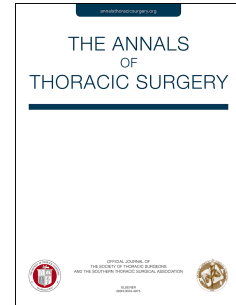


Accepted Manuscript

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Manraj K.S. Heran, Nikita Balaji, Richard C. Cook



PII: S0003-4975(18)31715-6

DOI: <https://doi.org/10.1016/j.athoracsur.2018.10.055>

Reference: ATS 32176

To appear in: *The Annals of Thoracic Surgery*

Received Date: 26 July 2018

Revised Date: 5 October 2018

Accepted Date: 16 October 2018

Please cite this article as: Heran MKS, Balaji N, Cook RC, Novel Percutaneous Treatment of Cerebral Malperfusion Prior to Surgery for Acute Type A Dissection, *The Annals of Thoracic Surgery* (2018), doi: <https://doi.org/10.1016/j.athoracsur.2018.10.055>.

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**Novel Percutaneous Treatment of Cerebral Malperfusion Prior to Surgery for
Acute Type A Dissection**

Manraj K.S. Heran¹, Nikita Balaji², Richard C. Cook¹

¹University of British Columbia, ²Imperial College

Correspondence:

Richard C. Cook, MD

St. Paul's Hospital

1081 Burrard Street

Vancouver, BC. V6Z1Y6

richard.cook@vch.ca

Abstract

We present the first known application of pre-operative percutaneous management of cerebral malperfusion in a patient with acute near-total occlusion of the right common carotid artery with left hemiplegia complicating an acute Stanford Type A aortic (Type A) dissection.

A known complication of Type A dissection is cerebral malperfusion, due to stenosis or occlusion of the brachiocephalic artery or common carotid arteries. The international registry of acute aortic dissection states that ~10% of aortic dissections are complicated by ischemic strokes(1). Management options for these patients are limited.

Our case describes the nearly complete reversal of major neurological deficits secondary to a Type A dissection with carotid artery occlusion, by a novel percutaneous endovascular approach for stenting of the brachiocephalic and right common carotid arteries before surgical repair of the Type A dissection.

An active 73-year-old professor of neuroscience presented after a sudden collapse with right-sided neck and jaw pain, as well as left leg weakness. His symptoms began at 12:30AM.

CT angiographic imaging revealed a Type A dissection extending from the aortic valve to the mid-descending thoracic aorta. The false lumen extended into the brachiocephalic, right subclavian and right common carotid arteries, with near complete occlusion of the latter (Figure 1). There were no early infarct changes and no identifiable hemorrhage.

Clinically, he had left sided hemiplegia, left homonymous hemianopia with right-sided gaze preference, severe sensory loss, and hemi-neglect. Given that he presented

less than 3 hours after the onset of his neurologic symptoms, there was a possibility that re-establishment of blood flow might improve his neurological deficits.

The patient was transferred to interventional radiology at 5:29AM. Initially there was an attempt to access the brachiocephalic artery with an angled catheter and Terumo guidewire (Figure 2A). This was unsuccessful. A novel and previously unreported technique was used. Percutaneous ultrasound-guided micropuncture access was achieved of the right common carotid artery, with puncture into the true lumen of the vessel, with the access directed towards the aortic arch. A 2-French inner microcannula was advanced over the micropuncture guidewire. Angiography demonstrated profoundly limited antegrade flow in the distal brachiocephalic and right common carotid arteries, with negligible blood flow into the ipsilateral intracranial circulation. A V-18 guidewire was then advanced through the 2-French microcannula into the aortic arch, with successful endovascular snaring of the guidewire in the proximal thoracic aorta (Figure 2B). This then allowed for advancement of a Penumbra 8 French Neuron Max guide sheath inside a Cook 8-French Shuttle sheath from the femoral arterial access, into the patent segment of the right common carotid artery. An eV3 Visi-Pro 10 mm x 37 mm balloon-expandable stent was then deployed from the right common carotid artery into the brachiocephalic artery, tacking the dissected artery open, with the proximal portion of the stent placed in the segment of the vessel having a good caliber to its true luminal component. Angiography after stent deployment demonstrated wide patency through the brachiocephalic and right carotid circulation, including the stented segment, with profound improvement in the circulation in the right carotid territory (Figure 2C). There was also marked

improvement of the flow into the right subclavian artery, and sluggish but antegrade filling into the right vertebral artery now seen.

The patient demonstrated immediate clinical improvement with return of strength to the left arm and leg, returning almost completely to his neurological baseline. The patient was taken immediately to the operating room following stenting to repair the aortic dissection. The skin incision time was recorded as 7:57AM.

The patient was extubated 9 hours post-operatively. He had no major complications during his subsequent hospital stay and was discharged after 11 days on ASA and Plavix for 3 months, with minimal to no neurological deficit. Followup CT angiography several months later demonstrated an excellent repair of the Type A dissection, including the brachiocephalic artery (Figure 3A), as well as maintained wide patency of the stent placed from the brachiocephalic artery into the proximal right common carotid artery (Figures 3B,C).

