

CORRELATION BETWEEN NUTRITIONAL STATUS AND CLINICAL RESULTS IN PATIENTS UNDERGOING SPINAL SURGERY

CORRELAÇÃO ENTRE ESTADO NUTRICIONAL E RESULTADOS CLÍNICOS EM PACIENTES SUBMETIDOS À CIRURGIA DA COLUNA VERTEBRAL

CORRELACIÓN ENTRE ESTADO NUTRICIONAL Y RESULTADOS CLÍNICOS EN PACIENTES SOMETIDOS A CIRUGÍA DE LA COLUMNA VERTEBRAL

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ABSTRACT

Objective: To investigate the relationship between preoperative vitamin D and albumin levels and postoperative quality of life in patients undergoing spinal surgery. **Methods:** Patients undergoing thoracic and lumbar spine surgery were evaluated in this prospective study. Their vitamin D and albumin levels were assessed before surgery and quality of life was measured by two questionnaires, Oswestry Disability Index (ODI) and Scoliosis Research Society - 22 (SRS-22), one year after the procedure. Data on infection occurrence and healing time were collected. Preoperative nutritional values and patients' quality of life were analyzed using the chi-square test and ANOVA for albumin and vitamin D, respectively. The relationship among nutritional status, healing time, and the occurrence of infection was evaluated by the Pearson correlation coefficient. **Results:** Forty-six patients were included and their mean nutritional values were 19.1 (6.6) ng/mL for vitamin D and 3.9 (0.6) g/dL for albumin [mean (standard deviation)]. No association was found between vitamin D and quality of life of patients measured by ODI ($p=0.534$) and SRS-22 ($p=0.739$) questionnaires. There was also no association between albumin levels and quality of life measured by ODI ($p=0.259$) and SRS-22 ($p=0.076$) questionnaires. No correlation was found between the healing time or occurrence of infection and nutritional values. **Conclusions:** There was no association between vitamin D and albumin levels and the surgical result, according to the patient's perception, besides the occurrence of complications with the surgical wound.

Keywords: Spine; Serum albumin; Vitamin D; Surgical wound infection; Quality of life.

RESUMO

Objetivo: Investigar a relação entre os níveis de vitamina D e albumina pré-operatórios e qualidade de vida pós-operatória em pacientes submetidos a cirurgia de coluna. **Métodos:** Pacientes submetidos a cirurgia de coluna nos níveis torácico e lombar foram avaliados neste estudo prospectivo. Seus níveis de vitamina D e albumina foram avaliados antes da cirurgia e a qualidade de vida foi medida por meio de dois questionários, Oswestry Disability Index (ODI) e Scoliosis Research Society - 22 (SRS-22), um ano após o procedimento. Os dados sobre ocorrência de infecção e tempo de cicatrização foram coletados. Os valores nutricionais pré-operatórios e a qualidade de vida dos pacientes foram analisados usando o teste de qui-quadrado e ANOVA para albumina e vitamina D, respectivamente. A relação entre o estado nutricional e o tempo de cicatrização e a ocorrência de infecção foram avaliados pelo coeficiente de Pearson. **Resultados:** Quarenta e seis pacientes foram incluídos e seus valores nutricionais médios foram 19,1 (6,6) ng/ml para vitamina D e 3,9 (0,6) g/dl para albumina [média (desvio-padrão)]. Não foi encontrada associação entre os níveis de vitamina D e qualidade de vida dos pacientes medidos pelos questionários ODI ($p = 0,534$) e SRS-22 ($p = 0,739$). Também não houve associação entre níveis de albumina e qualidade de vida medidos pelos questionários ODI ($p = 0,259$) e SRS-22 ($p = 0,076$). Não foi encontrada correlação entre o tempo de cicatrização ou ocorrência de infecção e valores nutricionais. **Conclusões:** Não se constatou associação entre os níveis de vitamina D e albumina e o resultado cirúrgico, conforme a percepção dos próprios pacientes, além da ocorrência de complicações com a ferida operatória.

Descritores: Coluna vertebral; Albumina sérica; Vitamina D; Infecção da ferida operatória; Qualidade de vida.

