

# Effects of Different Surgical Modalities on Clinical Outcome of Moyamoya Disease: A Prospective Cohort Study

Xiaofeng Deng MD; Dong Zhang; Yan Zhang MD; Rong Wang; Faliang Gao; Jizong Zhao MD

Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University; China National Clinical Research Center for Neurological Diseases (NCRC-ND), Beijing, China



## Introduction

Bypass surgery is the most common treatment for Moyamoya disease (MMD), but which surgical modality that is the best still remains controversial. The objective of this study was to evaluate the effects of different surgical modalities on clinical outcome of MMD.

## Methods

This prospective cohort study screened a series of 696 consecutive MMD patients from a single center of China between 2009 and 2015. All patients underwent digital subtraction angiography (DSA) or magnetic resonance angiography (MRA) and the diagnosis was based on the guidelines for MMD. In our institution, direct bypass (DB) and combined bypass (CB) are preferred surgical modalities, and indirect bypass (IB) was considered only when the donor or recipient artery was too small or fragile to perform artery anastomosis. Patients without revascularization surgeries or with different surgical modalities on bilateral hemispheres were excluded from this study. Finally, 529 patients who were followed up for at least 12 months were included: 438 patients underwent unilateral surgery and 91 patients underwent bilateral surgery. Of these, 241 patients received DB, 81 patients received combined CB and 207 patients received IB. Three clinical outcomes were evaluated and compared between different surgical groups, including recurrent stroke events, modified Rankin Scale (mRS) scores and change of main symptoms.

## Results

Of the total 620 surgical procedures, complications were observed in 58 operations (9.4%) and there was no significant difference among the three surgical modalities. The mean follow-up period was 40 months. During the follow-up period, recurrent stroke events were observed in 43 patients, including 15 patients with rerecurrent hemorrhage, 26 patients with recurrent ischemia (TIA in 19 and infarction in 7) and 2 patients with both hemorrhage and cerebral infarction. Kaplan-Meier analysis showed that patients receiving CB and DB had longer ischemia-free time compared to patients with IB ( $p=0.013$ ). But there was no significant difference in hemorrhage-free time between different surgical modalities ( $p=0.534$ ). A good neurological status (mRS=2) was achieved in 495 patients (93.6%), which was significantly more common in children (98.2%) than in adults (92.3%;  $p=0.022$ ). Surgical modalities were not significantly associated with neurological status outcome ( $p=0.860$ ). Moreover, improvement of symptoms was observed in 449 patients (84.9%), which was also significantly more common in children (93.0%) than in adults (82.7%;  $p=0.006$ ). No significant difference was observed between different surgical modalities, either ( $p=0.548$ ).

## Conclusions

CB and DB are more effective to prevent recurrent ischemic strokes than IB. However, there is no evidence that these three surgical modalities had significant difference in

## Learning Objectives

By the conclusion of this session, participants should learn that CB and DB are better than IB in preventing recurrent stroke events for ischemic-type moyamoya disease; but for hemorrhagic patients, which is the best surgical modality is still unclear.

