Clinical Significance of the Controlling Nutritional Status (CONUT) Score in Patients with Infective Endocarditis

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Summary
Risk stratification of patients with infective endocarditis (IE) is difficult. The Controlling Nutritional Status (CONUT) score is an index of immune function and nutritional status. We investigated the prognostic value of the CONUT score in IE and whether its prognostic value differed between IE patients with and without indications for surgery.

Clinical records were retrospectively evaluated for 92 patients with IE treated at Nihon University Itabashi Hospital and Nihon University Hospital between January 2014 and May 2019. The CONUT score was determined upon admission, and patients were divided into two groups at the median score (≤ 7 [n = 50] and ≥ 8 [n = 42]). The primary outcome was all-cause mortality at 90 days after admission.

The high CONUT group had significantly higher C-reactive protein and N-terminal pro-brain natriuretic peptide levels, as well as a significantly lower hemoglobin and estimated glomerular filtration rate (all P < 0.05), and considerably more valve perforation (26% versus 8%, P < 0.05). Kaplan-Meier analysis revealed that mortality was significantly higher in the high CONUT group (P < 0.001). Even after adjusting for the propensity score based on IE risk factors, a higher CONUT score was still associated with mortality. A receiver-operating characteristic analysis revealed that a CONUT score ≥ 8 had a sensitivity of 86% and specificity of 76% for predicting all-cause mortality. A CONUT score ≥ 8 was most strongly associated with mortality in patients with surgical indications (P < 0.001).

In patients with IE, a higher CONUT score was significantly associated with inflammation, heart failure, renal dysfunction, anemia, valve dysfunction, and short-term mortality, especially in patients with surgical indications.

Key words: Inflammation, Infection, Valvular heart disease, Heart failure

Treatment for infective endocarditis (IE) has improved significantly in recent years, but this disease still has a high mortality and poor prognosis.1-3) Early identification of high-risk patients is required to make clinical decisions in order to improve the prognosis. However, IE progression is complex and variable, making it difficult to predict adverse outcomes and perform risk stratification of patients. The inflammatory response triggered by IE causes hypoalbuminemia, a reduced serum level of high-density lipoprotein (HDL) cholesterol, and lymphopenia,4-6) with the extent of these changes being associated with the severity of infection and the prognosis of IE.5,8)

The Controlling Nutritional Status (CONUT) score was developed as a method for the early detection of poor nutritional status.7) The CONUT score is calculated from the serum albumin level, total cholesterol level, and total peripheral lymphocyte count and is thus an immune-nutritional index assessing both protein/lipid metabolism and immunocompetence. This score is a simple objective measure, and its prognostic value has been assessed in patients with many malignancies.8,9) Several studies have shown that the CONUT score can also predict adverse outcomes in patients with heart failure.10,11) However, the relationship between this score and the clinical outcomes of IE has not been fully evaluated.

We hypothesized that the CONUT score reflects the severity of inflammation caused by acute infections in patients with IE and could be helpful for the identification of IE patients with a high risk of poor outcome. Therefore, we conducted this study to investigate its prognostic value in IE. An important feature of IE is that surgical intervention greatly reduces mortality.12,13) suggesting that the clinical course may differ between IE patients who undergo surgery and those receiving drug therapy alone. However, few studies of prognostic biomarkers for IE...
have considered this point. In the present study, we also investigated whether the predictive value of the CONUT score differed between IE patients with and without indications for surgery.

Methods

Patients and study protocol: Patients with IE who were admitted to Nihon University Itabashi Hospital or Nihon University Hospital between January 2014 and May 2019 were analyzed retrospectively. IE was diagnosed according to the modified Duke criteria,14 and surgical intervention and drug therapy were performed according to Japanese IE guidelines.15 A total of 96 patients were reviewed. Four patients were excluded due to lack of data for one or more of the components of the CONUT score (serum albumin level, total cholesterol level, and total peripheral lymphocyte count), and the remaining 92 patients were investigated. Clinical information was collected upon admission, including demographic characteristics, laboratory findings, and echocardiographic data. The Ethics Committee of Nihon University Itabashi Hospital and Nihon University Hospital approved the study protocol and the use of patient information.

Laboratory tests and CONUT score: The CONUT score (range: 0 to 12) was calculated from the serum albumin, total cholesterol, and total peripheral lymphocyte count obtained upon admission, as presented in Table I. Patients were divided into two groups based on the median CONUT score.

