

CASE REPORT

A novel route of revascularization in basilar artery occlusion and review of the literature

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SUMMARY

Ischemia of the basilar artery is one of the most devastating types of arterial occlusive disease. Despite treatment of basilar artery occlusions (BAO) with intravenous tissue plasminogen activator, antiplatelet agents, intra-arterial therapy or a combination, fatality rates remain high. Aggressive recanalization with mechanical thrombectomy is therefore often necessary to preserve life. When direct access to the basilar trunk is not possible, exploration of chronically occluded vessels through collaterals with angioplasty and stenting creates access for manual aspiration. We describe the first report of retrograde vertebral artery (VA) revascularization using thyrocervical collaterals for anterograde mechanical aspiration of a BAO followed by stenting of the chronically occluded VA origin. Our novel retrograde–anterograde approach resulted in resolution of the patient's clinical stroke syndrome.

BACKGROUND

The first detailed description of basilar artery occlusion (BAO) was documented by Kubik and Adams¹ in 1946. Approximately 60% of patients have prodromal transient ischemic attacks consisting of vertigo, nausea, and headaches. More serious sequelae range from seizures to tetraplegia and a locked-in-state.²

Despite advances in antithrombotic and antiplatelet medications, mortality remains high. In 2009 the Basilar Artery International Cooperation Study (BASICS), the largest BAO data registry, showed 54% mortality among conventionally treated patients, with only 3% having a good outcome.³ Outcomes data from this and several other studies are shown in [table 1](#).

More sophisticated treatment modalities include intravenous thrombolysis (IVT), intra-arterial thrombolysis (IAT), and mechanical thrombectomy (MT). The BASICS registry reported no significant difference in good outcomes despite the more frequent use of IAT, including MT. However, patients who presented with severe deficits (defined as tetraplegia, coma, or locked-in-state) and underwent IVT or IAT showed a 19% and 10% lower absolute risk of death or dependency, respectively, compared with the IAT group. No significant differences were seen between the IVT and IAT groups.³ Mattle *et al*¹⁷ published a review of BAO case series from 1990 to 2011, which found no significant difference between the various treatment modalities.

Given the high mortality and poor recanalization rates of medical interventions, MT is often necessary. MT of BAO is commonly approached via

transfemoral, direct VA access, and transcirculation routes through a patent posterior communicating artery (PCoA). When these approaches are not possible, exploration of chronically occluded vessels through collaterals with angioplasty and stenting remains a feasible though technically challenging option. Here we describe mechanical aspiration of a BAO via a transfemoral route after opening a chronically occluded VA through a retrograde–anterograde approach followed by stent placement across the previously occluded VA origin.

CASE PRESENTATION

An elderly patient with a right femoral artery occlusion requiring thrombectomy and anticoagulation became acutely unresponsive. A CT scan demonstrated a subacute right cerebellar hypodensity in the superior cerebellar artery distribution. A CT angiogram of the brain showed a BAO, bilateral VA occlusions, and reconstitution of the left V3 segment via collaterals from the thyrocervical trunk. Tissue plasminogen activator (t-PA) was contraindicated due to the heparin infusion and recent surgery. The right femoral artery was not used because of the recent surgical thrombectomy. The left common femoral artery was accessed using a 10 cm/6 Fr sheath and diagnostic runs were performed using a 100 cm Simmons-2 catheter. The left subclavian artery demonstrated an occluded left VA with no evidence of an ostium, and a hypoplastic right VA ([figure 1](#)). The left proximal subclavian was explored with a Synchro (Stryker) and V-18 control wire (Boston-Scientific) but the left VA origin could not be traversed. The left thyrocervical trunk demonstrated a distal circuitous collateral that reconstituted the V3 segment of the VA. The PCoAs were diminutive bilaterally and no opacification of the basilar trunk was seen ([figure 1](#)).

