



# Patient safety: changes in hemoglobin and serum iron after liposuction and/or abdominoplasty

*Segurança do paciente: alterações da hemoglobina e ferro sérico após lipoaspiração e/ou abdominoplastia*

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## ■ ABSTRACT

**Introduction:** Liposuction is the second commonest procedure performed in Brazil. The scope for liposuction has broadened with advances in the technique, with better equipment, and increased safety in the surgical environment. However, there are concerns about patient safety. Safety committees have made recommendations on various aspects of the procedure including infiltration, anesthesia, patient selection, and aspirated volume. The Brazilian Society of Plastic Surgery and the Federal Council of Medicine have also determined the parameters for aspiration safety volumes, and for the aspiration of body surface. However, supporting literature for the recommendations is scarce. The objective is to evaluate changes in hemoglobin, serum iron, and total protein levels in the peri-operative days (between 7 and 10 days), in addition to its impact in patients. **Methods:** We performed a prospective study, with patients submitted to either liposuction alone, or in conjunction with abdominal dermolipectomy for esthetic indications. We evaluated 30 patients, collecting their demographic data, weight, body mass index, hemoglobin, serum iron, and total protein levels in both, the pre-operative period, and between 7 and 10 post-operative days. **Results:** The fall in hemoglobin levels were between 2 and 6 g/dL, with an average of 3.1 g/dL between 7 and 10 post-operative days. A minimum hemoglobin value of 7.8 g/dL was noted between 7 and 10 days after surgery, while the mean reduction of serum iron was found to be 44.87 g/dL. **Conclusion:** The reduction in hemoglobin levels was responsible for the clinical symptoms. Iron supplementation was required in the immediate post-operative period.

**Keywords:** Abdominoplasty; Hypochromic anemia; Lipectomy; Asthenia; Dizziness; Orthostatic hypotension; Tachycardia.

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## ■ ABSTRACT

**Introdução:** A lipoaspiração é o sendo segundo procedimento mais realizado no Brasil. Com os avanços da técnica, melhores equipamentos e aumento da segurança no ambiente cirúrgico, passaram-se a ser lipoaspiradas grandes áreas. Contudo, existe uma preocupação com a segurança do paciente. Comitês de segurança têm feito recomendações sobre a infiltração, anestesia, seleção do paciente, volume aspirado, entre outros. A Sociedade Brasileira de Cirurgia Plástica e o Conselho Federal de Medicina também determinaram parâmetros de volumes de segurança do aspirado e superfície corporal aspirada. Ainda assim, a literatura de apoio para as recomendações é escassa. O objetivo é avaliar as alterações dos níveis de hemoglobina, ferro sérico e proteínas totais no pré e pós-operatório mediato (7-10 dias), assim como seus reflexos nos pacientes. **Métodos:** Realizamos um estudo prospectivo, com pacientes submetidos à lipoaspiração isolada e associada à dermolipectomia abdominal, por indicações estéticas. Avaliamos 30 pacientes, sendo coletados dados demográficos, peso, Índice de Massa Corporal, níveis de hemoglobina, ferro sérico e proteínas totais, no pré-operatório, e entre 7 a 10 dias de pós-operatório. **Resultados:** A queda da hemoglobina foi entre 2-6g/dl, com média de 3,1g/dl aos 7-10 dia de PO. Tivemos como valor mínimo de hemoglobina 7,8g/dl no pós-operatório com 7-10 dias, enquanto o ferro sérico apresentou redução média de 44,87g/dl. **Conclusão:** A redução no nível da hemoblogina foi responsável pela sintomatologia clínica apresentada. A reposição de ferro se mostrou necessária no pós-operatório imediato. **Descritores:** Abdominoplastia; Anemia hipocrômica; Lipectomia; Astenia; Tontura; Hipotensão ortostática; Taquicardia.

