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Original article

Nutritional status assessment in patients with chronic pancreatitis

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Abstract. *Background and aim:* Malnutrition is a major problem in patients with chronic pancreatitis (CP); nevertheless, there has been scant research on their nutritional assessment and management. The study objective was to perform a complete nutritional assessment in patients with CP and identify anthropometric and analytical parameters that facilitate the early detection of malnutrition. *Methods:* Data were gathered from 31 patients with CP on food frequency questionnaire results, anthropometric measurements, and analytical parameters. *Results:* Around half of the patients were overweight or obese. Around half consumed sweets, snacks, soft drinks, and red meats daily and reported a low intake of fish, vegetables, and nuts; one-quarter of patients had low prealbumin and insulin-like growth factor 1 levels; almost half had elevated total cholesterol. *Conclusions:* Measures need to be taken to improve the diet of patients with CP and to monitor their body composition. Data on levels of insulin-like growth factor type 1, a little used biochemical parameter, proved highly useful for the early detection of malnutrition in these patients.

Key words: chronic pancreatitis, malnutrition, nutritional study, anthropometric parameters, insulin-like growth factor I

Introduction

Malnutrition is a major problem in patients with chronic pancreatitis (CP); nevertheless, there has been scant research on the nutritional assessment and management of these patients (1). A complete evaluation of their nutritional status requires information on clinical symptoms, exocrine and endocrine pancreatic functions, body composition, bone health, diet, and lifestyle, in a multidisciplinary approach (2).

Malnutrition-related symptoms (e.g., nausea, anorexia, pain) and risk factors (alcohol, tobacco) should be considered in the medical history and physical examination, although clinical manifestations often appear only in advanced stages of pancreatic deficiency (3). This deficiency can be caused by a poor diet, increased metabolic requirements, and/or malabsorption (4). Chronic malabsorption gives rise to weight loss, subcutaneous fat deficiency, and specific signs of fat-soluble vitamin loss (e.g., osteoporosis) (5). Previously, Tinju et al. carried out a complete assessment of the nutritional status of patients with CP and reported that stool elastase values were correlated with fecal fat excretion and body mass index (BMI), offering an indirect measurement of exocrine pancreatic function (6).

Many patients with CP experience weight loss during the course of their disease (7). However, Duggan et al. described overweight as the most common form of malnutrition in these patients, observing underweight in only 10% (8). Although the clinical repercussions of obesity in CP are uncertain, it is a risk factor for the development of comorbidities and

inflammation (9), with a marked loss of muscle mass, and for malnutrition and quality of life impairment (10).

The objective of this study was to perform a complete nutritional assessment in patients with CP and identify anthropometric and analytical parameters that facilitate the early detection of malnutrition.

Materials and methods

Study design and variables

This descriptive and analytical cross-sectional study included 31 patients diagnosed with CP at San Cecilio University Hospital of Granada between February and September 2022. Inclusion criteria were: Patients older than 18 years and diagnosed with CP by radiological and/or histological methods. Exclusion criteria were: Patients who declined participation, lost to follow-up or developed pancreatic cancer. Two age groups were established: 19-54 years (n = 16) and 55-73 years (n = 15). All patients signed informed consent before their inclusion in the study, which was approved by the Ethics Committee of Granada (code: 1269-M1-19) and complied with the principles of the Helsinki Declaration. CP diagnosis was defined by the presence in one or more imaging tests of pancreatic calcifications, and/or pancreatic duct irregularities or dilatation, and/or pancreatic duct stones, and/or atrophy.

Assessment of the nutritional status of patients was based on the results of a weekly food frequency questionnaire by directed medical interview during 15-20 minutes, anthropometric measurements (weight, height, BMI, and percentage weight loss), and the findings of biochemical (albumin, prealbumin, insulin-like growth factor 1 [IGF-1], transferrin, ferritin, and total cholesterol) and hematological (red blood cell, hematocrit, hemoglobin, and lymphocyte counts/percentages) analyses. All these biochemical and hematological parameters were analyzed in blood samples drawn from fasting patients. The food frequency questionnaire was adapted to recommendations of the healthy diet guidelines of the Spanish Community Nutrition Society (11). In addition, toxic habits (smoking and alcohol consumption) were recorded qualitatively.

Statistical analysis

Mean values and standard errors were calculated for each study variable. The Student's t-test for independent samples was used to compare between age groups, considering $p<0.05$ as significant. IBM SPSS 18.0 (Chicago, IL) was used for data analyses.

Results

Study population and the body mass index

The mean age of the 31 patients was 55.65 ± 11.37 years. Regarding smoking habit: 15 were active smokers, 13 ex-smokers and 3 non-smokers; for alcohol consumption: 6 were alcohol consumers, 18 ex-alcohol consumers and 7 non-alcohol consumers. Table 1 displays the anthropometric measurements, which did not significantly differ between age groups.

