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Effects of an Additional Chicken Egg in the Octogenarian Persons: Malnutrition and Hypoalbuminemia Probably Due to Chronic Liver Damage

Research Article

Sanai T[1,2*], Sasaki H[1], Eto T[1], Nakaishi K[1], Tamura T[1] and Fukamizu N[1]

[1]Department of Internal Medicine, Mitsumi Long-term Care Heath Facility, 5-8-55 Saitozaki, Higashi-ku, Fukuoka-City, 811-0321 Fukuoka, Japan

[2]Department of Hemodialysis Center, Fukumitsu Clinic, 4-10-1 Kashiihama, Higashi-ku, Fukuoka-City, 813-0016 Fukuoka, Japan

***Corresponding author:** Sanai T, Department of Internal Medicine, Mitsumi Long-term Care Heath Facility, 5-8-55 Saitozaki, Higashi-ku, Fukuoka-City, 811-0321 Fukuoka, Japan; Tel: +81-92-603-6321. Fax: +81-92-603-6000; E-mail: sunny@fukumitsuclinic.jp

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Abstract

Background & Objective: Hypoalbuminemia has become important with regard to mortality in the elderly people. Two - three / day additional chicken egg (CE) are usually added to meal and is a potentially effective therapy for treating malnutrition in the elderly people.

Methods: Hypoalbuminemia (the serum albumin (Alb) < 3.1 g/dL) was observed in the eight (age: 88.6±4.2 [mean±standard deviation]) of 79 octogenarian persons. The present study evaluates the efficacy of a/day additional CE was added in the improvement of the nutritional indices of people. We examined the nutritional indices, anemia, renal and hepatic function, and muscle anthropometry markers for 6 weeks with a/day additional CE in comparison with the thirteen ambulatory patients on chronic kidney disease (CKD) glomerular filtration rate (G) 2-4 used as a control.

Results: Although the serum total protein (TP) were not significantly different, the Alb were significantly lower in the octogenarian CE persons vs in the CKD patients (before: 2.9±0.4g/dL vs 4.2±0.3g/dL, p<0.05, 6 weeks: 3.0±0.4g/dL, p<0.05). The Alb / (TP–Alb) (A/G) were significantly more decreased (before: 0.76±0.11 vs 1.44±0.24, p<0.05, 6 weeks: 0.73±0.11, p<0.05). The aspartate aminotransferase (AST) / alanine aminotransferase (ALT) were significantly more increased in the CE vs the CKD groups (before: 1.78±0.37 vs 1.43±0.38, not significant [ns], 6 weeks after treatment: 1.83±0.44, p<0.05). The fatty mass were significantly more increased (triceps skin-fold thickness [TSF]; before: 6.9±2.2mm vs 5.0±3.0 mm, ns, 6 weeks: 8.5±4.1mm, p<0.05).

Conclusion: A / day additional CE was added to meal and an ineffective therapy for treating malnutrition in the octogenarian persons which might have the decrease of serum Alb and A / G, the elevation of AST / ALT, and the normal levels of TP probably due to chronic liver damage. In addition, the increase of TSF may assess fatty mass in the octogenarian persons..

Keywords: Aspartate aminotransferase (AST) / alanine aminotransferase (ALT); Chicken egg; Chronic liver damage; Chronic kidney disease (CKD); Hypoalbuminemia; Serum total protein; Triceps skin-fold thickness (TSF)

Introduction

The progression of cardiovascular disease, infection, and cerebrovascular disease remains a major clinical concern in the hemodialysis is elderly patients [1]. Additionally, the incidence of malnutrition, especially hypoalbuminemia, is also frequently encountered in the octogenarian persons.

Malnutrition (the low serum albumin [Alb], a decline in protein intake and fat masses), muscle wasting, cachexia, and inflammation in chronic kidney disease (CKD) have been paid attention. The International Society of Renal Nutrition and Metabolism have proposed a new term protein - energy wasting (PEW) [2]. The concept of "PEW" refers to the multiple nutritional and catabolic alterations that occurred in the patients with CKD and associated with mortality.

Two - three / day additional chicken egg (CE) are usually added to meal and is a potentially effective therapy for treating malnutrition in

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the elderly people [3]. However, the serum cholesterol (Chol) levels may be high in such people with two - three / day additional CE.

