EDITORIAL

Stroke after thoracic endovascular aortic aneurysm repair. Can we "plug" this phenomenon?

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Thoracic endovascular aortic repair (TEVAR) has improved the survival rate in patients with thoracic aortic disease (TAD) over open surgery with reported elective 30-day mortality rates of 3-8%.[1] However, neurological brain injury (NBI) remains the most feared complication following TEVAR, and can manifest as clinically overt stroke increasing the early mortality rate.[2] Strokes are mainly embolic stemming from the manipulation of endovascular instruments (stiff wires, catheters and delivery devices up to26Fr in size) through the aorta, often diseased with significant atheroma. Risk factors for embolic stroke include a more proximal extent of repair, acute aortic dissections, the large atherosclerotic burden of the aortic arch, intraoperative hypotension, chronic renal insufficiency, and known cerebrovascular disease.[3]

Recently, a study sheds light on another embolic mechanism of stroke, the gaseous embolization that is appeared during the deployment of all commercially available TEVAR devices.[4] This phenomenon results from the retention of a significant amount of "air bubbles" during the manufacturing processes, despite flushing with heparinized-saline to remove air within the device.[4]

Besides the embolic events, reduction in global cerebral perfusion is another leading cause of stroke perioperatively.[5] Up to 40 % of all patients undergoing TEVAR have lesions that extend to or involve the orifice of the left subclavian artery (LSA), which demand coverage of the LSA for adequate stent-graft seal.[5] This stroke scenario after LSA coverage was confirmed by a recently published study that revealed a pooled stroke rate up to 5.8% and 7.8% for the revascularized and no-revascularized group of patients, respectively.[6] Taking these results under consideration the use of fenestrated grafts seems to be a promising solution to prevent occluding branches of the aortic arch, but more studies are needed to support the benefit of these devices.[7]

Additionally, it should be highlighted that the stroke rate increases significantly as more the TEVAR moved toward the aortic arch. This conclusion has been stated from a recently published study that reported a 14% stroke rate for TEVAR in Ishimura zone 0. The authors concluded that this zone should be reserved only for patients at absolute prohibitive risk of open repair.[8]

Nowadays, few high-quality data exist regarding strategies to reduce stroke or cerebral infraction during TEVAR, and currently, there are scarce recommendations for intraoperative monitoring of brain function, perfusion, and postoperative evaluation of cerebral damage.[9] Some neuroprotective strategies against gaseous and cerebral embolization after TEVAR have been proposed, including the "CO_2 flushing" of TEVAR devices and the potential use of cerebral embolic protection devices (CEPD). In the former case, the "flushing" technique replace the air within the spaces of the delivery system and stent-graft with less harmful gas, while in the last case, the CEPD, thanks to their design, permits the ongoing cerebral perfusion while reducing embolic phenomena by solid debris (either by filtration or diversion of debris away from the cerebral circulation.[4, 6]

Regarding the intra and postoperative evaluation of brain function after TEVAR, the Transcranial Doppler (TCD) and the diffusion-weighted magnetic resonance imaging (DW-MRI) seems to be two reliable imaging modalities. The TCD has the ability during the TEVAR procedure to identify several high-risk phases for cerebral microembolization, while another significant characteristic of this imaging modality constitutes the capacity for discrimination of nature of emboli (solid or gas) based on the acoustic impendence and ultrasound reflectivity. Recently, a study using TCD monitoring during TEVAR detects microemboli, of which 90% were of gaseous origin.[10] On the other side, DW-MRI has the capacity to identify silent brain infarction (SBI) in up to 81% of patients within the first week after TEVAR involving the aortic arch.[7]

To understand better the incidence of, and risk factors for, stroke and cerebral damage after such procedures, the Stroke from Thoracic Endovascular Procedures (STEP) collaboration was initiated.[7] The STEP collaboration brings together multidisciplinary expertise from vascular surgery, neurology, neuroradiology, and interventional cardiology. This collaboration was compiled by operators who were considered experienced

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ISSN 2732-7175 / 2022 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

by manufactures in the use of thoracic stent-grafts in the ascending aorta and the aortic arch. Preliminary results of STEP collaborators study demonstrated an incidence of silent brain infarction (SBI) of 50% (45/91) detected by DW-MRI postoperatively.[7] The authors concluded that the SBI exist after TEVAR while highlighting the need for the development of innovative strategies to reduce embolization events.[7]

Summarizing the knowledge so far, stroke after TEVAR is often reported by the operator and not independently assessed by a neurologist. Further studies to investigate preventive strategies and provide evidence to improve cerebral outcomes after TEVAR are needed. STEP collaborators made the first step consisting a significant group of experts who will shed more light in this critical issue.

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