The plan was to revascularize the left VA in a two-stage approach. The first step involved a retrograde route up the thyrocervical collateral to the V3 segment and down through the occluded VA origin. The second stage involved an antegrade approach, advancing the base catheter through the revascularized VA with MT of the BAO using distal access catheters for aspiration followed by stenting of the VA origin. Selective catheterization of the left VA via the large thyrocervical trunk collateral was performed. Using two 300 cm V-18 control wires, the Simmons-2 catheter was exchanged for a 90 cm/6 Fr Neuron Max (Penumbra) and advanced proximal to the thyrocervical trunk origin. The V-18 control wires were maintained in the distal axillary artery for stability. A triaxial system



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Table 1 Outcomes data of non-surgical and surgical treatment of basilar artery occlusion

	Oral antithrombotics			Intravenous thrombolysis		Intra-arterial thrombolysis	
	BASICS ^{4*} Severe Deficitt	Broussalis <i>et al</i> ⁵	Schonewille <i>et al</i> ⁶	BASICS ^{4*} Severe Deficitt	SAMURAI ^{7‡}	BASICS ^{4*} Severe Deficitt	Jung <i>et al</i> ⁸
Patients (n)	79	22	82	72	23	196	106
Recanalization rate (%)	–	9	–	66	78	69	70
Good outcome (mRS 0–2) (%)	3	0	21 (mRS 0–3)	21	44	11	33
Poor outcome (mRS 4–5) (%)	38	50	39	28	48	34	13
Death (mRS 6) (%)	54	41	40	46	4	49	41

	Combination of intra-arterial thrombolysis and abciximab			Endovascular mechanical recanalization				
	Barlinn <i>et al</i> ⁹	Chiti <i>et al</i> ¹⁰	Nagel <i>et al</i> ¹¹	Broussalis ¹² <i>et al</i>	Baek <i>et al</i> ¹³	Jankowitz <i>et al</i> ¹⁴	Mohlenbruch <i>et al</i> ¹⁵	Mordasini <i>et al</i> ¹⁶
Patients (n)	20	10	43	77	25	6	24	14
Recanalization rate (%)	85	100	84	36	96	100	88	79
Good outcome (mRS 0–2) (%)	15 (mRS 0–3)	80	19	45	48	83	33	29
Poor outcome (mRS 4–5) (%)	40	10	23	29	–	17	21	36 (mRS 3–5)
Death (mRS 6) (%)	45	10	42	10	12	0	29	36

*The BASICS group defined the intra-arterial thrombolysis group as those receiving pharmacological, mechanical thrombolysis, or a combination of both.

†The severe deficit group is defined as patients who presented tetraplegic, comatose, or in a locked-in-state.

‡The Stroke Acute Management with Urgent Risk Factor Assessment and Improvement (SAMURAI): recombinant tissue plasminogen activator registry. BASICS, Basilar Artery International Cooperation Study; mRS, modified Rankin Scale.

