Proposal for a Vascular Computed Tomography-Based Grading System in Posterior Circulation Stroke: A Single-Center Experience

Valerio Da Ros, MD,* Alessandro Meschini, MD, PhD,*
Roberto Gandini, Associate Professor of Interventional Radiology,*
Costantino Del Giudice, MD,* Francesco Garaci, Associate Professor of Neuroradiology,*
Paolo Stanzione, Full Professor of Neurology,† Barbara Rizzato, MD,†
Marina Diomedi, MD,† Giovanni Simonetti, Full professor of Radiology,*
Roberto Floris, Full Professor of Neuroradiology,* and Fabrizio Sallustio, MD†‡

Objective: The aim of this study is to investigate the role of a computed tomography angiography (CTA)-based approach in patients undergoing mechanical thrombectomy for vertebrobasilar stroke treatment. *Methods:* A CTA and digital subtraction angiography (DSA) retrospective analysis of patients with acute vertebrobasilar stroke treated with thrombectomy was performed. A modified Rankin Scale score of 3 or lower at 3 months was considered as favorable outcome. The posterior circulation ASPECTS (pc-ASPECTS) was evaluated on CTA and vertebrobasilar segments involved in the occlusion were assessed using a 6-point posterior circulation computed tomography angiography (pc-CTA) vascular score aimed at evaluating the posterior circulation vascular pattern including collaterals. The primary end point was the correlation between pc-CTA and outcome; secondary end points included the concordance between CTA–DSA images and the correlation between pc-ASPECTS and outcome. *Results:* Fifteen patients with vertebrobasilar stroke were retrospectively analyzed. All patients in coma showed a bad outcome ($P = .01$) and all patients with an alert state showed a good outcome ($P = .004$). An excellent interobserver agreement for pc-CTA ($P = .001$) was observed with poor interobserver agreement for pc-ASPECTS ($P = .21$). No significant correlations between pc-ASPECTS and clinical outcome were observed. Patients with good outcome had a lower pc-CTA ($P = .02$). The patency of the distal third of the basilar artery and both posterior cerebral arteries was related with good outcome. *Conclusion:* The pc-CTA seems to have prognostic value in patients with vertebrobasilar stroke undergoing mechanical thrombectomy. It may be used as an additional prognostic triage technique in this subgroup of stroke patients. **Key Words:** Stroke—basilar artery—ASPECTS—computed tomography angiography—neurothrombectomy.

From the *Department of Diagnostic Imaging and Interventional Radiology, University of Rome Tor Vergata, Rome, Italy; †Stroke Unit, Department of Neuroscience, University of Rome Tor Vergata, Rome, Italy; and ‡Fondazione Santa Lucia IRCCS, Rome, Italy.
Received July 30, 2015; revision received September 17, 2015; accepted October 10, 2015.
Address correspondence to Valerio Da Ros, Department of Diagnostic Imaging and Interventional Radiology, University of Rome Tor Vergata, Viale Oxford 81, 00133, Rome, Italy. E-mail: valeriodaros@hotmail.com.
1052-3057/$ - see front matter

http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2015.10.008

Introduction

Vertebrobasilar stroke (VBS) due to basilar occlusion carries a mortality rate of 80%-90%.[1] Intravenous thrombolysis (IVT) with recombinant tissue plasminogen activator (rtPA) and endovascular mechanical thrombectomy (EMT) may reduce mortality in this subtype of stroke.[2] This improvement in outcome seems to be closely related to recanalization, time to treatment, and clinical presentation.[1,3] Among other prognostic factors that could be fundamental in decision making, collateral flow can reduce ischemic injury and has been related with patient outcome, as already described for the anterior circulation stroke.[4-6] However, there are only anecdotal reports on collaterals in VBS, with limited data on their prognostic value.[7] The aim of our study was to investigate a novel approach to evaluate collaterals in VBS and its correlation with functional outcome, using computed tomography angiography (CTA).

