Nutrition, Metabolism & Cardiovascular Diseases (2017) xx, 1–6

Available online at www.sciencedirect.com

Nutrition, Metabolism & Cardiovascular Diseases

journal homepage: www.elsevier.com/locate/nmcd

Long-term clinical impact of serum albumin in coronary artery disease patients with preserved renal function

H. Wada [a], T. Dohi [a,*], K. Miyauchi [a], J. Shitara [a], H. Endo [a], S. Doi [a], H. Konishi [b], R. Naito [c], S. Tsuboi [b], M. Ogita [b], T. Kasai [a], A. Hassan [a,d], S. Okazaki [a], K. Isoda [a], S. Suwa [b], H. Daida [a]

[a] Department of Cardiovascular Medicine, Juntendo University Graduate School of Medicine, Tokyo, Japan
[b] Department of Cardiovascular Medicine, Juntendo University Shizuoka Hospital, Izunokuni, Shizuoka, Japan
[c] Department of Cardiovascular Medicine, Juntendo University Urayasu Hospital, Urayasu, Chiba, Japan
[d] Department of Cardiology, Suez Canal University, Ismailia, Egypt

Received 15 August 2017; received in revised form 21 November 2017; accepted 21 November 2017
Handling Editor: Prof. F. Galletti
Available online ■ ■ ■

KEYWORDS
Serum albumin;
Coronary artery disease;
Percutaneous coronary intervention;
Preserved kidney function

Abstract *Background and aims:* Low serum albumin level is reportedly associated with worse clinical outcomes in patients with chronic kidney disease (CKD). However, associations between decreased serum albumin level and outcomes in non-CKD patients with coronary artery disease (CAD) remain unclear. Therefore, we aimed to evaluate the prognostic value of serum albumin concentrations in stable CAD patients with preserved renal function.
Methods and results: We studied 1316 patients with CAD and preserved renal function (estimated glomerular filtration rate $\geq$60 mL/min/1.73 m^2) who underwent their first PCI between 2000 and 2011 and had data available for pre-procedural serum albumin. Patients were assigned to quartiles based on pre-procedural albumin concentrations. The incidence of major adverse cardiac events (MACE), including all-cause death and non-fatal myocardial infarction, was evaluated. Mean albumin concentration was 4.1 $\pm$ 0.4 g/dL. During the median follow-up of 7.5 years, 181 events occurred (13.8%). Kaplan–Meier curves revealed that patients with decreased serum albumin concentrations showed a higher event rate for MACE (log-rank, $p < 0.0001$). Using the highest tertiles (>4.3 g/dL) as reference, adjusted hazard ratios were 1.97 (95% CI, 1.12–3.55), 1.77 (95% CI, 0.99–3.25), and 1.19 (95% CI, 0.68–2.15) for serum albumin concentrations of <3.9, 3.9–4.0, and 4.1–4.3 g/dL, respectively. Decreased serum albumin concentration was associated with MACE even after adjusting for other independent variables (HR, 2.21 per 1-g/dL decrease; 95% CI, 1.37–3.56, $p = 0.001$).
Conclusion: Decreased serum albumin concentration independently predicted worse long-term prognosis in non-CKD patients after PCI. Pre-procedural serum albumin concentration could offer a useful predictor for patients with CAD and preserved renal function.

* Corresponding author. Department of Cardiovascular Medicine, Juntendo University Graduate School of Medicine, 2-1-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan. Fax: +81 3 5802 3946.
E-mail address: tdohi@juntendo.ac.jp (T. Dohi).

https://doi.org/10.1016/j.numecd.2017.11.005
0939-4753/

Please cite this article in press as: Wada H, et al., Long-term clinical impact of serum albumin in coronary artery disease patients with preserved renal function, Nutrition, Metabolism & Cardiovascular Diseases (2017), https://doi.org/10.1016/j.numecd.2017.11.005

Introduction

Hypoalbuminemia is common in patients with renal failure, particularly end-stage renal disease (ESRD) [1], and is well known as a powerful predictor of mortality in these patients [2,3]. Serum albumin has generally been used as a quantitative measure of nutritional status. Furthermore, serum albumin levels are affected by various clinical factors other than nutritional status, such as inflammation [4]. Inflammation plays an important role in the progression and destabilization of atherosclerosis [5,6]. Previous studies have shown that low serum albumin concentrations were associated with increased risk for the incidence of myocardial infarction (MI), coronary artery disease (CAD), and stroke [7–9]. Decreased albumin concentration has recently been reported to be associated with poor clinical outcomes in patients with CAD [10,11]. In these studies, patients with lower serum concentrations of albumin displayed a higher prevalence of chronic kidney disease (CKD). However, associations between decreased serum albumin concentration and poor clinical outcomes in non-CKD patients with stable CAD remain uncertain.

