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Editorial–a New Method to Classify the Collateral Patterns in the Posterior Circulation

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Several studies have reported on collaterals in anterior circulation arterial occlusion seen in patients with acute ischemic stroke (1–4). The presence of collateral flow in basilar artery occlusion has been recognized in small studies (5,6). Moscow and Newton (5) reported nine cases of basilar artery occlusion located proximal to the origins of the superior cerebellar artery. The posterior cerebral and superior cerebellar arteries filled in all nine patients via collateral flow either through the posterior communicating artery (n=7) or pial anastomoses from the middle cerebral arteries to the posterior cerebral arteries (n=2). Subsequently, Archer and Horenstein (6) provided more in-depth data regarding frequency and type of collaterals on the surface of the cerebellum in 20 patients with basilar artery occlusion and three patients with bilateral vertebral artery occlusions. Drake (7) reported that three of the seven patients in whom basilar artery was surgically occluded to treat intracranial aneurysm survived with minimal deficits presumably due to collateral formation. Such observation highlighted that collateral flow can develop and adequately supply the posterior circulation distribution in the event of basilar artery occlusion.

Numerous studies have found that a large proportion of patients with basilar artery occlusion have a poor outcome despite recanalization following intravenous or endovascular thrombolytic treatment (8–11). This observation has prompted the investigators to look for factors such as collateral circulation that are associated with patient outcomes. Brandt et al. (11) determined the variables affecting recanalization and clinical outcome in 51 patients with basilar artery occlusion who were treated with either intra-arterial or intravenous thrombolysis. The initial collateral state was graded as follows: 0, no collaterals; 1 (minimal), anterograde or retrograde collaterals with partial or slight filling; 2 (moderate), anterograde or retrograde collaterals with filling of the superior cerebellar arteries; and 3 (maximal), collateralization with anterograde and retrograde channels or maximal bilateral filling of the superior cerebellar arteries. Collateral circulation was moderate or maximal in 32 patients and was associated with lower mortality independent of recanalization. However, collaterals that form over the surface of the cerebellum are not accounted for by this method.

A new classification scheme was proposed to categorize collateral circulation in patients with basilar artery occlusion or stenosis (see Table). The classification distinguishes the collateral flow in four grades. Grade 1: Retrograde filling of basilar artery through posterior cerebral artery with filling of the superior cerebellar artery; Grade 2: Retrograde filling of basilar artery through posterior cerebral artery without filling of the superior cerebellar artery; Grade III: Bilateral anastomoses of cerebellar or posterior cerebral arteries; and Grade IV: Unilateral anastomoses of cerebellar or posterior cerebral arteries. The reason for differentiation between Grade I and Grade II is based on the prognostic significance of superior cerebellar artery filling through collateral circulation observed by Brandt et al (11). Grades III and IV do not have filling of the basilar artery past the site of occlusion and therefore constitute a group in which the territories of penetrating and paramedian arteries are at high risk of ischemia.

If we apply the classification scheme to the individual patient angiographic data presented as a schematic by Archer and Horenstein (6), we find the following categories in the 23 patients with vertebral artery or basilar artery occlusion: Grade I (n=9); Grade II (n=3); Grade III (n=7), Grade IV (n=1), and no collaterals (n=3). The presence of Grade I collaterals appeared to be associated with lower rate of comatose presentation. Six of the nine patients who were not comatose had Grade I collaterals and two of the eleven patients who were comatose had Grade I collaterals. Further data are required to determine the prognostic significance of various patterns of collateral formation. The four grades in the current grading scheme may allow greater level of risk stratification in patients with vertebral or basilar arterial occlusions.

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Table.

Grading of collateral formation in the posterior circulation

Grade	Definition	Description
Grade I	Retrograde filling of basilar artery through the posterior cerebral artery and results in filling of at least one superior cerebral artery (posterior cerebral artery dependent); antereograde or retrograde basilar artery filling via anastomosis of cerebellar arteries (posterior cerebral artery independent) is categorized as Grade I B in presence of superior cerebellar artery filling.	The retrograde filling of basilar artery is through one or two posterior communicating arteries from internal carotid artery OR pial anastomoses between middle cerebral artery and posterior cerebral artery. The retrograde flow involves the proximal segment of posterior cerebral artery (ies). Infrequently, anterograde or retrograde filling of basilar artery may occur from the vertebral artery through anastomoses between posterior inferior cerebellar artery and anterior inferior cerebellar artery.
A. Posterior cerebral artery dependent		
B. Posterior cerebral artery independent		
Grade II	Retrograde filling of basilar artery through the posterior cerebral artery and does not result in filling of superior cerebral artery (posterior cerebral artery dependent); antereograde or retrograde basilar artery filling via anastomosis of cerebellar arteries (posterior cerebral artery independent) is categorized as Grade II B in absence of superior cerebellar artery filling.	A similar pattern of collateral formation but the extent of basilar artery that fills through the collaterals is different. Infrequently, anterograde or retrograde filling of basilar artery may occur from the vertebral artery through anastomoses between posterior inferior cerebellar artery and anterior inferior cerebellar artery.
A. Posterior cerebral artery dependent		
B. Posterior cerebral artery independent		
Grade III	Bilateral anastomoses of cerebellar or posterior cerebral arteries	Bilateral contribution can be through multiple anastomosis usually between posterior inferior cerebellar artery and anterior inferior or superior cerebellar arteries OR bilateral anastomoses between posterior cerebral arteries and either internal carotid artery (via posterior communicating artery) or between middle cerebral artery (via pial anastomoses).
A. Infratentorial with or without supratentorial		
B. Supratentorial only		
Grade IV	Unilateral anastomoses of cerebellar or posterior cerebral arteries	Unilateral contribution can be through one or more anastomosis usually between posterior inferior cerebellar artery and anterior inferior or superior cerebellar arteries OR unilateral anastomoses between posterior cerebral artery and either internal carotid artery (via posterior communicating artery) or middle cerebral artery (via pial anastomoses).
A. Infratentorial with or without supratentorial		
B. Supratentorial only		

Qureshi grading scheme for angiographic occlusions strongly correlates with the initial severity and in-hospital outcome of acute ischemic stroke. *J Neuroimaging* 2004;14:235–41.

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