

# Comparison of Functional Outcome between Lacunar Infarction and Branch Atheromatous Disease in Lenticulostriate Artery Territory

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*Background:* Branch atheromatous disease (BAD) is differentiated from lacunar infarction (LI). BAD is often associated with neurological deterioration in the acute stage, but outcome of BAD patients in the chronic stage is unclear. We aimed to explore the outcome of BAD in the lenticulostriate artery (LSA) territory in comparison with those of LI from the viewpoint of activities of daily living (ADLs). *Methods:* We retrospectively investigated patients who were admitted within 3 days after stroke onset. The patients underwent daily rehabilitation during hospitalization. BAD in LSA territory was defined by the presence of lesion representing 3 or more consecutive horizontal slices in magnetic resonance imaging. Patients having atrial fibrillation or more than 50% stenosis of the large artery in magnetic resonance angiography were excluded. We retrieved data on clinical characteristics and evaluation from medical records. *Results:* Subjects were 41 BAD and 35 LI patients. There was little difference in baseline characteristics. The National Institutes of Health Stroke Scale score was significantly higher in BAD patients ( $P < .05$ ). The Barthel Index (BI) score and the Brunnstrom recovery stage were lower in BAD patients at admission ( $P < .05$  and  $P < .05$ ). Hospital stay was longer in BAD patients ( $P < .01$ ), but the BI score at discharge was not different. To ambulate, 8 BAD and 1 LI patients depended on orthoses ( $P < .05$ ), and 21 BAD and 7 LI patients used canes ( $P < .01$ ). Multivariable analysis demonstrated that BAD lesion was correlated with AFO use independent of age and sex. *Conclusions:* BAD patients can obtain ADLs similar to LI patients. However, many BAD patients require canes and/or orthoses. **Key Words:** BAD—ADL—rehabilitation—neurorehabilitation—stroke—orthosis.

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## Introduction

Branch atheromatous disease (BAD) is differentiated from lacunar infarction (LI) by pathogenesis. It was reported that BAD is caused by the occlusion at the origin of the penetrating artery, whereas LI is caused by the lipohyalinosis of the penetrating artery.<sup>1</sup> Recently, several studies have reported that BAD is associated with clinical worsening of symptoms and causes relatively severe hemiparesis in the acute stage.<sup>2</sup> However, few studies have mentioned long-term prognosis of stroke patients with BAD. Little is known about activities of daily living (ADLs) of stroke patients with BAD in the chronic stage.

In the present study, we aimed to explore the outcome of BAD in the lenticulostriate artery (LSA) territory in comparison with that of LI in the same lesion area, especially from the viewpoint of ADL.

## Methods

### *Patient Recruitment*

We subjected the patients who were admitted to Tokyo General Hospital within 3 days of acute ischemic stroke onset to acute therapy and rehabilitation between April 2010 and December 2013 from medical records. We checked each diffusion-weighted imaging of their magnetic resonance imaging data at admission and recruited the patients who had a lesion in the LSA territory in accordance with radiologist interpretation.

### *Inclusion Criteria*

BAD in LSA territory was defined by the presence of a lesion representing 3 or more consecutive horizontal slices in diffusion-weighted imaging according to the previously reported definition.<sup>3</sup> LI in the LSA territory was defined by the presence of a lesion representing less than 3 horizontal slices in diffusion-weighted imaging.

### *Exclusion Criteria*

We excluded the patients who met at least one of the following criteria to rule out the possibility of cardioembolic infarction, atherothrombotic infarction, and carotid and vertebral artery dissections:

- (1) history of atrial fibrillation,
- (2) more than 50% stenosis of the large artery in magnetic resonance angiography, and
- (3) arterial dissections in magnetic resonance angiography.

### *Procedure*

As clinical evaluation, the National Institutes of Health Stroke Scale (NIHSS) score, the Brunnstrom recovery stage (Brs), and the Barthel Index (BI) score at admission were compared between BAD and LI patients. Rate of discharge to home, the average length of hospital stay, Brs,

and BI score at discharge were compared between the 2 groups. We compared BI subscales and degrees of dependence on canes and ankle-foot orthoses (AFOs) between the 2 groups to examine outcomes from the perspective of ADL. Furthermore, clinical characteristics and clinical evaluation were compared between AFO users and AFO nonusers.

### *Statistical Analysis*

Data were analyzed using SPSS 21.0 (IBM, Somers, NY). Statistical analyses were performed using  $\chi^2$  test for categorical variables, the Student *t*-test for parametric analysis, and the Mann-Whitney *U*-test for nonparametric analysis.

The study was approved by the ethics committee of Tokyo General Hospital.

## Results

We enrolled 41 BAD and 35 LI patients. There was no significant difference in baseline characteristics, as [Table 1](#) shows.

[Table 2](#) shows the clinical evaluation and outcomes between the 2 groups. The NIHSS score was significantly higher in BAD patients at admission. The BI score and the Brs were significantly lower in BAD patients at admission. However, the Brs and the BI score at discharge and the rate of discharge to home were not different in both groups. BAD patients were hospitalized for a longer time than LI patients.

[Table 3](#) shows that except for "transfer," each subscale of BI was not different between the 2 groups. However, BAD patients were much more dependent on canes and AFOs to obtain mobility capability.

[Table 4](#) shows the results of the univariate analysis of clinical characteristics and evaluation associated with AFO use. BAD lesion and Brs of the upper and lower extremities at admission were significantly correlated with AFO use. As the result of logistic regression analysis, the presence of BAD lesion was correlated with AFO use independent of age and sex, as [Table 5](#) shows.

## Discussion

The present study showed that BAD patients present more severe hemiparesis than LI patients at admission, but the ADLs of BAD patients are not much lower than those of LI patients in the chronic stage. However, many BAD patients depend on adaptive equipment such as canes and AFO to obtain ambulatory capability.

Some studies reported that early neurological deterioration occurs frequently in BAD patients.<sup>2,4</sup> Neurological deterioration could cause relatively severe hemiparesis and subsequent ADL dependence. In the present study, BAD patients had more severe hemiparesis and lower ADL scores than LI patients at admission. It was anticipated that severe hemiparesis and ADL dependence at

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