Original Article

Decline in anthropometric evaluation predicts a poor prognosis in geriatric patients

Rie Tsutsumi PhD[1], Yasuo M. Tsutsumi MD, PhD[2], Yousuke T. Horikawa MD, PhD[2], Yozo Takehisa MD[3], Toshio Hosaka MD, PhD [1], Nagakatsu Harada PhD [4], Tohru Sakai PhD[1], Yutaka Nakaya MD, PhD [4]

[1] *Department of Public Health and Applied Nutrition, Institute of Health Biosciences, The University of Tokushima, Japan*
[2]*Department of Anesthesiology, Institute of Health Biosciences, The University of Tokushima, Japan*
[3] *Hakuai Kinen Hospital, Tokushima, Japan*
[4] *Department of Nutrition and Metabolism, Institute of Health Biosciences, The University of Tokushima, Japan*

Objective: Malnutrition is frequent in the geriatric population and is often undetected and untreated. Although we often use serum albumin as a nutritional marker, it has limitations in elderly patients in terms of predicting diseases and infections. Anthropometric measurements are not commonly used, despite their simple, easy, and effective characteristics. We evaluated the associations between anthropometric measurements with other nutritional factors and examined its relationship with mortality, decubitus ulcer, length of hospital stay and antibiotic usage. Research methods and procedures: We enrolled 223 patients, performed anthropometric measurements and then followed them for a mean of 24 months. Results: Patients with hypoalbuminemia but with normal body measurements tended to increase serum albumin levels over the next 24 months and had more favorable outcomes including being discharged. Patients with normal albumin but decreased body measurements resulted in a progressive drop in serum albumin and had a higher mortality rate. Additionally, patients with hypoalbuminemia had higher antibiotic usage than patients without hypoalbuminemia. Decreases in anthropometric measurements were related to mortality, length of hospital stay, and decubitus ulcer. Conclusions: Anthropometric measurements are easily obtained and closely associated with mortality, decubitus ulcer, and length of hospital stay. Anthropometric measurements used in conjunction with serum albumin are more predictive of patient outcome then serum albumin alone.

Key Words: anthropometric measurements, geriatrics, serum albumin, mortality, decubitus ulcer

INTRODUCTION

Protein energy malnutrition (PEM) is quite prevalent and common in hospitalized patients, especially in the geriatric population. Malnutrition in hospitalized patients is estimated to affect 20% to 60% of all newly admitted inpatients.[1-3] PEM is constantly observed in medical, obstetric, psychiatric, and surgical patients at a relatively high frequency.[4,5] Malnutrition is associated with increased morbidity and complications, and leads to increased length of hospital stay and rehabilitation costs.[6] Many elderly patients are at higher risk because of their low incomes, food preference, and overall health status.[7,8] Thus, identification of malnourished patients is important so that an appropriate nutritional strategy/regimen can be followed.

Many different methods are used to assess an individual's nutritional status including: laboratory evaluation, history, physical examination, body composition and screening tools such as mini nutritional assessment, subjective global assessment (SGA), and nutritional risk screening (NRS2002). Biochemical methods are more sensitive than other methods in showing recent changes in nutritional status.[9,10] However, there are no clear criteria for interpretation in the elderly population. Laboratory tests that may reflect PEM are serum proteins, urine creatinine, immune-function parameters, serum cholesterol and hemoglobin.

Serum albumin levels have long been considered the primary measure of malnutrition and the defining value for diagnosing kwashiorkor. Many patients while hospitalized tended to have decreased serum albumin levels, which increased in severity as the hospital stay was prolonged.[2] Early recognition of malnutrition is an important

Corresponding Author: Dr Rie Tsutsumi, Department of Public Health and Applied Nutrition, Institute of Health Biosciences, The University of Tokushima Graduate School, 3-18-15, Kuramoto, Tokushima, 770-8503, Japan.
Tel. +81-88-633-7450; Fax. +81-88-633-9427
Email: rtsutsumi@nutr.med.tokushima-u.ac.jp
Manuscript received 2 November 2010. Initial review completed 12 May 2011. Revision accepted 8 August 2011.

step towards instituting nutritional support in a timely manner and optimizing patient outcome. However, the nutritional assessment methods currently available are not ideal for detecting patients at risk. Moreover, they are time consuming, expensive, and often require highly trained personals, and consequently, assessment of every patient is not feasible.

