Heart, Lung and Circulation (2015) **24,** 348–353
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2014.10.009

ORIGINAL ARTICLE

Risk Factors for Hospital Death in Patients With Acute Aortic Dissection

Jing Zhang, MD [a,b], Yujuan Jiang, MD [a], Chao Gao, BS [b], Jun Feng, MD [b], Ailing Wang, MD [a*]

[a]Department of Cardiovascular, the First Affiliated Hospital of An Hui Medical University, He Fei, China
[b]Department of Cardiovascular, the Second People Hospital of He Fei. He Fei, China

Received 8 August 2014; received in revised form 14 October 2014; accepted 22 October 2014; online published-ahead-of-print 1 November 2014

Background To determine the risk factors leading to hospital death with acute aortic dissection (AAD) patients and then to develop a simple risk prediction model to identify patients at increased risk of hospital death.

Methods A total of 360 patients with AAD were enrolled. Thirty risk factors were used in the statistical analysis for predicting hospital death. Risk factors for hospital death were investigated with univariate and multiple logistic regression analysis.

Results The hospital mortality rate was 21.4% (77 of 360 patients). Univariate analysis revealed 12 risk factors to be statistically significant predictors of hospital death ($P < 0.05$). Multiple logistic regression analysis identified that type A (OR, 10.53; $P = 0.001$), hypotension (OR, 5.72; $P = 0.04$), syncope (OR, 8.24; $P = 0.03$), ischaemic complications (OR, 4.67; $P = 0.05$), renal dysfunction (OR, 31.32; $P < 0.001$), and neutrophil percentage ≥80% (OR, 5.67; $P = 0.01$) were significant predictors of in-hospital death. With the simple prediction model, a total score of 4 offered the best point value.

Conclusions Independent risk factors for hospital death can be predicted with AAD patients. The risk prediction model could be used to identify the prognosis and to quickly determine the therapeutic technique for AAD patients.

Keywords Acute • Aortic dissection • Hospital mortality • Risk factors • Complication

Introduction

Acute aortic dissection (AAD) is the most catastrophic acute illness of the aorta, with high mortality due to potentially fatal complications. Data show that the mortality due to AAD early after the onset of symptoms was about 1%–2% per hour. The one-week mortality is as high as 60%-70%. Both diversity of symptoms and variability of the severity of symptoms lead physicians to misdiagnose AAD in approximately one in six patients with AAD [1]. Therefore, AAD has become an important topic of recent research.

Most studies, which have evaluated the predictors of hospital death in patients with AAD, were restricted to a small number of patients and type A or type B. Furthermore, these studies have focussed their attention only on the risk factors without using specific scores [2–7]. In this study, 360 patients with AAD were enrolled, and a simple risk model was built to predict the mortality in patients with AAD.

Materials and Methods

Study Population

A total of 360 patients with AAD were enrolled between January 1, 2008 and October 30, 2013 in the first affiliated hospital of Anhui Medical University. The diagnosis of aortic

*Corresponding author. Department of Cardiovascular, the First Affiliated Hospital of An Hui Medical University. 283 Ji Xi Street, He Fei, Anhui, 230009, China. Tel.: +86- 13695652797; Fax: +86-21-64085875., Email: eyna1215@aliyun.com

dissection (AD) was confirmed by symptoms, physical examination, transthoracic echocardiography, or further confirmed by findings from enhanced computed tomography or magnetic resonance imaging studies or visualisation at surgery. AD was classified according to the Stanford classification. A dissection was considered as an AAD if the time from the onset of the symptoms was within 14 days [1]. To minimise bias, patients who had traumatic dissection and those with infectious diseases or under maintenance haemodialysis were excluded.

Data Collection

Clinical variables were recorded on a standard form that included information on patient's age, sex, medical history of hypertension or Marfan syndrome, type of AD, clinical presentations, findings from physical examination, findings from laboratory examination, findings from electrocardiogram (ECG), method of treatment (medical or surgical), and prognosis. Definitions of the following clinical criteria included: hypertension - blood pressure $\geq$140/90 mmHg or the use of antihypertensive agents; hypotension - systolic blood pressure $\leq$110 mmHg. Marfan syndrome was diagnosed using the Ghent criteria. Glomerular filtration rate $\leq$60 mL/min was defined as renal dysfunction. The ischaemic complications included any pulse deficit, cerebral malperfusion, limb ischaemia, and mesenteric ischaemia. Abnormal ECG results were noted as left ventricular hypertrophy, pathologic Q waves, T-wave inversions, ST-segment deviation, or left bundle branch block.

