Ⅳ　研究成果の刊行物・別刷

effect in relation to myocardial infarction.[9] This is in line with various findings in an animal model,[10] yet our study does not show evidence of an association between CETP and CHD mortality in Caucasian men and women aged 55 and older. These findings combined suggest that the effect of the I405V CETP polymorphism may be relevant for CHD morbidity but that, by itself, its role is limited in terms of mortality. Further research aiming at the elucidation of the role of CETP in the metabolism of cholesterol and cellular functions will be pivotal for understanding CHD risk.

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ASSOCIATION BETWEEN FEEDING VIA PERCUTANEOUS ENDOSCOPIC GASTROSTOMY AND LOW LEVEL OF CAREGIVER BURDEN

To the Editor: Percutaneous endoscopic gastrostomy (PEG) has become the preferred method of providing enteral tube feeding to older people who have difficulty eating.[1] Although a number of studies have been conducted to evaluate the effects of long-term nutritional support via a PEG tube on the outcomes of the patients, including mortality and morbidity, the outcomes of PEG placement from a caregivers' perspective has received little attention. Over the years, research on family caregivers has consistently demonstrated that greater caregiver burden relates to poorer mental and physical health,[2,3] but little attention has been paid to the effect that providing care to a family member with PEG placement has on caregivers. This study assessed the caregiver burden of patients who underwent PEG tube placement and compared it with that of those who feed via other nutritional routes.

The present study consisted of a cross-sectional analysis of the baseline data of a subgroup of participants in the Nagoya Longitudinal Study of Frail Elderly.[4,5] The study population consisted of 1,196 caregivers (mean age ± standard deviation 63.9 ± 12.3, 75.7% female, 43.7% spouse, 33.2% adult child, 20.2% daughter-in-law, 3.0% other) and matched care recipients who were community-dwelling older people (aged 80.8 ± 8.2, 63.4% female) and were provided various home care services under the long-term care insurance (LTCI) program. The data included clients' demographic characteristics, a rating for 10 activities of daily living (range 0–20, mean score 11.4 ± 6.7), a rating for instrumental activities of daily living (IADLs, range 0–8, mean score 2.5 ± 2.4), and the Charlson Comorbidity Index (mean score 2.1 ± 1.6). Severity of dementia was evaluated according to the criteria provided by the public LTCI policy, which are classified into five levels (42.0% had at least some cognitive impairment).[6] The routes of nutrition and types of diet were classified into five categories: oral intake (1, solid regular-texture diet; 2, modified-texture diet (a minced or pureed texture); 3, nasogastric tube feeding; 4, PEG tube feeding; and 5, oral intake with enteral nutrition). Data were also obtained from caregivers concerning their own personal demographic characteristics, and their subjective burden as assessed using the Japanese version of the Zarit Burden Interview (ZBI, mean score 28.8 ± 17.0).[7] One-way analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used to compare caregiver burden according to the groups of nutrition routes and types of diet. Covariates of ANCOVA included relationship to the care recipient, IADL score, and cognitive levels. ANOVA with a Bonferroni correction for multiple comparisons was used to determine the difference in ZBI scores between groups.

Table 1. Routes of Nutrition, Types of Diet, and Caregiver Burden Score

Route of Nutrition and Type of Diet	Unadjusted*	Adjusted†
	Mean ± Standard Error	
Oral intake		
Solid regular-texture diet (n = 885)	27.9 ± 0.6‡	29.2 ± 0.6§
Modified-texture diet (n = 239)	31.8 ± 1.1‡	28.6 ± 1.1§
Tube feeding		
Via nasogastric tubes (n = 13)	32.2 ± 4.4	25.6 ± 4.5
Via percutaneous gastrostomy (n = 44)	29.3 ± 2.6	21.0 ± 2.6§
Oral diet with tube feeding (n = 15)	34.3 ± 3.7	30.1 ± 4.2

*One-way analysis of variance.

†Analysis of covariance: covariates include relationship to care recepient, instrumental activity of daily living (IADL) score, and cognitive levels, which were significantly associated with the Zarit Burden Interview score in a stepwise multiple linear regression analysis. Incorporated variables were caregiver's age, caregiver's sex, activity of daily living score, IADL score, relationship, cognitive levels, Charlson Comorbidity Index, frequency of day care service use, and number of family members.

$P <$ ‡.05, §.01.

Table 1 provides a comparison of ZBI scores between groups. In the crude model (ANOVA), there were significant differences in ZBI score between a solid regular-texture diet and a modified-texture diet ($P < .05$), but no differences were observed between the other groups. In the adjusted model (ANCOVA), of the five groups, the lowest ZBI score was observed in caregivers with PEG use, and there were significant differences in ZBI score between the PEG group and the oral intake groups (solid regular-texture diet, $P < .01$; modified-texture diet, $P < .01$).

The present study demonstrated that receiving enteral nutrients via PEG is associated with the lowest level of caregiver burden after adjusting for covariates and that a higher burden is observed for caregivers of participants who receive oral feedings. The participants in the present study were older people living in the community with functional disabilities. Therefore, even if they were receiving oral feedings, many caregivers seem to be engaged in feeding them. It is assumed that oral feeding for disabled elderly people is often difficult, time-consuming, and demanding for caregivers. It has been demonstrated that eating difficulties in older patients lead to a considerable burden for caregivers.[8] PEG placement may reduce the time required for assisted feeding, although our results do not encourage PEG placement for elderly people only because of the association between PEG use and the low levels of caregiver burden. Even when caregiver time is limited, it is unacceptable to initiate tube feeding via PEG merely to facilitate care or reduce care burden. Efforts to enhance oral feeding by altering the environment and creating patient-centered approaches to feeding should be part of routine care for patients with difficulty eating. Nevertheless, the association between feeding via PEG and a low level of caregiver burden is another consideration in decision-making for long-term enteral feeding in older adults.

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UPTAKE OF INFLUENZA VACCINATION IN DUTCH NURSING HOME PERSONNEL FOLLOWING NATIONAL RECOMMENDATIONS

To the Editor: Because recent studies have demonstrated substantial benefits from routine influenza vaccination in healthcare personnel of long-term care institutions, the Dutch association of nursing home physicians (Nederlandse Vereniging van Verpleeghuis Artsen) issued a guideline on influenza vaccination in nursing homes in 2004.[1] The disrupting effect of influenza on nursing home care has been acknowledged, and vaccinating healthcare workers against influenza reduces the occurrence of influenza infections and associated productivity loss.[2–4] Even more important, frail patients who may benefit less from immunization against influenza are indirectly protected by a reduction of influenza virus transmission.[4–6] Before the guideline, vaccine uptake in Dutch personnel was 5% to 8%.[1] Considering the fact that influenza vaccination rates in recommended patient groups in the Netherlands are among the highest in the world, such an uptake is extremely low. It was therefore hypothesized that introducing a national guideline might result in substantial improvement.

PARTICIPANTS, METHODS, AND RESULTS

In October 2005, a self-administered questionnaire was sent to the staff of all Dutch nursing homes (n = 335). Participants reported on uptake of influenza vaccination in patients and personnel in the preceding season (2004–2005 season), whether the institution had a written policy on influenza vaccination for personnel, what the current offering policy was (active request, employee's initiative, or none), and whether personnel were currently offered information on influenza vaccination.