Comment

The usual practice for management of cerebral malperfusion complicating Type A dissection is to replace the ascending aorta without pre-operative carotid revascularization, with the hope that repair of the dissection itself will correct the cerebral malperfusion(1,2). However, a substantial number of patients remain disabled due to carotid arterial occlusion that persists following aortic repair(3,4).

Apart from cerebral malperfusion, the University of Michigan group has found that management of malperfusion prior to surgical replacement of the ascending aorta, in patients who have mesenteric, renal, or limb malperfusion is associated with a reduction in mortality (7,8).

There is recent important randomized evidence from the stroke literature which demonstrates that a strategy of early endovascular treatment of acute occlusion of a proximal cerebral vessel is superior to a strategy of medical management(5). However, the only reported cases of carotid artery stenting in the setting of aortic dissection appear to be AFTER aortic repair(6).

It is important to note that in our patient, the CT head and CT angiogram done prior to the stenting procedure revealed no evidence of intracranial hemorrhage or thromboembolus, or of an evolving parenchymal stroke. Therefore, it was felt that the symptoms were based entirely on hypoperfusion and that the risk of hemorrhagic transformation was negligible. This allowed for full systemic heparinization almost immediately after the stent procedure. In patients in whom there is CT evidence of parenchymal damage or intracranial hemorrhage, this approach may not be applicable.

Conclusion

To our knowledge, there are no prior reports of the use of carotid stenting prior to replacement of the ascending aorta in patients with Type A dissection. We present a

novel technique for percutaneous endovascular stent placement allowing for treatment of a right hemispheric syndrome resulting from extension of the dissection into the brachiocephalic and right common carotid artery. Our patient had immediate and nearly complete resolution of his severe neurologic deficits, and subsequently underwent successful replacement of his ascending aorta.

Figure legends

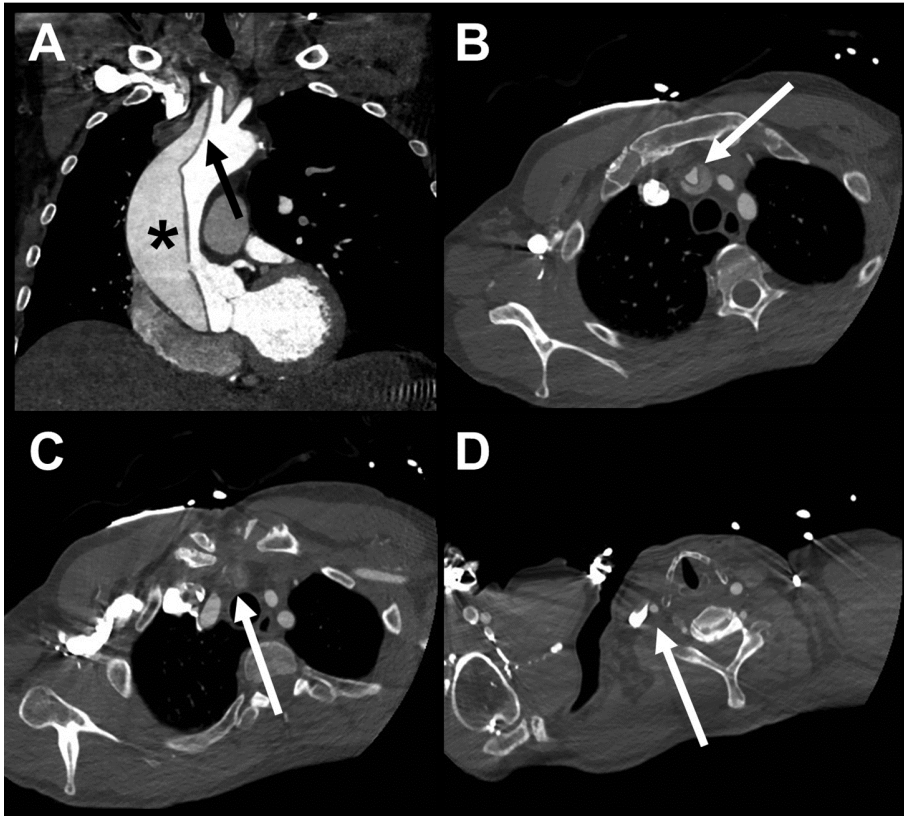
Figure 1: (A) Coronal reformatted image from CT angiogram demonstrating Type A aortic dissection (asterisk), with involvement of the brachiocephalic artery (black arrow), with (B,C) the false lumen resulting its near-complete occlusion (white arrow). (D) Cross-sectional CTA imaging further cranially demonstrates reduced luminal diameter and contrast attenuation in the true lumen of the right common carotid artery (white arrow), in comparison to the normal left common carotid artery, due to the profound flow limitation resulting from the dissection flap involving the innominate artery, extending into the proximal right common carotid artery.