The aim of the present study was to evaluate the prognostic value of serum albumin concentrations in stable CAD patients with preserved renal function following elective percutaneous coronary intervention (PCI).

Methods

Study population and data collection

The present investigation was a single-center, observational, retrospective cohort study. Among consecutive patients with CAD who underwent PCI for the first time at Juntendo University Hospital, Tokyo, Japan between January 2000 and December 2011, only patients for whom pre-procedural serum albumin concentrations were available were included. We excluded patients with CKD, defined as an estimated glomerular filtration rate <60 mL/min/1.73 m^2 as calculated using the modification of the diet in renal disease equation modified with a Japanese coefficient using baseline serum creatinine [12]. Patients were assigned to quartiles based on pre-procedural albumin concentrations (<3.9, 3.9–4.0, 4.1–4.3, and >4.3 g/dL).

Data on demographics, coronary risk factors, and medication use were collected from our institutional database. Blood samples were collected in the early morning after overnight fasting, and blood pressure (BP) was measured on admission. Patients with BP >140/90 mmHg or those receiving antihypertensive drugs were regarded as hypertensive. Dyslipidemia was defined as low-density lipoprotein cholesterol (LDL-C) ≥140 mg/dL, high-density lipoprotein cholesterol (HDL-C) ≤40 mg/dL, triglycerides ≥150 mg/dL, or current treatment with statins and/or lipid-lowering agents [13]. Diabetes mellitus was defined as either hemoglobin A1c ≥6.5% or medication with insulin or oral hypoglycemic drugs. Smoking status was defined as current for patients who were smoking at the time of PCI or who had quit smoking within 1 year before PCI. Left ventricular ejection fraction (LVEF) was assessed using left ventricular angiography or echocardiography before PCI. All patients showed symptoms of effort angina and/or proven myocardial ischemia according to noninvasive diagnostic tests. Written informed consent was obtained from all patients prior to PCI. This study was performed in accordance with the Declaration of Helsinki and with the approval of our institutional review board.

Primary endpoints

The primary outcome was major adverse cardiac events (MACE), defined as the first event of non-fatal MI or all-cause mortality during the follow-up. Clinical follow-up included a review of medical charts, telephone contact, and questionnaires sent to patients or their families. Mortality data were collected from the medical records of patients who died or who were treated at our institution, and details and causes of death were obtained from other hospitals to which patients had been admitted. MI was defined as evidence of myocardial necrosis in a clinical setting consistent with myocardial ischemia. Non-fatal MI was set in patients who survived for more than 30 days since the onset of MI or patients who died from other causes after MI.

Statistical analysis

Quantitative data are presented as mean ± standard deviation (SD) or median and interquartile range (IQR). Categorical variables are presented as frequencies. Continuous variables were compared using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test. Categorical variables (presented as frequencies) were compared using the chi-squared test. In addition, the trends of baseline characteristics through the groups of albumin level were assessed using Chi-squared test for linear trend and ANOVA for linear trend tests. Unadjusted cumulative event rates were estimated using Kaplan–Meier curves and the log-rank test was used to analyze significant differences among groups. Effects of serum albumin on clinical outcomes after PCI were determined using multivariate Cox proportional hazards regression analysis and Hazard ratios (HRs) with 95% confidence intervals (CIs) were calculated for each factor. Model 1 was adjusted for age. Model 2 was adjusted for age plus other variables showing values of $p < 0.05$ in univariate modeling. Differences were considered significant at the level of $p < 0.05$. Statistical analyses were carried out using JMP version 12.0 software (SAS Institute, Cary, NC).

Results

Baseline and procedural characteristics

Of the 2092 patients who underwent elective PCI, pre-procedural serum albumin data were available for 2007 patients (95.9%). Patients with CKD (n = 691) were

Please cite this article in press as: Wada H, et al., Long-term clinical impact of serum albumin in coronary artery disease patients with preserved renal function, Nutrition, Metabolism & Cardiovascular Diseases (2017), https://doi.org/10.1016/j.numecd.2017.11.005