Echocardiography: Echocardiography was performed by experienced echocardiographers to detect vegetations and the affected valve. Echocardiographic measurements were performed according to the guidelines of the American Society of Echocardiography. Briefly, left ventricular (LV) diastolic diameter (LVDd), LV systolic diameter (LVDs), and left atrial diameter (LAD) were measured in the parasternal long-axis view. The left ventricular ejection fraction (LVEF) was measured by the Teichholz method or the modified Simpson method. Using color flow Doppler images, aortic regurgitation (AR), mitral regurgitation (MR), and tricuspid regurgitation (TR) were graded on a 4-point scale. The long-axis diameter of the inferior vena cava (IVC) in the subcostal view was measured within 3 cm of its junction with the right atrium during passive respiration.

Definition of surgery and indications: Surgery was defined as replacement or repair of the affected valve. Indications for surgery included heart failure, detection of an abscess, high risk of embolism, uncontrolled infection, and severe valvular regurgitation.

Follow-up and endpoint: IE is an acute infectious disease with a high rate of in-hospital mortality. Therefore, the short-term prognosis was evaluated at 90 days utilizing the endpoint of all-cause mortality. All patients were followed up from the date of admission for 90 days or until death, whichever occurs first. Follow-up data were obtained by blind review of all available medical records.

Statistical analysis: Continuous variables were expressed as the median (interquartile range) and were compared by the Mann-Whitney U test. Categorical variables were expressed as numbers and percentages and were compared by the chi-squared test. To satisfy the model assumptions, data on N-terminal pro-brain natriuretic peptide (NT-pro BNP) were subjected to natural log transformation (ln). Kaplan-Meier analysis was employed to examine event-free survival, with differences being compared by the log-rank test. Univariate analysis was conducted with a Cox proportional-hazards model to evaluate the association between the CONUT score (continuous variable) and all-cause mortality. Moreover, hazard ratios with 95% confidence intervals (CIs) were calculated. Because of the small number of endpoints in this study, the model was adjusted by using a propensity score that was calculated on the basis of clinically relevant factors and potential IE risk factors that included age, sex, body mass index, NYHA class III or IV, C-reactive protein (CRP), estimated glomerular filtration rate (e-GFR), diabetes mellitus, Staphylococcus infection, and valve abscess.

The cutoff value of the CONUT score for identifying patients at risk of dying within 90 days of admission was calculated by receiver-operating characteristic analysis. Statistical analyses were conducted using JMP ver.11.0 (SAS Institute, Cary, NC, USA), and P < 0.05 was considered to indicate statistical significance.