Furthermore, a / day additional CE may be added to meal in the octogenarian persons. The effect of nutritional supplementation with a / day additional CE have a beneficial effect on the serum total protein (TP), Alb, Chol, aspartate aminotransferase (AST), alanine aminotransferase (ALT) levels, arm circumference (AC), triceps skin - fold thickness (TSF), and saturation of percutaneous oxygen (SpO_2) in the octogenarian CE persons in comparison with the CKD ambulatory patients.

Methods

Patients

A total of 79 octogenarian persons (the serum Alb levels: 3.5±0.5 [standard deviation (SD)] [2.6 - 4.3] mg/dL) at the Mitsumi Long - term Care Heath Facility were examined. The effect of a additional CE / day in the remaining eight octogenarian persons (10.1%, 2 case male, 6 case female; mean age: 88.6 ± 4.2 years; age range: 84 - 96 years; stage glomerular filtration rate (G) 2 - 4 : G2: 1 case, G3: 5 cases, G4: 2 cases; the CE group) with the presence of hypoalbuminemia (the serum Alb levels < 3.1 mg/dL: 2.9±0.4 [2.6 - 3.0] mg/dL) and the low geriatric nutritional risk index (GNRI) levels were performed, however, all of 79 octogenarian persons were added and get nourished by a / day additional CE (Figure 1).

The thirteen ambulatory patients with stage G2 - 4 (G2: 5 cases, G3: 7 cases, G4: 1 case) at the Fukumitsu Clinic (68.0±13.6 years; aged range: 41 - 93 years, 3 cases male, 10 cases female; the serum Alb levels: 4.2±0.3 [3.6 – 4.6] mg/dL; the CKD group) were included. The G5 patients were excluded, because the serum AST and ALT levels are very low in the G5, especially G5 (Dialysis) patients [4,5]. The thirteen ambulatory CKD patients were used as a control except for age, body weight (BW), and the serum Alb levels.

The serum Alb levels has a half - life of 21 days. A / day additional CE in octogenarian persons with hypoalbuminemia was performed for a period of 6 weeks between the overall study period of September 16, 2021 and October 28, 2021 (Figure 1). The serum nutritional indices, renal and hepatic functional markers, and the presence of anemia were assessed in these persons at the baseline characteristics (the CE and CKD groups) and the 6 weeks after treatment (the CE group) performed at the SRL Co. Ltd. (Fukuoka, Japan).

The present study was performed using a non - randomized analysis with a prospective and controlled design. The study procedures were carried out in accordance with the ethical standards of the Human Investigation Committee at the Mitsumi Long - term Care Heath Facility and the Fukumitsu Clinic (Fukumitsu Clinic No. 1 - 2023). All patients gave their written informed consent.

All procedures performed in the study involving human participants were in accordance with the ethical standard of the institutional and / or national research committee with the 1964 Helsinki declaration and its later amendments or comparable ethical standard.

Blood Sampling, Body Mass Index (BMI), AC, TSF, Arm Mucle Circumference (AMC), Arm Muscle Area (AMA), SpO_2 and GNRI

The serum TP, Alb, Alb / TP - Alb (A / G), AST, ALT, fibrosis - 4 index (FIB - 4 index), low density lipoprotein (LDL) - Chol, high density lipoprotein (HDL) - Chol, uric acid, corrected cacium (c - Ca), blood urea nitrogen (BUN), creatinine (Cr), hematcrit (Ht), hemoglobin (Hb), platelet (Plt) levels, BMI, AC, TSF, AMC, AMA, SpO_2 in evening or morning, and GNRI levels were measured in the non - fasted blood samples drawn immediately before and the 6 weeks after treatment.

The five indexes equation are calculated using the following equation:

$$\text{BMI (kg / m}^2\text{)} = \text{BW (kg)} / (\text{Height [m]})^2$$

$$\text{A/G} = \text{Alb (g/dL)} / (\text{TP [g/dL]} - \text{Alb [g/dL]})$$

$$\text{FIB-4 index} = \text{Age} \times \text{AST (IU/L)} / (\text{Plt } [10^4/\mu\text{L}] \times \sqrt{\text{ALT [IU/L]}}$$

$$\text{AMC (cm)} = \text{AC (cm)} - \pi \text{ TSF (mm)} / 10$$

$$\text{AMA (cm}^2\text{)} = (\text{AMC [cm]})^2 / 4\pi$$

The GNRI levels were developed by modifying the nutritional risk index for elderly people [6]. This index is calculated from the serum Alb levels and BW using the following equation:

$$\text{GNRI}=14.89\times\text{Alb (g/dL)} + 41.7\times\text{BW/ideal body weight (IBW)}$$

BW / IBW were set to 1 when the patient's BW exceeded the IBW. The IBW in the present study was defined as the value calculated from the height and a body mass index of 22, because of its validity [7].

