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Serum albumin and C-reactive protein levels predict clinical outcome in hemodialysis patients undergoing endovascular therapy for peripheral artery disease

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ABSTRACT

Objective: Peripheral artery disease (PAD) is frequently seen in hemodialysis patients, endovascular therapy (EVT) often being performed in such cases. We examined combined prognostic utility of pre-procedural serum albumin and C-reactive protein (CRP) in combination for predicting clinical outcome after EVT in HD patients with PAD.
Methods: A total of 450 hemodialysis patients successfully undergoing EVT for PAD were followed-up for up to 8 years. They were divided according to median serum albumin and CRP levels measured prior to EVT into four groups [those with high albumin and low and high CRP levels, respectively, and low albumin and low and high CRP levels, respectively]. We analyzed the incidence of major adverse events (MAE) as a composite endpoint including target lesion revascularization (TLR), amputation and all-cause death, and major adverse limb events (MALE) as a composite endpoint including TLR and amputation.
Results: During the follow-up period (36 ± 31months), 206 MAE (46%) including 67 TLR, 45 amputations and 94 deaths occurred. Event-free survival rates from MAE for 8 years were 41.9%, 21.2%, 29.8%, and 13.2% in groups with high albumin and low CRP levels, with high albumin and high CRP levels, with low albumin and low CRP levels, and with low albumin and high CRP levels, respectively ($P = 0.0001$). Similar tendency was also seen in incidence of MALE ($P < 0.0001$).
Conclusion: Lower albumin and elevated CRP levels could strongly predict MAE and MALE after EVT in hemodialysis patients.

1. Introduction

Peripheral artery disease (PAD) is a common disease in patients on hemodialysis (HD) [1]. In such situation, endovascular therapy (EVT) has become widely performed even in HD patients with PAD [2,3]. Although effectiveness of EVT to improve prognosis has been reported, HD influences amputation and mortality after EVT or surgical revascularization [3–5]. Thus, the risk stratification for cardiovascular mortality is an important issue in the clinical management of such patients.

A number of reports have suggested that C-reactive protein (CRP) levels can predict clinical outcomes in subjects on HD [6–9]. In addition, malnutrition and a chronically elevated inflammation status are frequently observed, linked to a poor cardiovascular outcome. This association is well known as the malnutrition, inflammation and atherosclerosis syndrome [10,11]. In the present study, we therefore focused on possible prognostic value of serum albumin and C-reactive protein (CRP) levels with reference to clinical outcomes after EVT in patients on HD and evaluated whether the combination of these variables could stratify the risk of future events in the affected population.

2. Methods

2.1. Study population

From April 1999 to March 2009, serum albumin and CRP levels were measured immediately before EVT in 450 HD patients with

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PAD. They were then prospectively followed-up. Excluded were those aged >80 years and patients who had cancer and/or active inflammation. EVT was performed with a plain old balloon at first and if an insufficient result was obtained, including a residual stenosis with a luminal diameter >30% or a residual flow-limiting dissection, a stent was implanted. For all patients, aspirin (100–162 mg/day) was administered orally. The study was in agreement with the guidelines of the ethics committee of our institution, and written informed consent was obtained from each patient.

Fasting blood samples from vein were obtained on the morning of the day of EVT procedure. We used cut-off levels of median values of albumin (3.6 g/dl) and serum CRP levels (3.0 mg/l), respectively, and patients were divided into four groups [those with high albumin and low and high CRP levels, respectively, and low albumin and low and high CRP levels, respectively]. Serum CRP levels were measured using a latex-enhanced high-sensitive CRP immunoassay.

We analyzed the incidence of major adverse events (MAE) as a composite endpoint including target lesion revascularization (TLR), amputation and all-cause death and major adverse limb events (MALE) as a composite endpoint including TLR and amputation. The clinical follow-up data were obtained from hospital charts and telephone interviews conducted by trained reviewers.

Lesion characteristics were classified with reference to angiographic findings according to the Trans Atlantic Inter-Society Consensus (TASC) guidelines [12]. DM was defined as a history of diabetes, a fasting plasma glucose concentration >126 mg/dl, a random plasma glucose concentration of >200 mg/dl and/or HbA1c levels ≥6.5%. Hypertension was defined as a history or presence of hypertension with systolic blood pressure >160 mm Hg and/or diastolic blood pressure >90 mm Hg, and/or antihypertensive treatment. Dyslipidemia was defined as a history or presence of dyslipidemia with low-density lipoprotein levels ≥140 mg/dl, triglyceride levels ≥150 mg/dl and/or high-density

Table 1
Clinical characteristics.

	All patients ($n = 450$)	Albumin > 3.6 g/dl and CRP < 3.0 mg/l ($n = 127$)	Albumin > 3.6 g/dl and CRP ≥ 3.0 mg/l ($n = 95$)	Albumin ≤ 3.6 g/dl and CRP < 3.0 mg/l ($n = 102$)	Albumin ≤ 3.6 g/dl and CRP ≥ 3.0 mg/l ($n = 126$)	*P* value
Male (%)	68.2	67.7	73.7	59.8	71.4	0.21
Age (years)	67 ± 10	66 ± 9	66 ± 11	66 ± 10	68 ± 9	0.099
Diabetes (%)	66.0	68.5	71.6	64.7	60.3	0.32
Hypertension (%)	67.6	68.5	70.5	68.6	63.5	0.65
Dyslipidemia (%)	29.3	27.6	28.4	38.2	24.6	0.14
Smoking (%)	25.1	26.0	31.6	22.5	21.4	0.42
Prevalence of coronary artery disease (%)	72.9	77.2	76.8	63.7	73.0	0.10
Stroke (%)	18.9	18.9	16.8	19.6	19.8	0.95
Indication for endovascular therapy (%)						0.20
Intermittent claudication	62.0	67.7	60.0	66.7	54.0	
Resting pain	15.1	13.4	14.7	16.7	15.9	
Ulcer/gangrene	22.9	18.9	25.3	16.6	30.1	
Preoperative ankle brachial pressure index	0.61 ± 0.30	0.65 ± 0.28	0.60 ± 0.30	0.62 ± 0.31	0.57 ± 0.32	0.36
Albumin levels (mg/dl)	3.6 ± 0.5	4.0 ± 0.2	4.0 ± 0.2	3.4 ± 0.2	3.2 ± 0.4	<0.0001
C-reactive protein (mg/l)	3.0 (1.0–11.1)	1.0 (1.0–2.0)	9.0 (5.9–23.0)	1.4 (1.0–2.2)	13.0 (6.4–29.5)	<0.0001
Administration of cilostazol (%)	30.7	35.4	31.6	28.4	27.0	0.49
N of lesions	721	201	151	164	205	
Lesion location (%)						0.51
Iliac artery	24.3	22.4	23.8	28.7	22.9	
Femoropopliteal artery	75.7	77.6	76.2	71.3	77.1	
TASC classification (%)						0.54
Type A + B	73.1	70.6	78.8	73.8	70.7	
Type C + D	26.9	29.4	21.2	26.2	29.3	
Stent use (%)	72.7	72.1	74.2	73.8	71.2	0.57

TASC: Trans Atlantic Inter-Society Consensus.