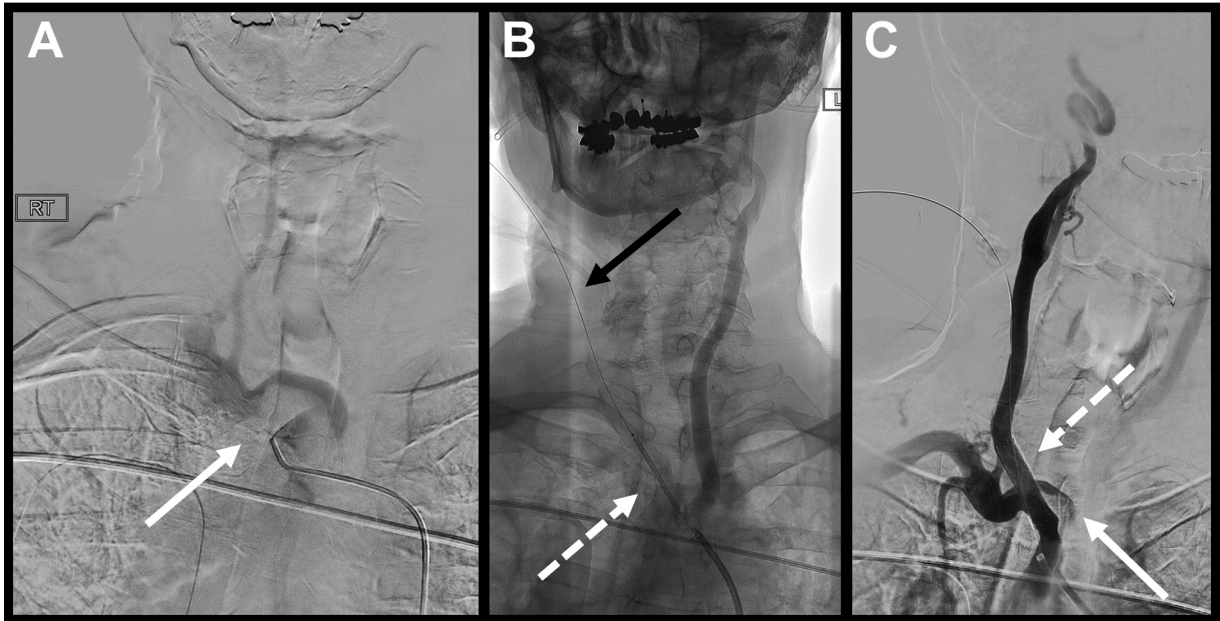
Figure 2: (A) Digital subtraction angiogram performed with the catheter positioned in the dissected brachiocephalic artery (white arrow) demonstrates markedly abnormal contrast filling, with visualization of only the right subclavian artery, and no opacification of the right common carotid artery. (B) Angiography performed at the time of positioning of the balloon-expandable stent across the site of the maximally stenotic aspect of the dissected right common carotid artery (white dashed arrow) demonstrates percutaneous access to the true lumen of the right common carotid artery above the level of the dissection (black arrow). (C) Digital subtraction angiogram demonstrates wide patency through the stented dissection extending from the brachiocephalic artery into the proximal right common carotid artery, with normal flow into the downstream carotid circulation and ipsilateral cerebral hemisphere (not shown). Dissection flap into the proximal right subclavian artery is again seen (dashed white arrow).

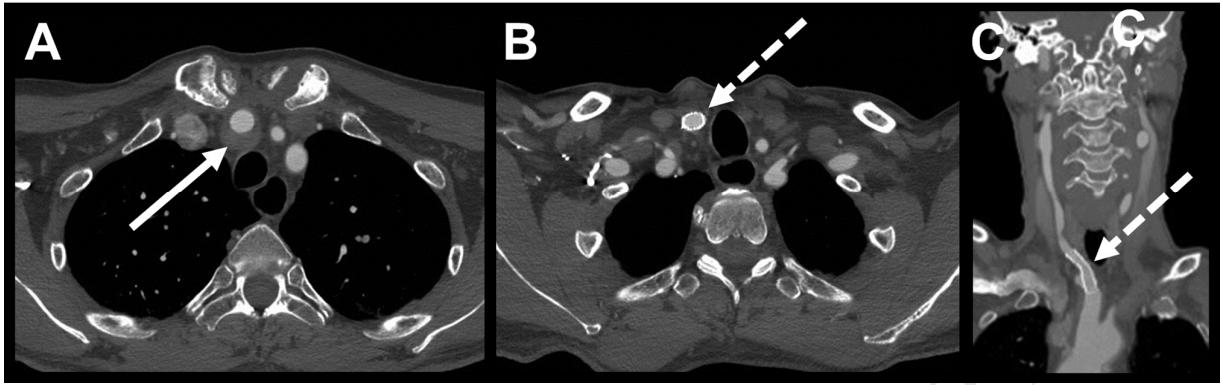
Figure 3: Selected images from late followup CT angiography demonstrate (A) glue-repaired brachiocephalic artery, with no evidence of residual dissection (arrow), and (B,C) a widely patent stent extending from the brachiocephalic artery into the proximal right common carotid artery (dashed arrow).

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