In all, 149 of the 335 (45%) questionnaires were completed and returned. The average vaccination rate was 10.5% for personnel (95% confidence interval of the mean (CI) = 8.7–12.3%) and 90.5% in patients (95% CI = 88.3–92.8%). Only 67 (45%) homes had a written policy. In all, 107 (72%) homes actively requested their employees to be vaccinated. Of homes with a written policy (n = 67), 65 (97%) actively requested their employees to be vaccinated. Of homes in which there was no written policy (n = 72), influenza vaccination was not offered in 27 (37%) and in seven (10%) was offered only if an employee asked for vaccination. Having a written policy, actively requesting personnel to be vaccinated, and informing personnel about influenza vaccination resulted in significantly higher mean vaccination rates in personnel (Table 1).

DISCUSSION

Compared with data from a similar questionnaire study from 2000,[7] only a 5% absolute increase was observed in having a written policy (40% vs 45%), although in homes with a written policy, the proportion with an active request rose substantially, from 22% to 97%. Despite these organizational improvements, the uptake of influenza vaccination in personnel did not improve substantially (from 5–8% before to 11% in the year after the introduction of the guideline). The response rate of the previous questionnaire study was higher (73% vs 45%), but similar vaccination rates were found in patients (86% vs 90%). Also, the method used was similar, and bias is therefore highly unlikely. After all, awareness of a newly issued guideline should be most prominent in the first year. Even so, having a written policy, actively requesting personnel to get vaccinated, and informing personnel about influenza vaccination resulted in only slightly higher mean vaccination rates (12%). To implement the guideline successfully, more strategies are clearly needed. International research has shown a number of behavioral and organizational determinants to be of importance in raising vaccination levels among healthcare personnel in general, such as perceived influenza risk and severity, perceived vaccine effectiveness, and easy access to free vaccination.[8–10] Further research is needed to asses which behavioral, organizational, and ethical determinants of vaccine uptake in Dutch nursing home personnel should be focused on when developing an effective influenza vaccination campaign.

Table 1. Effects of Policy Determinants on Mean Influenza Vaccination Rates in Nursing Home Personnel (N = 149)

Policy Determinant	Yes	No	*P*-Value†
	Number of Homes (%*)		
Having a written policy	67 (12.4)	72 (7.8)	.01
Actively requesting personnel to get vaccinated	107 (12.1)	37 (5.3)	.002
Offering information to personnel in any way	111 (11.9)	22 (3.6)	.001

*Mean vaccination rate of nursing home personnel.
†Differences in mean vaccination rates were considered significant if $P < .05$.

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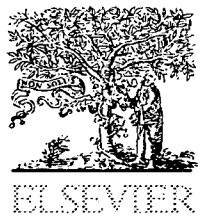

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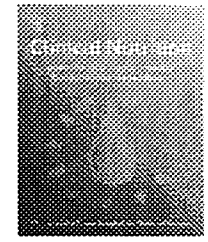

ORIGINAL ARTICLE

Is serum albumin a good marker for malnutrition in the physically impaired elderly?

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Summary
Background and Aims: Although serum albumin is well known as a marker of nutritional status, it has remained unclear whether impaired physical function affects serum albumin concentrations in older people. We examined whether hypoalbuminemia can be used as a marker of malnutrition in elderly subjects with various levels of physical impairment.
Methods: A total of 262 elderly subjects without acute illness were enrolled from various geriatric settings. For the nutritional assessment, serum albumin, total cholesterol, anthropometric measurements, and subjective global assessment (SGA) were determined. Physical function was evaluated by rating score of activity of daily living (ADL).
Results: As a whole, participants' serum albumin levels correlated with various nutritional parameters including anthropometric measurements and levels of serum total cholesterol as well as the SGA evaluation. However, after adjusting for age and gender, serum albumin levels in participants with a low ADL function did not correlate with nutritional parameters. Approximately 80% participants with low ADL function who were evaluated as being well nourished according to SGA evaluation had serum albumin levels lower than 35 g/l.
Conclusions: The utility of serum albumin and the traditional cutoff (35 g/l) in older people with low ADL function is questionable even among those without inflammation.

Introduction

Malnutrition is a common finding in the elderly, not only in institutionalized populations but also in community-dwelling

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elderly, with prevalence rates ranging from 12% to 85%.[1,2] Malnutrition is associated with increased hospitalization, increased susceptibility to infection, decreased wound healing, reduced quality-of-life, and increased mortality in the elderly.[3,4]

Multidimensional screening tools such as subjective global assessment (SGA),[5] and anthropometry measurements such as body mass index (BMI), mid-arm circumference (MAC), calf circumference (CC), and skin-fold thickness are generally considered the most easily obtainable, inexpensive, and noninvasive method by which to assess nutritional state. Biochemical measurements such as serum albumin and total cholesterol are also well known as markers for protein energy malnutrition (PEM).[6,7] Among the biochemical parameters, serum albumin levels have long been considered a major measure of malnutrition. On the other hand, some reports have cautioned against using albumin as a measurement of nutritional status in hospitalized patients.[8–10] The criticism is based on the fact that albumin is inversely correlated with markers of inflammatory activity and can behave as an acute-phase reactant, with markedly reduced levels in the setting of acute illness. In addition, it remains unknown whether impaired physical function affects serum albumin concentrations in older people. Thus, we still do not know whether hypoalbuminemia can be used as a marker of malnutrition for elderly people at various levels of activities of daily living (ADL) impairment, especially in the absence of inflammation or acute illness.

In the present study we examined whether hypoalbuminemia defined by a serum albumin level lower than 35 g/l can be used as a marker of malnutrition in elderly subjects without inflammation or acute illness. In addition we also examined whether physical impairment may affect the serum albumin concentration among well-nourished older people.

Subjects and methods

Subjects

We enrolled 262 consecutive elderly subjects (86 males and 176 females, mean age $\pm$SD: 81.8$\pm$7.5; range: 65–95 years) from our geriatric outpatient clinic ($n = 69$), a nursing home ($n = 56$), and geriatric hospitals ($n = 72$). Among 262 participants 55 participants were receiving tube feeding and there were no participants receiving parenteral nutrition. The participants from geriatric hospitals were transfers from the acute care setting or from nursing homes for the care of chronic diseases or for the rehabilitation. The nutritional assessments were conducted at the admission. Informed consent for participation, according to procedures approved by the institutional review board of Nagoya University Graduate School of Medicine, was obtained verbally from the patients, or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian) and from caregivers. Subjects diagnosed with infection, inflammation, liver disorders, kidney disorders, cancer at least within 2 months, or serum C-reactive protein $\geqq$1.0 mg/dl were not included among the 262 participants to avoid the influence of inflammation on serum albumin levels.

Anthropometric measurements and biochemical markers

BMI is defined as weight in kg divided by height in meters squared. Triceps skin-fold (TSF) was measured with Harpenden calipers over the triceps muscle at the midway point between the acromion and the olecranon process. MAC and CC were measured on the left arm and calf with a tape measure. Arm muscle circumference (AMC = MAC(cm)-$\pi \times$ TSF(mm)/10) and arm muscle area (AMA) were calculated using the standard formula shown below: AMA $cm^2 = (AMC(cm^2))^2/4\pi$. Three repeat measurements were taken to the nearest 0.5 mm, with the mean taken as the true value. All anthropometric measurements were taken at least twice by two different investigators; the reported values are the means of the repeated measurements. Blood samples were collected after an overnight fast. Serum albumin and total cholesterol levels were determined using automated analyzers.