Materials and Methods

We retrospectively analyzed the results of the noncontrast computed tomography (NCCT), CTA, and DSA of patients with acute VBS, treated within 24 hours of symptom onset by using EMT, prospectively recruited at our comprehensive stroke center from August 2009 to November 2013. On a predefined treatment algorithm, patients were treated by thrombectomy, preceded or not by intravenous administration of a full dose (i.e., .9 mg/kg) of rtPA. In particular, patients presenting within 6 hours of symptom onset were treated with IVT; thrombolysis was continued until the angiographic suite was ready for urgent EMT and during the endovascular procedure itself (i.e., bridging therapy [BT]).[8] Patients presenting beyond the time window of 6 hours, or with major contraindications to IVT, underwent EMT without IVT (i.e., stand-alone thrombectomy). Patient demographics, recanalization, procedural times (PTs), and baseline, 24-, and 48-hour National Institutes of Health Stroke Scale (NIHSS) scores were noted. In case of persisting intubation and general anesthesia at 24 hours, the NIHSS score was assessed after extubation. Three-month functional outcome was evaluated by the modified Rankin Scale (mRS), and an mRS score of 3 or lower was considered as favorable outcome.

Imaging Protocol

The complete computed tomography (CT) protocol (NCCT and CTA) was performed as a single examination using a multidetector CT scanner (GE LightSpeed VCT 64-slice CT scanner; GE Healthcare, Waukesha, WI). CTA was performed using thin-section slices (.625 mm) with optimized administration of iodinated contrast medium (300-400 mg/I/mL) using the bolus tracking technique. The examination included the region from the aortic arch to the vertex, with a minimum section thickness and reduced pitch. The presence and morphological features (calcifications, irregular surface, ulcerations) of intraluminal plaques and quantification of the degree of stenosis according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria were evaluated.[9] A brain NCCT was performed within 24/48 hours of symptom onset to assess ischemic lesion and to rule out any intracranial hemorrhage (ICH).

Imaging Analysis

To assess the interobserver reproducibility of the imaging evaluation, 2 neuroradiologists (V.D.R. and A.M.), blinded to clinical outcomes, each independently, preliminarily reviewed brain NCCT to rule out hemorrhage, stroke mimics, and signs of established infarction within the posterior circulation territory. CTA source images were read to define the occlusion site and thrombus length in the intra- and extracranial arteries. The posterior circulation ASPECTS (pc-ASPECTS) was evaluated on CTA source images using various window width and center level settings for optimal detection of ischemic hypoattenuation.[10] Collateral blood flow was assessed using a posterior circulation computed tomography angiography (pc-CTA) vascular score conceived at our institution, based on CTA and DSA images, the last considered as the gold standard.

pc-CTA Vascular Score

The pc-CTA vascular score is a 6-point score aimed at evaluating collateral flow, based on antegrade or retrograde contrast opacification of vessels within the occluded territory. For this purpose, we divided the posterior circulation arterial tree in 6 segments, each scoring 1 if occluded:

i. the 2 intracranial vertebral arteries (VAs);

The basilar artery (BA) is divided into 3 segments:

ii. the proximal segment, extending from its origin to the origin of the anterior inferior cerebellar artery (AICAs);
iii. the middle segment, from the origins of the AICAs to the origin of the superior cerebellar arteries (SCAs);
iv. the rostral segment, from the origin of the SCA to its rostral end;

The posterior cerebral arteries:

v. the right posterior cerebral artery (PCA);
vi. the left PCA.

This scoring system is based on the simple counting of the occluded vascular segments, divided according to the classification of Archer.[11] A pc-CTA score of 0 indicates the patency of the whole arterial tree, whereas a score of 6 indicates the complete occlusion of posterior circulation, including at least 1 VA and both PCAs.

This simple method aims to give information about the extent of occlusion (the greater the extent, the higher the pc-CTA) and the presence of a good collateral circulation,