## INTRODUCTION

The advent of newer surgical techniques and greater social acceptance has led to a progressive increase in the demand for plastic surgery. Liposuction, a surgical procedure in use for more than 30 years was devised by Fournier, Illouz and others<sup>1</sup>. It is the second most performed procedure in Brazil, with up to 209,165 procedures performed in 2016; during the same period, 257,334 procedures were documented in the United States<sup>2</sup>.

Initially, the goal was to treat specific regions, but advances in understanding the physiological effects of liposuction improved equipment and techniques, increased safety in the surgical environment, and experience, over the years. This led surgeons to routinely remove large amounts of adipose tissue. As liposuction became commonplace, hematological alterations became evident, and some adaptations were necessary.

However, patient safety remains the prime concern. Most research and publications focus on the techniques and complications of liposuction, rather than on care for safety, which involves attention to blood and metabolic changes, and their possible complications.

Pre-operative evaluation is the key to performing a safe surgical procedure, and this includes everything from detailed anatomical and physiological knowledge, to decision-making regarding the most appropriate technique for individual patients<sup>3</sup>. Patients undergoing liposuction require similar evaluation to other surgical patients.

Observational studies indicate that findings of relevant pre-operative laboratory tests (e.g., hemoglobin, hematocrit, clotting tests), may be predictive of perioperative blood loss, transfusion risk, or other transfusion-related adverse events<sup>4</sup>. Consequently, a thorough pre-operative assessment is necessary, particularly to identify factors that may predispose to complications.

Another important safety parameter to mention in relation to blood loss during liposuction is the volume of the aspirate. The resolution of the Federal Medical Council of Brazil determined that the volumes aspirated should not exceed 7% of the body weight, when using the infiltrative technique, or 5% when using the non-infiltrative technique. The same resolution also states

that the total liposuction area should not exceed 40% of the body area, regardless of the technique used<sup>5</sup>.

In 2009, the safety committee of the *American Society of Plastic Surgery (ASPS)*<sup>6</sup> published an article on safety recommendations, developed as a complete review of the scientific evidence from the literature on liposuction. In addition to other aspects of liposuction, recommendations on technique, cannulas, infiltrative solutions, type of anesthesia, patient selection, aspirate volume, and fluid replacement have been defined. However, most of the existing literature on safety has little or no systematic evidence.

Thromboembolic phenomena, the surgery association, infections (necrotizing fasciitis, perforations, toxic shock syndrome), and the surgical location, are proven risk factors in mortality after liposuction; these complications are well documented in literature.

The present study focused on the observation and reporting of our experience related to post-operative hematological changes including fall in hemoglobin levels, in patients undergoing liposuction alone, or in conjunction with abdominoplasty. This is a particularly relevant aspect in regard to patient safety, as it causes definitive delays in the patient's recovery, requires emergency admission, diagnostic failures, and exhaustion and misunderstanding in the surgeon and patients alike.

## OBJECTIVE

This study intended to compare and evaluate levels of hemoglobin, serum iron, and total protein in the peri-operative period (between 7 and 10 days). In addition, the study also intended to assess the impact of these differences on patients undergoing liposuction as an isolated procedure, or combined with abdominoplasty.

## METHODS

We conducted a prospective study including patients either undergoing liposuction alone, or in conjunction with abdominal dermolipectomy, for esthetic indications. A total of 30 patients aged between 23 and 59 years were studied between 2017 and 2018; among these individuals, 27 were females and 3 were males. All procedures were performed at the Plastic Surgery Clinic, in Belo Horizonte-MG, by the same surgical and anesthetic team.

The peri-operative care was uniform in all cases, all evaluation being made by the main surgeon. The demographic data, weight, body mass index (BMI), hemoglobin, serum iron, and total protein levels of all patients were collected pre-operatively, and also between 7 and 10 post-operative days. The patients were evaluated post-operatively at 7 days and 10 days

as part of the post-operative surgery control, and notes were made on their clinical evaluation, and on the hemodynamic status. The laboratory tests were done in the same laboratory and tabulated.