Nutritional status using SGA was conducted by trained dieticians who were blinded to the levels of serum albumin, total cholesterol, and hemoglobin. SGA consists of a brief nutritional history (weight loss during the last 6 months; dietary change; and a short physical examination of subcutaneous fat, muscle mass, and fluid balance).[5] SGA classifies patients as having PEM or moderate PEM or being well nourished; it focuses on medical issues and was constructed mostly from experience with surgical patients, but the use of SGA in older populations has also been validated.[11]

Each site's nursing staff assessed each patient's functional status which included a rating for seven basic ADL (feeding, bathing, grooming, dressing, using the toilet, walking, and transferring) using summary scores ranging from 0 (total disability) to 20 (no disability).[12] Information obtained from medical records included physician-diagnosed chronic conditions comprising the Charlson comorbidity index,[13] which represents the sum of a weighted index that takes into account the number and seriousness of preexisting comorbid conditions.

Definition of malnutrition

A BMI of less than 20 is widely accepted to indicate that the subject is underweight, particularly in well-developed countries, and 18.5 is recommended as a practical lower limit for most populations.[14] Therefore, a diagnosis of malnutrition was made when BMI was less than 18.5 kg/m^2. Serum albumin and total cholesterol levels were used as the biochemical markers of undernutrition: levels lower than 35 g/l of albumin or 3.88 mmol/l (1.5 g/l) of total cholesterol were taken to indicate malnutrition.[15,16]

Statistical analysis

The ADL score (range 0–20) was categorized into three groups with approximately equal number of participants in each group: high ADL function (ADL score $\geqslant$19), mid ADL function (ADL score 2–18), and low ADL function (ADL score $<$2). Differences between ADL function groups were determined by analysis of variance with a Bonferroni

correction, the χ^2 test, or the Kruskal–Wallis test, as appropriate. Partial rank correlation coefficients adjusted for age and gender were used to measure the relationships between serum albumin levels and anthropometric measurements, biochemical markers, and SGA evaluation. To examine the relationships between ADL scores and serum albumin levels, partial-rank correlation coefficients were used after adjusting for age, gender, and AMC or SGA evaluation. The sensitivity and specificity of 35 g/l of serum albumin as a cutoff point for predicting malnutrition based on the various nutritional markers were also calculated. The significance level was set at 0.05. Data evaluation was carried out using the SPSS software package (SPSS Inc., Chicago, USA).

Results

The age, ADL score, Charlson comorbidity index, anthropometric measurements, serum biochemicals (albumin and total cholesterol), and SGA assessment for total participants and groups categorized by ADL score are shown in Table 1.

The group of low ADL function had the highest comorbidity condition, lowest anthropometric measurements, and lowest levels of serum albumin and total cholesterol compared with the mid or high ADL-function group. Of the low, mid, and high ADL-function groups, 28%, 57.4%, and 87.2% were evaluated as being well nourished according to the SGA classification, respectively.

Among all participants, serum albumin levels were well correlated with various nutritional parameters including anthropometric measurements and the levels of serum total cholesterol as well as SGA classification after adjusting for age and gender (Table 2). Among high and mid ADL-function groups there was also good correlation between serum albumin levels and all nutritional makers tested except for AMA and AMC in the high ADL-function group. However, in the low ADL-function group no correlation was observed between serum albumin level and any nutritional marker tested. Among total participants after adjusting for age, gender and ADL score, serum albumin levels were correlated with BMI ($r = 0.202$, $P = 0.002$), MAC ($r = 0.213$, $P = 0.001$), TSF ($r = 0.265$, $P < 0.0001$), CC ($r = 0.190$, $P = 0.003$), serum total cholesterol ($r = 0.275$, $P < 0.0001$), and SGA classification ($r = 0.288$, $P < 0.0001$) but not with

Table 1 ADL and nutritional characteristics.

	Total, $n = 262$		Low ADL function, ADL score ≦1, $n = 82$		Mid ADL function, ADL score = 2–18, $n = 94$		High ADL function, ADL score ≧19, $n = 86$		P
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Men/women (% of male)	86/176	32.8	29/53	35.4	25/69	26.6	32/54	37.2	0.2666*
Age	81.8	7.5	83.6	8.6	82.5	7.3	79.4	5.7	0.0006
Activities of daily living (ADL, range: 0–20)	10.2	8.7	0.2	0.4	10.3	6.1	19.8	0.4	<0.0001
Charlson index	2.1	1.8	2.6	1.5	2.5	1.9	1.3	1.5	<0.0001
Body mass index (BMI, kg/m^2)	19.7	3.9	17.4	2.8	19.5	3.4	22.2	3.9	<0.0001
Midarm circumference (MAC, cm)	22.2	3.7	20.2	3.3	21.9	3.4	24.6	3.1	<0.0001
Triceps skinfold (TSF, mm)	9.8	5.9	7.2	3.8	8.1	4.1	14.5	6.7	<0.0001
Arm muscle circumference (AMC, cm)	19.1	2.8	17.9	2.7	19.4	2.8	20.0	2.5	<0.0001
Arm muscle area (AMA, cm^2)	29.7	8.6	26.1	7.8	30.6	8.7	32.3	8.1	<0.0001
Calf circumference (CC, cm)	27.0	5.2	22.2	3.3	27.4	3.8	31.7	3.5	<0.0001
Albumin (g/l)	36.0	5.7	31.1	4.0	35.6	4.7	41.0	3.3	<0.0001
Total cholesterol (Tch, mmol/l)	4.8	1.1	4.2	0.9	4.8	1.1	5.3	0.9	<0.0001
Subjective global assessment (n, (% of total))									
Well nourished	152	(58.0)	23	(28.0)	54	(57.4)	75	(87.2)	
Moderatly malnourished	87	(33.2)	42	(51.2)	34	(36.2)	11	(12.8)	<0.0001**
Severely malnourished	23	(8.8)	17	(20.7)	6	(6.4)	0	(0.0)	

Age: high ADL vs. low ADL ($P = 0.0006$) or mid ADL ($P = 0.016$). Charlson index: high ADL vs. low ADL ($P < 0.0001$) or mid ADL ($P < 0.0001$).
BMI, MAC, CC: albumin: high ADL vs. low ADL ($P < 0.0001$) or mid ADL ($P < 0.0001$); mid ADL vs. low ADL ($P < 0.0001$).
TSF: high ADL vs. low ADL ($P < 0.0001$) or mid ADL ($P < 0.0001$).
AMC; high ADL vs. low ADL ($P < 0.0001$), mid ADL vs. low ADL ($P = 0.0012$).
AMA: high ADL vs. low ADL ($P < 0.0001$), mid ADL vs. low ADL ($P = 0.0013$).
Tch: high ADL vs. low ADL ($P < 0.0001$) or mid ADL ($P = 0.011$), mid ADL vs. low ADL ($P < 0.0001$).
SD: Standard deviation.
*χ^2-test.
**Kruskal–Wallis test, others were determined by analysis of variance with a Bonferroni correction.

Table 2 Correlation between serum albumin and neutritional variables.

	Total, $n = 262$		Low ADL function, ADL score ≦1, $n = 82$		Mid ADL function, ADL score = 2–18, $n = 94$		High ADL function, ADL score ≧19, $n = 86$	
	r	P	r	P	r	P	r	P
Body mass index	0.482	<0.0001	0.135	0.2370	0.367	0.0010	0.2391	0.039
Midarm circumference	0.485	<0.0001	0.176	0.1230	0.395	<0.0001	0.2511	0.030
Triceps skinfold	0.501	<0.0001	−0.022	0.8500	0.417	<0.0001	0.3978	<0.0001
Arm muscle circumference	0.297	<0.0001	0.205	0.0710	0.285	0.0090	−0.0335	0.775
Arm muscle area	0.281	<0.0001	0.195	0.0870	0.265	0.0160	−0.0384	0.744
Calf circumference	0.636	<0.0001	0.096	0.4010	0.457	<0.0001	0.2957	0.010
Total cholesterol	0.469	<0.0001	0.194	0.0890	0.394	<0.0001	0.2525	0.029
Subjective global assessment (SGA)	0.499	<0.0001	0.199	0.0810	0.258	0.0190	0.5488	<0.0001

ADL: activities of daily living. Data were adjusted for age and gender.
SGA rating: 0, well nourished; 1, moderatly malnourished; 2, severely malnourished.