RESUMEN

Objetivo: Investigar la relación entre los niveles preoperatorios de vitamina D y albúmina y la calidad de vida postoperatoria en pacientes sometidos a cirugía de columna. **Métodos:** Pacientes sometidos a cirugía de columna en los niveles torácico y lumbar fueron evaluados en este estudio prospectivo. Sus niveles de vitamina D y albúmina se evaluaron antes de la cirugía y la calidad de vida se midió a través de dos cuestionarios, Oswestry Disability Index (ODI) y Scoliosis Research Society - 22 (SRS-22), un año después del procedimiento. Los datos sobre la ocurrencia de infección y el tiempo de cicatrización fueron recolectados. Los valores nutricionales preoperatorios y la calidad de vida de los pacientes se analizaron mediante la prueba de chi-cuadrado y ANOVA para la albúmina y la vitamina D, respectivamente. La relación entre el estado nutricional y el tiempo de cicatrización y la ocurrencia de infección fue evaluada mediante el coeficiente de Pearson. **Resultados:** Cuarenta y seis pacientes fueron incluidos y sus valores nutricionales promedios fueron 19,1 (6,6) ng/ml para la vitamina D y 3,9 (0,6) g/dl para

la albúmina [media (desviación estándar)]. No se encontró asociación entre los niveles de vitamina D y la calidad de vida de los pacientes medidos por los cuestionarios ODI ($p = 0,534$) y SRS-22 ($p = 0,739$). También no hubo asociación entre los niveles de albúmina y la calidad de vida medidos por los cuestionarios ODI ($p = 0,259$) y SRS-22 ($p = 0,076$). No se encontró correlación entre el tiempo de cicatrización o la ocurrencia de infección y los valores nutricionales. Conclusiones: No se constató asociación entre los niveles de vitamina D y albúmina y el resultado quirúrgico, según la percepción de los propios pacientes, además de la ocurrencia de complicaciones con la herida operatoria.

Descriptores: Columna vertebral; Albúmina sérica; Vitamina D; Infección de la herida quirúrgica; Calidad de vida.

INTRODUCTION

The preoperative nutritional status of the individual is an important predictor of morbidity, complications, and overall surgical success.^{1,2} Albumin is the most abundant serum protein and preoperative hypoalbuminemia is a factor that is intimately related to perioperative morbidity and mortality since it affects the vascular diffusion of nutrients, which impacts the immunological system and the maintenance of homeostasis.^{3,4}

Vitamin D is another important nutrient, fundamental to mineral homeostasis and bone metabolism. It regulates bone remodeling by stimulating formation and reabsorption.^{5,6} The active metabolite of vitamin D (1,25-(OH)₂D) binds to an intracellular receptor called "vitamin D receptor" (VDR) that is distributed in various tissues of the human body. This wide distribution is responsible for the broad range of physiological actions of vitamin D.⁷ Because of this, other actions not related to mineral metabolism have been attributed to this liposoluble steroid hormone, such as its relationship to the quality of life and pain of individuals.⁸⁻¹⁰

However, to date there have been no studies conducted in Brazil that seek to confirm whether there is a relationship between the levels of serum albumin and vitamin D and the postoperative characteristics of patients who undergo surgical orthopedic procedures. Therefore, the objectives of this study were to confirm whether there is a relationship between the preoperative levels of serum albumin and vitamin D and the complication rates of healing, infection, and the quality of life of patients submitted to orthopedic spine surgery.

METHODS

This prospective study was approved by the Institutional Review Board (opinion no. 1.283.577).

Subject Selection

Patients who underwent spine surgery for different pathologies, including deformities, degenerative cervical and lumbar diseases, trauma, tumors, and infection between March 2014 and July 2015 were invited to participate in the study. It is, therefore, a study with a convenience sample.

To be included, the subject had to have serum albumin and vitamin D measured preoperatively, in addition to having consented to their participation by signing the Informed Consent Form. Patients with incomplete medical records and/or missing data were excluded.

Clinical Examination

Pre-and post-operative patient data were collected from an analysis of medical records and in medical consultations, respectively.

Preoperative Data: On the day of admission, a patient blood profile was collected, including serum albumin and vitamin D levels. The concentration of 25-hydroxyvitamin D (25OH-vitamin D) was measured using the Architect i2000SR instrument (Abbot Diagnostics, Lake Forest, IL, USA). Serum albumin was measured by photometric assay using the AU5800 system (Beckman Coulter Inc., Brea, CA, USA).

Using these values, the nutritional state of the patients was classified as follows:

Vitamin D: 25OH-vitamin D levels below 30 ng/mL were considered insufficient and levels below 20 ng/mL were considered to be significantly deficient.

Albumin: albumin concentrations lower than 3.5 g/dL were considered hypoalbuminemia.

Postoperative Data: The surgical outcome was evaluated by the Oswestry Disability Index (ODI)¹¹ and Scoliosis Research Society-22

(SRS-22)¹² questionnaires, both validated in the Portuguese language, and pain intensity by the Visual Analog Scale (VAS).¹³ The presence of infection and the occurrence of complications of the surgical wound, such as delayed healing, were also considered. All the information was collected 12 months after surgery.

Statistical Analysis

The information collected was tabulated and analyzed using Stata 11 for Windows (StataCorp LP, College Station, TX, USA).