Results

Patient characteristics: The median (interquartile range) CONUT score was 7 (5-9). The patients were divided into two groups at this median score; 50 patients with a score ≤ 7 formed the low CONUT group, and 42 patients with a score ≥ 8 formed the high CONUT group (Table II). Age, sex, and the prevalence of diabetes mellitus, hemodialysis, and prosthetic valve infection did not differ significantly between the two groups. Compared with the low CONUT group, the high CONUT group had a higher white blood cell count, CRP level, blood urea nitrogen level, and NT-pro BNP level and lower hemoglobin level, platelet count, and e-GFR (all P < 0.05). In addition, the high CONUT group had a more advanced NYHA functional class than the low CONUT group, as well as a significantly higher
| Item                                                                 | Low CONUT (n = 50) | High CONUT (n = 42) | P value |
|----------------------------------------------------------------------|-------------------|---------------------|---------|
| **Baseline clinical data**                                          |                   |                     |         |
| Age, years                                                           | 66 (45-78)        | 70 (62-81)          | 0.088   |
| Male, n (%)                                                         | 35 (70)           | 32 (76)             | 0.50    |
| Body mass index, kg/m²                                              | 21.4 (19.0-23.1)  | 20.4 (17.1-22.6)    | 0.088   |
| NYHA class III or IV, n (%)                                         | 11 (22)           | 18 (42)             | 0.032   |
| Heart failure, n (%)                                                | 11 (22)           | 20 (47)             | 0.009   |
| Diabetes mellitus, n (%)                                            | 9 (18)            | 9 (21)              | 0.67    |
| Hypertension, n (%)                                                 | 16 (32)           | 11 (26)             | 0.54    |
| Hemodialysis, n (%)                                                 | 3 (6)             | 6 (14)              | 0.18    |
| Malignancy, n (%)                                                   | 3 (6)             | 5 (12)              | 0.31    |
| Cirrhosis of liver, n (%)                                           | 1 (2)             | 3 (7)               | 0.22    |
| Statin usage, n (%)                                                 | 11 (22)           | 5 (12)              | 0.20    |
| Immunosuppressive therapy, n (%)                                     | 1 (2)             | 0 (0)               | 0.35    |
| Previous IE history, n (%)                                          | 2 (4)             | 2 (5)               | 0.85    |
| Prosthetic valve IE, n (%)                                          | 10 (20)           | 13 (31)             | 0.22    |
| Valve abscess, n (%)                                                | 7 (14)            | 11 (26)             | 0.14    |
| Valve perforation, n (%)                                            | 4 (8)             | 11 (26)             | 0.018   |
| Vegetation diameter > 10 mm, n (%)                                   | 22 (44)           | 23 (54)             | 0.30    |
| Mitral valve infection, n (%)                                       | 34 (68)           | 16 (38)             | 0.004   |
| Aortic valve infection, n (%)                                       | 9 (18)            | 17 (40)             | 0.017   |
| Multi-valve infection, n (%)                                        | 2 (4)             | 7 (16)              | 0.041   |
| Tricuspid valve infection, n (%)                                     | 1 (2)             | 2 (5)               | 0.45    |
| Time from symptom onset to diagnosis (days)                         | 17 (6-34)         | 11 (4-30)           | 0.49    |
| Acute cerebral infarction, n (%)                                     | 15 (30)           | 12 (28)             | 0.88    |
| Acute intracranial hemorrhage, n (%)                                | 4 (8)             | 5 (12)              | 0.53    |
| **Microbiology**                                                     |                   |                     |         |
| Streptococcus species, n (%)                                        | 16 (32)           | 17 (40)             | 0.39    |
| Staphylococcus species, n (%)                                       | 15 (30)           | 14 (33)             | 0.73    |
| Other bacterial strains, n (%)                                      | 5 (10)            | 5 (12)              | 0.77    |
| Negative culture test result, n (%)                                 | 14 (28)           | 6 (14)              | 0.11    |
| **Laboratory data**                                                 |                   |                     |         |
| White blood cell count, μL                                          | 8300 (6750-11400) | 11450 (7750-14575)  | 0.026   |
| Neutrophil cell count, μL                                           | 6977 (4697-9066)  | 9804 (6376-12861)   | 0.002   |
| Lymphocyte count, μL                                                | 1230 (877-1563)   | 592 (423-900)       | <0.001  |
| Hemoglobin, g/dL                                                    | 11.3 (10.1-12.8)  | 9.3 (7.9-11.2)      | <0.001  |
| Platelet count, × 10^9/μL                                           | 204 (148-288)     | 133 (76-192)        | <0.001  |
| C-reactive protein, mg/L                                           | 4.6 (1.0-8.2)     | 11.2 (4.7-20.3)     | <0.001  |
| Total bilirubin, mg/dL                                              | 0.5 (0.3-0.8)     | 0.6 (0.4-1.1)       | 0.35    |
| AST, U/L                                                            | 24 (19-36)        | 31 (20-49)          | 0.32    |
| ALT, U/L                                                            | 19 (12-38)        | 17 (11-33)          | 0.44    |
| BUN, mg/dL                                                          | 14 (10-23)        | 30 (19-49)          | <0.001  |
| Creatinine, mg/dL                                                   | 0.8 (0.6-1.1)     | 1.1 (0.7-2.0)       | 0.011   |
| eGFR, mL/minute/1.73 m²                                             | 64 (49-95)        | 44 (23-70)          | 0.002   |
| Albumin, g/dL                                                       | 3.3 (3.0-3.7)     | 2.5 (2.1-2.6)       | <0.001  |
| Sodium, mmol/L                                                     | 137 (135-141)     | 136 (134-140)       | 0.28    |
| Total cholesterol, mg/dL                                            | 149 (128-176)     | 116 (99-141)        | <0.001  |
| NT-pro BNP, pg/mL                                                   | 638 (237-1892)    | 7403 (3647-15445)   | <0.001  |
| **Echocardiographic data**                                          |                   |                     |         |
| LVEDd, mm                                                           | 51 (45-55)        | 49 (41-54)          | 0.22    |
| LVEF, %                                                             | 65 (57-72)        | 63 (57-69)          | 0.46    |
| LAD, mm                                                             | 38 (32-46)        | 40 (34-50)          | 0.24    |
| TRPG, mmHg                                                          | 22 (18-27)        | 27 (18-34)          | 0.10    |
| Severe regurgitation, n (%)                                         | 19 (39)           | 24 (57)             | 0.096   |
| Maximum IVC diameter, mm                                            | 14 (11-19)        | 16 (13-20)          | 0.12    |