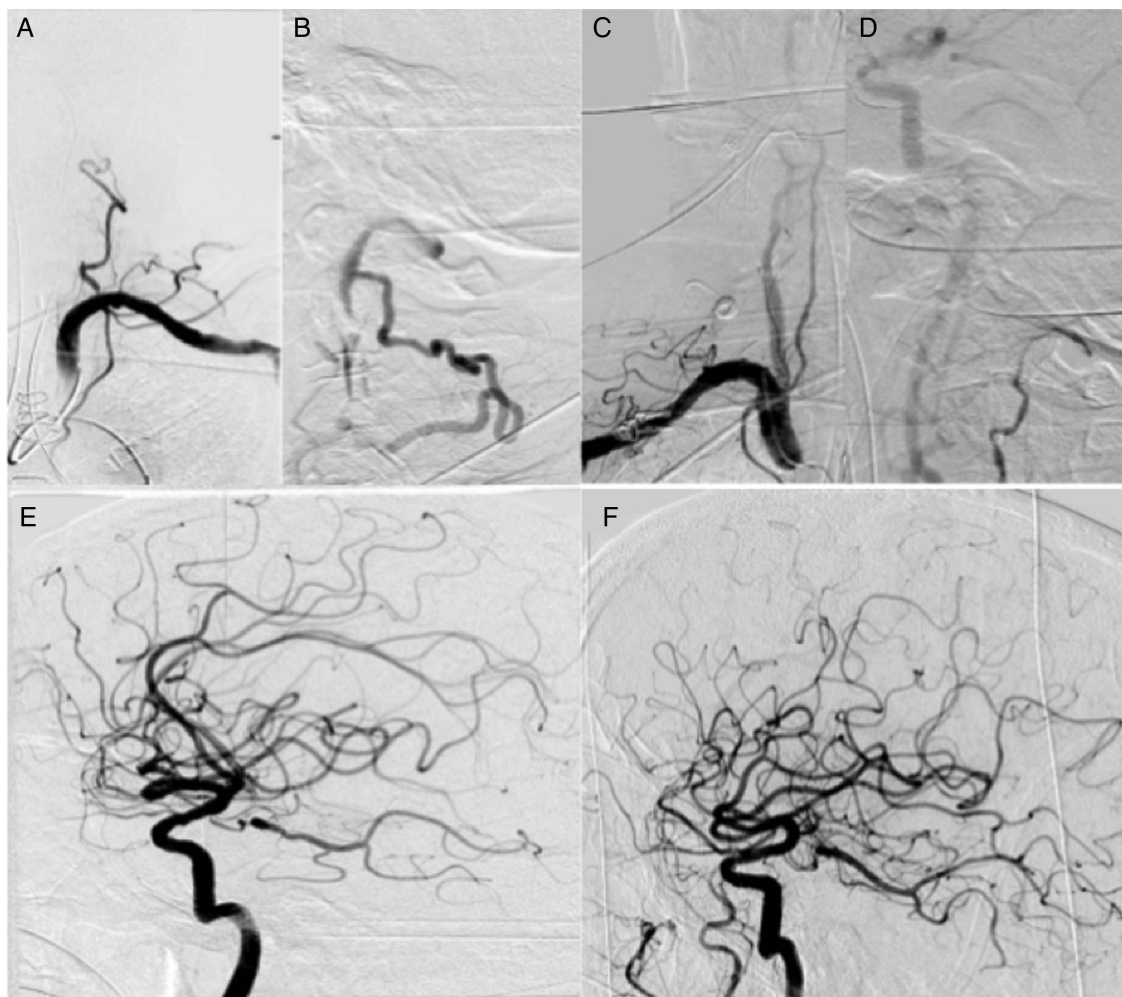


Figure 1 Left subclavian anteroposterior (A) and lateral (B) injection demonstrating a completely occluded left vertebral artery (VA) with distal reconstitution of the V3 segment via tortuous muscular collaterals from the thyrocervical trunk. Right subclavian anteroposterior (C) and lateral (D) injection showing a hypoplastic VA with no intracranial opacification of the posterior circulation. Right (E) and left (F) internal carotid artery lateral injection demonstrating diminutive posterior communicating arteries bilaterally with no retrograde flow down the basilar.