Statistical Analysis

The data are expressed as mean±standard deviation. Statistical differences were computed using the unpaired *t* test. A *p* value of < 0.05 was considered statistically significant.

Results

In shown as Table 1, the BW were significantly altered by CE treatment and the BMI was lower upon treatment with CE (before: 20.0±2.1 kg/m^2 vs 21.7±4.3 kg/m^2, not significant [*ns*], and the 6 weeks after treatment: 20.5±2.7 kg/m^2, *ns*). The GNRI was significantly lower upon treatment with CE (before: 81.6±2.9 vs 104.0±10.9 g/dL, $p<0.05$ and the 6 weeks after treatment: 83.0±9.0, $p<0.05$).

The serum TP levels were not significantly different in the CE vs the CKD groups (before: TP; 6.8±0.5 g/dL vs 7.2±0.4 g/dL, *ns,* and the

Table 1: Change in age, bodyweight, body mass index, geriatric nutritional risk index, total protein, albumin and albumin/ globulin.

	CE (n=8)		CKD (n=13)
	Before	After 6 Weeks	
Age (year old)	88.6±4.2*	-	68.0±13.6
Bw (kg)	44.0±5.4*	45.1±6.1*	54.7±13.7
BMI (kg/m^2)	20.0±2.1	20.5±2.7	21.7±4.3
GNRI	81.6±2.9*	83.0±9.0*	104.0±10.9
TP (g/dL)	6.8±0.5	7.0±0.6	7.2±0.4
Alb (g/dL)	2.9±0.4*	3.0±0.4*	4.2±0.3
A/G	0.76±0.11*	0.73±0.11*	1.44±0.24

The data are expressed as mean±standard deviation.
*: p< 0.05 compared with the data of CKD; Bw, body weight; BMI, body mass index; GNRI, geriatric nutritional risk index; TP, total protein; Alb, albumin; and A / G, Alb / Globulin

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6 weeks after treatment: TP; 7.0±0.6 g/dL, *ns*). The serum Alb levels significantly more decreased in the CE group (before: 2.9±0.4 g/dL vs 4.2±0.3 g/dL, *p<0.05,* and the 6 weeks after treatment: 3.0±0.4 g/dL, *p<0.05)*. The serum A / G levels significantly more decreased in the CE group (before: 0.76±0.11 vs 1.44±0.24, *p<0.05,* and the 6 weeks after treatment: 0.73±0.11, *p<0.05)* (Table 1).

The observed increase in the Hb and Ht levels from before treatment to the 6 weeks after treatment was not significantly different in the CE group (Table 2). The Plt levels were not significantly different in the CE and the CKD groups before treatment.

In Table 3, the serum AST, ALT levels and FIB - 4 index were not significantly different. The serum AST / ALT ratio increased in the CE vs the CKD groups (before: 1.78±0.37 vs 1.43±0.38, *ns,* and the 6 weeks after treatment: 1.83±0.44, *p<0.05*).

The serum uric acid, c - Ca, BUN and Cr levels were not significantly altered by CE treatment. The observed decrease in the LDL - Chol levels from before treatment to the 6 weeks after treatment were not significantly different in the CE than in the CKD groups, however, serum HDL - Chol levels from before to the 6 weeks after treatment were significantly lower (before: 40±8 mg/dL vs 64±14 mg/dL, *p<0.05,* and the 6 week after treatment: 40±9 mg/dL, *p<0.05)* (Table 4).

As shown Table 5, the TSF levels significantly more increased in the CE vs the CKD groups (before: 6.9±2.2 mm vs 5.0±3.0mm, *ns*, and the 6 weeks after treatment: 8.5±4.1 mm, *p<0.05*). The observed decreased in the AC, AMA and AMC levels from before to the 6 weeks after treatment were not significantly different in the CE group.

