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Original article

The importance of serum albumin determination method to classify patients based on nutritional status

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SUMMARY

The global health community has recognized the role of food and nutrition in health maintenance and disease prevention. Undernutrition is an important problem in clinical circles but it is still not highly considered by specialists. It is well known the consequences of undernutrition on the immunological systems. Furthermore, the main consequences are an increase of morbidity-mortality rates, post-operative complications, length of stay and number of hospital early readmissions. These are all reasons to lead to increase health-care financial costs.

The total assistance quality could be improved by the arrangement of an automatic detection system of undernutrition. In our hospital, we use the screening tool "CONtrolling NUTritional status" (CONUT). To measure albumin, the laboratory could use bromocresol green (BCG) and bromocresol purple (BCP) method. The aim of this study is to evaluate the CONNUT tool to classify patients using two different albumin methods to measure.

Material and Methods: The albumin and cholesterol performed in Advia 2400 analyzer using bromocresol green and purple methods to measure albumin. The total lymphocytes performed in Advia 2120. We calculate CONNUT index and classify the patients based on nutritional status.

When we classified our patients based on nutritional status (CONNUT), 28% were misclassified, almost in moderate and severe groups. This is very important because this tool generates a multidisciplinary action to the patient. Therefore, in the Clinical Laboratory we have to know the methods we use, the validity of these methods in future tools/index and the management and outcome of the patients.

1. Introduction

Scientific literature refers to the prevalence of hospital malnutrition between 20 and 40%. The prevalence of malnutrition in Spain is also estimated between 26.7% and 50.0% in hospitalized patients, but some studies mention a percentage up to 87.5%. Those huge differences depend on the scenario, for instance, country, group of patients, age, geographic location, sociocultural level and main diagnosis [1–8]. It is also important to take into consideration which nutrition tool was used. This problem appears not only in hospitalized patients but also in general population, as there is a relationship between malnutrition and health maintenance and disease prevention. Despite the magnitude of this problem, largely unnoticed by health and nutrition professionals and hospital responsibles, it is an essential topic in clinical practice. It is well known that a malnourished patient is more likely to suffer a serious illness because of the impact of nutrition on the immunological systems, gastrointestinal tract, endocrine system, cardiorespiratory function and wound healing process (postoperative or skin ulcers). Furthermore, the main consequences are an increase in morbidity-mortality rates, post-operative complications, length of stay and number of hospital early readmissions. These are all reasons that lead to increase health-care financial costs [9–16].

In 2005, a screening tool for CONtrolling NUTritional status (CONNUT) was reported as an automatic daily assessment of nutritional status. This index includes serum albumin level as an indicator of protein reserves, serum cholesterol level as a caloric

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depletion parameter and total lymphocyte count as immune indicator. These levels give a "screening total score" that classifies patients in four groups: normal (0–1), light (2–4), moderate (5–8) and severe (9–12) undernutrition. The advantage of this system is that an automatic CONUT index is calculated in real time for each patient without additional cost when a routine blood analysis is carried out [17–25].

Albumin is the most abundant protein in human plasma, synthesized in the liver and its depletion mechanism is unknown but seems to take place in all organs. Albumin plasma concentrations are often used as a nutritional status marker and hepatic function. This protein plays an important regulatory role in body fluid distribution, acid-base physiology, and it is essential to transport a lot of substrates. The lowering albumin levels are associated with an increased risk of complications and mortality, and a worse outcome of the patient. Nevertheless, changes in an acute situation are not very sensitive as a nutritional marker because of the long half-life (20 days) [26–28].

Clinical Laboratory results have a huge impact on patient outcome because doctors rely on those values to make an accurate diagnosis, similar risk classification, treatment and prognosis. Because of that, one of the laboratory challenges is to harmonize tests, units and assays also. But this harmonization is complicated because of the large number of clinical laboratory, platforms, assay, among others. For all these reasons, clinicians should communicate with laboratory staff in order to know which is the method used and if the result obtained is adequate to calculate an index. In clinical laboratories, albumin levels are usually measured by dye-binding methods such as bromocresol green (BCG) and bromocresol purple (BCP). Despite BCP is a more specific method than BCG for albumin, the most widely used method is the BCG, perhaps due to the lower cost or the availability in the platform used. It is normal to find different concentrations of albumin depending on the determination method used, being higher with BCG. These differences could cause another patient classification when CONNUT is used as screening nutritional status and generate a multidisciplinary action to the patient, whereas the consequences of those special actions generate an increased health cost [29,31,32].