## Surgical protocol

All surgeries were performed in a specialized plastic surgery clinic (Plastic Surgery center). All patients received, read, and signed in advance, the informed consent form, the authorization for photographs, and the service contract. All patients were administered epidural anesthesia and sedation. Prophylactic antibiotic therapy (cephalothin 2 g) was also administered during anesthetic induction, and replicated after 3 hours.

In general, we used a super wet technique for tissue infiltration, respecting the safety limit of 0.07 mg/kg of adrenaline, using 1 ampoule of adrenaline (1:1000) for every 500 mL of saline solution, without lidocaine. In all cases, a classic liposuction was performed, either alone, or in conjunction with other surgical procedures.

We used intermittent compression of the lower limbs for active prophylaxis against intraoperative deep venous thrombosis. Preheated solutions (37°C) were used to replace intravenous fluids. In the immediate post-operative period, all patients were hospitalized for fluid replacement, blood pressure control, monitoring of the pulse, assessment of urinary output (spontaneous), intermittent compression of the lower limbs, and for analgesia by the intravenous or oral route. Pharmacological prophylaxis against thrombosis was also instituted with enoxaparin 20 mg SC on the day of surgery, and with enoxaparin 40 mg SC from the next post-operative day (POD).

All patients were released on the following day, after having met all the clinical parameters mentioned in resolution CFM 1886/2008 (spontaneous walking, urination without difficulty, normal sensitivity in the perineal region after spinal block, enlightened companion, etc.)<sup>7</sup>.

## RESULTS

Thirty patients underwent classical liposuction between 2016 and 2017 (Table 1). The mean age of the patients was 39.2 years (range: 23-57 years), with a predominance of female patients (n = 25, 89%). The mean pre-operative weight of the patients was 72.18 kg (range: 55-105 kg), and the mean BMI was 27.03 kg/m<sup>2</sup> (range: 20.6-37.4 kg/m<sup>2</sup>). A total of 6 patients were categorized as grade I obesity; grade II obesity was noted in 1 patient. The patients are still on follow-up, and have maintained weight loss after surgery.

All 30 patients underwent classical liposuction. Additional surgical procedures were performed in 20

patients (66%), while 10 patients underwent liposuction as a single procedure. Additional procedures included abdominal dermolipectomy, and fat grafting on the buttocks. An average of 2,500 ml of intravenous fluids were given. The mean duration of the surgical procedure was 4 hours.

The volume of the aspirate in all cases was less than both, 7% of the body weight, and 40% of the total body area. No patient had severe complications. Fifteen complained of symptoms such as dizziness, dyspnea, tachycardia, and orthostatic hypotension, but no patient needed blood transfusion.

All our patients had pre-operative values of hemoglobin above 12 g/dL, except 3 female patients, who had values between 11.3 and 11.8 g/dL.

The fall in hemoglobin levels was between 2 and 6 g/dL, with a mean of 3.01 g/dL, corresponding to 22.16% of the pre-operative hematocrit. Our cohort had a hemoglobin level of 7.8 g/dL for up to 10 days in the post-operative period. The serum iron levels had reduced between 44 µg/dL and 122 µg/dL, with a mean reduction of 45.15 µg/dL (39.32%).

Two patients had pre-operative serum iron levels below the lower limit of normal. These two patients experienced a fall in hemoglobin by 3.5 and 4.0 g/dL, respectively. The total protein levels varied between 0.1 and 3.1 g/dL, with a mean of 1.06 g/dL, representing a mean variation of 14.6 g/dL.

## DISCUSSION

With refinement in techniques, liposuction has become one of the most performed surgical procedures in plastic surgery. A look at the liposuction techniques used in the evolutionary phases, since being described in the 1970s, it is evident that the main objective of the technical refinements was to minimize blood loss during the procedure. The initial "dry method" used general anesthesia without injecting any vasoconstricting solutions.

This method was abandoned in favor of wet infiltration techniques, reducing blood loss from 20-45%, to 15-30%, in wet techniques<sup>8</sup>. The use of the super-infiltration technique (*superwet*) or 1: 1 has been recommended by most authors to be the most suitable for safe liposuction<sup>6</sup>.

