Sir,

Both carotid endarterectomy (CEA) and transfemoral carotid artery stenting (TFCAS) for carotid stenosis cannot be performed in certain situations. Transcarotid arterial revascularization (TCAR) is now an established alternative in “difficult carotids.” Herein, we describe a “similar” hybrid technique for CAS that obviates the need for expensive hardware.

A 56-year-old woman presented with two episodes of transient right-sided hemiparesis over 1 month. MRI brain showed multiple left MCA territory infarctions and magnetic resonance angiography (MRA) showed a near-total occlusion of the left internal carotid artery (ICA) at the origin. Due to significant tortuosity at the ICA origin and mid-common carotid artery (CCA), TFCAS was unsuccessful despite multiple attempts. As the CCA bifurcation was at the level at C2 level and behind the angle of the jaw, CEA was not considered as it would necessitate a mandibulotomy or a mandible dislocation.

The patient was positioned under general anesthesia (GA) and near-infrared spectroscopy (NIRS) was used. After placing a shoulder roll the head was rotated to the right and extended. A linear incision starting from the suprasternal notch along the anterior border of the sternocleidomastoid muscle was extended upwards for 5 cm. The internal jugular vein (IJV) was retracted posteriorly. The carotid sheath was opened and the left CCA was exposed and an umbilical tape was placed at the proximal CCA. The left hypoglossal nerve was also identified and looped away at the base of the mastoid. A self-retaining mastoid retractor was placed to widen the field of view. The left CCA was punctured near the clavicle and a road map was obtained, after which a Terumo guidewire was placed in the left external carotid artery (ECA). Progressive dilatation of the arteriotomy was done with a 5 Fr, 6 Fr, and 8 Fr sheath. As the 8 Fr sheath was 11 cm in length, it was shortened to 7 cm and introduced into the mid-CCA [Figure 1].

A digital subtraction angiography (DSA) was taken which showed a 70% stenosis at the origin of the left ICA extending for a length of ~1.5 cm. The distal left ICA showed severe tortuosity and a 360° loop in the distal cervical ICA. We tried to negotiate an Abbott Emboshield device into the left ICA, but due to the 360° loop, it would not advance further into a straight segment and hence it was withdrawn. A 2.5 × 20 mm coronary balloon and an 8 × 40 mm Abbott Xact stent were prepared and kept ready. To achieve flow reversal and prevent distal embolization, the proximal CCA loop was retracted to stop the flow into the left CCA and the side port of the sheath was opened to let the reversed blood flow out into a transfer bag. A BMW wire was quickly negotiated into the distal ICA past the loop. A 2.5 × 20 mm coronary balloon was inflated to 6 atmospheres (ATM) and the stenotic area was angioplastied to achieve adequate lumen to pass the stent. The Xact stent was placed across the stenotic area with adequate

Figure 1: Panel A; CTA showing a tortuous left CCA. Panel B; MRI; coronal FLAIR images showing scattered left MCA infarcts. Panel C; Shows the Carotid cut down and sheath in situ. Panel D; DSA showing the left ICA stenosis. Panel E; DSA showing the final angiographic run

| Table 1: Indications for direct carotid access in CAS[5] |
|----------------------------------------------------------|
| Absence of a plaque at the site of CCA access             |
| Irradiated neck                                           |
| Unfavourable (high) bifurcation anatomy                   |
| Presence of type III aortic arch and tortuous CCA         |
| Failure of transfemoral -CAS                              |
| Severe aortic calcification                               |
| Tortuous distal ICA precluding embolic filter placement   |
| Prior history of radical neck dissection                  |
| Restenosis after the previous endarterectomy.             |
| Distance between the clavicle and carotid bifurcation must be at least 5 cm |