An optimal nutrition assessment test should be capable of detecting organic functional impairment resulting from malnutrition. To be clinically important, an optimal method should be able to predict whether the individual is likely to have increased morbidity and mortality in the absence of nutritional support. The ability to screen for malnutrition with simple, reliable tools used by non-specialized personal would decrease the workload of the nutritional support team without compromising patient safety. Patients identified as being at risk could then be assessed by conventional methods.

In this study, we used well-established nutritional assessment methods, like serum albumin levels and anthropometry measurements, to determine the prevalence of malnutrition in elder patients admitted to our hospital. The aim of this study was to assess the nutritional status of geriatric medical patients staying in our hospital for more than 1 year, to evaluate current prevalence of chronic malnutrition. We further wanted to evaluate whether anthropometry and serum albumin levels alone, or both in combination were useful to identify patients with malnutrition. This would enable us to anticipate and predict hospital length of stay, morbidity, mortality, and risk of decubitus ulcers.

MATERIALS AND METHODS

Patients

Data were collected in the Hakuai Kinen Hospital (Tokushima, Japan) and the study protocol was approved by the Human Research Ethics Committee of the Hakuai Kinen Hospital. Two hundred and twenty-three patients aged 65 years or older, who were admitted to the Hakuai Kinen Hospital between March 2003 and February 2005 were enrolled. These patients were from acute medical units from other hospitals or from home and transferred to our geriatric rehabilitation or long-term care unit in internal medicine. The most frequent medical diagnoses were pulmonary disease, congestive heart failure, and cerebral vascular accident. Patients with cirrhosis, severe diabetes, or near terminal disease were excluded.

Demographic characteristics, primary and secondary disease and previous surgeries or medical care were recorded in all patients. The dietitian recorded these parameters after SGA and performed the screening tests that were studied.

Patients were divided into 4 groups by protein levels, defined by albumin concentration, and energy status, triceps skinfold thickness (TSF), and arm muscle circumference (AMC). Group A or patients with normal serum albumin and normal body composition were defined as patients whose serum albumin level was >3.5 mg/dL and TSF and AMC were >90% of average normal values at the beginning of monitoring. Group B or patients with hypoalbuminemia and normal body composition were those patients whose serum albumin level was $\leq$3.5 mg/dL but TSF and AMC were >90%. Group C or patients with normal serum albumin and decreased body composition were defined as patients with serum albumin level was >3.5 mg/dL but TSF and AMC were $\leq$90%. Finally, Group D or patients with both hypoalbuminemia and decreased body composition were patients with serum albumin level was $\leq$3.5 mg/dL and TSF and AMC were $\leq$90%.

A prospective follow-up study was performed for 12 months with regard to mortality, decubitus ulcer formation, length of hospital stay, and antibiotics usage.

A multidisciplinary medical group consisting of a geriatrician, nurses, pharmacists, physical therapists, language therapists, dietitians and a social worker participated in this study. The patients' chart was reviewed to determine the recording of nutritional assessment by the physicians, nurse and dietitian. Documentation of height, weight, weight loss, oral intake and decreased appetite, gastrointestinal review of systems, functional status, albumin levels, and classification of nutritional status was noted. In addition, inclusion of nutrition as a significant medical problem in the problem list was noted.

Anthropometric measurements

Body weight, height and body mass index (BMI) (weight/height^2) were recorded. Of patients, 74% were immobilized or bedridden and measurements were done in supine position.[9] Measurements of height and weight of the immobilized patients were estimated by measuring length of knee using a knee height caliper.[11,12] TSF at midpoint of the non-dominant arm was measured with standard calipers (Adipometer skinfold calipers, Abbot Laboratories, Japan, Tokyo, Japan). Mid-arm circumference (MAC) was measured at the same location in a resting position by the same operator and the average of three consecutive measurements was calculated. MAC was calculated as follows; mid-arm muscle circumference (cm) = mid-arm circumference (cm) – (3.1415×TSF [cm]).[13] AC, AMC, and TSF values were compared to age- and sex-matched reference values for Japanese Anthropometric Reference Data (JARD2001).

Dietary intake

Patients received a normal diet given at Hakuai Kinen Hospital, supplying an average of 1,700 kcal/day with proportions of approximately 60% carbohydrates, 25% lipids and 15% proteins. The information regarding eating habits and the amounts of food consumed were obtained from nurse records and patients' families. To avoid day-to-day variations and transient changes, food intake was recorded at least 10 times every week.