Values are expressed as the median (interquartile range) or number (%). CONUT score indicates Controlling Nutritional Status score; NYHA, New York Heart Association; IE, infectious endocarditis; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate; NT-pro BNP, N-terminal pro-brain natriuretic peptide; LVEDd, left ventricular diastolic diameter; LVEF, left ventricular ejection fraction; LAD, left atrial diameter; TRPG, tricuspid regurgitation pressure gradient; and IVC, inferior vena cava.
prevalence of multi-valve infection (16% versus 4%) and valve perforation (25% versus 6%). Of the 92 patients, 77 (83%) underwent transesophageal echocardiography, and the echocardiographic parameters (LVDd, LVEF, and LAD) did not differ between the two groups.

CONUT score and clinical outcomes: During the 90-day follow-up period, 21 patients died (15 from sepsis, 3 from heart failure, 2 from cerebral hemorrhage, and 1 from cerebral infarction), and the mortality rate of IE was 22.8%. Kaplan-Meier analysis revealed that the mortality rate was significantly higher in the high CONUT group compared with the low CONUT group (P < 0.001 by log-rank test) (Figure 1A). According to univariate Cox regression analysis, a higher CONUT score was associated with all-cause mortality, along with older age, higher NYHA class, valve abscess, lower hemoglobin level, lower platelet count, higher CRP level, higher total bilirubin level, lower e-GFR, lower albumin level, lower total cholesterol level, higher ln [NT-pro BNP], and lower LVDd (Table III). Conversely, surgical treatment was a protective factor (hazard ratio: 0.37, 95% CI: 0.13-0.91, P = 0.030) (Table III). A higher CONUT score was independently associated with all-cause mortality, after the propensity score adjustment to the model. The propensity score was calculated on the basis of clinically relevant factors and potential IE risk factors that included age, sex, body mass index, NYHA class III or IV, CRP, e-GFR, diabetes mellitus, *Staphylococcus* infection, and valve abscess (Table IV). Receiver-operating characteristic analysis revealed that a cutoff CONUT score ≥ 8 had a sensitivity of 86% and specificity of 76% for predicting all-cause mortality (area under the receiver-operating characteristic curve = 0.77, P < 0.001).

Surgical treatment and clinical outcomes: Sixty-nine patients (75%) had indications for surgery. Among them, 44 (47% of all patients and 63% of patients with surgical indications) underwent surgery during the study period. The other 25 patients with surgical indications did not undergo surgery for the following reasons: stroke in 6, sepsis in 5, cerebral hemorrhage in 3, older age in 3, scheduled future surgery in 3, poor prognosis regardless of treatment in 3, technical difficulty of surgery in 1, and hemodynamic instability in 1. Kaplan-Meier analysis revealed a significantly higher mortality rate of patients with surgical indications who did not undergo surgery compared with those who had indications and underwent surgery and also with those having no surgical indications who were managed medically (P < 0.001, log-rank test) (Figure 1B).

CONUT score and clinical outcomes in patients with and without surgical indications: Among the patients without surgical indications, mortality did not differ significantly between those with a CONUT score ≥ 8 and those with a CONUT score ≤ 7 (P = 0.34, log-rank test) (Figure 2A). In contrast, among the patients with surgical indications, mortality was significantly higher for those with a CONUT score ≥ 8 than those with a CONUT score ≤ 7 (P < 0.001, log-rank test) (Figure 2B). Furthermore, among the patients with surgical indications, those with a CONUT score ≥ 8 who did not undergo surgery had a significantly lower survival rate compared with all other patients in this category (P < 0.001, log-rank test) (Figure 3).
the worst prognosis. A high CONUT score who did not undergo surgery had indications. Fourth, patients with surgical indications and associated with short-term mortality in patients with surgical mortality rate at 6 months is still estimated to be 25%-30%. Early identification of high-risk patients is required to make accurate clinical decisions that can improve the prognosis. Several adverse prognostic factors have been identified, including old age, heart failure, diabetes, renal failure, CRP, S. aureus infection, and prosthetic valve endocarditis. However, IE progression can be variable, so prediction of adverse outcomes and risk stratification are challenging. Thus, it is important to find new biomarkers that can identify patients at high risk of poor outcome.