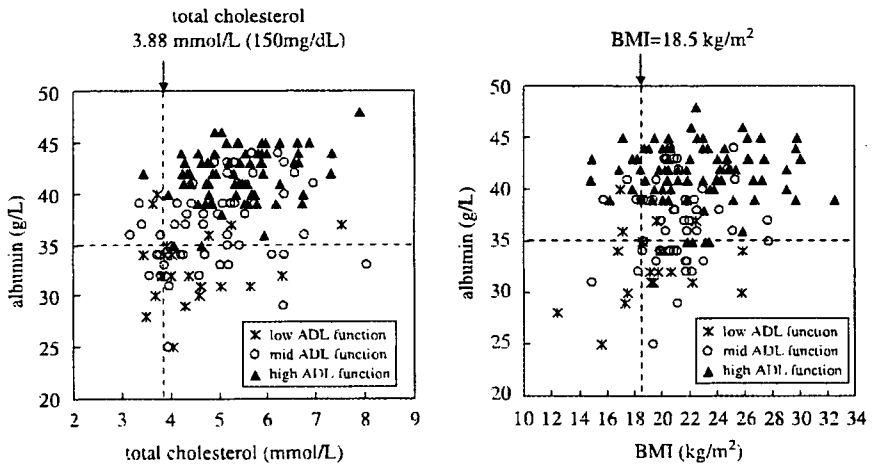

Figure 1 The relationship between levels of serum albumin and total cholesterol or BMI according to the three categories of ADL function among the well-nourished subjects as evaluated by SGA.

AMA ($r = 0.069$, $P = 0.285$) or AMC ($r = 0.086$, $P = 0.183$). Total ADL scores were well correlated with serum albumin concentration after adjusting for gender and age ($r = 0.726$, $P<0.0001$). This correlation persisted after adjusting for SGA classification ($r = 0.650$, $P<0.0001$) or AMC ($r = 0.699$, $P<0.0001$), or both ($r = 0.644$, $P<0.0001$).

Figure 1 shows the relationship between levels of serum albumin and total cholesterol or BMI according to the three categories of ADL function among the subjects evaluated as well nourished by SGA. There were no participants with albumin <35 g/l among the well-nourished high ADL-function group with total cholesterol ≧3.88 mmol/l (150 mg/dl) or BMI ≧18.5 kg/m^2. However, 13 out of 16 participants (81.3%) of the well-nourished low ADL-function group, and 13 out of 44 participants (29.5%) of well-nourished mid ADL-function group had albumin <35 g/l and total cholesterol ≧3.88 mmol/l (150 mg/dl). Furthermore, 12 out of 15 participants (80.0%) of the well-nourished low ADL-function group and 15 out of the 46 participants (32.6%) of the well-nourished mid ADL-function group had albumin <35 g/l and BMI≧18.5 kg/m^2.

In the low ADL-function group, 77.3% of the participants evaluated as being well-nourished according to SGA classification, 78.2% of the participants with serum total cholesterol concentration ≧3.88 mmol/l, and 82.1% of the participants with BMI≧18.5 kg/m^2 had a serum albumin level <35 g/l (Table 3). By contrast, among the high ADL-function group there were no participants with a serum albumin level <35 g/l among those evaluated as being well nourished. Furthermore, only 3.6% of participants with total cholesterol levels ≧3.88 mmol/l and 2.9% of participants with BMI≧18.5 kg/m^2 had serum albumin levels <35 g/l. The sensitivity and specificity of 35 g/l serum albumin as a cutoff point of malnutrition based on the various nutritional markers are presented in Table 3. Among low ADL-function participants with nutritional status based on either SGA evaluation, total cholesterol levels (<3.88 mmol/l), or BMI (<18.5 kg/m^2), the 35 g/l serum albumin cutoff point had

Table 3 Validity of cutoff point of serum albumin (<35 g/l) for malnutritional markers.

Nutritional markers		Serum albumin				P^*	Specificity	Sensitivity
		<35 g/l		≧35 g/l				
		n	%	n	%			
Total								
SGA	Well nourished	34	22.8	115	77.2		0.772	
	Moderatly malnourished	57	64.0	32	36.0	<0.0001		
	Severely malnourished	18	78.9	5	21.7			0.783
Tch	≧3.88 mmol/l	73	34.1	141	65.9	<0.0001	0.659	
	< 3.88 mmol/l	35	77.8	10	22.2			0.778
BMI	≧18.5 kg/m^2	45	28.7	112	71.3	<0.0001	0.713	
	< 18.5 kg/m^2	64	62.1	39	37.9			0.621
Low ADL function (*ADL socre*: ≦1)								
SGA	Well nourished	17	77.3	5	22.7	0.421	0.227	
	Moderatly malnourished	34	79.1	9	20.9			
	Severely malnourished	15	88.2	2	11.8			0.882
Tch	≧3.88 mmol/l	43	78.2	12	21.8	0.500	0.218	
	< 3.88 mmol/l	22	84.6	4	15.4			0.880
BMI	≧18.5 kg/m^2	23	82.1	5	17.9	0.787	0.179	
	< 18.5 kg/m^2	43	79.6	11	20.4			0.796
Mid ADL function (*ADL score*: 2–18)								
SGA	Well nourished	17	32.7	35	67.3	0.033	0.673	
	Moderatly malnourished	20	57.1	15	42.9			
	Severely malnourished	3	50.0	3	50.0			0.500
tch	≧3.88 mmol/l	27	36.0	48	64.0	0.003	0.640	
	< 3.88 mmol/l	13	76.5	4	23.5			0.765
BMI	≧18.5 kg/m^2	20	33.9	39	66.1	0.014	0.661	
	< 18.5 kg/m^2	20	60.6	13	39.4			0.606
High ADL function (*ADL socre*: ≧19)								
SGA	Well nourished	0	0.0	75	100.0	<0.0001	1.000	
	Moderatly malnourished	3	27.3	8	72.7			
	Severely malnourished	0		0				
tch	≧3.88 mmol/l	3	3.6	81	96.4	0.947	0.964	
	< 3.88 mmol/l	0	0.0	2	100.0			
BMI	≧18.5 kg/m^2	2	2.9	68	97.1	0.672	0.971	
	< 18.5 kg/m^2	1	6.3	15	93.8			0.063

SGA: subjective global assessment, tch: total cholesterol, BMI: body mass index, ADL: activities of daily living.
*χ^2 test.

high sensitivity (0.882, 0.880, or 0.796, respectively) but low specificity (0.227, 0.218, or 0.179, respectively) as an indicator of malnutrition. Among low ADL-function participants with nutritional status based on SGA evaluation, the 3.88 mmol/l serum total cholesterol as a cutoff point had high specificity (0.727) but low sensitivity (0.500) as an indicator of malnutrition.

