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Case Report

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Carotid Stenting Can Improve Contralateral Perfusion and Function

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Abstract

For patients with carotid artery stenosis, carotid endarterectomy and carotid angioplasty and stenting are two methods that are effective in reducing stroke risk. These procedures have also been known to increase perfusion to the ipsilateral hemisphere and improve function; however, it is unknown if these procedures can improve function by increasing perfusion to the contralateral hemisphere. Longitudinal language assessment and neuroimaging data from this case study offers evidence that supports stenting of the contralateral common carotid artery and blood pressure elevation to improve collateral blood flow and, in turn, language performance.

1. Background

While both carotid endarterectomy (CEA) and carotid angioplasty and stenting (CAS) are effective in reducing risk of stroke for people with carotid artery stenosis, these procedures also occasionally improve function by increasing perfusion of the ipsilateral hemisphere [1-3]. One case report showed that vertebral artery stenting resulted in improved collateral perfusion of the contralateral hemisphere [4]. It is also plausible that either CEA or carotid stenting might improve function by increasing perfusion of the contralateral hemisphere. Here we describe such a case that included longitudinal language testing and MRI with perfusion weighted imaging. The objective of this case is to illustrate the functional benefit of contralateral carotid stenting and blood pressure maintenance to improve collateral blood flow and perfusion of the symptomatic hemisphere in a case of carotid occlusion.

2. Case Report

A 76-year-old right handed woman with history of hypertension, hypercholesterolemia, and coronary artery disease had left CEA in 11/2015. Due to restenosis of the left internal carotid artery and severe stenosis of the left common carotid artery (CCA), she underwent stenting of the CCA in 8/2017. In 5/2018 she had episodes of aphasia and right sided weakness, and was found to have multiple small left carotid borderzone infarcts. In 6/2018, cerebral angiogram showed narrowing the left CCA near the common carotid stent. MRI of the brain showed a new small acute infarct in the left anterior cerebral artery territory as well as multiple subacute left MCA territory infarcts, concerning for ongoing artery to artery embolism from the left CCA plaque, despite maximal medical therapy with dual anti-platelets and high dose statin. Based on these findings, she had a repeat CCA stent to reduce risk of further strokes. In 1/2019, she developed aphasia and right arm weakness, and CT and CT angiogram showed decreased left cerebral hemisphere perfusion and occluded CCA stent. Her fluctuating aphasia and right arm weakness resolved only in supine position. Her aphasia was characterized by severely impaired sentence production in oral reading and in narrative speech. Spontaneous speech was hesitant and telegraphic. Auditory comprehension was intact. She named most objects accurately but was impaired in naming actions (63% correct).

We monitored response to interventions using an objective measure of her description of the "cookie theft" picture from the National Institutes of Health Stroke Scale [5]. We counted the number of content units (CU) – concepts (words/phrases or their synonyms expressed by healthy controls in describing the picture) [6]. We compared her measures to published mean for her age, using the normal mean as the optimum score [6,7]. We used Fisher's exact tests to evaluate change following intervention.

Opening the occluded left stent was not an option. Because she also had severe stenosis of the right CCA (without right hemisphere infarcts), a right CCA stent was placed in 1/2019, with the aim of increasing collateral blood flow to the left hemisphere. Following stent placement, her aphasia and right arm weakness improved. She improved in CUs ($p = 0.007$). (Figure 1). However, she maintained these gains only with moderately high mean arterial pressure (MAP, >100 mmHg) using midodrine. Perfu-

sion-weighted MRI showed improved left hemisphere perfusion from pre- to post-stent (Figure 2).

She was discharged to subacute rehabilitation, where MAP dropped well below goal when midodrine was held. She was re-admitted in 2/2019 with small left frontal infarct and significant decline in syllables ($p<0.00001$) and modest decline in CU in picture description (Figure 1) as well as action naming (69% to 56%, ns). When blood pressure was subsequently elevated by giving intravenous saline and resuming midodrine, she showed significant improvement in CU ($p = 0.01$), syllables ($p<0.00001$) and syl/ CU ($p = .001$) (Figure 1). MRI obtained after blood pressure elevation showed slight improvement in left hemisphere perfusion on PWI and the recent infarct on diffusion weighted imaging (Figure 2). She was maintained on midodrine with MAP>100, with no significant worsening by discharge or one month later.

3. Discussion

This case illustrates that in the case of symptomatic occlusion of one internal carotid artery and stenosis of the other carotid artery, stenting of the non-occluded artery can improve collateral perfusion and function of the contralateral, symptomatic side. It also shows that maintenance of at least normal blood pressure, which can be achieved with hydration and/or medications (e.g. midodrine) may be necessary to maintain collateral perfusion. Finally, it illustrates how functional neurological improvement in response to interventions can be monitored with very simple, objective bedside measures, such as the number of accurate concept (CU) expressed in describing a picture.

