

The Geriatric Nutritional Risk Index is Independently Associated with Prognosis in Patients with Critical Limb Ischemia Following Endovascular Therapy

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WHAT THIS PAPER ADDS

The geriatric nutritional risk index (GNRI) is simple and well established nutritional screening method. The GNRI is independently associated with overall and limb prognosis for patients with critical limb ischemia after endovascular therapy.

Objectives: Patients with critical limb ischemia (CLI) have poor overall and limb prognosis. Although nutritional status influences overall prognosis, and the Geriatric Nutritional Risk Index (GNRI) is a widely used, simple and well established nutritional status screening method, the association between the GNRI and the overall and limb prognosis of patients with CLI following endovascular therapy (EVT) has not been explored.

Methods: Clinical outcomes were retrospectively evaluated in 473 consecutive patients (74 ± 10 years; 59% male) with CLI who underwent EVT. The GNRI on admission was calculated as follows: $[14.89 \times \text{albumin (g/dL)}] + [41.7 \times (\text{body weight/ideal body weight})]$. Cox proportional hazard analysis was performed to explore the independent association between the GNRI and mortality and major amputation.

Results: Patients (53% ambulatory, 38% wheelchair bound, and 9% bedridden) were divided into two groups based on the median GNRI: the higher group (GNRI ≥ 91.2 , $n = 237$) and the lower group (GNRI < 91.2 , $n = 236$). Median follow up duration after EVT was 11.3 months. Three years after EVT, the survival rate (74% in the higher GNRI, and 48% in the lower GNRI, respectively), and limb salvage rate (92% in the higher GNRI, and 84% in the lower GNRI) were significantly lower in the lower GNRI group. GNRI (hazard ratio [HR], 1.03; 95% confidence interval [CI], 1.01–1.05), along with being wheelchair bound (HR, 1.87; 95% CI 1.17–2.97; vs. ambulatory status), being bedridden (HR, 3.10; 95% CI, 1.63–2.97; vs. ambulatory status), being on hemodialysis (HR, 2.33; 95% CI, 1.49–3.64), and having chronic heart failure (HR, 2.22; 95% CI, 1.44–3.43) were the independent predictors of mortality. The GNRI (HR, 1.04; 95% CI, 1.01–1.07), being bedridden (HR, 4.15; 95% CI, 1.67–10.3; vs. ambulatory status), isolated below knee disease (HR, 2.49; 95% CI, 1.30–4.77), and hemodialysis (HR, 2.44; 95% CI, 1.23–4.85) were independently associated with major amputation.

Conclusions: The GNRI on admission was independently associated with mortality and major amputation after EVT in patients with CLI.

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INTRODUCTION

Lower extremity peripheral artery disease (LE-PAD), which is associated with decreased functional capacity and quality of life and increased limb amputation and death risk, has become more frequent because of aging and lifestyle

changes of the population. Critical limb ischemia (CLI), the most advanced form of LE-PAD, is optimally treated by revascularization¹ albeit with poor prognosis and high mortality (43% at 3 years)^{2,3} and amputation (20% at 3 years) rates.³

Predictive scoring models for CLI patients were developed from the FINNVASC, PREVENT III, and BASIL trials.^{4–6} Nutritional variables, serum albumin, or body mass index (BMI) were not systematically examined in the FINNVASC and PREVENT III studies.^{4,5} In the BASIL scoring model, underweight was identified as one of the developed variables.⁶ A recent study has demonstrated that nutritional

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status related factors including BMI $< 18.5 \text{ kg/m}^2$ and the serum albumin level, were independent predictors of mortality for CLI patients after endovascular therapy (EVT).⁷

Nutritional status influences the overall prognosis,^{8,9} and nutritional factors were potentially a correctable parameter for reducing the risk of adverse outcomes. The geriatric nutritional risk index (GNRI), which is calculated from both serum albumin and the components of the BMI, was developed as a simple and well established objective nutritional status screening method for elderly patients.¹⁰ The GNRI is also useful to estimate prognosis for patients on hemodialysis and with chronic heart failure.^{11–13} However, whether nutritional status assessed by the GNRI at admission influences the overall and limb prognosis of CLI patients following EVT has not been explored, and is therefore the subject of this study.