The normality of the data was tested using the Shapiro Wilk test. The correlation between the vitamin D and serum albumin levels and the quality of life following surgery, as well as the pain intensity reported by the patient and the occurrence of infection and surgical complications were confirmed by the Pearson correlation test.

In addition, the average differences between the variables were calculated by means of the unpaired Student's t-test and the associations by means of the Chi-Square test. A significance level of 5% was considered for all analyses.

RESULTS

Forty-six patients with an average age of 50 years (standard deviation 19 years) were included, 17 (37%) of whom were men and 29 (63%) of whom were women. Of the total, 58.7% underwent spine surgery for degenerative pathology, 19.6% for deformity, 8.7% for infection, 8.7% for fracture, and 4.4% for tumor.

The average preoperative level of vitamin D was 19.1 ± 6.6 ng/mL (average value \pm standard deviation) and of albumin was 3.9 ± 0.6 ng/mL.

Table 1 shows the average values reported by the subjects included in the study for postoperative pain intensity and quality of life. The correlation between these variables and the level of vitamin D as measured by the ODI and SRS-22 questionnaires are shown in Table 2. The same is described for albumin in Table 3.

The average healing time was 18 days (standard deviation 14 days). The Pearson test showed no correlation between this variable and the albumin measurement ($r = -1$; $p = 0.359$).

The rate of postoperative infection was 19.6%, corresponding to 9 patients. Deep infection was confirmed in 5 of them and superficial infection in the other 4. No correlation between postoperative infection and the quality of life was confirmed as measured by the ODI and SRS-22 questionnaires (Table 4).

Table 1. Average values for pain and quality of life from the questionnaires.

Variable	Average	Standard Deviation	Minimum	Maximum
VAS				
Back	5.0	2.9	0	10
Limbs	4.7	3.6	0	10
Oswestry (%)	39.4	24.1	2	94
SR-22				
Function	2.9	1.0	1.0	4.8
Pain	3.1	1.2	1.0	5.0
Appearance	3.0	1.0	1.0	5.0
Mental	3.1	0.9	1.2	4.8
Satisfaction	3.6	1.2	1.0	5.0
Subtotal	3.0	0.9	1.3	4.7
Total	3.1	0.9	1.3	4.7

VAS = visual analog scale for pain.

Table 2. Average values and correlation between the level of vitamin D and the intensity of postoperative pain and quality of life.

Variable	r	p	Comparison of the averages			
			< 20 ng/mL Average (SD)	20 to 29 ng/mL Average (SD)	≥ 30 ng/mL Average (SD)	p
VAS						
Back	0.1	0.418	4.5 (3.1)	7.4 (2.7)	8.0 (0)	0.253
Limbs	0.0	0.794	4.2 (3.4)	5.1 (3.9)	7.5 (0.7)	0.396
Oswestry (%)	0.1	0.534	38.6 (25.9)	39.9 (23.5)	46.0 (0)	0.909
SR-22						
Function	0.1	0.683	3.0 (1.0)	2.8 (1.1)	2.8 (0.6)	0.788
Pain	-0.1	0.740	3.2 (1.6)	2.9 (1.2)	2.6 (0.8)	0.611
Appearance	0.0	0.928	3.1 (1.1)	3.0 (1.0)	2.3 (0.1)	0.558
Mental	0.0	0.268	3.1 (1.0)	3.1 (0.6)	3.4 (0.1)	0.891
Satisfaction	0.1	0.602	3.6 (1.2)	3.5 (1.2)	3.5 (1.4)	0.985
Subtotal	0.0	0.754	3.1 (1.0)	2.9 (0.9)	2.8 (0.5)	0.795
Total	0.1	0.739	3.1 (0.9)	3.0 (0.9)	2.8 (0.5)	0.812

VAS = visual analog scale for pain; r = Pearson correlation coefficient.

Table 3. Average values and correlation between the albumin level and the intensity of postoperative pain and quality of life.

Variable	r	p	Comparison of the Averages		
			Normal average (SD)	Changed average (SD)	p
VAS					
Back	-0.2	0.267	4.6 (3.0)	6.5 (2.1)	0.064
Limbs	-0.2	0.123	4.2 (3.7)	6.2 (3.0)	0.120
Oswestry (%)	-0.2	0.259	37.6 (25.0)	45.4 (20.8)	0.354
SR-22					
Function	0.1	0.359	3.0 (1.1)	2.6 (0.8)	0.204
Pain	0.3	0.088	3.3 (1.2)	2.5 (0.7)	0.067
Appearance	0.3	0.092	3.2 (1.1)	2.4 (0.7)	0.027
Mental	0.3	0.041	3.3 (0.9)	2.5 (0.7)	0.011
Satisfaction	0.2	0.111	3.7 (1.2)	3.0 (0.9)	0.074
Subtotal	0.3	0.078	3.2 (1.0)	2.5 (0.6)	0.030
Total	0.3	0.076	3.2 (1.0)	2.6 (0.6)	0.031

VAS = visual analog scale for pain; r = Pearson correlation coefficient; SD = Standard deviation.