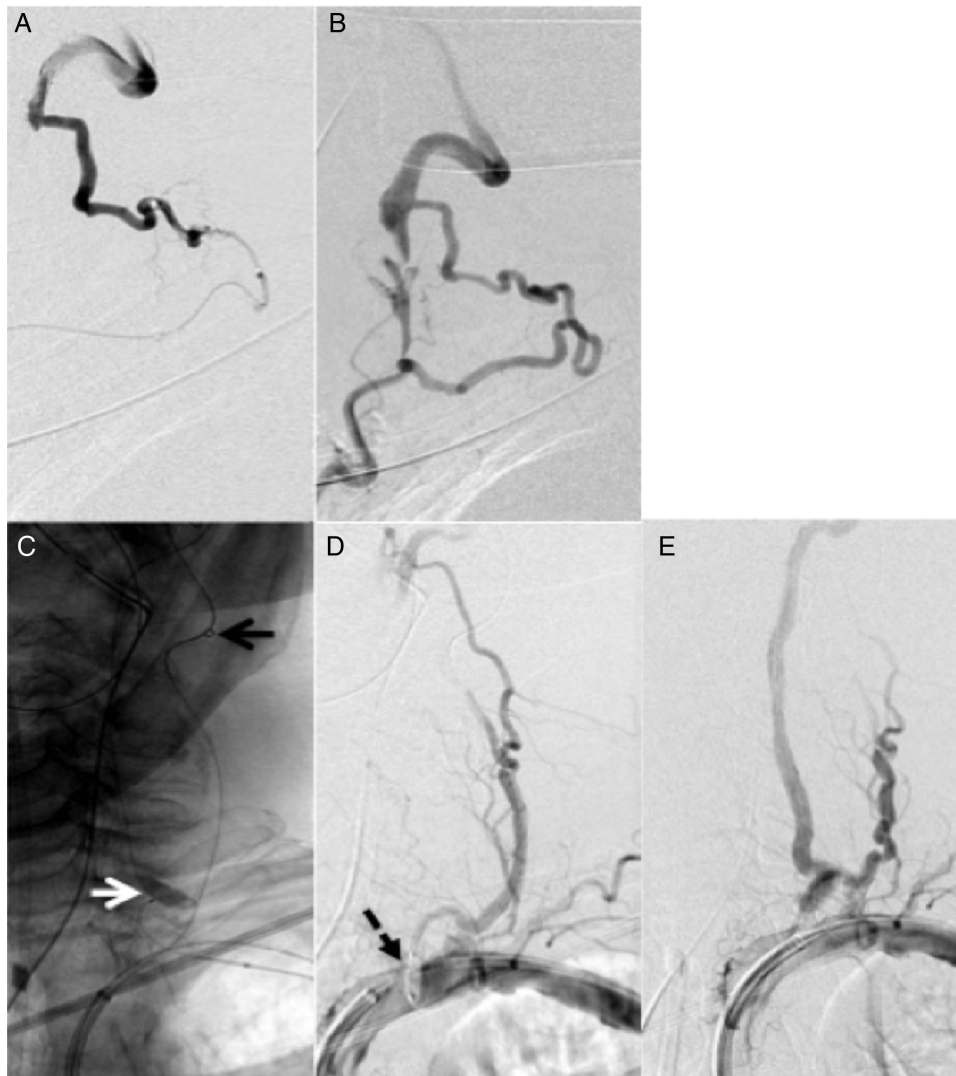


Figure 2 Selected left thyrocervical anteroposterior (A) and lateral (B) injection demonstrating circuitous collaterals to the left V3 segment. The triaxial system was placed antegrade up the left thyrocervical trunk (C) using a 4.3 Fr distal access catheter (black arrow) and retrograde access down the left vertebral artery (VA) through the occlusion at the origin into the left subclavian using an 18 L and synchro (white arrow). A 3.00 mm×8 mm balloon (dashed black arrow) was advanced across the lesion (D). Post-angioplasty runs demonstrate anterograde flow through the left VA (E).

consisting of a 4.3 Fr/136 cm distal access catheter (Concentric Medical), an 18 L Merci microcatheter (Concentric Medical), and a 300 cm/0.014 inch Synchro was advanced to the distal ascending cervical anastomosis with the V3 segment. The system was then advanced retrograde down the left VA through the origin occlusion into the left subclavian artery. The distal access catheter and 18 L microcatheter were removed and a 3.00 mm×8 mm Trek balloon was advanced across the origin and angioplasty was performed. Subsequent control runs revealed filling of the left VA (figure 2). A 6 Fr Neuron Max was advanced into the now patent distal V2 segment. A control run confirmed occlusion of the mid-basilar segment. A triaxial system consisting of 058–115 cm distal access catheter, 18 L microcatheter, and Synchro was advanced across the basilar occlusion followed by manual aspiration of a large 7 mm×0.5 mm thrombus on a single pass and control runs demonstrated Thrombolysis in Myocardial Infarction/Thrombolysis in Cerebral Infarction grade 3 flow (figures 3 and 4) 2.5 h after groin puncture. After revascularization, the left VA origin was

stented using a Mini Trek 2.0 mm×8 mm balloon mounted stent with good persistent patency. The femoral artery was closed using a 6 Fr Angio-Seal. The following morning the patient was awake, alert, and following commands with 4/5 muscle tone in all four extremities, but remained intubated for congestive heart failure. MRI demonstrated minimal strokes and no hemorrhagic conversion (figure 5).

Despite neurological recovery, the patient was ultimately palliated for inoperable recurrent bacterial endocarditis found after emergency thrombectomy.