Statistical analysis

All results are expressed as mean$\pm$standard deviation. The differences between groups, and diagnosis classifications were analyzed by two-way functional ANOVA, using Statview 5.0, with post-hoc Bonferroni test. A correlation coefficient was calculated using Microsoft Excel. Statistical significance was set at $p<0.05$ for all tests.

RESULTS

Patient and group demographics

Table 1. Characteristics of the study population at baseline.

	A:(n=26) Men	A: (n=40) Women	B: (n=20) Men	B: (n=33) Women	C: (n=19) Men	C: (n=36) Women	D: (n=18) Men	D: (n=31) Women
Age (y)	76±10	77±12	75±9	78±13	79±12	79±11	80±13	80±11
Alb(g/dL)	3.78±0.21	3.82±0.34	3.13±0.22	3.24±0.23	3.87±0.37	3.95±0.34	3.18±0.39	2.98±0.39
TP (g/dL)	7.31±0.67	7.11±0.78	6.45±0.42	6.12±0.65	6.72±0.54	6.97±0.67	6.02±0.75	6.10±0.64
TC(mg/dL)	180.4±27.5	178.6±29.7	168.2±20.5	176.4±18.6	180.5±14.3	186.6±23.4	169.4±18.7	160.6±28.7
Hb (g/dL)	12.8±1.56	11.8±1.76	11.9±0.98	11.0±1.43	12.0±1.09	11.2±1.32	11.1±0.99	10.6±0.89
BUN(mg/dL)	18.1±4.21	17.8±3.69	17.5±3.65	14.8±3.97	17.5±4.08	17.9±5.32	15.7±4.35	14.8±4.56
Cre (mg/dL)	0.83±0.16	0.86±0.21	0.99±0.25	0.91±0.66	0.82±0.30	0.87±0.42	0.86±0.16	0.74±0.41
TSF (%)	109±17.4	114±16.8	110±21.2	107±17.9	69.9±21.6	67.8±19.8	63±20.5	58.6±25.3
AC (%)	118±9.7	105±10.5	102±14.6	101±16.1	83.1±13.1	79.7±15.7	69.9±18.7	65.6±20.4
AMC (%)	99.7±10.8	101±9.8	98.7±12.7	100±9.9	85.3±17.7	78.4±10.5	70.1±19.6	69.3±21.5
AMA (%)	101±10.7	106±10.3	98.9±7.9	99.8±11.2	79.7±16.3	75.7±16.8	68.6±20.4	63.6±24.7

Age, albumin (Alb), total protein (TP), hemoglobin (Hb), blood urea nitrogen (BUN), creatinine (Cre), triceps skin fold (TSF), arm circumference (AC), arm muscle circumference (AMC), and arm muscle area (AMA) were measured for men and women at baseline. There were no significant differences between men and women. Group A (Alb >3.5 mg/dL, TSF and AMC >90%), Group B (Alb ≤3.5 mg/dL, TSF and AMC >90%), Group C (Alb >3.5 mg/dL, TSF and AMC ≤90%) and Group D (Alb ≤3.5 mg/dL, TSF and AMC ≤90%)

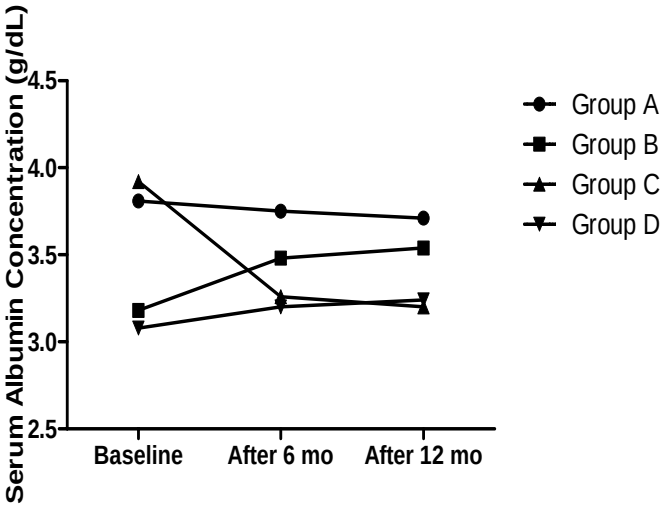


Figure 1. Serum albumin changes over twelve months. Patients with normal anthropometry measurements were able to maintain or improve serum albumin over twelve months (Groups A and B). However patients with decreased anthropometry measurements displayed a severe decline in serum albumin levels over twelve months.