Statistical Analysis

The study comprised two groups: survivors and dead patients. Missing data were not defaulted to negative. Quantitative variables were presented as mean±standard deviation and categorical variables as percentages. Continuous variables were compared using the t-test and categorical data were compared using the Fisher's exact or Chi-square tests. Multivariate binary logistic regression analyses (backward-LR method) were performed to identify the predictors of in-hospital mortality. Initial modelling used variables marginally suggestive of an unadjusted association with in-hospital death ($P < 0.10$). Variables were reviewed for clinical significance before testing. A Hosmer-Lemeshow test and ward statistic were used for the final model selection. The odds ratio (OR) and the 95% confidence interval (CI) were also calculated. $P < 0.05$ was considered as statistical significance. The analysis was performed using SPSS 19.0 software.

Development of a Risk Prediction Model

Those significant variables associated with in-hospital death in the regression analyses were assigned a point equal to their coefficients in the model ($P < 0.05$). Each patient would have a sum of score. According to the known prognosis of patients, the sensitivity and specificity of every score to predict in-hospital death were evaluated. The appropriate point could then be used to predict in-hospital death. A simple risk prediction model would have a threshold value with sensitivity and specificity in predicting in-hospital mortality for patients with AAD.

Results

Clinical Characteristics of all Inpatients

Among the 360 patients, 283 (78.6%) patients survived and 77 (21.4%) patients died during hospitalisation. Thus, the study comprised two groups of patients: survival and death. The mean age of overall patients was 57.1 $\pm$ 12.6 years, with a majority being males (75.8%) and 121 (33.6%) patients had type A AAD. About 45% of the patients had a medical history of hypertension and 25% of the patients had a fast heart rate ($\geq$100 bpm). Nearly half (48.3%) of the patients underwent surgery for repair of AD. A small number of patients with AAD had associated renal dysfunction (20%), pericardial or pleural effusion (13.1%), syncope (8.9%), and ischaemic complications (6.7%). On the other hand, a large number (85.8%) of patients with AAD had abnormal ECG findings (Table 1).

Univariate Predictors of In-Hospital Death in Patients with AAD

Analysis of the types of AAD showed that patients with type A AAD were more likely to die in the hospital when compared to those with type B AAD (70.1% vs 23.7%, $P < 0.0001$). Compared to the patients who survived, those who died in the course of AAD generally had a low blood pressure (36.4%) and platelet count (18.2%), besides high activated partial thromboplastin time (25.9%), and D-dimer (41.5%). Mean white blood cell (WBC) count (13.0 $\pm$ 4.98 vs 9.54 $\pm$ 3.67 $\times$ 10^9/L, $P < 0.0001$) and neutrophil percentage (83.8 $\pm$ 8.27% vs 77.1 $\pm$ 11.5%, $P < 0.0001$) were significantly higher in patients who died in the hospital. Furthermore, complications such as syncope, ischaemia of the internal organs and limb, and kidney failure were associated with higher in-hospital mortality rates. There was significant difference in the two groups for surgical treatment (59% vs 22.1%, $P < 0.0001$). On the other hand, there was no significant difference in age, sex, medical history of hypertension and Marfan syndrome, heart rate, the blood levels of total cholesterol, triglyceride, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, potassium, calcium, magnesium, prothrombin time, international normalised ratio, C-reactive protein (CRP), and erythrocyte sedimentation rate between the two groups ($P > 0.05$). At the same time, the presence of abnormal ECG findings and pericardial or pleural effusion was similar in the two groups of patients (Table 1).

Multivariate Predictors for In-Hospital Death in Patients with AAD

In multivariate logistic regression analysis, the independent predictors of death on admission were hypotension (OR, 5.72; 95% CI, 1.07 to 20.51; $P = 0.04$), syncope (OR, 8.24; 95% CI, 1.25 to 33.85; $P = 0.03$), ischaemic complications