MATERIALS AND METHODS

Subjects

This single center retrospective analysis of a prospectively maintained database included 473 consecutive CLI patients (473 first treated limbs) who underwent EVT for de novo infrainguinal lesions at the institution from April 2010 to December 2013. One limb was included per enrolled patient. The prevalence of bilateral CLI was 27% (130/473) of this population. Patients who underwent conservative treatment, primary amputation, or primary bypass surgery, and patients with acute limb ischemia were excluded. Demographics, medical history, comorbidity, and laboratory data were collected from individual medical records according to pre-specified definitions. All measurements were collected on admission. Patients were routinely followed up at 1, 3, and 6 months after EVT, and thereafter every 3 months. Follow up data were obtained in outpatient visits or by telephone interview. Assessment procedures were performed in line with principles set by the Declaration of Helsinki and were approved by the ethics committee.

GNRI

The GNRI was calculated from individually obtained height, body weight, and serum albumin level on admission for initial EVT as follows:¹⁰

$$\text{GNRI} = [14.89 \times \text{albumin (g/dL)}] + [41.7 \times (\text{body weight/ideal body weight})]$$

$$\text{BMI} = \text{body weight (kg)}/\text{height}^2 (\text{m}^2)$$

The ideal body weight was calculated from the height and a BMI of 22.

EVT procedure

EVT was performed under local anesthesia. A stent was implanted in iliac lesions. For femoropopliteal lesions, angioplasty was initially performed with an optimally sized balloon; if the post balloon result was suboptimal, a nitinol

stent was implanted. For infrapopliteal lesions, only balloon angioplasty was conducted. Medical treatment selection was left to the doctor's discretion.

Outcome measures and variables

Outcome measures were mortality and major amputation after EVT. The study also evaluated whether the GNRI was an independent predictor of mortality and major amputation after EVT. The following variables were collected for analysis: age, sex, ambulatory status, ischemic tissue loss, bilateral CLI, isolated below knee (BK) disease, GNRI, hypertension, dyslipidemia, diabetes mellitus, hemodialysis, smoking, and chronic heart failure.

Definitions

Major amputation was defined as above ankle amputation. Cardiovascular death was defined as death from heart failure, myocardial infarction, arrhythmia, sudden death, stroke, bowel ischemia, and other cardiovascular related death. Ischemic tissue loss was defined in accordance with Trans-Atlantic Inter-Society Consensus guidelines as tissue loss associated with ankle pressure $< 70 \text{ mmHg}$ or toe pressure $< 50 \text{ mmHg}$.¹ When these measurements could not be obtained, skin perfusion pressure (SPP) was measured. A SPP $< 40 \text{ mmHg}$ was defined as indicating ischemic tissue loss.¹⁴ Isolated BK disease was defined as a lesion localized in the infrapopliteal arteries. Ambulatory status was defined as walking without assistance or crutch walking, and non-ambulatory status was classified into wheelchair bound and bedridden. Hypertension was diagnosed as systolic blood pressure $\geq 140 \text{ mmHg}$ or diastolic blood pressure $\geq 90 \text{ mmHg}$ or having been treated for hypertension. Dyslipidemia was defined as serum low density lipoprotein cholesterol $\geq 140 \text{ mg/dL}$ or high density lipoprotein cholesterol $< 40 \text{ mg/dL}$ or triglycerides $\geq 150 \text{ mg/dL}$ or having been treated for dyslipidemia. The diagnosis of diabetes mellitus was based on World Health Organization criteria or on having been treated with insulin and/or oral hypoglycemic agents. Current smoker was defined as a history of smoking within 1 month before EVT. Chronic heart failure was defined as a past history of admission for heart failure treatment, or left ventricular ejection fraction $\leq 50\%$ by ultrasound examination.

Statistical methods

Data are expressed as mean and standard deviation for continuous variables or as a percentage for dichotomous variables, unless otherwise stated. Patients were divided into two groups based on the median GNRI: the higher group (GNRI ≥ 91.2 , $n = 237$) and the lower group (GNRI < 91.2 , $n = 236$). Continuous variables were compared between groups using the unpaired t test. The chi-square test was used to compare proportions between groups. Mortality, major amputation, repeat EVT, and required surgical bypass therapy rates were calculated by the Kaplan–Meier method. The independent association between GNRI and mortality or major amputation was

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