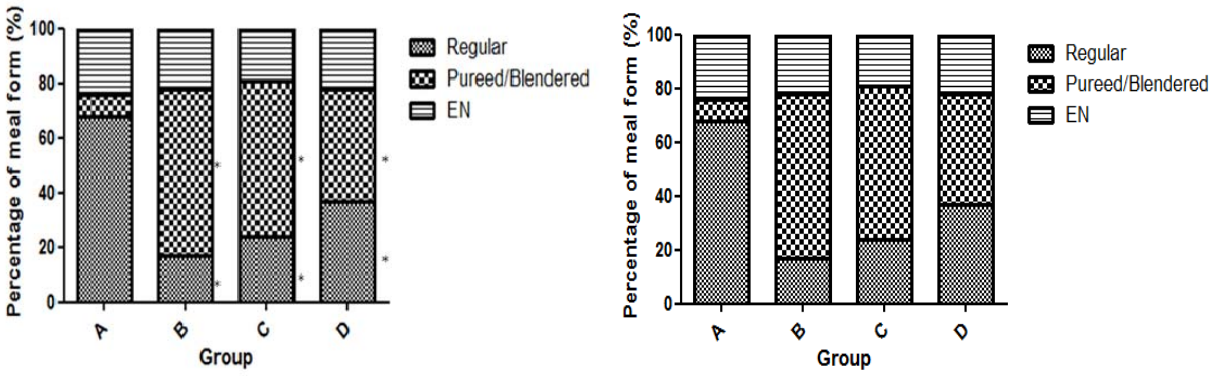
The patient and group demographics are shown in Table 1. The study population consisted of 223 patients whose mean age was 78 years and was 37% male. The most common indication for hospitalization was cardiovascular disease followed by various infectious conditions. When we defined hypoalbuminemia as below 3.5 mg/dL of serum albumin and decreased body composition as fewer than 90% of JARD baseline, 102 patients (45.7%) had hypoalbuminemia and 104 patients (46.6%) had decreased body composition. Of the total 223 patients, 66 patients (26 men and 40 women) were divided into group A, group B consisted of 53 patients (20 men and 33 women), group C had 55 patients (19 men and 36 women), and group D had 49 patients (18 men and 31 women). Some patients who presented with hypoalbuminemia were recognized as malnourished and were already under nutritional care prior to the start of this study.

Long-term albumin status varies with anthropometric measurements

Serum albumin levels of patients in group A (Alb >3.5 mg/dL, TSF and AMC >90% showed tendency to decrease during 12 months of monitoring (Figure 1, p=0.06). Patients in group B (Alb ≤3.5 mg/dL, TSF and AMC >90%) significantly increased in serum albumin levels (p<0.05) whereas those in group C (Alb>3.5 mg/dL, TSF and AMC≤90%) significantly decreased (Figure 1, p<0.05). Patients in group D (Alb ≤3.5 mg/dL, TSF and AMC ≤90%) did not show any significant changes (Figure 1). The value of anthropometric measurements during 12 months had no significant change in each group (data not shown).

Patients with higher anthropometric measurements had increased diets

Patient meals were classified into 3 diets: normal/tender diets, pureed/chopped diets for patients with difficulty chewing foods, and finally liquid diets that could be taken orally, via nose, stomach or intestine. Most patients in group A ate a normal/tender diet compared to pureed/chopped diets (p<0.05). Patients in group B and C were mostly on pureed/chopped diets, which was significantly greater than group A (p<0.05). Patients in group D were split evenly between the 3 diets (Figure 2A).



2A **2B**

Figure 2. A. Meal compositions and consumption. Significantly more patients in group A were eating a normal/regular diet, however, patients in the other groups had a larger proportion of pureed foods. Interestingly, enteral feeds (EN) did not change significantly between the groups. B. As expected patients in group A ate the largest percentage of their meals. Patients with decreased anthropometry measurements also had decreased food intake.

