Prediction of Ischemic Stroke-Associated Pneumonia: A Comparison between 3 Scores

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Background: Stroke is a leading cause of death and disability worldwide. Among all poststroke complications, pneumonia constitutes a major complication with a strong impact on morbidity and mortality. To identify patients at high risk of stroke-associated pneumonia (SAP) and to tailor a prophylactic approach, a reliable scoring model for prediction may be useful in daily stroke care. *Objectives:* This study aimed to compare the performance of the Age, Atrial fibrillation, Dysphagia, Sex, Stroke Severity (A^2DS^2) score, the acute ischemic stroke-associated pneumonia score (AIS-APS), and the Preventive ANtibacterial THERapy in acute Ischemic Stroke (PANTHERIS) score in predicting SAP. *Methods:* Seventy consecutive patients with ischemic stroke admitted to the Critical Care Medicine Department of Alexandria Main University Hospital were included. Patients were prospectively followed up for primary outcome of pneumonia within the first 7 days after admission diagnosed by the Centers for Disease Control and Prevention criteria. Accuracy in predicting outcome measures was assessed by calculating the area under receiver operating characteristic curve (AUC). *Results:* Twenty-six (37.1%) patients developed pneumonia by the seventh day; the A^2DS^2 score AUC was .847 (95% CI: .741-.922), and the AIS-APS AUC was .798 (95% CI: .685-.884). The PANTHERIS score AUC was .715 (95% CI: .595-.817). The A^2DS^2 score AUC was significantly higher than the AIS-APS and the PANTHERIS score AUCs ($P = .048$ and $P = .009$ respectively), and the AIS-APS AUC was significantly higher than the PANTHERIS score AUC ($P = .044$). *Conclusions:* The A^2DS^2 score is a valid tool for the prediction of SAP based on routinely collected data, and among the 3 studied scores, it shows the best performance in predicting SAP. **Key Words:** Stroke-associated pneumonia—Ischemic stroke—A^2DS^2 score—PANTHERIS score—AIS-APS.

Introduction

Stroke is a leading cause of death and disability worldwide. Medical complications are frequent among individuals who have had a stroke, increasing the length of hospitalization as well as the costs of care. These complications are a major cause of death in the acute and subacute stroke phases.[1] Among all poststroke complications, pneumonia constitutes a major complication with a strong impact on morbidity and mortality.[1-3] Preventive antibiotic therapy has been shown to be a promising strategy to prevent poststroke infections.[4]

To effectively evaluate the risk of stroke-associated pneumonia (SAP), several scales including different risk factors have been developed.[5-7] The Age, Atrial fibrillation, Dysphagia, Sex, Stroke Severity (A^2DS^2) score is a simple 10-point scoring system developed from routinely collected data that were available immediately after hospital admission. It was developed from the Berlin Stroke Register cohort[5] and was subsequently validated using German,[5]

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Chinese,[8] and UK[9] stroke registry data. The Preventive ANtibacterial THERapy in acute Ischemic Stroke (PANTHERIS) score is a simple 12-point scoring system to predict SAP in acute stroke based on routinely collected data including age, Glasgow Coma Score (GCS), early blood pressure increase, and early leukocytosis.[6] The acute ischemic stroke-associated pneumonia score (AIS-APS) is a 35-point score that was developed from a set of independent predictors based on the China National Stroke Registry.[7]

The aim of the present work was to compare the performance of the A^2DS^2 score, the AIS-APS, and the PANTHERIS score in predicting SAP.

Methods

The study was carried out on 70 adult patients with acute ischemic stroke admitted consequently to the units of Critical Care Medicine Department of Alexandria Main University Hospital from 1 March to 30 September 2015. Informed consent was taken from the next of kin of every patient included in the study. The study had been approved by the local ethics committee of the Faculty of Medicine.

Inclusion Criteria

- adult patients (age ≥18 years)
- with acute ischemic stroke, which is defined as "[a]n episode of neurological dysfunction caused by focal cerebral ischemic injury based on symptoms persisting ≥ 24 hours"[10]

Exclusion Criteria

- hemorrhagic stroke
- clinical signs of infection on admission
- white blood cell count greater than 11.000/μL at admission
- preceding or ongoing antibiotic therapy within the last 24 hours

Data Collected

For every eligible patient, the following data had been collected:

- demographic data including age and sex
- vital signs
- GCS[11] on admission after primary respiratory and hemodynamic stabilization
- stroke severity on admission assessed by the National Institutes of Health Stroke Scale (NIHSS)[12]
- All patients will receive a computed tomography scan of the brain on admission. Diagnostic procedures such as Doppler ultrasound of the carotid arteries, magnetic resonance imaging, and echocardiography will be ordered if deemed necessary by the treating physician.
- stroke subtype classification using the Oxfordshire Community Stroke Project[13]
- pre-existing comorbid conditions (any treatment or patient's self-report): hypertension, diabetes mellitus, atrial fibrillation, chronic obstructive pulmonary disease, congestive heart failure, and current smoking.
- evidence for any type of dysphagia documented by a standardized dysphagia screening test[14]
- laboratory data: White blood cell count, C-reactive protein, and blood glucose will be done daily.
- The collected data were used to assign each patient a score on the A^2DS^2 score, the AIS-APS, and the PANTHERIS score.

Outcome Measures

Enrolled patients were prospectively followed up for a primary outcome of the diagnosis of pneumonia within the first 7 days after admission. Diagnosis was made according to modified criteria of the Centers for Disease Control and Prevention.[15] Secondary outcome was in-hospital or 30-day mortality.

Statistical Analysis

Data are presented as median with interquartile range (IQR) for continuous variables, and as frequencies and percentages for categorical variables. Accuracy in predicting outcome measures was assessed by calculating the area under receiver operating characteristic (ROC) curve. The best cutoff point was chosen as one that maximizes the Youden index (sensitivity + specificity – 1). Comparison of the areas under ROC curves (AUC) was performed using the nonparametric technique described by DeLong et al.[16] Data were analyzed by SPSS Statistics 21.0 for Windows (SPSS Inc., Chicago, IL), and ROC curve analyses were performed by MedCalc Version 15.8.0.0 (Frank Schoonjans, Mariakerke, Belgium). All hypotheses were constructed 2-tailed, and P value of ≤.05 was considered significant.

Results

Median age was 60 years (IQR 52-70). Thirty-seven patients (52.9%) were women; the median NIHSS on admission was 13 (IQR 8-23), and the median GCS score was 9 (IQR 7-11). Dysphagia screening revealed that 31 (44.3%) patients were dysphagic. Patient characteristics are summarized in Table 1.

When predicting pneumonia, the A^2DS^2 score AUC was .847, the sum of sensitivity and specificity was maximized at a A^2DS^2 score of six (sensitivity = 76,9%; specificity = 84.1%). The AIS-APS AUC was .798; the sum of sensitivity and specificity was maximized at an AIS-APS of 12 (sensitivity = 88.5%; specificity = 72.7%). The PANTHERIS score AUC was .715; the sum of sensitivity and specificity was maximized at a PANTHERIS score