DISCUSSION

Advances in endovascular technology permit novel approaches for thrombolysis and thrombectomy of BAO when standard approaches are not possible. Liu *et al*⁴ described the anterior-posterior revascularization method for MT of BAO through a patent PCoA in a patient with a left VA occlusion and unfavorable right VA with a prior stent across the origin. Additionally, Hui *et al*¹⁸ reported successful revascularization of a middle

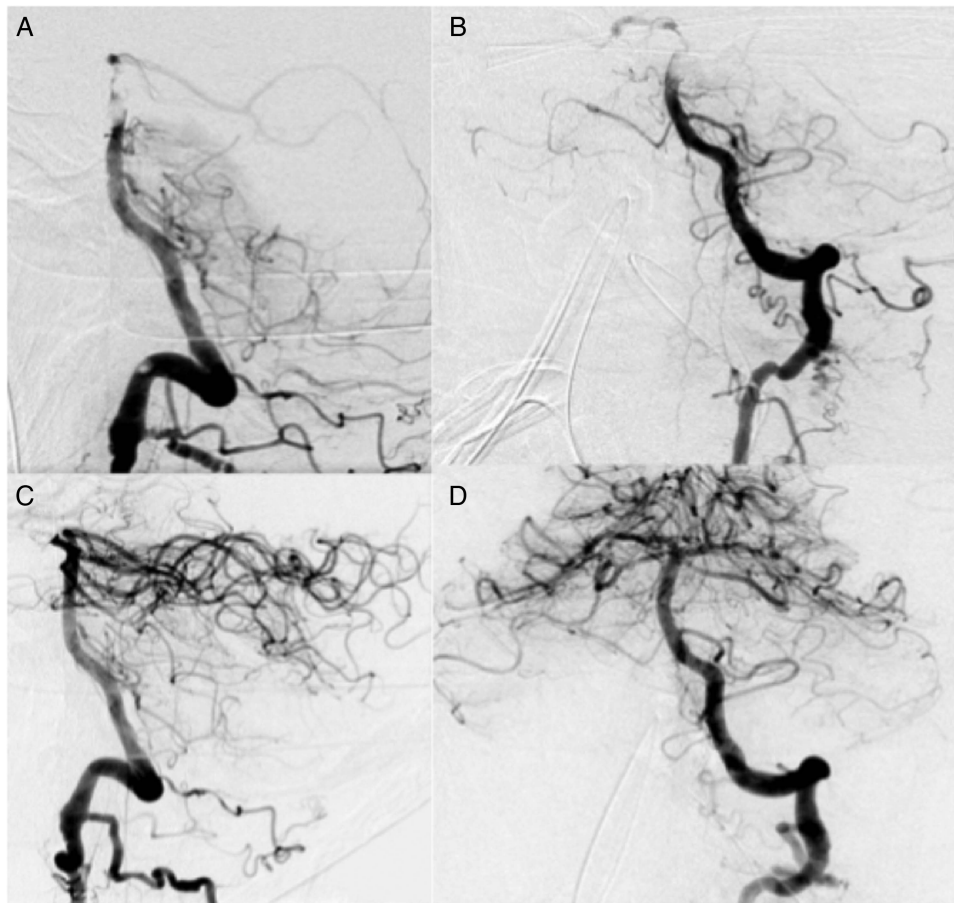


Figure 3 Lateral (A) and anteroposterior (B) projections of left vertebral artery (VA) runs after initial revascularization of the left VA demonstrating a thrombus in the distal basilar artery. Lateral (C) and anteroposterior (D) projections of the left VA after thrombectomy of basilar artery thrombus.

cerebral artery (MCA) occlusion via a posterior circulation approach using a patent PCoA and MT. Although MT was not used, Kole *et al*¹⁹ and Ozdemir *et al*¹² have demonstrated that

