

Comparison between surgical trauma and albumin concentration in the postoperative period

Comparaç o entre trauma cir rgico e concentraç o de albumina no p s-operat rio

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Financial support: CNPq, Brazil and FAPEMIG, MG, Brazil.

Conflict of interest: None.

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Submitted: 25 may 2011. Accepted, after review: 27 july 2011.

ABSTRACT

Purpose: Surgical trauma can provoke systemic alterations including changes in hepatic protein synthesis. Thus, it is important to point out the influence of this phenomenon on serum albumin concentration. To assess the effect of surgical trauma on serum albumin concentration during the immediate postoperative period. **Method:** The study was conducted on 200 randomly chosen adult patients submitted to elective major surgeries (Group 1) and to medium size surgeries (Group 2), identified according to sex, age and skin color. Blood samples for the determination of serum albumin concentration were obtained on the day preceding and following the surgical procedure. **Results:** There was a reduction in serum albumin both in Group 1 ($p < 0.0001$) and Group 2 ($p < 0.0001$), with no difference between sexes or patient skin colors for major surgeries. However, women showed a lower reduction in serum albumin than men in medium-sized surgeries. Also, the reduction of albumin was lower in black-skinned patients than in pheodermics and lower in the latter than in white-skinned patients. With respect to age range, a greater reduction of albumin was observed in both groups among patients older than 65 years, followed by younger patients (< 45 years) and finally by patients aged 45 to 65 years. **Conclusion:** Medium-sized and majors operations provoked an acute reduction in albuminemia, which was more intense among men, among the aged and among white-skinned patients.

Key words: Serum albumin. Surgery. Trauma. Proteins. Postoperative.

RESUMO

Objetivo: O trauma cirúrgico pode provocar alterações sistêmicas, incluindo mudanças na síntese protéica hepática. Assim, é importante ressaltar a influência desse fenômeno sobre a concentração sérica de albumina. Para avaliar o efeito do trauma cirúrgico na concentração sérica de albumina, durante o período pós-operatório imediato. **Método:** O estudo foi conduzido em 200 pacientes adultos escolhidos aleatoriamente submetidos a cirurgias eletivas de grande porte (Grupo 1) e cirurgias de médio porte (Grupo 2), identificadas de acordo com sexo, idade e cor da pele. Amostras de sangue para determinação da concentração de albumina sérica foram obtidas no dia anterior e após o procedimento cirúrgico. **Resultados:** Houve uma redução da albumina sérica tanto no Grupo 1 ($p < 0,0001$) quanto no Grupo 2 ($p < 0,0001$), sem diferença entre os sexos ou cor da pele de pacientes para cirurgias de grande porte. No entanto, as mulheres apresentaram uma menor redução da albumina sérica do que os homens após as operações de médio porte. Além disso, a redução de albumina foi menor nos pacientes de pele negra do que em faiodérmicos e menor nestes do que em pacientes de pele branca. Com relação à faixa etária, uma maior redução da albumina foi observada em ambos os grupos entre os pacientes com mais de 65 anos, seguidos pelos pacientes mais jovens (<45 anos) e, finalmente, por pacientes com idade entre 45 e 65 anos. **Conclusão:** As intervenções cirúrgicas de médio e de grande portes provocaram uma redução aguda na albuminemia, que foi mais intensa entre os homens, entre os idosos e entre os pacientes de pele branca.

Descritores: Albumina sérica. Cirurgia. Trauma. Proteínas. Pós-operatório.

Introduction

Identifying patients with high surgical risk is essential in indications and surgical decisions, which are often limited by the potential morbidity and mortality of the procedure. In this sense, clinical and laboratory parameters that may point to greater risk of postoperative complications are very important.

From the 1970s, researchers attempted to define risk factors for the various surgical procedures considered midsize surgery and major surgery¹. In 1975, MacLean et al made their first publication that enhances the cutaneous test of delayed hypersensitivity in predicting postoperative outcome, showing the correlation between abnormal responses to this test and a higher incidence of complications and postoperative mortality². Although this line of study, Bistran et al (1974) found 40% to 50% of patients hospitalized with malnutrition. This situation was severe in operated

patients, who had high morbidity and mortality³. Subsequent studies evaluated the effect of nutritional replacement therapy, especially total parenteral nutrition in order to minimize the operative risks^{4,5}. The surgical aggression causes systemic disorders mediated by the phenomena of organic adaptation to the new condition and response to trauma. This set of factors is called the acute phase reaction after trauma and is characterized by endocrine-metabolic changes, release of adrenal and pituitary mediators, leading to increased catabolism of protein and lipid, non glucose hyperglycemia and salt retention¹.