The SpO_2 levels more decreased in the CE vs the CKD groups (morning; before: 97.0±1.4% vs 97.8±1.3%, *ns,* and the 6 weeks after treatment: 95.9±1.1%, *p<0.05*, evening; before: 96.3±1.8%, *ns,* and the 6 weeks after treatment: 96.3±1.7%, *ns*) (Table 5).

No acute adverse or chronic adverse effects associated with a / day additional CE were observed during the treatment (6 weeks) and follow-up period.

Table 2: Change in hemoglobin, hematocrit, and platelet.

	CE (n=8)		CKD (n=13)
	Before	After 6 Weeks	
Hb (g/L)	11.7±1.1	11.7±1.3	13.0±1.7
Ht (%)	37%±4%	36%±4%	40%±5%
Plt ($10^4/\mu L$)	23.3±8.7	-	20.8±6.4

The data are expressed as mean±standard deviation.
Hb, hemoglobin; Ht, hematocrit; and Plt, platelet.

Table 3: Laboratory data change of aspartate aminotransferase, alanine aminotransferase and fibrosis - 4 index.

	CE (n=8)		CKD (n=13)
	Before	After 6 Weeks	
AST (IU/L)	23±8	21±9	23±5
ALT (IU/L)	14±4	13±7	18±9
AST / ALT	1.78±0.37	1.83±0.44*	1.43±0.38
FIB - 4 index	2.77±1.58	2.65±1.12	2.05±0.99

The data are expressed as mean±standard deviation. *: p< 0.05 compared with the data of CKD: ASL, Aspartate aminotransferase; ALT, Alanine aminotransferase; and FIB - 4 index, fibrosis - 4 index

Table 4: Laboratory data of cholesterols, uric acid, corrected calcium, blood urea nitrogen and creatinine.

	CE (n=8)		CKD (n=13)
	Before	After 6 Weeks	
LDL-Chol (mg/dL)	105±23	110±34	114±34
HDL-Chol (mg/dL)	40±8*	40±9*	64±14
UA(mg/dL)	4.6±1.4	4.8±1.4	5.7±1.6
c -Ca(mg/dL)	8.9±0.2	8.9±0.3	9.1±0.3
BUN (mg/dL)	18.3±7.7	19.2±6.1	19.8±6.4
Cr (mg/dL)	0.81±0.22	0.78±0.21	0.99±0.47

The data are expressed as mean±standard deviation. *: p< 0.05 compared with the data of CKD; LDL-Chol, low density lipoprotein - cholesterol; HDL-Chol, highdensity lipoprotein - cholesterol; UA, uric acid; c-Ca, corrected calcium; BUN, blood urea nitrogen; and Cr, creatinine

Table 5: Change of arm circumference, triceps skinfold thickness, arm muscle circumference, arm muscle area and saturation of percutaneous oxygen.

	CE (n=8)		CKD (n=13)
	Before	After 6 Weeks	
AC (cm)	21.7±2.4	22.6±4.5	24.7±4.9
TSF (mm)	6.9±2.2	8.5±4.1*	5.0±3.0
AMC (cm)	19.6±2.3	19.9±4.6	22.6±5.1
AMA (cm^2)	30.9±6.9	33.1±13.3	43.2±18.3
SpO_2(%) morning	97.0±1.4	95.9±1.1*	97.8±1.3
SpO_2(%) evening	96.3±1.8	96.3±1.7	-

The data are expressed as mean±standard deviation. *:p< 0.05 compared with the data of the CKD. AC, arm circumference; TSF, triceps skinfold thickness; AMC, arm muscle circumference; AMA, arm muscle area; SpO_2, saturation of percutaneous oxygen; SpO_2 morning: all supine and evening: 2 supine, 6 sitting

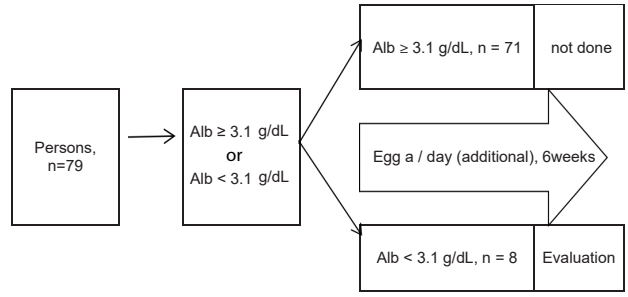

Figure 1: A total of 79 people enrolled in this study. Alb, serum albumin levels.

