

# The Basilar Artery on Computed Tomography Angiography Score for Acute Basilar Artery Occlusion Treated with Mechanical Thrombectomy

Haihua Yang, MD,<sup>\*,†</sup> Ning Ma, MD,<sup>\*</sup> Lian Liu, MD,<sup>\*</sup> Feng Gao, MD,<sup>\*</sup>  
Dapeng Mo, MD,<sup>\*</sup> and Zhongrong Miao, MD<sup>\*</sup>

**Background:** Recently, the Basilar Artery on Computed Tomography Angiography (BATMAN) score predicts clinical outcome of acute basilar artery occlusion (BAO), yet there is no extensive external validation. The purpose of this study was to validate the prognostic value of BATMAN scoring system for the prediction of clinical outcome in patients with acute BAO treated with endovascular mechanical thrombectomy by using cerebral digital subtraction angiography (DSA). **Methods:** We analyzed the clinical and angiographic data of consecutive patients with acute BAO from March 2012 to November 2016. The BATMAN scoring system was used to assess the collateral status and thrombus burden. Thrombolysis in Cerebral Infarction (TICI) score 2b-3 was defined as successful recanalization. Receiver operating characteristic (ROC) curve was used to determine the area under the curve (AUC) and the optimum cutoff value. Multivariate regression analysis was used to identify the predictor of clinical outcome. **Results:** This study included 63 patients with acute BAO who underwent mechanical thrombectomy. Of these patients, 90.5% (57/63) achieved successful recanalization (TICI, 2b-3) and 34.9% (22/63) had a favorable outcome (modified Rankin Scale score 0-2). ROC analysis indicated that the AUC of the BATMAN score was .722 (95% confidence interval [CI], .594-.827), and the optimal cutoff value was 3 (sensitivity = 72.73, specificity = 63.41). In multivariate logistic regression analysis, the BATMAN score higher than 3 was associated with favorable outcome (odds ratio, 5.214; 95% CI, 1.47-18.483;  $P = .011$ ). **Conclusions:** The BATMAN score on DSA seems to predict the functional outcome in patients of acute BAO treated with mechanical thrombectomy. **Key Words:** Stroke—angiography—thrombectomy—prognostic—basilar artery.

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From the <sup>\*</sup>Department of Interventional Neurology, Beijing Tiantan Hospital; and <sup>†</sup>Department of Neurology, Beijing Daxing Hospital, Capital Medical University, Beijing, China.

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Address correspondence to Zhongrong Miao, MD, Department of Interventional Neurology, Beijing Tiantan Hospital, Capital Medical University, No.6, Tiantan Xili, Chongwen district, Beijing, China. E-mail: [zhongrongm@163.com](mailto:zhongrongm@163.com).

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## Introduction

Although acute basilar artery occlusion (BAO) accounts for about 1% of all stroke diseases, it can lead to high disability and mortality rates.<sup>1-3</sup>

Even if the recanalization rate was significantly improved after intra-artery thrombolysis, there was no significant difference in clinical outcome between patients who had intravenous thrombolysis and patients who had intra-arterial thrombolysis, according to the Basilar Artery International Cooperation Study (BASICS).<sup>3</sup> Similarly, mechanical thrombectomy improved the recanalization rate, whereas the favorable prognosis of BAO was only approximately 35%.<sup>4,5</sup> Several factors affected the clinical outcome including baseline National

Institutes of Health Stroke Scale (NIHSS) score, collateral status, and length of thrombus.<sup>6-10</sup>

Basilar Artery on Computed Tomography Angiography (BATMAN) score is a 10-point scoring system that can be easily evaluated.<sup>11</sup> The scoring system includes collateral circulation and thrombus burden, which can predict the functional prognosis after acute BAO. However, this scoring system has not been extensively validated. The purpose of this study was to assess the predictive value of the BATMAN score on digital subtraction angiography (DSA) in patients with acute BAO who underwent endovascular treatment.

## Methods

### Patients

We retrospectively analyzed 63 consecutive patients with acute BAO treated with mechanical thrombectomy from March 2012 to November 2016. The ethics committee approved the study and informed consent was obtained from patients and their families before the procedure.

