

BRIEF REPORT

Low biochemical nutritional parameters in acutely ill hospitalized elderly patients with and without stage III to IV pressure ulcers

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ABSTRACT. Background and aims: Pressure ulcers are associated with impaired nutritional status in acutely ill elderly patients. The objective of this study was to establish whether a difference exists between biochemical nutritional parameters in acutely ill elderly with stage III to IV pressure ulcers and a group of acutely ill elderly with no pressure ulcers. **Methods:** In a retrospective study we compared 8 biochemical nutritional markers in a group of 22 acutely ill elderly patients consecutively admitted to the geriatric ward who had stage III to IV pressure ulcers (PU group) in addition to their acute illness with a control group of 40 acutely ill elderly patients with no pressure ulcers (NPU group). **Results:** The PU group compared with the NPU group had significantly lower ($p < 0.0001$) values of albumin, transferrin, hemoglobin, cholesterol, iron, and zinc ($p < 0.0059$). Total lymphocyte count was slightly, but not significantly lower in the PU group. In contrast, C-Reactive Protein levels were significantly higher ($p < 0.0001$) in the PU group compared with the NPU group, indicating a more severe illness in the presence of additional pressure ulcers. **Conclusions:** In this study, serum levels of biochemical nutritional parameters in acutely ill elderly patients with stage III to IV pressure ulcers are lower than those of acutely ill elderly subjects with no pressure ulcers, indicating a worse nutritional status of the PU patients. These findings, while not documenting a causal relationship, suggest the need for routine nutritional assessment and support in older patients, especially those with pressure ulcers.

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INTRODUCTION

Malnutrition is increasingly appreciated as the most frequent comorbid condition in ill elderly patients (1). Specific pressure ulcer risk factors studied in the ill elderly include low biochemical markers of nutritional status such as low serum albumin, serum cholesterol, and hemoglobin levels (2). Wound healing is complicated by the high prevalence of malnutrition, immobility, and systemic diseases (3). Pressure ulcers are associated with impaired nutritional status in acutely ill elderly patients. Since malnutrition is potentially reversible, providing adequate nutrition to patients with pressure ulcers is a promising treatment approach (4, 5).

The objective of this study was to establish whether a difference exists between biochemical nutritional parameters in acutely ill elderly patients with stage III to IV pressure ulcers and a group of acutely ill elderly subjects with no pressure ulcers.

METHODS

Study population

The collection of 12 biochemical nutritional markers on Day 1 after admission of patients to the ward has been routine for ten years at the Geriatric University Clinic in Basel. This retrospective study examined 8 biochemical nutritional parameters in 22 acutely ill elderly patients with stage III to IV pressure ulcers (PU) who had been admitted consecutively to the geriatric ward. Ulcer classification as proposed by Shea (6) was used. Biochemical nutritional parameters were also analyzed in a control group of 40 acutely ill elderly patients with no pressure ulcers (NPU), admitted consecutively at the same time period and with comparable comorbidity. The biographical and clinical characteristics of the study and control subjects are shown in Tables 1 and 2.

Key words: Albumin, elderly, iron, malnutrition, pressure ulcer, zinc.

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Table 1 - Biographical data of the study subjects (PU) and the controls (NPU).

	PU	NPU
Total no. (N) of subjects	22 (100%)	40 (100%)
Male	6 (27%)	11 (27%)
Female	16 (73%)	29 (73%)
Age (years), mean (male+female)	80.3±8.1	82.2±6.6
Male, mean ±SD	72.8±7.6	78.7±5.1
Range	53-82	65-97
Female, mean ±SD	83.1±6.9	83.5±6.0
Range	53-94	68-92

PU: Pressure Ulcer Patients; acutely ill elderly patients with stage III to IV pressure ulcers. NPU: Non-Pressure Ulcer Patients (controls); acutely ill elderly patients without pressure ulcers but with comorbidity comparable to the PU subjects (Table 2).

Biochemical nutritional parameters

Eight biochemical laboratory tests that may reflect protein energy malnutrition were performed with certified methods using the following analyzers: Hitachi 917 and Baxter Advia 120.