2. Materials and methods

2.1. Subjects

This retrospective study was conducted on 1176 patients hospitalized, female 626 and male 550, with an average age of 54.2 years, minimum one month and maximum 100 years, in La Paz University Hospital, Madrid, Spain (tertiary Hospital). We enrolled all the patients whose albumin serum test was required during 1 week at the Hospital. We excluded patients who did not have all the parameters to calculate CONNUT index (total lymphocytes in EDTA blood and/or total cholesterol and/or albumin in serum concentration) and critically ill patients. The study was conducted in full accordance with the Declaration of Helsinki and no additional blood withdrawal was performed in any of the patients included in this study.

2.2. Blood samples and laboratory measurements

All blood samples were obtained by venopuncture when the patient performed a routine analysis. All samples were collected after a minimum of 8 h fasting and were centrifuged at 3500 r.p.m for 10 min to obtain serum.

Serum cholesterol and albumin were measured on Advia 2400 (Siemens Healthineers), using cholesterol esterase and bromocresol green and purple reaction, respectively, and total blood lymphocytes on Advia 2120 (Siemens Healthineers).

We created a reflex test in the laboratory middleware so that in all hospitalized patients, except from critical units, with an albumin determination request, immediately after routine laboratory tests were completely finished, albumin concentration was measured again, but in that moment by bromocresol purple method. Because of that, there are no differences related to sample conservation.

2.3. Evaluation of nutritional status

Following the CONNUT index, patients were classified in normal, light, moderate and severe malnutrition, first using total lymphocytes, total cholesterol and bromocresol green albumin and after, the same index was calculated using total lymphocytes, total cholesterol and bromocresol purple albumin.

2.4. Statistical analysis

Statistical analysis was analyzed by SPSS v.2.4. Qualitative variables (normal, light, moderate and severe) were used to classify the malnutrition status of the patients and a chi-square Pearson contingency table was used to evaluate significant differences between the two methods of albumin determination, green and purple, and their subsequent classification.

3. Results

The average age of the study population was 54.2 ± 23.1 (range 1 month–100 years). The 1176 patients (626 female and 550 male) were classified according to the albumin method used:

Based on the BCG method, 618 patients were classified in normal malnutrition (53%), 449 in light (38%), 105 in moderate (9%) and only 4 patients in severe malnutrition (0%) (Fig. 1).

On the other hand, based on BCP method, 492 patients were classified in normal malnutrition (42%), 454 in light (39%), 192 in moderate (16%) and 38 patients in severe malnutrition (3%) (Fig. 2).

Statistical analysis showed very significant differences ($p < 0.001$) in the classification of the patients depending on the albumin method used. Table 2

BCG method classified 4 patients in a severe state of malnutrition, whereas with BCP method this group increased to 38 patients; 4 of them match with BCG, 32 were classified by green as moderate, and 2 as light. Table 1

105 patients were classified as moderately undernourished with BCG method, 73 of which were classified in the same way with BCP method, but 32 were classified as severe with BCP method. Table 1

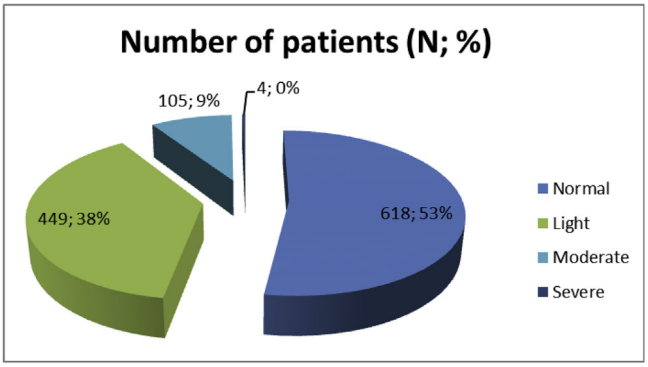

Fig. 1. Patients classification using BCG method.

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