The hepatic response is very important, with decreased synthesis of albumin and ferritin. Moreover, there is increased serum concentration of C-reactive protein, ceruloplasmin and other proteins related to immune processes⁶⁻⁸. Specifically, albumin is a protein of hepatic origin of long half-life (21 days). So, changes in its concentration during a short interval can't be explained by changes in nutrition or liver function⁹. Some studies show that albumin below 3 g/l is accompanied by anergy and more frequent and severe postoperative complications. Parenteral nutrition improves reactive state tests of delayed hypersensitivity and reduces the number of postoperative complications^{1,7,10-15}. According to Puskarich et al¹⁶, between 5th and 10th postoperative days there is a decrease in serum albumin. Several hypotheses try to explain this fact, as the dilutional effect and changes in this protein binding sites¹⁷⁻¹⁹. However, we found no studies considering the concentration of albumin in the immediate postoperative period.

Given the need for further subsidies to the study of systemic repercussions in the presence of surgical trauma, this study aimed to evaluate the serum albumin after midsize and major surgery.

Methods

This research followed the recommendations of the Declaration of Helsinki and Resolution 196/96 of the Ministry of Health on research involving humans and was approved by the Ethics Committee, Department of Surgery, Faculty of Medicine, Federal University of Minas Gerais²⁰.

We prospectively evaluated 200 adult patients, 100 men and 100 women, treated at the Division of General Surgery from the hospitals: Hospital Júlia Kubitschek, Hospital das Clínicas da UFMG and Mário Penna Hospital, Belo Horizonte, Brazil. Patients were divided into two groups according to the type of surgical procedure: Group 1 (n = 127): major surgeries such as esophagectomy, gastrectomy, colectomy, hepatectomy and portal-variceal disconnection. Group 2 (n = 73): Midsize surgeries such as inguinal or incisional hernia, gastrojejunostomy, cholecystectomy, colostomy and thyroidectomy. Blood samples (1 ml of serum) were collected on days preceding and following the surgical procedure to determine the serum concentrations of albumin,

together with routine examinations. The dosages were performed by using the biuret and bromocresol green method, and the reference values for serum albumin were 3.5 g/dL and 5.5 g/dL.

Epidemiological parameters such as age, sex and skin color (white, pheodermics and black) were also comparatively evaluated with the aim of characterizing the influence on surgical albumin in different population groups. We excluded patients who had undergone radiotherapy or chemotherapy for cancer, blood transfusions in the last six weeks, preoperative parenteral nutrition and emergency surgery, and those who did not fit perfectly in this research proposal or when there was doubt about the studied parameters.

The pre-and postoperative results of serum albumin were compared by paired t test. Comparisons between populations were made with using the Student t test. Differences were considered significant when $P \leq 0.05$.

Results

The patients' ages ranged from 20 to 87 years, with an average of 52.9 ± 16.6 years. There was no significant difference between the ages of men (54.1 ± 16.8 years) and women (51.6 ± 16.5 years). According to the data, 88 patients were leukodermics (44%), 65 pheodermics (32.5%) and 47 black patients (23.5%). There was no difference in this distribution between the groups of major surgery (53 were white, 46 pheodermics and 28 black). Among the patients submitted to midsized surgery, 34 were white, 20 pheodermics and 19 were black patients. The values of serum albumin decreased in the postoperative period of patients undergoing major surgeries (Group 1) from $3.76 \pm 2.87 \pm 0.69 \pm 0.79$ ($p < 0.0001$). The serum albumin in those patients of midsized group surgery (Group 2) were from $3.82 \pm 3.35 \pm 0.70 \pm 0.65$ ($p < 0.0001$). Table 1 shows the values of albumin in the preoperative and postoperative patients evaluated for age, sex and skin color, according to the size of the surgery. There was no difference between the sexes in Group 1. However, in Group 2, the women had less reduction in albumin with a significance of $p = 0.0047$ compared to men, whose difference showed a significance of $p < 0.0001$.

TABLE 1: Albuminemia (g/dL) (mean±sd) on preoperative and postoperative, according to the size of surgery, skin color and age.

	Surgery size			
	Major		Medium	
	Preoperative	Postoperative	Preoperative	Postoperative
SEX				
Male	3.80±0.69	2.81±0.75	3.85±0.75 ⁺	3.35±0.62 ⁺
Female	3.73±0.69	2.91±0.81	3.77±0.61 ^{**}	3.35±0.72 ^{**}
SKIN COLLOR				
Leukodermic	3.74±0.61 ⁺	2.93±0.78	3.73±0.5 ⁺	3.27±0.63
Pheodermic	3.71±0.71 ⁺	2.81±0.87	4.13±0.6 [*]	3.53±0.73 [*]
Melanodermic	3.81±0.78 ⁺	2.92±0.67	3.78±0.87	3.36±0.61
AGE				
< 45 years	3.72±0.56	2.85±0.73	3.80±0.55	3.37±0.51
45-65 years	3.87±0.68 ^{**}	3.00±0.78 ^{**}	3.80±0.80 ^{**}	3.32±0.67 ^{**}
> 65 years	3.65±0.80 ⁺	2.71±0.84 ⁺	3.92±0.68 ⁺	3.04±0.74 ⁺

