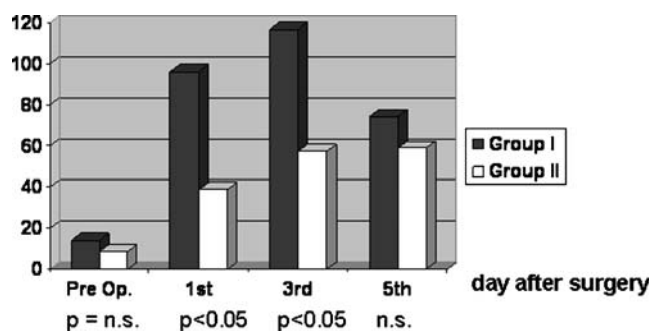


Fig. 3 Values of C-reactive protein (CRP) expressed as milligram per liter before surgery and at the first, third, and fifth day after either laparotomic or laparoscopic gastric bypass

One year after bariatric surgery, these parameters [15, 16] become normalized once a substantial loss of weight has been achieved. However, in our extensive review of the available literature, we could not find any special reference to what happens with some of the inflammatory parameters immediately after surgery. In the present study, our results suggest that gastric bypass surgery, whether laparotomic or laparoscopic, is followed by a substantial change in some of these inflammatory traces, such as the white blood cell count and the C-reactive protein, without any change in body temperature. However, the increase in temperature 1 or 3 days after surgery does not necessarily indicate the presence of an infection but rather a nonspecific inflammation in near two thirds of the patients. In a recent paper evaluating the behavior of CRP in 100 patients submitted to elective orthopedic surgery [17], Orrego et al. described a significant peak 2 or 3 days after surgery, returning to normal values around 30 days after surgery.

We could measure these values only up to 5 days after surgery, and they remained higher than the preoperative values. Therefore, we believe that it is important to know exactly the behavior of these inflammatory parameters in patients having a “normal” postoperative evolution, and this routine monitoring for inflammation could be useful in determining the presence of an abnormal response. We agree with the Sao Paulo group, when they propose that all these determinations could be useful in the bariatric surgeon’s arsenal in order to detect any early infectious complications [18]. In short, the first 5 days after gastric bypass surgery, a significant increase in the white blood cell count and C-reactive protein is observed. This increase reaches its peak 3 days after surgery and is higher in patients submitted to the laparotomic approach when compared to the laparoscopic approach. Five days after surgery, the white blood cell count is completely normal and similar to the preoperative values, but the C-reactive protein is still significantly higher when compared to the preoperative values.

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