Table 2. Percentage of decubitus ulcers, discharged patients, mortality, and antibiotic usage.

	Group A	Group B	Group C	Group D
Decubitus ulcer	3.2%	14.6%	9.8%	18.9%
Discharged	30.8%	22.1%	26.3%	5.4%
Mortality	4.3%	25.2%	34.2%	46.3%
Antibiotic usage	5.6% (4 d/m)	39.3% (110 d/m)	19.5% (45 d/m)	51.6% (363 d/m)

Data was collected over a 2 year period and reported as percentages of the group. Total number of antibiotic usage days per month is reported in parenthesis.

Patients in group A and group B had the largest meal intake whereas patients in group C and D had lower meal intake (Fig. 2B, A vs. C or D; B vs. C or D, $p<0.05$).

Serum albumin and anthropometric measurements are important in predicting decubitus ulcers, mortality, and antibiotic usage.

Group A had the fewest patients who developed decubitus ulcers at 3.2%, while groups B and D had the most patients that developed ulcers at 14.6 % and 18.9%, respectively (Table 2). Interestingly, 79.5% of patients who developed decubitus ulcers had serum albumin levels less than 3.4 g/dL with a correlation coefficient of 0.694. Of these patients 53.4% also had anemia with hemoglobin levels less than 11.0 g/dL. Patients in group A had the highest percentage of discharge and the least mortality, whereas group D had the least percentage of discharges and the highest mortality (Table 2). Although patients in group B had a lower discharge percentage than in group C, mortality was lower in group B suggesting a better predictive value of anthropometric measurements over albumin. 65% of all discharged patients were able to maintain their fat and muscle content (Data not shown). Interestingly, patients with hypoalbuminemia and anemia had a high mortality rate (38.5% and 41.1% over 2 years). Out of the patients who did not survive, 96.3% had hypoalbuminemia, 76.4% had anemia, 74.2% had decreased TSF, and 66.9% of the patients had decreased AMC (Data not shown).

The inflammatory response is highly related to malnutrition and was closely related to albumin levels. 51.9% of patients in group D used antibiotics and 39.3% of group B (Table 2). 82% of all patients using antibiotics had hypoalbuminemia. Of these patients 54.8% also had anemia. Patients in group D had the most frequent antibiotic usage as well as the most total antibiotic days/month (Table 2). Interestingly, when patients were divided into anemic or non-anemic, patients with anemia used antibiotics as frequently as patients in group D (450 total days per month and 10.0 days per person), suggesting another correlation between hypoalbuminemia and anemia.

Subjective global assessment (SGA) correlates with anthropometric and albumin measurements

SGA calculated that 134 (60%) of all patients were malnourished, with 37 (16.6%) being severely malnourished (SGA-C) and 57 (25.6%) being moderately malnourished (SGA-B). Nearly all patients in group A and nearly half of patients in group B were assessed to be well nourished, whereas, patients in group C and D were assessed to be mainly moderately to severely malnourished (Table 3). The agreement degree between these 4 groups and SGA as measured by kappa index was 0.322.

DISCUSSION

Our results demonstrate that when using anthropometry in conjunction with serum albumin that malnutrition is widely prevalent among hospitalized patients in our hospital even though individual nutritional care is provided. Secondly, our data suggests that anthropometry is more useful than serum albumin to predict mortality and length of hospital stay. Finally, our results suggest that measuring albumin alone may not be sufficient to assess nutritional status.

Table 3. Relationship with subjective global assessment (SGA) evaluation.

	Group A	Group B	Group C	Group D
Well-nourished	92.4%	49.1%	3.6%	0
Mild	7.6%	39.6%	14.5%	12.2%
Moderate	0	9.4%	54.6%	44.9%
Severe	0	1.9%	27.3%	42.9%

Identification of malnutrition depends upon its definition. Various countries define malnutrition differently.[14-16] Other investigators have suggested an interplay between disease and malnutrition. In our investigation we did not observe higher rates of malnutrition in cancer patients when compared to the patients without cancer as been suggested by other authors.[17,18] However, some publications suggested that cancer patients had higher malnutrition and that aging may be the contributing factor.[19-22] Nutrition plays an important role in maintaining health especially in the elderly.[22-24] Therefore, special nutritional care with efficient management is required in the elderly.