| Table 2: Potential complications and limitations of our hybrid procedure |
|------------------------------------------------------------------------|
| Limitations                                                            |
| The requirement for a hybrid lab                                       |
| The requirement of a concurrent vascular or neurosurgeon for carotid exposure and closure. |
| Poor circle of Willis collaterals and cross-flow from the other side  |
| Extreme tortuosity or coiling of ICA after bifurcation precluding passage of carotid stents |
| General anesthesia                                                     |
| Complications                                                          |
| Periprocedural stroke due to residual flow despite proximal ligature   |
| Neck hematoma                                                          |
| Cranial nerve injury                                                   |
| Postprocedural Horner’s syndrome                                        |
landing zones above and below the stenosis, with the proximal landing zone in the distal CCA. To reduce the residual waste, the stent was again angioplastied with a 4 × 20 mm coronary balloon. The flow reversal was maintained for a total of 3 min during the angioplasty and stenting period and the vascular loop then was loosened to re-establish forward flow and the side port was connected back to heparinized saline. The post-procedure DSA showed adequate flow through the stent and good hemispheric flow. The sheath was removed and the arteriotomy was closed with 6–0 prolene sutures transversely to avoid future vessel narrowing. The site was then closed in layers and the patient was extubated uneventfully. Near infrared spectroscopy (NIRS) was monitored for 4 days and blood pressure was maintained below 140/90 mmHg to prevent cerebral hyperperfusion. The postoperative period was uneventful and on day 3, a CTA showed a well-recanalized left ICA. The patient had no new focal neurological deficits and was discharged on day 4.

Multiple techniques have been described for CAS in “difficult carotids” including the direct carotid puncture and transcatheter arterial revascularization (TCAR).[1] Balloon guide catheters (BGC) have been used to occlude flow into the ICA during the procedure. We describe a novel technique for difficult carotids in the Indian scenario, which has the potential to reduce procedure time, contrast use, achieve flow reversal with just vascular loops instead of expensive hardware such as BGC’s or the ENROUTE Transcarotid 91 Neuroprotection System (NPS) (Silk Road Medical, Inc., Sunnyvale, California, USA) which is yet unavailable in India.[2] There are several advantages to this hybrid procedure. The short 8 Fr sheath eased the stent deployment by reducing the tracking distance. Although a distal filter device was not deployed, distal embolization was reduced by flow reversal akin to TCAR by using inexpensive vascular loops and redirecting reverse flow out through the sheath port.[3] Direct arteriotomy sutures also reduced the chance of neck hematoma due to persistent carotid leaks. New guidelines favor TCAR over TFCAS as patients undergoing TCAR have less than half the risk of in-hospital TIA or stroke or death.[4] Although our approach should be restricted to selected cases [Tables 1 and 2], it provides a novel hybrid technique for CAS in selected cases.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

Boby Varkey Maramattom, Reji Paul, Nidhin E1, Jithendra T1, George Varghese Kurien2
Departments of Neurology, 1Anaesthesia, 2Cardiothoracic Surgery, Aster Medcity, Kochi, Kerala, India

Address for correspondence: Dr. Boby Varkey Maramattom, Department of Neurology, Aster Medcity, Kochi, Kerala, India.
E-mail: bobvarkey@gmail.com

REFERENCES
1. Luk Y, Chan YC, Cheng SW. Transcarotid artery revascularization as a new modality of treatment for carotid stenosis. Ann Vasc Surg 2019;69:92-103. doi: 10.1016/j.avsg.2019.11.001. [Epub ahead of print]
2. Kashyap VS, King AH, Foteh MI, Ianko M, Jim J, Motaganahalli RL, et al. A multi-institutional analysis of transcarotid artery revascularization compared to carotid endarterectomy. J Vasc Surg 2019;70:123-9.
3. Malas MB, Leal J, Kashyap V, Cambria RP, Kwolek CJ, Criado E. Technical aspects of transcarotid artery revascularization using the ENROUTE transcarotid neuroprotection and stent system. J Vasc Surg 2017;65:916-20.
4. Malas MB, Bakour-Aridi H, Wang GJ, Kashyap VS, Motaganahalli RL, Eldrup-Jorgensen J, et al. Transcarotid artery revascularization versus transfemoral carotid artery stenting in the society for vascular surgery vascular quality initiative. J Vasc Surg 2019;69:92-103.
5. Wu WW, Liang P, O’Donnell TFX, Swerdlow NJ, Li C, Wyers MC, et al. Anatomic eligibility for transcarotid artery revascularization and transfemoral carotid artery stenting. J Vasc Surg 2019;69:1452-60.

Submitted: 16-Feb-2020 Revised: 04-Mar-2020 Accepted: 05-Mar-2020 Published: 08-Dec-2020

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com
DOI: 10.4103/aian.AIAN_99_20