Table 4. Correlation values between the rate of infection and the intensity of postoperative pain and quality of life.

Variable	Infection			p
	Absent average (SD)	Superficial average (SD)	Deep average (SD)	
VAS				
Back	5.16 (3.0)	3.75 (2.2)	5.20 (3.3)	0.659
Limbs	4.95 (3.7)	2.75 (3.6)	4.4 (3.0)	0.517
Oswestry (%)	39.9 (26.2)	29.0 (13.5)	44.2 (8.0)	0.679
SR-22	2.9 (1.1)	3.25 (1.3)	2.9 (0.8)	0.817
Function	3.1 (1.2)	3.2 (1.2)	3.1 (1.0)	0.978
Pain	3.1 (1.1)	3.4 (1.2)	2.6 (0.8)	0.586
Appearance	3.1 (0.9)	3.7 (0.6)	2.7 (0.9)	0.239
Mental	3.6 (1.2)	3.6 (1.8)	3.3 (0.9)	0.881
Satisfaction	3.0 (1.0)	3.4 (0.9)	2.82 (0.8)	0.665
Subtotal	3.1 (0.9)	3.4 (1.0)	2.9 (0.8)	0.705
Total	5.16 (3.0)	3.75 (2.2)	5.20 (3.3)	0.659

VAS = visual analog scale for pain; r = Pearson correlation coefficient; SD = Standard deviation.

DISCUSSION

The serum albumin level is one of the simplest and most used markers for evaluating the nutritional status of patients who will undergo surgery.¹⁴ Klein et al.¹ observed a significant increase in the rate of complications in malnourished patients (serum albumin <3.5 g/dL or total lymphocyte count <1500/mm³) as compared to patients with results for these exams within the normal range. Several other studies have shown a close relationship between nutritional deficiency and the occurrence of infection following general surgery, including orthopedic surgery, which implies a high morbidity risk.¹⁵⁻¹⁷

Micronutrients also participate in the wound healing process. Amino acids and proteins, including albumin, are essential to tissue repair through neovascularization, fibroblast and collagen deposition, and the production of lymphocytes.^{18,19} Therefore, patients with preoperative hypoalbuminemia have a higher risk of complications related to the healing of the surgical wound.^{1,3,15,20}

This study, however, found no significant correlation between preoperative hypoalbuminemia and the rates of postoperative infection or of complications in the wound-healing process. Some authors affirm that albumin should not be used as a standalone criterion for the nutritional assessment of patients, and that it should be associated with other nutritional indicators, such as anthropometry and body composition.^{21,22} This is due to their possible influence on the serum concentration of albumin, especially of changes in vascular permeability caused by the inflammatory process. Said situation generates a loss of albumin from the intravascular to the extravascular space and reduces their serum levels. Other factors that influence serum albumin concentration are prolonged half-life and the dilution effect caused by intravenous solutions.^{21,23}

Similarly, no correlation was found between the vitamin D level and the quality of life and pain reported by patients submitted to spine surgery. In fact, the influence of vitamin D on these factors is not clear and needs more prospective studies, mainly due to the heterogeneity of the studies already conducted in terms of population, sample size, and result definition.⁷

Specifically in relation to quality of life, several recent studies have made their evaluations using the Short-Form 36 (SF-36) questionnaire and observed results similar to those described here.^{24,25} Witham et al.⁸ conducted a similar study in patients with heart failure with a questionnaire specific to the pathology and found that there was an improvement in the quality of life reported by patients who took vitamin D supplements. This study used the ODI and SRS-22 specific to patients with spine pathologies and validated for the Portuguese language.

The effect of vitamin D on pain reported by patients was evaluated in the elderly, post-menopausal women, and patients with diffuse musculoskeletal pain and osteoarthritis with concentrations of this hormone less than 20 ng/dL.^{24,26} These studies did not show any

difference in the intensity of pain in relation to the patient levels of vitamin D, which corroborates the findings in our study.

Several limitations in the design of this study should be discussed, particularly regarding the sample characteristics. Because we used a small convenience sample, our results should be interpreted with caution and generalizations should be avoided. Additionally, the heterogeneity of the pathologies of the subjects included, even though all of them were operated on by the same medical team, is a limitation. On the other hand, this is the first study conducted with the Brazilian population.

CONCLUSION

In view of the above, we concluded that there was no relationship found between the preoperative levels of serum albumin and vitamin D and the rate of surgical wound complications or the surgical outcomes of patients submitted to orthopedic spine surgery.

All authors declare no potential conflict of interest related to this article.

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