Body mass index (BMI) results are exhibited in Table 2, classified according to Spanish Society of Obesity criteria. An elevated BMI was observed in half of the patients, with no significant difference between age groups; however, 66.7% of the patients with obesity were in the younger group.

Table 1. Age, body mass index and weight loss of patients.

	Total population	**19-54 years group**	**55-73 years group**
n	31	15	16
Age (years)	55.65 ± 11.37	47.00 ± 8.90	63.75 ± 6.29
BMI (Kg/m^2)	25.20 ± 3.45	25.25 ± 3.28	25.15 ± 3.71
Weight lost (%)	6.19 ± 8.08	5.05 ± 6.46	7.25 ± 9.43

Table 2. Distribution of the population according to their body mass index.

	Total population	**19-54 years group**	**55-73 years group**
Under weight	0 (0%)	0 (0%)	0 (%)
Normal weight	16 (51.61%)	7 (46.67%)	9 (56.25%)
Overweight	12 (38.71%)	6 (40%)	6 (37.5%)
Obesity	3 (9.68%)	2 (13.33%)	1 (6.25%)

Study of food consumption

The study population was characterized by a high weekly consumption of potatoes, olive oil, and fruit and a low consumption of nuts. A significantly higher consumption of red meats, sweets, and butter was observed in the younger age group, but the consumption of other foods did not differ between the groups (Table 3).

Study of biochemical markers and hematological parameters

The biochemical markers that were most frequently below the normal range were prealbumin and IGF-I, especially in the older group. Most patients had normal transferrin and ferritin levels. Total cholesterol values were elevated in around half of the patients and were below the normal range in only three patients (Table 4).

Among the hematological parameters, low hematocrit, red blood cell, and hemoglobin counts were more frequent in the older group (Table 5).

Discussion

Around half of the subjects in this study of patients with CP were classified as overweight (38.7%) or obese (9.7%). There has been little research on malnourishment in these patients, and reports have varied. In previous studies, Armbrecht found that 32% of patients with CP had a BMI <20 (12), while Tinju et al. observed that 27% were overweight (6), and Duggan et al. described overweight/obesity in 53.3% of male patients and 41.2% of female patients (8). Other researchers found that patients with CP had normal BMI or were mildly overweight (13).

Many patients lose weight during the course of CP, with frequent reports of a moderate loss of muscle strength and physical resistance (14). This may lead to reduced functional capacity, as observed in around one-third of patients with moderate to severe weight loss (15). In our study, we observed a weight loss in the patients, which may be favored by increased resting energy expenditure, especially in those with a low BMI.

Table 3. Frequency of consumption by food groups.

Food group [recommended times/week]	Total population (Times/week ± SD)	19-54 years group (Times/week ± SD)	55-73 years group (Times/week ± SD)
Potatoes, rice, bread and pasta [28-42]	20.1 ± 7.7	20.53 ± 8.56	19.69 ± 7.33
Vegetables [≥ 14]	4.82 ± 3.79	4.53 ± 3.36	5.09 ± 4.14
Fruit [≥ 21]	15.1 ± 11.08	14.73 ± 14.05	15.44 ± 8.33
Olive oil [21-42]	18.52 ± 6.89	19.6 ± 5.42	17.5 ± 8.08
Milk and derivatives [14-28]	16 ± 8.13	13.87 ± 9.61	16.88 ± 7.08
Fish [3-4]	1.81 ± 0.83	1.67 ± 0.72	1.94 ± 0.93
Lean meats and eggs [3-4]	4.68 ± 1.66	4.73 ± 1.87	4.63 ± 1.5
Legumes [2-4]	2.1 ± 1	2.37 ± 1.04	1.84 ± 0.91
Nuts [3-7]	1.09 ± 2.04	0.9 ± 1.75	1.27 ± 2.32
Fatty meats [occasional and moderate]	2.68 ± 2.37	3.6 ± 2.61	1.81 ± 1.79*
Sweets, snacks, and soft drinks [occasional and moderate]	7.08 ± 8.34	9.63 ± 9.5	4.69 ± 6.51*
Margarine and butter [occasional and moderate]	1.11 ± 2.35	1.8 ± 2.75	0.47 ± 1.75*

*$p < 0.05$

Table 4. Biochemical markers.

Biochemical marker [Reference range]	Total population (Mean ± SD)	19-54 years group (Mean ± SD)	55-73 years group (Mean ± SD)
Albumin (g/dL) [3.5 – 5.2 g/dL]	4.22 ± 0.34	4.36 ± 0.28	4.08 ± 0.34
Prealbumin (mg/dL) [20 – 40 mg/dL]	25.23 ± 6.03	25.81 ± 8.7	23.05 ± 6.04
Transferrin (mg/dL) [200 – 360 mg/dL]	276.45 ± 80.56	293.93 ± 65.52	260.06 ± 91.55
IGF-I (µg/L) [81 – 225 µg/L]	149.87 ± 70.05	180.6 ± 63.41	121.06 ± 65.06*
Ferritin (ng/mL) [20 – 250 ng/L]	141.38 ± 146.02	110.11 ± 86.49	130.47 ± 116.23
Total cholesterol (mg/dL) [140 – 200 mg/dL]	182.68 ± 64	192.87 ± 54.1	173.13 ± 72.53

IGF-I: Insulin-like growth factor I; *$p < 0.05$

Table 5. Hematological parameters.