Discussion

In the present study we demonstrated that the serum albumin cutoff point of 35 g/l as an indicator malnutrition is not suitable for the elderly with low ADL function. In older people with low ADL function serum albumin levels were not correlated with various nutritional parameters including anthropometric measurements, levels of serum total cholesterol, and SGA evaluation after adjusting for age and gender. Using a serum albumin level <35 g/l as a malnutrition indicator for the ADL-impaired elderly, about 80% of older people without malnutrition would be classified as malnourished (low specificity) while 11–20% of elderly persons with malnutrition would be missed (sensitivity). These results suggest that the use of a serum albumin level <35 g/l as a marker of malnutrition for elderly with low ADL function leads to over-diagnosis of malnutrition. It should be noted that we also observed that the use of a serum total cholesterol level <3.88 mmol/l as a marker of malnutrition would miss the half of the ADL-impaired elderly person with malnutrition.

The observation that serum albumin is a negative acute-phase protein suggests that serum albumin concentration could be a marker of inflammation. In fact, serum levels of albumin decrease in response to acute or chronic inflammation by altering the normal hepatic protein metabolism and inducing capillary leak.[8–10] This concept is responsible for the reports that albumin is not a good marker for the nutritional status of the hospitalized elderly with illness.[17] However, in this study we excluded patients having high C-reactive protein levels or acute illness within the past 2 months. It has been reported that serum albumin levels and SGA, two possible measurements of nutritional status in hospitalized older people, are often discordant.[18] However, this previous interesting report did not address the interaction between serum albumin and the presence of inflammation or ADL status among hospitalized older people.

It has been reported that posture affects serum albumin levels; 1 h in the sitting position after resting in the supine posture during an overnight sleep increases serum albumin by 6.3%.[19] Simply standing upright or sitting increases hydrostatic pressure, and this shift in balance between hydrostatic and oncotic pressures leads to a net movement of fluid from intravascular to interstitial spaces.[20] Most participants with low ADL function in the present study were hospitalized patients, and most of these were bed-ridden elderly. Blood specimens were drawn from low ADL-function participants lying in bed and from high ADL-function ambulatory participants in a sitting position. These postural differences may have affected the serum levels of albumin in both types of participants. However, it has been reported that there is an increase from the lying to the sitting position of about 6.5–7.7% in serum concentrations, not only of proteins but also of lipids including cholesterol.[21,22] Therefore, the posture at the collection of blood samples may not explain our results.

We have demonstrated that ADL function is well correlated with serum albumin levels. One study has demonstrated that severe disability in ADL is strongly associated with anthropometric and biohumoral parameters including serum albumin levels suggesting the presence of malnutrition.[23] However, this is not the case here, since the association between serum albumin and ADL status persists after adjusting for SGA classification, suggesting that this association is not mediated through nutritional status. It is possible that the correlation of serum albumin with ADL function may be mediated by muscle mass, since physical disability is well known to be related with muscle atrophy[24] A cross-sectional study found an association between lower serum albumin concentration and lower muscle mass in the elderly.[25] It is known that several inflammatory cytokines down-regulate serum albumin concentration and increase muscle protein breakdown, which could potentially explain the association of low serum albumin with low muscle mass.[8,26] One study has demonstrated that a low serum albumin concentration in older persons was associated with a greater loss of muscle mass during a 5-year follow-up even after adjusting for the effect of inflammation, although no association was detected between albumin levels and muscle mass at the baseline.[27] In the present study we demonstrated that albumin levels were well correlated with AMC or AMA, markers of muscle mass, among older people without acute illness and inflammation, indicating that inflammation is not involved in the correlation between serum albumin levels and muscle mass, at least in the present study. However, after adjusting for ADL levels there was no correlation between serum albumin and the markers of muscle mass. In addition, the ADL score was well correlated with serum albumin levels after adjusting for muscle mass, suggesting that serum albumin levels might be associated with muscle mass through ADL function rather than with muscle mass directly among older people without acute illness or inflammation. Previous observation has demonstrated that physical exercise increases hepatic synthesis of albumin, resulting in the elevation of plasma albumin content.[28] It is possible that physical activity may be involved in the maintenance of serum albumin concentration through an increase in hepatic synthesis of albumin. Further studies will be required to determine the exact mechanism of the correlation of serum albumin concentration and ADL impairment in well-nourished older people. Since it has been reported that lower serum albumin is independently associated with weaker muscle strength,[29] further research is needed to clarify the exact interactions among serum albumin concentration, ADL status, and not only muscle mass but also muscle strength.

There are limitations in the present study. The distribution of ADL scores of our participants was not the normal distribution. Therefore, no line could be drawn separating the older people with poorer ADL function from those with better ADL function using $<35\,g/l$ of serum albumin as the cutoff point of malnutrition. A limitation included the relative small sample size in each categorized ADL subgroup which may affect the correlation between serum albumin and other nutritional parameters. Another potential limitation of this study was the reliance on self-reported past dietary change and past weight change which are included in SGA in subjects with potential for impaired cognition. We used only anthropometric measurements, AMC and AMC, for assessment of muscle mass; upper arm muscle mass might not reflect the full range of muscle mass.

In the present study we demonstrated that impaired physical function reduced serum albumin concentration even in well-nourished older people. The use of $<35\,g/l$ serum albumin as a marker of malnutrition for the elderly with low ADL function leads to over-diagnosis of malnutrition. Although the exact mechanism of the association between low albumin concentration and disability of ADL function remains unknown, lower muscle mass or decreased physical activity may be involved in this association. Therefore, when nutritional assessment is conducted for older people with impaired ADL function, special attention should be given to the interpretation of results of anthropometric measurements and serum albumin.

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Influence of diabetes mellitus on in-hospital mortality in patients with acute myocardial infarction in Japan: A report from TAMIS-II

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Abstract

Background: The relation between diabetes mellitus (DM) and mortality among patients with acute myocardial infarction is still controversial. We evaluated the influence of DM on the in-hospital mortality of acute myocardial infarction (AMI) patients using data from the Tokai Acute Myocardial Infarction Study-II, a multi-hospital prospective study performed in Japan.

Methods: All of the study subjects were patients hospitalized for newly diagnosed AMI at 1 of 13 acute care hospitals between January of 2001 and December of 2003. We abstracted the baseline and procedural characteristics from detailed chart reviews. Multivariate analysis was performed, controlling for the variables found to be significantly different between AMI patients with and without DM by chi-square test or unpaired *t*-test. We evaluated a total of 940 DM and 2284 non-DM patients.

Results: DM patients had roughly twice the in-hospital mortality rate of non-DM patients, with an unadjusted odds ratio of 1.77 (95% CI, 1.37–2.30). However, according to the multivariate analysis, DM was not identified as an independent predictor of in-hospital death, with an adjusted odds ratio of 5.73 (95% CI, 0.97–33.88).

Conclusions: DM is not an independent predictor of in-hospital mortality, and that there is a need for additional studies to confirm our conclusion.

Keywords: Acute myocardial infarction; Diabetes mellitus (DM); Early mortality; Predictor

1. Introduction

Diabetes mellitus (DM) is an independent risk factor for coronary artery disease. In addition, DM has been regarded as an independent predictor of mortality in patients with acute myocardial infarction in the thrombolytic era [1–5].

The introduction of new mechanical techniques for revascularization has been shown to significantly improve the survival of patients with acute myocardial infarction (AMI) [6–8]. Although better outcome in diabetic patients is expected, there are conflicting reports from the studies addressing this issue. For example, Mathew et al. [9] demonstrated that DM was independently associated with death at 9 months in 2684 diabetics and 8798 non-diabetics undergoing

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percutaneous coronary intervention. Moreover, Elezi et al. [10] demonstrated that DM represents an independent risk factor for early mortality. In contrast, Fujiwara et al. [5] reported similar rates of in-hospital death in 62 diabetics and 152 non-diabetics treated with primary coronary stenting. Thus, it is still unclear whether the new techniques neutralize the excess mortality that diabetic patients present after revascularization.