Fasting venous blood samples of PU and NPU subjects were collected using routine procedures on the morning after overnight fasting on Day 1 after hospital admission. Blood specimens were collected in lithium heparinate tubes for the analysis of CRP, albumin, iron, cholesterol and transferrin. Blood specimens for the zinc analysis by atomic absorption spectroscopy Varian (7) were collected using zinc-free needles and metal-free lithium heparinate tubes. Blood specimens for the measurements of total lymphocyte count and hemoglobin concentration were collected in EDTA tubes. All blood specimens were brought to the laboratory within an hour.

Statistical methods

Data are expressed as mean ±SD and ranges unless otherwise specified. Statistical differences among groups were tested using the unpaired *t*-test and the Wilcoxon test for CRP. *P*-values less than 0.05 were considered statistically significant. Stat View Version 4.0 (Abacus Concepts, Inc.) was used for statistical calculations.

RESULTS

Study population

Table 1 shows the biographical data of the study and control subjects. There was no significant age or gender difference between the PU and NPU groups. Clinical characteristics, as shown in Table 2, were quite similar for both the study (PU) and the control (NPU) subjects, except for bed fast immobility in 41 and 0%, for diabetes mellitus in 36 and 15%, and for hyperthyroidism in 18 and 0%, respectively, which were more frequent in the PU group. In contrast, mean age was higher, and coro-

nary heart disease and carcinoma more frequent in the NPU group.

Biochemical nutritional parameters

Table 3 summarizes the results of the 8 biochemical plasma parameters.

C-Reactive Protein (CRP) was significantly higher ($p < 0.0001$) in the PU group (79.8±65.8 mg/L; range 6-224) compared with that of the NPU group (13.5±14.9 mg/L; range 2-139). Plasma levels of albumin, transferrin, hemoglobin, total cholesterol and iron were significantly lower ($p < 0.0001$) in the PU group.

When malnutrition is classified as mild (albumin 34-30 g/L), moderate (albumin 29-26 g/L), or severe (albumin <26 g/L), only 5 of 22 PU patients were in the normal range, 5 in the mild, 6 in the moderate and 6 in the severe range. In contrast, 29 of 40 NPU patients were in the normal range, 9 in the mild, 1 in the moderate, and 1 in the severe group. Plasma zinc levels were significantly lower ($p < 0.0059$) in the PU group, and total lymphocyte count was slightly but not significantly lower in the PU group.

DISCUSSION

Acutely ill elderly patients suffer from malnutrition, and pressure ulcers have been associated with impaired nutritional status in these patients, although a causal relationship has not been documented. The aim of the present study was to compare 8 biochemical nutritional parameters of a group of acutely ill patients who had stage

Table 2 - Clinical characteristics of the PU and NPU subjects.

	PU N (%)	NPU N (%)
Total no. of subjects	22 (100)	40 (100)
Pressure ulcer	22 (100)	0 (0)
Immobility, bed fast	9 (41)	0 (0)
Paresis / plegic states	3 (14)	7 (18)
Arthrosis	5 (23)	8 (20)
Parkinsonism	4 (18)	4 (10)
Diabetes mellitus	8 (36)	6 (15)
Hyperthyroidism	4 (18)	0 (0)
Coronary heart disease	10 (45)	23 (58)
Hypertension	10 (45)	20 (50)
Peripheral vascular disease	6 (27)	7 (18)
Venous disease	2 (9)	2 (5)
Renal insufficiency	2 (9)	4 (10)
COPD (pulmonary disease)	3 (14)	8 (20)
Peptic ulcer	3 (14)	7 (18)
Minor depression	3 (14)	6 (15)
Carcinoma	1 (5)	5 (13)

PU: Pressure Ulcer Patients; NPU: Non-Pressure Ulcer Patients (controls).

Table 3 - Biochemical nutritional parameters of the PU and NPU subjects.

	Normal values	PU		NPU		p*
		Mean±SD	Range	Mean±SD	Range	
CRP	<10 mg/L	79.8±65.8	6-224	13.5±14.9	2-139	<0.0001
Albumin	35-52 g/L	28.8±6.1	18-39	36.1±3.9	24-43	<0.0001
Transferrin	2.3-4.5 g/L	1.8±0.5	0.9-3.2	2.4±0.5	1.4-3.5	<0.0002
Cholesterol	3.0-5.2 mmol/L	4.0±1.0	2.7-6.6	5.3±1.1	2.8-7.5	<0.0001
Iron	9.5-33.8 µmol/L	6.3±4.9	1.9-21.2	12.6±5.3	4.3-24.6	<0.0001
Zinc	10.7-22.9 µmol/L	9.3±1.9	6.3-11.9	10.7±1.6	8.9-14.8	<0.0059
Hemoglobin	12-16 g/%	11.1±1.7	8.6-14.0	13±1.7	9.4-16.8	<0.0002
Lymphocyte ^a	>1500/µL	1299±724	575-3642	1583±744	452-4000	NS

PU: Pressure Ulcer Patients; NPU: Non-Pressure Ulcer Patients; CRP: C-Reactive Protein.