The CONUT score is determined from the serum albumin level, total cholesterol level, and total peripheral lymphocyte count, and it was developed for the early detection of poor nutritional status. It is an integrated index that reflects protein metabolism, lipid metabolism, and immunocompetence and has been used to evaluate the nutritional status of patients with inflammatory diseases and chronic liver disease. Several reports have suggested that the CONUT score can predict perioperative complications and long-term prognosis in patients with malignan-

### Table III. Univariate Cox Proportional-Hazards Analysis for the Risk of All-Cause Mortality

| Item                                                      | Hazard ratio | 95% CI        | P value |
|-----------------------------------------------------------|--------------|---------------|---------|
| Age (per 1 year increase)                                 | 1.02         | 1.00-1.06     | 0.046   |
| Male sex                                                  | 0.55         | 0.23-1.39     | 0.19    |
| NYHA class III or IV                                      | 4.51         | 1.89-11.4     | <0.001  |
| Diabetes mellitus                                         | 1.69         | 0.60-4.17     | 0.29    |
| Previous IE history                                      | 2.82         | 0.44-9.76     | 0.22    |
| Prosthetic valve IE                                       | 2.17         | 0.86-5.17     | 0.097   |
| Multi-valve infection                                    | 1.67         | 0.39-4.95     | 0.43    |
| Valve abscess                                             | 2.89         | 1.14-6.88     | 0.026   |
| Staphylococcus species                                   | 1.15         | 0.43-2.77     | 0.76    |
| Intracranial complications                                | 1.03         | 0.39-2.49     | 0.93    |
| White blood cell count (per 1 × 10³/μL increase)          | 1.03         | 0.96-1.09     | 0.27    |
| Neutrophil cell count (per 1 × 10³/μL increase)           | 1.04         | 0.97-1.10     | 0.15    |
| Hemoglobin (per 1 g/dl increase)                          | 0.67         | 0.52-0.85     | <0.001  |
| Platelet count (per 1 × 10³/μL increase)                  | 0.98         | 0.97-0.99     | <0.001  |
| C-reactive protein (per 1 mg/L increase)                  | 1.04         | 1.00-1.08     | 0.030   |
| Total bilirubin (per 1 mg/dL increase)                    | 2.43         | 1.25-4.18     | 0.011   |
| eGFR (per 10 mL/minute/1.73 m² increase)                  | 0.72         | 0.60-0.85     | <0.001  |
| Albumin (per 1 g/dL increase)                             | 0.18         | 0.06-0.43     | <0.001  |
| Sodium (per 1 mmol/L increase)                            | 0.97         | 0.88-1.07     | 0.61    |
| Total cholesterol (per 1 mg/dL increase)                  | 0.98         | 0.96-0.99     | 0.005   |
| ln [NT-pro BNP] (per 1.0 increase)                        | 1.78         | 1.31-2.51     | <0.001  |
| LVDD (per 1 mm increase)                                  | 0.93         | 0.89-0.98     | 0.008   |
| Low LVEF (LVEF < 50%)                                     | 1.02         | 0.24-3.03     | 0.96    |
| TRPG (per 1 mmHg increase)                                | 1.04         | 0.99-1.08     | 0.069   |
| CONUT score (per 1 increase)                              | 1.37         | 1.16-1.64     | <0.001  |
| Surgical indications                                      | 3.60         | 1.04-22.6     | 0.041   |
| Surgical treatment                                        | 0.37         | 0.13-0.91     | 0.030   |

CI indicates confidence interval. Other abbreviations are the same as in Table II.

### Table IV. Results of the Cox Proportional-Hazards Analysis for the Risk of All-Cause Mortality Determined by the CONUT Score

| CONUT score (per 1 increase) | Crude HR (95% CI) | P value | Adjusted HR* (95% CI) | P value |
|-------------------------------|-------------------|---------|----------------------|---------|
|                               | 1.37 (1.16 - 1.64) | < 0.001 | 1.25 (1.00 - 1.55) | 0.041   |

HR indicates hazard ratio; CI, confidence interval; and other abbreviations are the same as in Table II. *Adjusted by a propensity score calculated on the basis of the age, sex, body mass index, NYHA class III or IV, C-reactive protein, estimated glomerular filtration rate, diabetes mellitus, Staphylococcus infection, and valve abscess.