By definition, in the super wet technique, 1-2 mL of solution is infiltrated for every 1 mL of aspirate, presenting a blood loss of 1-2% of the total aspirate. The tumescent technique, described by Klein in 1985, uses saline solution, epinephrine, sodium bicarbonate, and lidocaine in an infiltrated volume: aspirate volume ratio equal to, or greater than 2-3: 1; the incidence of bleeding is approximately 1%.

According to the Brazilian Society of Plastic Surgery and the Federal Council of Medicine (SBCP/CFM), 3 major variables are to be analyzed in order to define the safe limits of liposuction: the volume of the aspirate, which should not be greater than 7% of the body weight, the aspirate composition, and the aspirated body surface, because the larger the area, the greater the damage; it is also not recommended to aspirate more than 40%, as exceeding the limits of each item will increase the surgical risk considerably<sup>9</sup>.

In 2009, the *American Society of Plastic Surgery* (ASPS) safety committee published the *Evidence-Based Patient Safety Advisory: Liposuction* by Haeck et al.<sup>6</sup>. This was a complete review of the scientific literature on liposuction, providing evidence on the relevant aspects of patient safety before, during, and after liposuction.

In this advisory, the supporting literature was critically evaluated in terms of study quality. Most of the recommendations were classified as Grade D. The notes in this recommendation correspond to the levels of evidence provided by the supporting literature. This review of scientific literature showed that there was no scientific data available to support a specific maximum volume at which liposuction is no longer safe, especially when performed in a hospital setting.

The risk of complications may increase as the volume of aspirate, and the number of anatomical sites treated, increase.

Among the patients studied, neither the aspirated volume limit, nor the maximum aspirated body surface exceeded the limits determined by the SBCP and the CFM.

Cupello, and the liposuction committee of SBCP<sup>10</sup>, reported that the number of deaths in combined surgeries is 4 times higher than that of non-combined surgeries, and reports of serious complications were increased when high-volume liposuction was combined with procedures like abdominoplasty.

The restriction of liposuction in combination with various procedures has been the subject of many discussions, mainly because the actual volume of liposuction aspirate that can be safely removed during a combined procedure is still unknown.

Pre-operative anemia is an important issue because it is the strongest predictor of blood component transfusions, which carry many risks, and is likely to increase morbidity and mortality. In addition to the increased risks related to the higher need for transfusion, anemia has been associated with deleterious effects, per se<sup>11</sup>.

The prognostic value of anemia in surgery has been studied in many populations, including cardiac and non-cardiac surgery. These studies have shown that

**Table 1.** Data summary.

WEIGHT (KG)	BMI	Hb pre-operative (g/dL)	Hb post-operative (g/dL)	Variation (g/dL)	Serum Iron pre-operative (mcg/dL)	Serum Iron post-operative (mcg/dL)	Variation (mcg/dL)
73	28.5	13.4	11.2	2.2	111	41	70
70	26.7	13.8	10.4	3.4	89	28	61
105	33.5	16.2	14.7	1.5	89	52	37
58	22.9	13.7	9.4	4.3	179	62	117
61.7	22.4	13.6	9.8	3.8	84.6	35	49.6
62	23.1	13.2	10.4	2.8	69	62	7
62	25.5	13.1	8.8	4.3	84	41	43
70	25.1	11.8	9.7	2.1	182	94	88
69	27	13.4	9.4	4	72	65	7
74	25.3	12.4	8.8	3.6	131	52	79
57	21.5	11.3	8.9	2.4	100	41	59
77	27.9	16.4	10.4	6	86	64	22
74	27.9	12.9	11.5	1.4	86	57	29
70	28	12.2	8.7	3.5	49	35	14
86	30.1	14	12.6	1.4	111	65	46
73	31.2	13.6	11.3	2.3	87	42	45
55	22.9	11.3	7.8	3.5	115	68	47
81	34.6	13.1	9.1	4	47	47	0
63	23.4	12.5	10.6	1.9	66	64	2
95	31	18	14.9	3.1	129	61	68
56	20.6	14.1	10.1	4	102	88	14
99.4	37.4	13	9	4	138	90	48
62	24.2	15.3	12.5	2.8	205	83	122
67	26.2	13.4	13.1	0.3	88	83	5
65	25.4	14.6	12.8	1.8	82	69	13
69	27.6	12.6	9.7	2.9	113	33	80
83	30.5	14.1	10.8	3.3	94	58	36
84	26.5	14.1	11.1	3	117	69	48
64	25,5	14,1	10,4	3,7	85	50	35
74	33,2	14,8	11,8	3	135	71	64

