Petrous, Lacerum, and Cavernous Internal Carotid Artery Branches: Prevalence and Importance for Balloon Test Occlusion

Allen, J. W.1- Alastra, A. J.2- Nelson, P. K.1
1New York University, New York, NY, 2Vanderbilt Medical Center, Nashville, TN.

Purpose
To determine the prevalence of angiographically identifiable branches of skull base segments of the internal carotid artery (ICA) that may provide collateral support during balloon test occlusion (BTO), an established technique for assessing a patient's ability to undergo ICA sacrifice without developing cerebral ischemia. Despite the addition of various maneuvers to neurologic testing during BTO, the number of patients who tolerate temporary occlusion but subsequently develop infarction after permanent ICA sacrifice remains between 4-10%. Some infarctions may result from unrecognized collateral support to the proximal intracranial ICA and differences between the anatomical level of temporary and permanent occlusion.

Materials & Methods
A retrospective review of cerebral angiograms done during Wada testing was performed. Four hundred ninety-five cases were reviewed with each ICA examined separately for a total of 990 ICAs. The study population was primarily comprised of patients undergoing Wada testing for preoperative planning for intractable seizures, and contained 243 men and 252 women with a mean age of 32 years. Angiograms were performed via femoral artery puncture with selective catheterization of each ICA. Biplane digital subtraction angiography (DSA) was performed with nonionic contrast administered by a power injector.

Results
Two hundred seventy (54.6%) patients had at least one angiographically identifiable skull base branch of the ICA and 112 (22.6%) patients had two or more such branches. A meningohypophyseal artery supplying more than a hypophyseal blush was identifiable arising from the right cavernous ICA in 114 (23.03%) patients and from the left ICA in 125 (25.25%). A branch of the petrous ICA, the vidian artery, was seen on the right in 61 (12.32%) patients and on the left in 33 (6.67%). The inferolateral trunk was detectable as a branch of the right cavernous ICA in 18 (3.64%) patients and on the left in 33 (6.67%). The caroticotympanic artery was identifiable only in 1 (0.20%) patient as a branch of the left cavernous ICA. A persistent trigeminal artery was seen on the right in 2 (0.40%)
patients and on the left in 3 (0.61%).

Conclusion
Over half of the study population had angiographically identifiable branches arising from skull base ICA segments, and nearly 25% of patients had more than one identifiable branch. As these were robust enough to be detected during DSA, they may represent conduits for significant collateral reconstitution of the distal ICA during temporary BTO; potentially leading to overestimation of a patient's tolerance to carotid occlusion, particularly when the balloon is inflated within the cervical ICA segments. We hypothesize that certain patients cleared for carotid occlusion by BTO that later experience delayed postsurgical stroke may harbor hemodynamically significant collaterals between the ECA and skull base ICA segments - permitting successful adaptation during balloon test occlusion - that are later interrupted during ICA sacrifice at the supraclinoid level. Considering the prevalence of potential conduits identified in this study, angiographic evaluation of such collateral pathways should be included during routine BTO, and where present, balloon inflation should be performed within the cavernous or ophthalmic ICA segments to increase the positive predictive power of BTO.