Original Article

Serum Gamma-glutamyl Transferase Levels Predict Functional Outcomes after Aneurysmal Subarachnoid Hemorrhage*

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Abstract

Objective We aim to explore the potential association between serum gamma-glutamyl transferase levels and functional outcome after aneurysmal subarachnoid hemorrhage in a Chinese population.

Methods A total of 386 aneurysmal subarachnoid hemorrhage patients were included in the study from September 2007 to February 2015. Baseline serum gamma-glutamyl transferase levels and 6-month follow-up functional outcomes were determined. A poor outcome was defined as a modified ranking scale score of ≥ 3. The multivariable logistic model was used to analyze the relationship between serum gamma-glutamyl transferase and clinical outcomes after aneurysmal subarachnoid hemorrhage.

Results The adjusted poor outcome rates of patients with gamma-glutamyl transferase levels of < 30 U/L, 30-50 U/L and ≥ 50 U/L were 16.7%, 19.6%, and 34.4%, respectively (P < 0.01). The age-sex and multivariable adjusted odds ratios (95% confidence intervals) of poor prognosis comparing the top group (≥ 50 U/L) with the lowest group (< 30 U/L) were 5.76 (2.74-12.13), 6.64 (2.05-21.52), and 6.36 (1.92-21.02). A significant linear trend existed between gamma-glutamyl transferase level and aneurysmal subarachnoid hemorrhage prognosis. This association was also observed among nondrinkers.

Conclusion Patients with higher gamma-glutamyl transferase levels were more likely to have a poor prognosis. Serum gamma-glutamyl transferase can be considered to be an independent predictor of functional outcomes after aneurysmal subarachnoid hemorrhage.

Key words: Aneurysmal subarachnoid hemorrhage; Gamma-glutamyl transferase; Functional outcome; Predictor

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INTRODUCTION

Subarachnoid hemorrhage (SAH), which is due to the rupture of an intracranial aneurysm, occurs with a frequency of between six and eight cases per 100,000 people in most western populations[1]. Aneurysmal subarachnoid hemorrhage (aSAH) is a devastating illness that causes high disability and mortality rates[2]. It accounts for approximately 75% of SAH cases. Although better treatment methods have been used recently, the long-term mortality of aSAH patients still reaches 10%-24%[3-4]. It is crucial for us to find novel and accurate predictors of aSAH prognosis.

Gamma-glutamyl transferase (GGT), which is a plasma membrane enzyme and is involved in glutathione metabolism, has been shown to be involved in oxidative events associated with atheroma plaque formation[5-6]. Several studies have shown that a higher level of GGT is a risk factor for cardiovascular and cerebrovascular disease incidence regardless of alcohol consumption[7-9]. In addition, GGT is considered to be a predictive biomarker for stroke and acute coronary syndrome prognosis[10-11]. However, there have been no studies that have specifically evaluated the relationship between GGT and aSAH prognosis. It is unclear whether elevated GGT levels could increase the risk of poor prognosis in aSAH patients. Our objective is to explore this potential association in a Chinese population.

MATERIALS AND METHODS

Study Population

From September 2007 to February 2015, 558 patients with aneurysmal SAH, confirmed by computerized tomography (CT) angiography with or without digital subtraction angiography, who were admitted to the affiliated hospital of Nantong University, were evaluated in this study. Patients were excluded from the study if they had any one of the following criteria: (1) age < 18 years; (2) admission time of more than 72 h since onset of symptoms; (3) without available GGT data upon admission; (4) without a 6-month follow-up after aSAH episode; (5) have hepatobiliary and non-alcoholic fatty liver diseases; and (6) not eligible for either surgical clipping or endovascular coiling. Based on these exclusion criteria, a total of 386 aSAH patients were retrospectively included in this study. This study was approved by the ethical committee of the affiliated hospital of Nantong University.

Data Collection

Baseline data were collected at admission *via* interviews with the patients or their family members. Data on demographic characteristics, life-style risk factors and medical history were documented. Alcohol consumption was defined as consuming any type of alcoholic beverage at least once per week during the last year. The Hunt-Hess grade, Fisher scale and Glasgow Coma Score (GCS) were used to evaluate severity upon admission[12]. According to a common protocol that was adapted from procedures recommended by the American Heart Association, three baseline blood pressure measurements were obtained with a standard mercury sphygmomanometer while the study participants were in the supine position. The diameter and location of aneurysms were recorded by 3-dimensional CT angiography. We analyzed the CT images for the presence of delayed cerebral ischemia and recorded the time that any delayed cerebral ischemia occurred after the aneurysm treatment. All patients underwent daily serial neurological evaluations to detect any delayed cerebral ischemia. Delayed cerebral ischemia was defined as the occurrence of focal neurological impairment (such as hemiparesis, aphasia, apraxia, hemianopia, or neglect), or a decrease of at least 2 points on the Glasgow Coma Scale [either on the total score or on one of its individual components (eye, motor on either side, verbal)]. This should last for at least 1 h, is not apparent immediately after aneurysm occlusion, and cannot be attributed to other causes by means of clinical assessment, CT or MRI scanning of the brain, and appropriate laboratory studies[13] .

Blood specimens were collected from all subjects within 24 h of hospital admission (with subjects fasting for at least 8 h). The glucose oxidase-peroxidase method was used to determine plasma glucose levels[14]. The serum GGT levels were measured by an enzymatic colorimetric method (Roche Modular P; Roche Diagnostics, Mannheim, Germany)[15], and total bilirubin (tbil) was determined by the 2,5-dichlorophenyldiazonium (DPD) method[16].

Outcome Assessment

The outcome assessed in this study was a