In order to investigate why malnutrition was so prevalent in our hospital we decided to look at our local nursing home where the elderly population received the same style of meal as our inpatients. Although nutrition was better at the nursing home to our surprise we found nearly 38% of the nursing home population to be malnourished by serum albumin screening alone (data not shown). We believe that the reason why so many of our inpatients were found to have PEM is likely because by the time they are transferred from acute care hospitals they are already malnourished due to their illness or inability to maintain nutrition. However, we found that even fully-nourished people may develop PEM after they are admitted in the hospital. Therefore, we believe that PEM may progressively develop due to decreased intake during the patients' stay. This is further supported by our data with regard to percentage of food consumed (Fig 2B). Even if appropriate caloric demand for each patient is calculated, the patient may not be able to ingest the entire meal.

Traditionally, serum albumin has been used to identify malnutrition and is still in use in Japan.[25,26] However, serum albumin levels alone are not completely sufficient to predict prognosis and although it is simple to measure, it has some limitations.[27] We showed that our patients with hypoalbuminemia, but with normal body composition were generally able to improve their serum albumin levels (Figure. 1) and as a result hasten discharge time, decrease mortality, and decrease antibiotic use (Table 2). Whereas, serum albumin levels can be affected by infections and inflammatory processes.[28]

To further understand our patients' malnourished background, we studied the relationship between food intake and malnutrition in each group. Although most of the nourished patients were provided with regular meals, about 40% of the patients in group D, with hypoalbuminemia and decreased body composition were also provided with regular meals. Regular meals are ideal for all patients however, many elderly patients are unable to completely eat their meals, especially in group D. In general many of our elderly patients had difficulties finishing their meals, even patients in group A or our nourished patients. Patients stated that they had difficulties eating their meals due to decreased appetite from advanced aging or prolonged hospitalization. In order to address these issues, we provided energy and protein supplemental drinks, although ironically this additional fluid added to their sensations of being full. Excluding patients receiving enteral nutrition, percent of total meal consumption varied amongst each group. Interestingly, patients with decreased body composition tended to have worse appetites. Not only did these groupings help identify malnutrition but also helped identify patient prognosis and outcome. We often see decubitus ulcers in malnourished patients, and as expected we observed a 6-fold higher increase in patients in group D, with hypoalbuminemia and decreased body composition, as compared to the patients in group A, with normal albumin level and normal body composition. We also found that mortality was also higher in those patients, by nearly 10-fold. Likewise, one third of patients with normal serum albumin and body composition were successfully discharged, whereas most of patients with hypoalbuminemia and decreased body composition could not be discharged as they did not recover sufficiently. Unfortunately, results from patients in group B and C, were not as clear cut, suggesting that other factors such as antibiotic use or other infectious processes may be affecting patient outcomes as we observed in our data. We also observed that many of our patients with hypoalbuminemia tended to have an infectious process and that if the patient was able to maintain body measurements, they had a higher chance of regaining normal albumin levels. As a result, we believe that improving and maintaining adequate serum albumin and body composition are important for both the patient's prognosis and outcome. There are also some interesting reports regarding serum albumin/anthropometric measurements among disabled Japanese elder.[29,30]

Subjective global assessment (SGA) is known as a helpful tool for nutrition assessment.[31,32] Planas *et al*. reported anthropometry identifies more patients with malnutrition than SGA, but they detected that the presence of malnutrition in 33.9% of patients with normal BMI.[33] Therefore they concluded that SGA was a better indicator of disease-related malnutrition than anthropometric data. On the other hand, some publications have shown that malnutrition was underestimated when based on anthropometry instead of the SGA.[34] However, we feel that BMI is less advantageous than anthropometry especially in elderly patients who may have other factors affecting BMI such as edema. We tried to correlate the SGA results and anthropometry assessment, to see if we can consider real muscle and fat amount. In our study, SGA seems to reflect the results of grouping patients with serum albumin level and anthropometric measurement because most of our group A patients (with normal serum albumin and normal body composition) were identified as well-

nourished and most of group D patients (with hypoalbuminemia and decreased body composition) were identified as severely malnourished. Interestingly, patients in group C (with normal serum albumin and decreased body composition) were identified as severely malnourished as equally to patients in group D. These observations suggest that decreased body composition may cause malnutrition without affecting serum albumin. Likewise, severe malnutrition may decrease body composition resulting in a vicious cycle.