4. Funding

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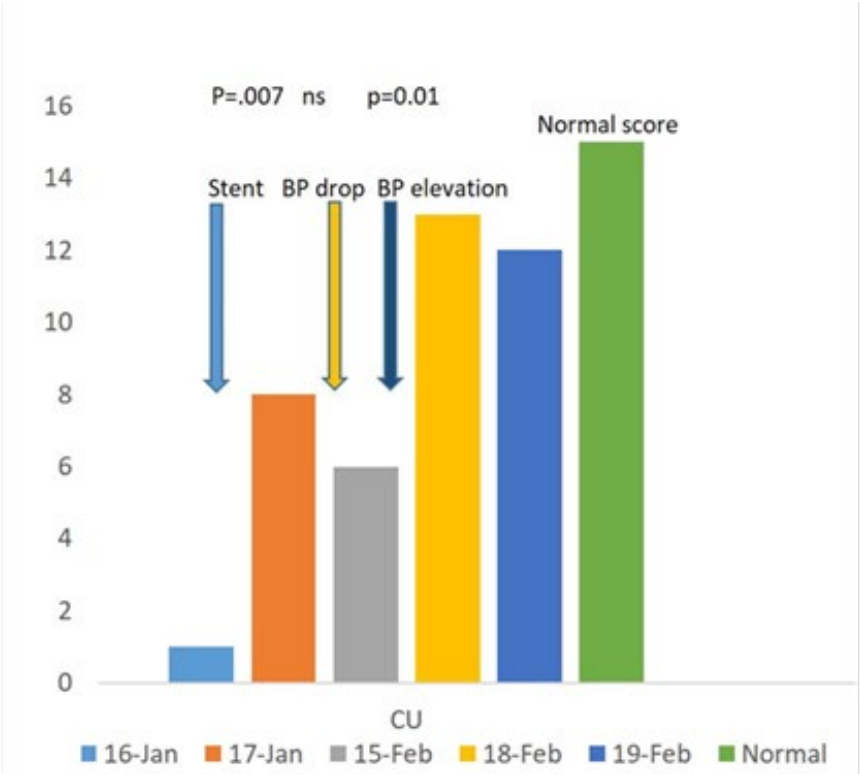

Figure 1: Change in Correct Content Units (CU) Expressed in Describing Picture in Response to Interventions.

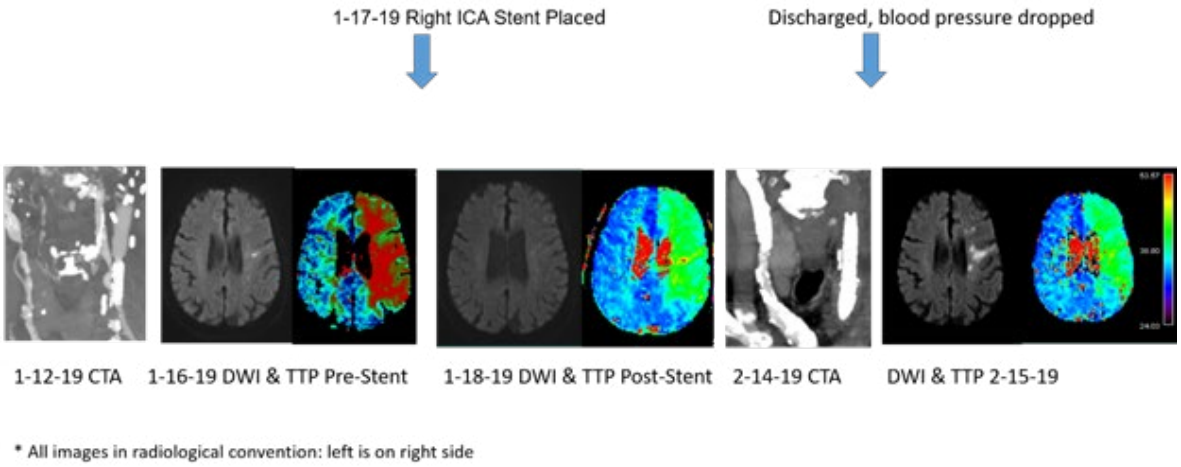

Figure 2: MRI Scans Before and After Interventions

Diffusion weighted images in gray scale show acute infarct (bright). Perfusion weighted imaging show time to peak (TTP) arrival of contrast in each voxel, with black/red being lowest perfusion and blue being normal perfusion. Computed Tomography Angiograms (CTA) show occluded left carotid artery at both time points and stenotic right carotid artery pre-stent.

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