⁺ Significant differences p<0,0001

^{**} Significant differences p=0,0047

^{*} Significant differences p=0,00052

^{**} Significant differences p=0,0038

Considering the skin color, in Group 1 we did not find difference between the reductions of albumin in major size surgeries. However, among the mid-sized surgery, black patients had the smallest reduction of albumin (p = 0.0024), followed by pheodermics (p = 0.0005) and by then were white, who had the greatest decrease (p<0,0001).

Regarding age groups, we observed that in both mid-sized as well as in major operations, a greater decrease of albumin in patients over 65 years (p <0.0001 for both groups), when compared with patients aged < 45 years (Group 1 - p = 0.0042 and Group 2 - p = 0.0058) The patients aged between 45 and 65 had the lower reduction of serum albumin (p = 0.0038 for both groups).

Discussion

Since the low immunological organic defense and malnutrition were recognized as potential sources of increased postoperative morbidity and mortality, several studies have been performed in the field of immunosuppression and early detection of malnutrition in surgical patients^{2,5,21,22}. Malnourished patients have a higher risk of postoperative complications and death compared with well-nourished patients

undergoing similar surgical procedures. This finding is important in order to propose an effective treatment of nutritional control, with the aim of decreasing the operative morbidity and mortality⁵. Most studies have compared the results of clinical parameters with that observed in the postoperative period. However, we did not find in the literature studies about association of albuminemia with the operative procedures.

Major surgical trauma, is often followed by tissue and systemic inflammatory phenomena, with large mobilization of fluid into the interstitial and intravascular spaces. The stress response is accompanied by a decrease in plasma albumin concentration^{23,24}.

Hypoalbuminemia may be partly explained by changes in vascular permeability and the dilution effect secondary to the infusion of saline and glucose during surgery and postoperatively. In a double-blind clinical study, Wolf et al²⁴ found that the infusion of two liters of saline 0.9% or dextrose 5% decreases the serum albumin. The reduction of albumin was proportional to the amount of fluid infused. While excess water is removed quickly, the sodium overload is excreted slowly, causing dilution of the extracellular fluid and albumin. The change in serum albumin concentration is proportional to the hemoglobin, suggesting that the distribution of protein compounds plays an important role in this process¹⁹.

Changes in bioimpedance also reflect the electrolyte content and alter the protein concentration. The inflammatory phenomena that follow the surgical trauma cause tissue edema with protein spill into the interstitial space²⁵. This output of albumin from capillaries can be measured by the increased capillary hydraulic conductance and decreased reflection coefficient of macromolecules in plasma. According Rodoman et al²⁶, the fluorescent albumin test shows that there is change in the albumin binding centers in both preoperatively and during surgery, due to psychological stress. In this case, the change is less pronounced. In this work we included patients aged over 20 years old, since before that age there is an intense process of anabolism, which may be accompanied by a decrease in serum albumin.

There was a great tolerance of women to the midsize surgery. Although the variation of albumin was significant in both sexes, the decrease was smaller in females. No relate was found in the literature to explain this finding. One hypothesis is based on the female hormone physiology, which is accompanied by changes in the body component of salt intake throughout the menstrual cycle. Additionally, the women are naturally adapted to a monthly blood loss. This could, somehow, better prepare women to respond to surgical trauma.

The Brazilian people are a mix of various ethnicities. White people are from various European countries, mainly Portugal, Italy and Germany. Blacks are descendants of West African countries, especially Angola, Mozambique and Nigeria. The few indigenous people are gathered in small groups located in various regions, especially in the north²⁷. More than a third of the population is composed of a mixture of various ethnic groups and is therefore classified as mixed. This mixed origin of the

Brazilian population makes this discussion very conflicting. However, a classification according to skin color is possible. We found no scientific publication about the physiopathology of trauma response that could explain the observed differences in relation to skin color.

The exclusion criteria adopted in the present study aimed to reduce the variables that directly influence the synthesis of albumin (corticosteroids, radiotherapy, immunosuppressive therapy, chemotherapy) or that lead to a dosage that did not correspond with the actual albumin. For example, patients underwent blood transfusions or operated under emergency conditions, especially if large volumes of crystalloid or colloid solutions had been administered..

Conclusion

The midsize and major operations cause reduction of serum albumin, immediately after surgery. In men, in caucasians and in people after 65 years of age, a decrease of albumin is greater.

Acknowledgements

The authors thank CNPq and FAPEMIG for financial assistance which enabled this work.

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