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## Letter by Sposato et al Regarding Article, “Neurocognitive Improvement After Carotid Artery Stenting in Patients With Chronic Internal Carotid Artery Occlusion and Cerebral Ischemia”

To the Editor:

We read with interest the article “Neurocognitive Improvement After Carotid Artery Stenting in Patients With Chronic Internal Carotid Artery Occlusion and Cerebral Ischemia” by Lin et al.<sup>1</sup> The authors state that they found an improvement of global cognitive function, attention, and psychomotor processing speed in patients with chronic internal carotid artery occlusion undergoing carotid artery stenting. Similarly, in a recent prospective study, we found an improvement of executive functioning after carotid artery stenting among patients with internal carotid artery stenosis.<sup>2</sup> Despite the innovative aspect of Lin et al’s study (eg, comprising patients with internal carotid artery occlusion, unlike previous studies including participants with unilateral internal carotid artery stenosis), we would like to point out some concerns regarding methodological aspects that could affect the validity of its results.

The authors found an improvement of mean values on the Alzheimer Disease Assessment Scale, Mini-Mental State Examination, and Color Trail Making “A” after carotid artery stenting. However, group analyses of this nature provide no information regarding the actual proportion of patients who performed well or who had performance deficits in each test. In fact, statistically significant improvements in group analyses do not always reflect clinically significant changes of individual patients. The same applies to the statement raised by the authors that increased cerebral perfusion was reflected in improved global cognitive function; correlation analysis does not allow for individualization of how many participants actually showed both an improved cognitive function and increased cerebral perfusion. In this sense, it would have been of interest to perform event rate analyses.

Performance results derived from neuropsychological tests administered to the same patients over short periods are expected to improve even in the absence of a real change in the patient’s cognitive status. This phenomenon could be explained by various mechanisms, including a learning effect. The authors mention that the absence of variation of the results of neurocognitive tests before and after “unsuccessful” carotid revascularization excludes the possibility of a learning effect. However, this observation should be regarded with caution, because there is no consensus on how learning effects can be avoided.<sup>3</sup> Furthermore, different statistical approaches can influence the level of significance of the same results (eg, standardized regression-based versus fixed cutoff techniques).<sup>4</sup> In fact, scores improved the most on the Mini-Mental State Examination, originally designed as a screening tool that taps on a variety of cognitive domains typically impaired in patients with dementia, especially Alzheimer disease, and which is highly prone to practice effects. It is also worth noting that in Lin et al’s study, the more complex the task, the less performance improved after carotid artery stenting. For example, performing the Color Trail Making “B” demands more cognitive resources than its “A” counterpart,

which is more prone to being affected by the learning effects of practice.<sup>5</sup> The fact that a significant baseline versus postprocedural improvement was found for the latter, but not for the more cognitively difficult task, may be suggestive of improvement due to repeated exposure to the same kinds of task. Moreover, to argue that psychomotor speed processing improved based solely on the difference found in Color Trail Making “A” may be considered an assumption not supported by the study’s findings.

Although we highlight the novelty of Lin et al’s report, we consider it important to raise suggestions in the hopes that future studies including populations with cerebrovascular diseases will take into account some of the most fundamental issues in neuropsychology when designing their methods and, most importantly, when interpreting their findings. Evidently, further prospective studies evaluating the effect of carotid artery stenting on cognitive function of patients with symptomatic and asymptomatic internal carotid artery disease are needed.

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**Luciano A. Sposato, MD, MBA**  
INECO and INECO Foundation  
Institute of Neurosciences  
Favaloro University Hospital  
Buenos Aires, Argentina  
Universidad Diego Portales  
Santiago, Chile

**Ezequiel Gleichgerrcht, BSc**  
**Facundo Manes, MD**  
INECO and INECO Foundation  
Institute of Neurosciences  
Favaloro University Hospital  
Buenos Aires, Argentina

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Luciano A. Sposato, Ezequiel Gleicherrcht and Facundo Manes

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