

## INVITED COMMENTARY

## Status of the Circle of Willis and Intolerance to Carotid Cross-clamping

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A sufficient cerebral collateral circulation mainly formed by the Circle of Willis (CoW) is considered essential in patients undergoing carotid endarterectomy (CEA) as carotid cross clamping (CC) leads to interruption of the principal blood supply to the ipsilateral hemisphere. Montisci et al. studied the value of preoperative MRA imaging of the CoW to predict CC intolerance.<sup>1</sup>

Intolerance to CC was found in 11/71 (15.5%) procedures presenting as motor weakness along with mental confusion, convulsions, or loss of consciousness. However, the laterality of CoW abnormalities in relation to the side of symptoms remains unclear. Furthermore, CC intolerance was not pre-defined and the question remains how to respond to more subtle deterioration in neurological status. Of note, 50 of 71 patients included had an asymptomatic preoperative status.

A large variability exists in the configuration of the basal arteries of the CoW. For practical reasons, MRA based CoW findings were split in three groups — Complete CoW; versus “One” versus “Two or more” agenesis using a “force choice method”: absent or present. Implicitly, the authors assume that a standard or perfect circle does exist, although the CoW is incomplete in approximately 70% of healthy adults.<sup>2</sup> The applied score however seems ideal for future clinical implications and repetition in other cohorts, and resulted in a high inter observer concordance (kappa 0.93). However, this approach does not learn on the functional status of the CoW. Besides morphology of the arterial system and balance in blood supply, blood viscosity, accepted blood pressure thresholds, and duration of the agenesis will influence dynamics in collateral circulation.

Further details on anterior versus posterior pathways, and different levels of collateral circulation with secondary pathways such as the external carotid artery, ophthalmic and leptomeningeal collaterals will be essential in optimizing the predictive power.<sup>3</sup> Previous studies found that MRA determined incompleteness of the CoW could predict shunt placement only in patients without contralateral

carotid occlusion.<sup>4</sup> In the present study, no associations between contralateral occlusion with CC intolerance were noted, due to their limited number of occurrence.

The authors reported a significant association of CC intolerance with the presence of 2 or more agenesis with a PPV of 60%. However, of even more clinical relevance, presence of only one agenesis in the CoW, not associated to contralateral occlusion or low blood pressure, appeared to be insufficient to determine CC intolerance with an NPV of 96%. For clinical practice, an imaging based prediction model should mainly aim to achieve lower number of “unnecessary” shuntings. For both standard versus selective shunt believers, it would especially be of help to exclude those patients with no risk for CC intolerance at all, and to identify those cases that can be operated on 100% safely without a shunt.

At present, based on this small study no strict “non-shunting” criteria can be formulated based on a single preoperative imaging technique. Therefore these interesting findings should be confirmed in other data sets, including the status of the posterior circle.

### REFERENCES

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