CONCLUSION

Each patient is uniquely different and from different backgrounds, disease, and health states. We believe that anthropometric measurements in addition to serum albumin levels better predicts patient prognosis and outcomes. Which allows medical providers to individualize meal plans especially in the elderly, to better increase meal consumption and nutrition.

ACKNOWLEDGEMENTS

This work was supported in part by a Grant-in Aid for Scientific Research (RT:22700749) from the Japan Society for the Promotion of Science, Tokyo, Japan.

AUTHOR DISCLOSURES

None

REFERENCES

1. Edington J, Boorman J, Durrant ER, Perkins A, Giffin CV, James R. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. Clin Nutr. 2000;19:191-5.
2. Waitzberg DL, Caiaffa WT, Correia MI. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. Nutrition. 2001;17:573-80.
3. Kyle UG, Pirlich M, Schuetz T, Lochs H, Pichard C. Is nutritional depletion by Nutritional Risk Index associated with increased length of hospital stay? A population-based study. J Parenter Enteral Nutr. 2004; 28:99-104.
4. Bollet AJ, Owens S. Evaluation of nutritional status of selected hospitalized patients. Am J Clin Nutr. 1973;26:931-8.
5. Gross SJ, David RJ, Bauman L, Tomarelli RM. Nutritional composition of milk produced by mothers delivering preterm. J Pediatr. 1980; 96:641-4.
6. Neelemaat F, Thijs A, Seidell JC, Bosmans JE, van Bokhorst-de van der Schueren MA. Study protocol: cost-effectiveness of transmural nutritional support in malnourished elderly patients in comparison with usual care. Nutr J. 2010;9:6.
7. Linn BS. A protein energy malnutrition scale (PEMS). Ann Surg. 1984;200:747-52.
8. Stratton RJ, Elia M. Deprivation linked to malnutrition risk and mortality in hospital. Br J Nutr. 2006;96:870-6.
9. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, Part II: Laboratory evaluation. Nutrition. 2000;16:131-40.
10. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, part I: History, examination, body composition, and screening tools. Nutrition. 2000;16:50-63.
11. Cockram DB, Baumgartner RN. Evaluation of accuracy and reliability of calipers for measuring recumbent knee height in elderly people. Am J Clin Nutr. 1990; 52:397-400.
12. Jung MY, Chan MS, Chow VS, Chan YT, Leung PF, Leung EM. Estimating geriatric patient's body weight using the knee height caliper and mid-arm circumference in Hong Kong Chinese. Asia Pac J Clin Nutr. 2004;13:261-4.
13. Nursal TZ, Noyan T, Atalay BG, Koz N, Karakayali H. Simple two-part tool for screening of malnutrition. Nutrition. 2005;21:659-65.
14. Soeters PB, Schols AM. Advances in understanding and assessing malnutrition. Curr Opin Clin Nutr Metab Care. 2009;12:487-94.
15. Hoffer LJ. The need for consistent criteria for identifying malnutrition. Nestle Nutr Workshop Ser Clin Perform Programme. 2009;12:41-52.
16. Bross MH, Soch K, Smith-Knuppel T. Anemia in older persons. Am Fam Physician. 2010; 82: 480-7.
17. Strohle A, Zanker K, Hahn A. Nutrition in oncology: the case of micronutrients (review). Oncol Rep. 2010; 24:815-28.
18. Jager-Wittenaar H, Dijkstra PU, Vissink A, van der Laan BF, van Oort RP, Roodenburg JL. Malnutrition and quality of life in patients treated for oral or oropharyngeal cancer. Head Neck. 2011;33:440-6.
19. Wellman NS, Weddle DO, Kranz S, Brain CT. Elder insecurities: poverty, hunger, and malnutrition. J Am Diet Assoc. 1997;97:S120-2.
20. Lyder CH. Assessing risk and preventing pressure ulcers in patients with cancer. Semin Oncol Nurs. 2006;22:178-84.
21. Hutton JL, Baracos VE, Wismer WV. Chemosensory dysfunction is a primary factor in the evolution of declining nutritional status and quality of life in patients with advanced cancer. J Pain Symptom Manage. 2007;33:156-65.
22. Mamhidir AG, Kihlgren M, Soerlie V. Malnutrition in elder care: qualitative analysis of ethical perceptions of politicians and civil servants. BMC Med Ethics. 2010; 11:11.
23. Drewnowski A, Warren-Mears VA. Does aging change nutrition requirements? J Nutr Health Aging. 2001;5: 70-4.
24. Arends J. Metabolism in cancer patients. Anticancer Res. 2010;30:1863-8.
25. Spiekerman AM. Proteins used in nutritional assessment. Clin Lab Med. 1993;13:353-69.
26. Mojon P, Budtz-Jorgensen E, Rapin CH. Relationship between oral health and nutrition in very old people. Age Ageing. 1999;28:463-8.
27. Covinsky KE, Covinsky MH, Palmer RM, Sehgal AR. Serum albumin concentration and clinical assessments of nutritional status in hospitalized older people: different sides of different coins? J Am Geriatr Soc. 2002;50:631-7.