BMI: Body mass index; Hb: Hemoglobin; g/dL: Grams per deciliter; mcg/dL: Micrograms per deciliter; kg: kilogram.

anemia is an important risk factor for short- and long-term outcomes in the general population.

Only 3 of our patients had pre-operative anemia as defined by the criteria of the World Health Organization (WHO), which identifies anemia as hemoglobin thresholds of 12.0 g/dL for children aged 12.0 to 14.99 years and non-pregnant women aged 15 years or older, and a threshold of 13.0 g/dL for men older than 15 years<sup>12</sup>.

As detailed earlier, blood loss in liposuction is considerably decreased (1% of total aspirate) when super wet or tumescent infiltration techniques are employed. However, this does not consider the “hidden” bleeding that occurs in the tissues, which is not “registered”<sup>13</sup>.

Many variables affect this data, so this makes it difficult for the surgeon to predict the exact blood loss of an individual. There are formulas for the calculation of blood loss, but they depend on post-operative measurements of hematocrit and/or hemoglobin. The most suitable moment for collection is not known, because in the first 24 to 72 hours, there are changes caused by hemodilution, and it is not exactly known when it ceases. Additionally, the organism is producing new red blood cells for replacement, which may also interfere with the results.

In our sample of 30 patients, we observed that in both the sexes, the changes in hemoglobin and

serum iron levels after liposuction of the abdomen, flanks, and back, alone, or in conjunction with classic abdominoplasty, were superior to the expected values. The expected values are based on the knowledge of 1% of blood loss with super wet infiltration, and follow the standards of aspirated volume, and treated body surface. These blood losses were directly related to the post-operative clinical symptoms.

The changes in total protein levels did not appear to be important, since post-operative hypoproteinemia was not noted in any patient. The indication of transfusions is based on the laboratory results of the clinic that the patient attended in the post-operative period. Transfusions are needed only in exceptional conditions, and there is no formal indication for its routine prophylactic use. In cases where maximum aspirated volume equals 5% of body weight, and a super wet liposuction has been performed without other concomitant surgeries, neither auto-, nor normo-dilution volume transfusions are indicated.

According to the Carson and Kleinman<sup>14</sup> criteria, transfusion is always recommended with hemoglobin levels less than 6 g/dL, and is usually indicated with hemoglobin levels between 6 and 7 g/dL. None of our patients required blood transfusion.

Twenty (66%) of the patients underwent other procedures in conjunction with liposuction, which is contrary to the *ASPS Advisory* recommendations of 2009.

We noted no major complications.

## CONCLUSION

In the cases studied, we determined that the reduction in levels of hemoglobin was responsible for the patients' clinical symptoms. We therefore avoided the procedures that require blood transfusion when performed in patients with hemoglobin levels below 12 g/dL.

Iron supplementation was necessary in the immediate post-operative period, to return hemoglobin to normal levels and to minimize undesirable clinical symptoms.

## COLLABORATIONS

**RC** Analysis and/or interpretation of data, statistical analysis, final approval of the manuscript, data collection, conceptualization, methodology, completion of operations and/or experiments, writing - preparation of the original, writing - review and editing, supervision, validation, visualization.

**NARS** Analysis and/or interpretation of data, statistical analysis, conceptualization, conception and design of the study, research, completion of operations and/or experiments, writing - review and editing.

**BVBLC** Research, performing of operations and/or experiments, writing - review and editing, supervision

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