The Tokai Acute Myocardial Infarction Study-II (TAMIS-II) is a multi-hospital prospective and observational study performed in the Tokai region of central Japan. All of the study subjects were adult patients who had been hospitalized for newly diagnosed AMI at any of 15 acute care hospitals between January 2001 and December 2003. Using the TAMIS-II data set, we evaluated the influence of DM on the in-hospital mortality of AMI patients.

2. Methods

TAMIS-II is a multi-hospital prospective observational study conducted in the Tokai region. All of the 3274 study subjects were adult patients who had been hospitalized for newly diagnosed AMI at any of 15 acute care hospitals between January 2001 and December 2003. The diagnosis of AMI was based on the review of medical records of patients hospitalized with a primary or secondary discharge diagnosis of AMI. With regard to the recruitment of participant hospitals, we first selected major hospitals that had an interchange of personnel with Nagoya University Hospital, where we are based. We then sent out a prospectus on our research to the selected hospitals. Fifteen of those hospitals agreed to participate in the study; all of them were municipal or non-profit general hospitals that provide coronary angiography (CAG) and percutaneous coronary intervention (PCI). As soon as possible after the discharge or death of each study patient, we abstracted the baseline and procedural characteristics from detailed chart reviews, which included the notes of both physicians and nurses who had been educated to obtain medical records. However, because of the large number of study patients and the quantity of data on them, we did not lay down a time limit on data collection. The questionnaire gathered information on baseline characteristics, procedural course, and outcome as follows: age, independent activities of daily living (ADLs), body temperature, heart rate, systolic blood pressure, body mass index, hypertension, hypercholesterolemia, diabetes, previous angina, previous heart failure, previous myocardial infarction (MI), smoking status, arrhythmia, renal failure, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), aortic aneurysm, peptic ulcer, cancer, allergies, dementia, end-of-life stage, shock or bleeding on hospital admission, Killip class, pulmonary edema, locations of MIs, ejection fraction, number of coronary arteries narrowed (>75% according to the American Heart Association (AHA) classification including left main coronary artery), transfer to ICU/CCU, thrombolytics, vasopressor, intra-aortic balloon pumping (IABP), mechanical ventilation, PCI, stent placement, and in-hospital mortality. Pulmonary edema was confirmed by X-ray examination. Additionally, the locations of MIs and the ejection fraction were confirmed by ultrasound-echocardiograph examination. A history of various comorbid conditions was recorded as present if documented in the medical charts. Renal failure was defined as the serum creatinine level > or =2.5 or treatment with hemodialysis. DM was confirmed if one or more of the following criteria were met: (1) treatment with insulin or an oral hypoglycemic agent or both; (2) the diagnosis ascertained before admission or during hospitalization. We excluded from the present analysis those subjects whose diagnosis of DM had not been specified.

2.1. Statistical analysis

We compared the baseline and procedural characteristics and clinical outcomes between patients with DM and patients without it. Statistical analysis was performed using the chi-square test for categorical variables and the unpaired *t*-test for continuous variables. We also performed multiple logistic regression analysis to identify the independent association between DM and in-hospital mortality, after adjusting for other baseline and procedural factors that differed significantly between the two groups. Univariate predictors of the cardiac care with a *p*-value less than 0.05 were allowed to enter the model. We present the results as odds ratios and 95% confidence intervals. A *p*-value less than 0.05 was considered statistically significant.

3. Results

We evaluated a total of 940 DM and 2284 non-DM patients. The baseline characteristics are shown in Table 1. Of 940 DM patients, 138 had insulin-requiring DM. The DM patients were the same age as the non-DM patients. The DM patients were more frequently dependent in ADLs; they had higher heart rates and higher BMI values on admission; and they had greater incidences of cardiogenic shock, Killip class $\geqq 3$, and pulmonary edema. The diabetic patients had greater prevalences of hypertension, previous angina, previous heart failure, previous myocardial infarction, renal failure, and cerebrovascular disease, and had lower prevalences of COPD and peptic ulcer. There were fewer smokers among the DM patients. Also, the DM patients frequently had a reduced left ventricular function and multi-vessel coronary disease.

Table 2 shows the procedural characteristics of the subjects. The vasopressors, IABP, and mechanical ventilation were more likely to be used in the DM group, although acute PCI was less likely.

Multiple regression analysis was carried out to more systematically examine the relationships between DM

Table 1
Baseline characteristics and clinical features of the subjects

	DM (n = 940)	%	Non-DM (n = 2284)	%	p-Value
Age (mean ± S.D.)	65.70	±0.35	66.10	±0.25	NS
Gender (female)	230	24.47	543	23.77	NS
Independent ADL	869	92.45	2175	95.23	<0.01
Body temperature (mean ± S.D.)	36.29	±0.04	36.22	±0.02	NS
Heart rate (beats/min, mean ± S.D.)	81.73	±0.66	79.13	±0.39	<0.01
Systolic blood pressure (mmHg, mean ± S.D.)	131.72	±2.01	128.59	±0.84	NS
Body mass index	23.92	±0.13	23.33	±0.08	<0.01
Hypertension	461	49.04	939	41.11	<0.01
Hypercholesterolemia	173	18.40	370	16.20	NS
Insulin DM	138	14.68	–	–	–
Previous angina	165	17.55	251	10.99	<0.01
Previous heart failure	48	5.11	68	2.98	<0.01
Previous myocardial infarction	113	12.02	206	9.02	<0.01
Smoking	444	47.23	1200	52.54	<0.01
Arrhythmia	48	5.11	122	5.34	NS
Renal failure	47	5.00	46	2.01	<0.01
Cerebrovascular disease	123	13.09	231	10.11	<0.05
COPD	4	0.43	30	1.31	<0.05
Aortic aneurysm	6	0.64	31	1.36	NS
Peptic ulcer	66	7.02	230	10.07	<0.01
Cancer	51	5.43	105	4.60	NS
Allergy	42	4.47	121	5.30	NS
Dementia	18	1.91	46	2.01	NS
End-of-life stage	1	0.11	7	0.31	NS
Shock	203	21.60	424	18.56	<0.05
Bleeding	146	15.53	372	16.29	NS
Killip class ≧ 3	369	39.26	768	33.63	<0.01
Pulmonary edema (X-ray)	272	28.94	549	24.04	<0.01
Locations of MI (UCG)					
Antero/septal	432.00	45.96	1051.00	46.02	NS
Lateral	69.00	7.34	170.00	7.44	
Posterior	112.00	11.91	280.00	12.26	
Inferior	354.00	37.66	835.00	36.56	
Subendocardial	7.00	0.74	19.00	0.83	
Others	23.00	2.45	65.00	2.85	
UCG-EF (%, mean ± S.D.)	50.24	±0.75	52.77	±0.41	<0.01
Number of coronary arteries narrowed >75% in AHA classification (angiographic data)					
1	415	44.15	1283	56.17	<0.01
>1	404	42.98	718	31.44	
Left main	18	1.91	41	1.80	NS

DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; ADL, activity of daily living; UCG, ultrasound-electrocardiogram; EF, ejection fraction; AHA, American Heart Association.