28. Fuhrman MP, Charney P, Mueller CM. Hepatic proteins and nutrition assessment. J Am Diet Assoc. 2004;104:1258-64.
29. Kaburagi T, Hirasawa R, Yoshino H, Odaka Y, Satomi M, Nakano M, Fujimoto E, Kabasawa K, Sato K. Nutritional status is strongly correlated with grip strength and depression in community-living elderly Japanese. Public Health Nutr. 2011:14:1893-9.
30. Okada K, Enoki H, Izawa S, Iguchi A, Kuzuya M. Association between masticatory performance and anthropometric measurements and nutritional status in the elderly. Geriatr Gerontol Int. 2010;10:56-63.
31. Pirlich M, Lochs H. Nutrition in the elderly. Best Pract Res Clin Gastroenterol. 2001;15:869-84.
32. Makhija S, Baker J. The Subjective Global Assessment: a review of its use in clinical practice. Nutr Clin Pract. 2008;23:405-9.
33. Planas M, Audivert S, Perez-Portabella C, Burgos R, Puiggros C, Casanelles JM, Rossello J. Nutritional status among adult patients admitted to an university-affiliated hospital in Spain at the time of genoma. Clin Nutr. 2004;23:1016-24.
34. Kyle UG, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: a population study. Clin Nutr. 2006;25:409-17.

Original Article

Decline in anthropometric evaluation predicts a poor prognosis in geriatric patients

Rie Tsutsumi PhD[1], Yasuo M. Tsutsumi MD, PhD[2], Yousuke T. Horikawa MD, PhD[2], Yozo Takehisa MD[3], Toshio Hosaka MD, PhD [1], Nagakatsu Harada PhD [4], Tohru Sakai PhD[1], Yutaka Nakaya MD, PhD [4]

[1] Department of Public Health and Applied Nutrition, Institute of Health Biosciences, The University of Tokushima, Japan
[2]Department of Anesthesiology, Institute of Health Biosciences, The University of Tokushima, Japan
[3] Hakuai Kinen Hospital, Tokushima, Japan
[4] Department of Nutrition and Metabolism, Institute of Health Biosciences, The University of Tokushima, Japan

體位指標偏低可預測年老病人較差的預後

目的：老年人經常有營養不良的現象，且常未被察覺及治療。雖然血清白蛋白通常被當做一個營養指標，但它對於年老的病人疾病及感染的預測力有限。儘管體位測量簡單、容易及有效，卻不常被使用。我們評估體位測量值與其他營養因素的相關性，並且檢測它們與死亡率、褥瘡性潰瘍、住院天數及抗生素使用量之關聯。研究方法及流程：納入 223 名病人，執行體位測量，隨後平均追蹤 24 個月。結果：血清白蛋白偏低但體位測量指數正常的病人，在接下來的 24 個月裡，血清白蛋白量有增加的趨向，且預後較佳，包括出院。病人有正常的血清白蛋白但是體位測量值偏低者，追蹤結果顯示血清白蛋白值會逐漸降低，且有較高死亡率。此外，血清白蛋白偏低的病人，比起沒有低白蛋白血症者，有較高的抗生素使用劑量。體位測量值偏低與死亡率、住院天數及褥瘡性潰瘍具有相關性。結論：體位測量值較容易取得，並與死亡率、褥瘡性潰瘍及住院天數有密切相關。結合體位測量值與血清白蛋白值，比起單獨檢視血清白蛋白，可更佳預測病人出向。

關鍵字：體位測量、老年人、血清白蛋白、死亡率、褥瘡性潰瘍