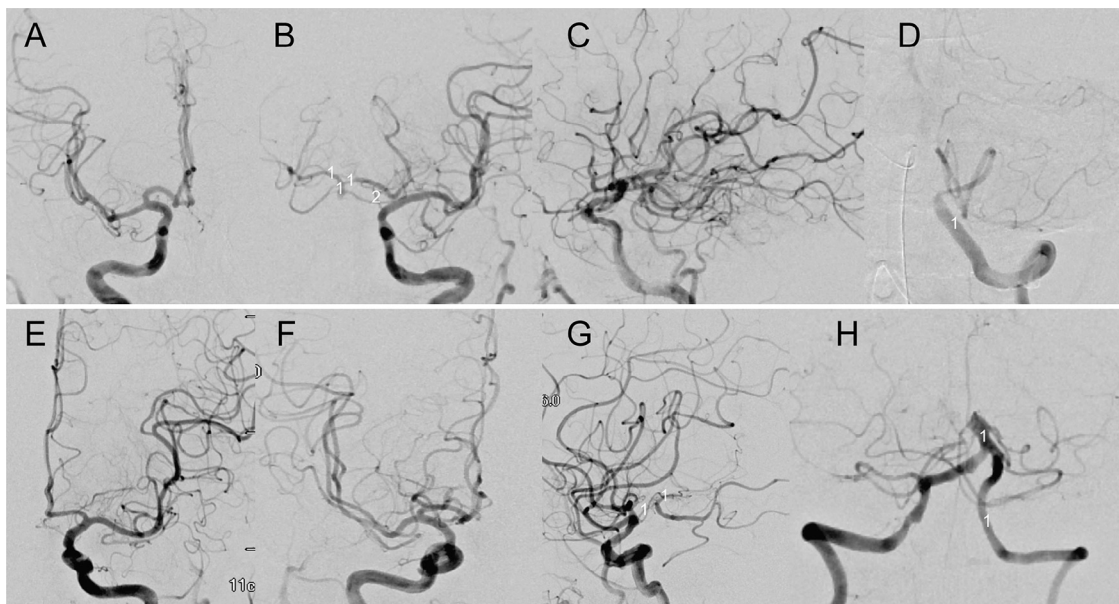
The inclusion criteria were as follows: (1) magnetic resonance angiography or computed tomography angiography (CTA) confirmed acute BAO; (2) modern thrombectomy device was used for endovascular treatment; (3) procedure was performed within 24 hours; and (4) carotid and vertebral angiograms were obtained. The exclusion criteria were as follows: (1) computed tomography or

magnetic resonance imaging found intracranial hemorrhage or tumor; (2) patient had contrast allergy; (3) the modified Rankin scale (mRS) score was higher than 3 before onset.

### Imaging Analysis: Grading System

The BATMAN score is a 10-point semiquantitative scoring system based on CTA, including collateral quality and thrombus burden.<sup>11</sup> According to the result of cerebral DSA, 1 point was allocated for patent segment of either intracranial vertebral artery, each segment of the basilar artery (the proximal segment, the middle segment, and the distal segment), and each P1 segment of the posterior cerebral artery. Two points was given for each patent posterior communicating arteries (PCoM), and 1 point for hypoplastic PCoM (caliber smaller than 1 mm) if retrograde blood flow can arrive to the distal basilar artery via P1 segment, or 3 points for each fetal PCoM. Examples using the BATMAN scoring system are presented in [Figure 1](#). Two interventionalists reviewed the radiological images independently, blinded to the clinical features and prognosis of the patients. In case of discrepancy, the final BATMAN score was determined by consensus.

Endovascular therapy was performed under local anesthesia or general anesthesia. The stent retriever was used for performing mechanical thrombectomy as the primary treatment approach. The location of BAO was defined as proximal segment (from the confluence of the verte-



**Figure 1.** A patient with acute vertebrobasilar artery occlusion (A to D). (A) There are no collaterals between the right anterior circulation and the posterior circulation. (B and C) The apex of basilar artery including bilateral posterior cerebral artery and superior cerebellum artery are irrigated from the left anterior circulation via the left PCoM. (D) Occlusion of distal vertebral artery after origin of posterior inferior cerebellar artery is found. The BATMAN score is 6 (1 for right P1 segment, 1 for left P1 segment, 1 for distal basilar artery, 2 for left PCoM, and 1 for vertebral artery) for this case. Another patient with acute basilar artery occlusion (E to H). (E) There are no collaterals between the left anterior circulation and the posterior circulation. (F and G) The right posterior cerebral artery is irrigated via a hypoplastic PCoM. (H) Occlusion of the basilar artery after origin of bilateral anterior inferior cerebellar arteries is found. The BATMAN score is 4 (1 for right hypoplastic PCoM, 1 for right P1 segment, 1 for proximal basilar artery, and 1 for vertebral artery) for this case. Abbreviations: BATMAN, Basilar Artery on Computed Tomography Angiography; PCoM, posterior communicating artery.

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