Table 2
Procecural characteristics of the subjects

	DM (n = 940)	%	Non-DM (n = 2284)	%	p-Value
Transfer to ICU/CCU	771	82.02	1898	83.10	NS
Thrombolytics	100	10.64	268	11.73	NS
Vasopressor	344	36.60	704	30.82	<0.01
IABP	192	20.43	360	15.76	<0.01
Mechanical ventilation	177	18.83	245	10.73	<0.01
PCI	740	78.72	1848	80.91	NS
Acute PCI	655	69.68	1672	73.20	<0.05
Stent placement	505	53.72	1268	55.52	NS

DM, diabetes mellitus; ICU/CCU, intensive care unit/coronary care unit; PCI, percutaneous coronary intervention; IABP, intra-aortic balloon pump.

Table 3
Comparison of in-hospital mortality between DM vs. non-DM

Number of in-hospital deaths				Odds ratio unadjusted	95% CI	Odds ratio adjusted for age	95% CI	Odds ratio adjusted for age and other variables[a]	95% CI
DM ($n = 940$)	%	Non-DM ($n = 2284$)	%						
153	16.28	106	4.64	1.77	1.37–2.30	2.00	1.53–2.62	5.73	0.97–33.88

CI, confidence interval; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; ADL, activity of daily living; EF, ejection fraction; PCI, percutaneous coronary intervention; IABP, intra-aortic balloon pump.

[a] Controlling for age, ADL, heart rate, body mass index, hypertension, previous angina, previous heart failure, previous myocardial infarction, smoking, renal failure, cerebrovascular disease, COPD, peptic ulcer, shock, Killip class, pulmonary edema, EF, number of coronary arteries narrowed, vasopressor, IABP, mechanical ventilation, and acute PCI.

and in-hospital mortality while controlling for statistically significant predictors of outcome. The unadjusted and multivariable-adjusted results of in-hospital mortality are shown in Table 3. DM patients had roughly twice the in-hospital mortality rate of non-DM patients, with an unadjusted odds ratio of 1.77 (95% CI, 1.37–2.30). However, according to the multivariate analysis, DM was not identified as an independent predictor of in-hospital death, with an adjusted odds ratio of 5.73 (95% CI, 0.97–33.88).

4. Discussion

This study examined the influence of DM on in-hospital mortality in patients with AMI undergoing PCI. Several recent reports have found that DM patients at the time of presentation with AMI have higher rates of in-hospital death than non-DM patients [1–3,5,11,12] test. However, it appears that at least some of these higher in-hospital mortality rates in DM patients may be due to a higher incidence of less efficacious, though still accepted therapeutic interventions and a greater prevalence of poor clinical presentation or coronary risk profiles [5,12,13]. The present results are consistent with these previous studies. We also found that DM patients were more likely to suffer complications, including hypertension, previous angina, previous heart failure, previous myocardial infarction, renal failure, and cerebrovascular disease. It is well known that these disease profiles are strongly related to DM. Also, DM patients had lower levels of ADLs. Because some researchers suggested that the level of functional impairment is a reliable predictor of mortality [14,15], the level of ADLs is a possible predictor of in-hospital mortality. In addition, DM patients showed poorer clinical conditions, such as a greater prevalence of shock or congestive heart failure on presentation and poor LV ejection fraction. The higher incidence of pump failure and decrease in left ventricular ejection fraction among diabetic patients has been reported in previous studies [9,16,17]. Nevertheless, a considerable increase in the clinical manifestations of heart failure occurred with a modest decrease in left ventricular ejection fractions between the groups (50% versus 52%). We may explain that the higher incidence of heart failure or cardiac shock with a relatively preserved ejection fraction is due to a preexisting diastolic dysfunction [17]. It is also possible that the difference in pump failure may be due to unsuccessful PCI or new adverse cardiac event such as restenosis or recurrent angina [5,10,18], although this study did not assess the rate of procedural success such as Thrombolysis in Myocardial Infarction (TIMI) flow in the culprit coronary artery or new cardiac event soon after coronary angioplasty. These would offer good explanations of our results.

Because therapeutic options could contribute to in-hospital mortality, we examined the differences in the care options between DM and non-DM patients in the present study. In our data, we detected significant differences in the use of vasopressors, IABP, mechanical ventilation, and acute PCI. The greater use of vasopressors, IABP, and mechanical ventilation in DM patients may be a consequence of poorer clinical conditions, such as cardiac shock or Killip class, among them. According to the ACC/AHA guidelines for the management of patients with myocardial infarction [19], primary PCI is required if the patient presents with cardiogenic shock. Because this clinical feature was more common in DM patients, we would not expect a lower referral rate of DM patients than non-DM patients for acute PCI. We can attribute the lower-than-expected use of acute PCI to a higher prevalence of high-risk vessel diseases for PCI, such as progressive coronary atherosclerotic change in DM patients [16,20]. However, our explanations are limited because coronary angiographic results were not fully obtained in the study. Further research is

needed to determine the related factors that account for the difference in referral for acute PCI between DM and non-DM patients.

The present study demonstrates that in-hospital mortality after AMI in patients undergoing PCI was higher among DM patients than among non-DM patients before adjustment. However, we were unable to detect differences after adjustment for other predictors of mortality. Thus, our findings are consistent with previous studies in suggesting that other baseline variables account for much of the higher in-hospital mortality in DM patients [13,21]. There is one good explanation for the similar mortality rates between patients with DM and those without it. PCI has been shown to significantly improve the survival of patients with AMI, and this improvement has reduced the frequency of the lack of myocardial reperfusion in DM patients, who often have immediate vascular and hemodynamic complications [21].

However, the results of this study have not demonstrated that mortality rates between DM and non-DM patients are very similar, as seen in the 95% confidence interval. Additional studies are needed to determine the influence of DM on mortality.

4.1. Study limitations

This study had several important limitations:

1. Due to the small number of patients and limited study settings, our study patients may not be representative of the general population.
2. Our database does not always capture the full extent of angiographic data and PCI results.
3. Also, some omitted characteristics could contribute to mortality, especially the degree of control over DM.

5. Conclusions

Using TAMIS-II data, we identified the difference in in-hospital mortality between DM and non-DM patients with AMI. Our results suggest that DM is not an independent predictor of in-hospital mortality, and that there is a need for additional studies to confirm our conclusion.

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ORIGINAL ARTICLE

Factors associated with change in walking ability in very elderly patients hospitalized for acute myocardial infarction

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Background: The aim of this substudy was to identify the predictors of a lesser ability to walk in very elderly patients with acute myocardial infarction (AMI).

Methods: Data from 15 acute care hospitals in the Tokai Acute Myocardial Infarction Study (TAMIS)-II sample were used. This is a prospective study of all patients admitted to the hospitals with the diagnosis of AMI from 2001 to 2003. We abstracted the baseline and procedural characteristics including walking ability from detailed chart reviews. In this substudy, patients aged 75 and over were included. Patients were stratified into two categories: 412 patients whose ability to walk was maintained (MA group) and 30 patients whose ability to walk declined (DA group).

Results: The DA patients were more likely to have a lower body mass index (BMI) score and signs of heart failure on presentation (cardiac shock, 56.7% vs 15.5%; Killip class > or = III, 73.3% vs 36.6%; pulmonary edema, 60.0% vs 27.91%). DA group patients were more likely to receive vasopressors, intra-aortic balloon pump, or mechanical ventilation. After controlling for statistically significant predictors of a declined ability to walk, DA group patients were significantly more slender than MA group patients, with an adjusted odds ratio of 0.75 (95% confidence interval, 0.62–0.91). DA group patients had a higher shock or mechanical ventilation rate than MA group patients, but not significantly.

Conclusions: Our results suggest that a lower BMI value and severe heart failure are significant predictors of reduced walking ability during hospitalization among very elderly patients with AMI.