^aTotal lymphocyte count per µL. p*: p-value less than 0.05 was considered statistically significant; NS: non significant.

III to IV pressure ulcers in addition to their acute illness, with the nutritional parameters of a control group of acutely ill patients with no pressure ulcers.

C-Reactive Protein (CPR) levels were significantly higher in the PU group, which may be an effect of the ulcer or reflect a more serious underlying condition (8). Matsuyama (8) also found plasma CRP and fibrinogen significantly increased in PU patients suggesting an acute inflammatory reaction releasing proinflammatory cytokines.

CRP levels correlated positively with the severity of disease in this study and may indicate higher concentrations of catabolic cytokines, including interleukin-1 (IL-1), interleukin-6 (IL-6) and tumour necrosis factor alpha (TNF alpha), which are known to aggravate malnutrition and hypercatabolism in pressure ulcer patients (9, 10).

Zinc levels were significantly lower ($p<0.0059$) in the PU group. Low zinc and prealbumin levels have been found in patients with PUs (11). Healing of 21-day-old skin incisions is impaired in the presence of zinc deficiency, as measured by a significantly decreased wound breaking strength in zinc-deficient rats compared with that of pair-fed controls (12). Zinc, copper and manganese enhance keratinocyte migration in cell cultures using normal human keratinocytes (13), and topical zinc may stimulate leg ulcer healing by enhancing re-epithelialization, decreasing inflammation and bacterial growth, and correcting a local zinc deficit in wound tissue (14). Zinc supplementation may soon be routine in PU patients with low zinc levels.

Albumin concentrations were very significantly lower ($p<0.0001$) in the PU group. Serum albumin is reported to be lower in tube-fed nursing home patients with pressure sores than in tube-fed patients without sores (15).

Low albumin levels correspond with higher mortality and a more severe disease condition in elderly patients (16). Low albumin levels in animal studies are reported to increase the pressure ulcer risk (17). A multivariate anal-

ysis, taking into account all diagnoses and potential risk factors, indicates that low albumin levels at hospital admission represent an independent risk factor for developing a pressure ulcer, and that nutritional intervention lowers the risk (18).

Transferrin levels were significantly ($p<0.0002$) lower in the PU group. Since transferrin is synthesized in the liver and regulated by the body iron store, these low levels may reflect iron rather than protein deficiency (19).

Plasma iron ($p<0.0001$) and hemoglobin ($p<0.0002$) levels were significantly lower in the PU group. Both plasma iron and hemoglobin levels are reported to be lower in tube-fed pressure ulcer patients than in tube-fed patients without pressure ulcers (15). Anemia and iron deficiency in ill elderly patients have been recently reported to be caused partly by malnutrition (20).

Total lymphocyte count was slightly, but not significantly lower in the PU group. The lack of significance may be due to the wide range of normal values or the computational methods used in this analysis. Total lymphocyte count and the CD4/CD8 ratio are decreased in malnourished patients (21).

Plasma cholesterol was significantly lower ($p<0.0001$) in the PU group. Patients with stage IV pressure ulcers are found to have lower plasma cholesterol levels than patients with stage II or III pressure ulcers (15). Hypocholesterolemia occurs late in the course of malnutrition, which limits the value of cholesterol as an early screening tool. However, it is a major indicator of long-lasting undernutrition (22).

CONCLUSIONS

The purpose of this study was to compare biochemical nutritional parameters in a group of acutely ill elderly patients who had stage III to IV pressure ulcers with those in a control group of acutely ill patients without pressure ulcers. Both groups had signs of malnutrition, but most nutritional markers were significantly worse

in the PU group. These findings, while not documenting a causal relationship, suggest a need for routine nutritional assessment and support in acutely ill elderly patients, especially those with pressure ulcers (5).

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