### Discussion

This study was the first to investigate the association between the CONUT score and all-cause mortality in patients with IE. There were four major findings. First, a higher CONUT score was associated with a different clinical profile to a lower score. Patients with a higher CONUT score were more likely to have inflammation, heart failure, renal dysfunction, anemia, and valve dysfunction. They also had a higher white blood cell count, CRP level, and NT-pro BNP, as well as a lower hemoglobin level and e-GFR. Moreover, they have a higher prevalence of multi-valve infection and valve perforation. Second, a higher CONUT score upon admission for IE was independently associated with short-term mortality. Third, a higher CONUT score upon admission was strongly associated with short-term mortality in patients with surgical indications. Fourth, patients with surgical indications and a high CONUT score who did not undergo surgery had the worst prognosis.

Treatment of IE has improved in recent years, but the
Figure 2. Kaplan-Meier plot of overall survival in IE patients from the low CONUT group (score ≤ 7, blue line) and the high CONUT group (score ≥ 8, red line) without surgical indications (A) or with surgical indications (B).

Figure 3. Kaplan-Meier plot of overall survival stratified according to surgical indications, surgical treatment, and the CONUT score.

cies, such as esophageal cancer, gastric cancer, and hepatocellular carcinoma.\textsuperscript{22,23} The relationship between the immune-nutritional status and the prognosis of patients with cardiovascular disease has also attracted great attention, and the CONUT score has been associated with all-cause mortality in patients with coronary artery disease or heart failure.\textsuperscript{24-27} However, the relationship between this score and the IE prognosis remains unclear.

The inflammatory response caused by IE can lead to hypoalbuminemia, low serum HDL cholesterol, and lym-
phoenia, and the degree of these changes is associated with the severity of the infection and the IE prognosis. Since the CONUT score was calculated from the serum albumin level, total cholesterol level, and total peripheral lymphocyte count, we demonstrated that the CONUT score reflects the severity of inflammation observed in IE patients with acute infections. The present study revealed that a higher CONUT score was associated with inflammation, heart failure, renal dysfunction, anemia, valve dysfunction, and mortality rate of IE. Thus, the CONUT score may more closely reflect the severity of inflammatory changes in IE, rather than the baseline nutritional status.

Regarding the relationship between surgical treatment and clinical outcomes, we found that patients with surgical indications who did not undergo surgery had a worse prognosis than those who did or those without surgical indications. In a prospective study conducted by the International Collaboration on Endocarditis, 25% of patients with surgical indications were treated with drug therapy alone. Patient factors related to poor prognosis and S. aureus etiology were the main reasons why surgery was not performed in that study. In our study, a higher CONUT score was associated with worse clinical outcomes among patients with surgical indications receiving drug therapy alone.

We found that a CONUT score ≥ 8 upon admission was useful for predicting short-term mortality, with a sensitivity of 86% and specificity of 76%, and a CONUT score ≥ 8 was strongly associated with mortality in patients with surgical indications. Multiple predictors have already been used to evaluate the clinical outcomes of IE. The CONUT score is based on only three measurements and is an objective, simple, and cost-effective index. Our findings suggest that it may be a useful biomarker for risk stratification and management of patients with IE.

There were several limitations of this study. First, it was a retrospective study and conducted at only two institutions with a small sample size, since IE is an uncommon disease. Second, we did not obtain long-term follow-up data. Finally, the CONUT score was only determined up data. Finally, the CONUT score was only determined upon admission, so whether the score changed over time is unknown. Because our results revealed that the CONUT score is a significant predictor of adverse outcomes in IE, a large-scale multicenter study should be conducted to confirm this finding.

Conclusion

A higher CONUT score upon admission was strongly associated with inflammation, heart failure, renal dysfunction, anemia, valve dysfunction, and mortality in patients with IE and with short-term mortality in patients with surgical indications. These results suggest that the CONUT score can predict the prognosis of IE and may be useful for improving risk stratification.

Disclosure

Conflicts of interest: None.
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