Hematological parameter [Reference range]	Total population (Mean ± SD)	19-54 years group (Mean ± SD)	55-73 years group (Mean ± SD)
Hematocrit (%) [39.5 – 50.5 %]	45.05 ± 4.04	45.76 ± 3.95	44.39 ± 4.13
Erythrocytes ($x10^6$/µL) [4.3 – 5.75 $x10^6$/µL]	4.84 ± 0.46	4.89 ± 0.49	4.79 ± 0.44
Hemoglobin (g/dL) [13.5 – 17.2 g/dL]	14.96 ± 1.59	15.24 ± 1.72	14.7 ± 1.48
Total lymphocytes ($x10^6$/µL) [1100 – 4500 $x10^6$/µL]	2310 ± 671	2289 ± 716	2330 ± 649
Lymphocytes (%) [20 – 44 %]	27.57 ± 6.99	28.25 ± 7.87	26.94 ± 6.25

The dietary information obtained is inadequate to quantitate the degree to which optimal nutritional requirements were met. However, it can be concluded that the dietary pattern of around half of the patients did not follow recommendations, including those proposed by the strategy for Nutrition, Physical Activity, and the Prevention of Obesity. Specifically, they reported an inadequate intake of nuts, fish, and vegetables and an excessive intake of sweets, snacks, soft drinks, fatty meats, red meats, dairy products, and cereals. The carbohydrate intake may have been limited in the present patients with CP because of their greater susceptibility to diabetes mellitus (16). Almost half of our patients reported never consuming nuts, which offer a good alternative source of proteins and fats of vegetable origin, with the latter being especially indicated for patients with CP (17). Nuts are also a major source of vitamin E, and a deficit in this vitamin has been associated with the fat malabsorption experienced by patients with CP (18).

Previously, some authors reported that certain blood analysis results may assist the detection of malnutrition in patients with CP (19), whereas others found that most values were within normal ranges (6). Further research is therefore warranted to identify analytical parameters that are useful to establish the

nutritional status of these patients. One of the altered parameters in the present study population was prealbumin, whose levels were previously described as a good indicator of the nutritional status of patients (20). The other altered analytical value was IGF-I, which is synthesized in the liver and mediates action of the growth hormone (GH), highly sensitive to nutritional signals; thus, GH secretion is decreased in obesity and can give rise to low IGF-I levels (21). In states of malnutrition, GH levels can be normal or elevated in order to increase low IGF-I levels; hence, there is a state of resistance to GH, with an inadequate response at liver level. In this way, protein-calorie malnutrition and isolated vitamin deficiencies can produce GH resistance, with an association between normal or elevated GH levels and low IGF-I levels (22). Values for transferrin, which is highly susceptible to changes in the presence of inflammatory and/or infectious processes, were within the normal range in most of the present patients (23). Cholesterol levels were elevated, consistent with the high percentage of patients with overweight and an excessive consumption of fats, sweets, and butter. It was also observed that patients with cholesterol levels below normality were receiving hypolipidemic drugs (statins). Lymphocyte counts can be altered by inflammatory and/or infectious processes, and they are also considered alongside albumin and total cholesterol values in the CONUT malnutrition screening method (24). However, this technique would not be useful in the present population, given that albumin values were normal and total cholesterol values were elevated.

Among other researchers, Lindkvist et al. proposed the combination of multiple analytical parameters for nutritional assessment, finding that exocrine pancreatic insufficiency (EPI) was associated with hemoglobin, albumin, prealbumin, and retinol-binding protein values below the normal range, glycosylated hemoglobin above normal, and magnesium values <2.05 mg/dL (19). These data appear to be useful for the detection of EPI when pancreatic function tests are not available. The early identification of EPI is important because it can be responsible for poor digestion, steatorrhea, and malnutrition, and pancreatic enzyme substitution therapy may avoid these complications (25).

The main limitation found in our study is the limited sample size, mainly due to the fact that CP is an underdiagnosed disease. Also, to avoid possible seasonal variability, it would have been interesting to carry out the food consumption frequency questionnaire at different times of the year. Finally, another weakness detected is that, within the anthropometric parameters, sarcopenia was not estimated using brachial circumference.

Conclusions

A complete nutritional evaluation of patients with CP is needed to support recommendations on diet and oral supplementation as a means of improving their BMI and reducing their fecal fat excretion. Our study highlights the need to emphasize the qualitative analysis of the intakes of these patients as well as the potential of somatomedin C as a value to be used in their nutritional assessment. Efforts should be made to minimize risk factors (e.g., smoking and alcohol consumption), maximize adherence to medical treatments, and provide appropriate pain treatment when necessary.

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