Discussion

The present findings clearly indicate that CE might be an effective and well - tolerated nutritional supplement, and might improve the serum Alb levels and GNRI in the octogenarian people. Two - three / day additional CE are usually added to meal and is a potentially effective therapy for treating malnutrition in the elderly people [3]. On the other hand, this research study also demonstrates that a / day additional CE was ineffective, especially the serum Alb levels and A / G low, in the octogenarian CE persons.

Surveys using classic measures of nutritional status indicate that approximately 18 - 75% of patients with CKD undergoing maintenance hemodialysis therapy show evidence of wasting [2,8-10]. Thus, PEW (Protein-energy wasting) is the state of decreased body stored of protein and energy fuels, and four main and

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established categories are recognized for the diagnosis of PEW: 1) Serum chemistry, 2) Reduced body mass, 3) Decease in muscle mass, and 4) Low protein or energy intake [2]. At least three out of the four listed categories must be satisfied for the diagnosis of kidney disease - related PEW [2]. This research study could not improve, however, the serum Alb levels, GNRI, AC, AMA and AMC in the octogenarian CE group.

Aspiration pneumonia was due to decreased muscle strength of swallowing and the ratio of aspiration pneumonia patients dramatically increased with aging [11,12]. Futhermore, the serum Alb levels seemed to be important for the management of aspiration pneumonia [13]. This study could not improve the serum Alb levels. On the contrary, the data of the 6 weeks after treatment in the SpO_2 (morning) was seemed to decrease in the octogenarian CE persons in this research study (Table 5).

Various nutritional screening tools have been described in the literature for the end – stage renal disease patients on maintenance hemodialysis [14]. These include the serum Alb levels and geriatric nutritional risk index developed by modifying the nutritional risk index for elderly patients [6], the malnutrition - inflammation score (MIS) [15], the nutritional screening tools objective score of nutrition on dialysis (OSND) [16], the malnutrition screening tool (MST) [17], the malnutrition universal screening tool (MUST) [18], the nutritional screening tools nutritional risk score (NRS) [19] and the mini nutritional assessment (MNA) [20]. This research study could not improve the serum Alb levels and GNRI in the octogenarian CE persons (Table 1).

This research study demands mass of skeletal muscle, function of skeletal muscle, skeletal fatty mass [16], bone, and cardiac muscle to assess the effect for sarcopenia baseline characteristics (the CE and CKD groups) and the 6 weeks after treatment (the CE group). The data of skeletal muscle areas, function, and bone (BMI, the serum AST, c - Ca levels, AC, AMA, and AMC), and the data of cardiac muscle (the serum AST levels) were not significantly investigated (Tables 1, 3 - 5). In contrast, the data of TSF might demand only skeletal fatty mass at the 6 weeks after treatment in the octogenarian CE persons. However, the observed decrease of the serum LDL - Chol levels was not significant in the octogenarian CE persons. This clinical and research study indicates on the assumption that the elevated AST / ALT ratio is predictive of long terms of chronic liver disease including the non - alcoholic fatty liver disease with the decrease levels of the HDL - Chol levels [21].

In general, the serum Alb levels may be low and the serum TP levels may be high or normal in liver dysfunction. Furthermore, our findings suggested that the decrease of the serum Alb and A / G levels, and the normal levels of the serum TP had liver dysfunction probably due to chronic liver disease in the octogenarian CE persons. Moreover, the serum AST / ALT ratio were significantly increased at the 6 weeks after treatment [21] (Table 3). Consequently, we had found chronic liver damage in the octogenarian CE persons in this research study.

This study is associated with several potential limitations. A limitation of the present study was the observational nature of the study performed in a prospective and controlled design with small sample size at the Mitsumi Long-term Care Heath Facility with neither x - ray photography nor ultrasonography. Thus, this study was an observational study of daily clinical practice. The need for the two – three / day additional CE may partially reflect the physiological senile changes that are commonly found in the octogenarian individuals.

Conclusion

The administration of a / day additional CE was proved to be an ineffective therapy for treating malnutrition in the octogenarian CE persons. In fact, TSF mass at the 6 weeks after treatment was significantly increased with the decrease of the serum HDL - Chol levels. Finally, we can safely assume that chronic liver damage was due to the decrease of the serum Alb levels and A / G, the elevation of the serum AST / ALT ratio, and the normal levels of the serum TP in the octogenarian CE persons in this clinical study.

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