Keywords: acute myocardial infarction, body mass index (BMI), malnutrition, very elderly, walking.

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Conflict of interest declaration: The authors declare that they have no competing interests.Description of authors' roles: YH participated in data collection, performed the statistical analysis, and wrote the paper. YM designed the study, supervised data collection and assisted in drafting the paper. TK and MK participated in coordinating the study. AI and KU were responsible for the design and interpretation of data.

Introduction

In many industrialized countries, the ratio of the elderly population has been on the rise. Aging sets in motion a gradual inability to perform activities of daily living (ADL) and, thus, the aged often need to be cared for by others after hospitalization with a serious illness. Therefore, the increased elderly population intensifies the demand and the cost for care services, which, in turn, place a heavier social and economic burden on society

Coronary artery disease is highly prevalent in elderly people and this trend is expected to grow considerably

in the near future.[1,2] In particular, acute myocardial infarction (AMI) is a major cause of admission to hospitals of the elderly.[2-4] The authors hypothesize that elderly patients admitted with AMI are more likely to have a low ability to perform ADL, although studies on the topic are few.

Therefore, we examined the database from a prospective observational study, Tokai Acute Myocardial Infarction Study (TAMIS)-II, using a chart review of patients diagnosed with AMI who were admitted to 15 acute care hospitals from January 2001 to December 2003. The aim of this substudy was to identify the predictors of a lesser ability to walk in very elderly patients with AMI.

Methods

Tokai Acute Myocardial Study II

The TAMIS-II is a multihospital prospective observational study performed in the Tokai region. General patient recruitment for TAMIS-II began in January 2001 and continued through December 2003. The 3274 study subjects were adult patients who were hospitalized for newly diagnosed AMI at 15 acute care hospitals. Their diagnoses were confirmed by a later chart review. With regard to the enrollment of participant hospitals, we selected major hospitals which had an interchange of personnel with Nagoya University Hospital where we are based, and sent them a prospectus on our research. A total of 15 hospitals agreed to take part in the study. These were municipal or non-profit general hospitals equipped to provide coronary angiography (CAG) and percutaneous coronary intervention (PCI).

We abstracted the baseline and procedural characteristics from detailed chart reviews which included both physician notes and nursing notes by physicians or nurses skilled at collecting medical records. The questionnaire contained information on age, sex, medical condition (body temperature, heart rate, systolic blood pressure), body mass index, serum albumin concentration, medical history, in-hospital outcomes (shock, bleeding, length of stay, death), pulmonary edema, Killip score on hospital admission, walking ability on hospital admission and at discharge, locations of myocardial infarctions (MI), ejection fraction, number of coronary arteries narrowed >75% in American Heart Association (AHA) classification including left main coronary artery, and procedural characteristics during hospitalization (transfer to intensive care unit/coronary care unit, thrombolytics, vasopressor, intra-aortic balloon pump (IABP), mechanical ventilation, acute PCI). Pulmonary edema was confirmed by X-ray examination. Also, location of MI and ejection fraction were confirmed by ultrasound-echocardiogram examination. History of comorbid conditions was recorded as present if documented in the medical charts. Walking ability on hospital admission and at discharge was assessed using an original 3-item scale (able to walk without help, able to walk with help, or unable to walk).

Study population

Out of 798 TAMIS-II patients age 75 and over, the present analysis included patients who were able to walk without help on hospital admission, and whose information on their ability to walk was available at discharge. We excluded from the analysis the 137 subjects who died during hospitalization and 219 subjects whose data was missing. Therefore, the present analysis included a subsample of 412 patients whose ability to walk was maintained (MA group) and 30 patients whose ability to walk declined (DA group).

Statistical analysis

We compared the baseline and procedural characteristics and the clinical outcomes between the two groups. A statistical analysis was performed using the χ^2 test for categorical variables and the unpaired *t*-test for continuous variables.

We also performed a multivariable logistic regression analysis to identify the independent predictors of a lower ability to walk, after adjusting for baseline characteristics, medical history, and clinical features that differed significantly between the two groups. Univariate predictors of a lower ability to walk with a *P*-value of less than 0.05 were allowed to enter the model. We present the results as odds ratios and 95% confidence intervals (95%CI). A *P*-value of less than 0.05 was considered statistically significant.

Results

In the analysis of the 442 subjects whose information on their ability to walk was available at discharge, no statistical difference was found in the hospital to which they were admitted between the two groups (data was not shown).

Table 1 illustrates the baseline characteristics and clinical features of the subjects. There were no significant differences in demographic characteristics including age and sex between the two groups. The DA patients were more likely to have a lower body mass index (BMI) score and signs of heart failure on presentation (cardiac shock, 56.7% vs 15.5%; Killip class > or = III, 73.3% vs 36.6%; pulmonary edema, 60.0% vs 27.9%). The DA patients had a significantly longer duration of stay than the MA patients.

Table 2 illustrates the procedural characteristics of the subjects. DA group patients were more likely to receive vasopressors, IABP or mechanical ventilation.

Table 1 Baseline characteristics and clinical features of subjects

	MA ($n = 412$)	DA ($n = 30$)	*P*-value
Age (years)	80.3 ±0.2	80.6 ±0.6	NS
Female (%)	42.0	50.0	NS
Body temperature (°C)	36.2 ±0.0	36.3 ±0.1	NS
Heart rate (beats/min)	80.5 ±0.9	87.3 ±3.8	NS
Systolic blood pressure (mmHg)	129.0 ±1.2	126.8 ±6.1	NS
Body mass index (kg/m^2)	21.8 ±0.2	19.7 ±0.7	<0.01
Serum albumin concentration (g/L)	3.7 ±1.6	3.2 ±0.5	NS
Medical history (%)			
Hypertension	47.8	40.0	NS
Hypercholesterolemia	9.0	6.7	NS
Diabetes	24.0	30.0	NS
Previous angina	11.9	23.3	NS
Previous heart failure	5.6	3.3	NS
Previous myocardial infarction	10.2	10.0	NS
Smoking	29.6	30.0	NS
Arrhythmia	5.6	3.3	NS
Renal failure	2.7	0.0	NS
Cerebrovascular disease	12.4	20.0	NS
COPD	1.0	0.0	NS
Aortic aneurysm	2.4	3.3	NS
Peptic ulcer	8.3	10.0	NS
Cancer	9.5	10.0	NS
Allergy	4.6	6.7	NS
Dementia	2.7	3.3	NS
End of life stage	0.2	3.3	<0.05
In-hospital outcomes (%)			
Shock	15.5	56.7	<0.01
Bleeding	15.5	23.3	NS
Duration of stay (days)	20.9 ±19.2	54.2 ±55.0	<0.01
Killip class ≥3 (%)	36.7	73.3	<0.01
Pulmonary edema (X-ray) (%)	27.9	60.0	<0.01
Locations of MI (UCG) (%)			
Antero/septal	43.7	66.7	NS
Lateral	7.3	3.3	
Posterior	12.1	3.3	
Inferior	39.3	30.0	
Subendocardial	1.2	0.0	
Others	1.7	0.0	
Number of coronary arteries narrowed >75% in AHA classification (Angiographic data) (%)			
1	46.1	43.3	NS
>1	31.1	23.3	
Left main	1.9	0.0	NS

Data are presented as the mean value SD or percentage of subjects. MA group, patients whose ability to walk was maintained; DA group, patients whose ability to walk declined. ADL, activities of daily living; AHA, American Heart Association; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; UCG, ultrasound-echocardiogram.