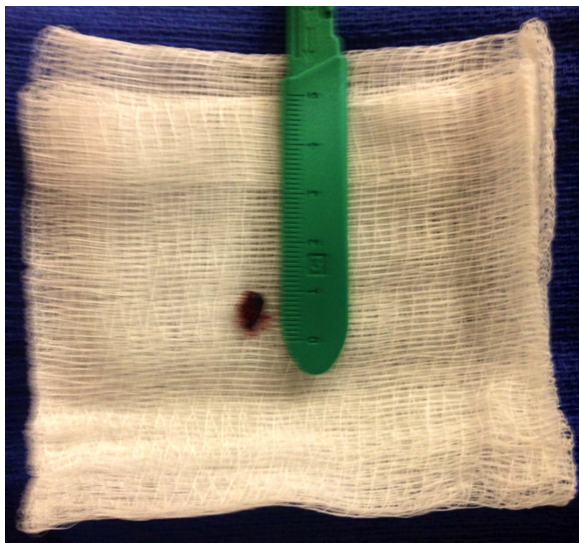


Figure 4 8x2 mm thrombus evacuated from the mid-basilar trunk.

MCA occlusions may be recanalized with IA-tPA using a patent PCoA with excellent clinical outcomes.

Here we describe the first report of retrograde VA revascularization using thyrocervical collaterals for anterograde mechanical aspiration of a BAO followed by stenting of the chronically occluded VA origin. Recanalization of a BAO through chronically occluded vessels or cervical collaterals may be necessary when direct access to the basilar trunk is not practical. Given the morbidity and mortality associated with BAO, we recommend aggressive recanalization of the vertebrobasilar system through both direct and indirect routes.

Learning points

- ▶ The literature on basilar artery occlusion (BAO) outcomes is conflicting and there is currently no gold standard of treatment.
- ▶ Aggressive mechanical recanalization is often necessary when medical interventions fail as patients with BAO have a poor prognosis.
- ▶ When direct access is not feasible, attempts should be made to explore chronically occluded vessels or cervical collaterals.

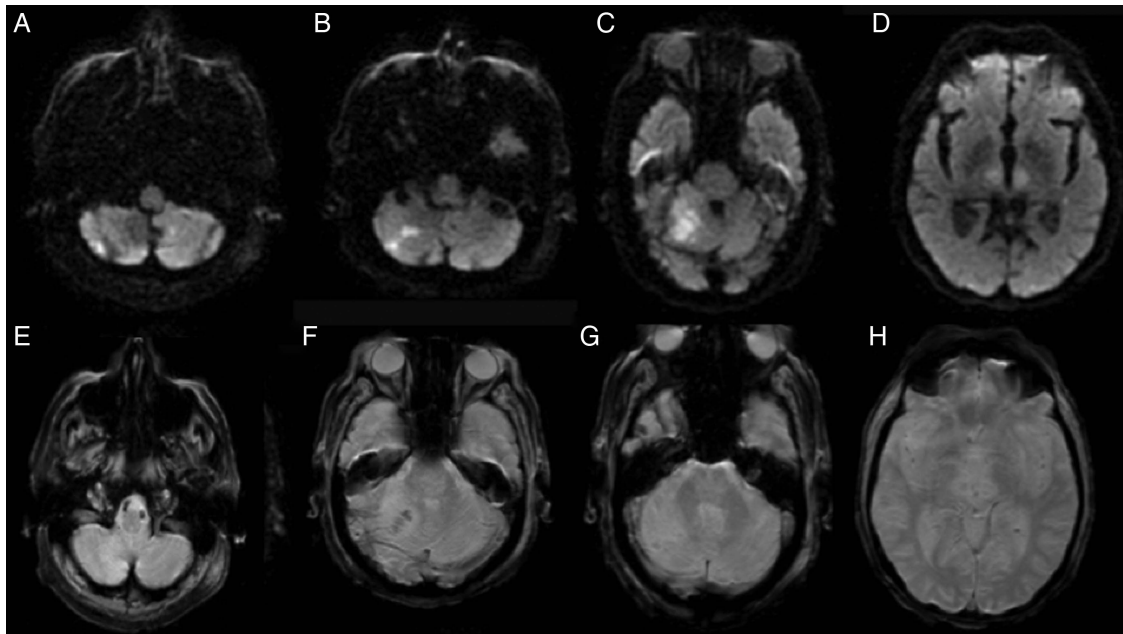


Figure 5 (A–D) Axial diffusion-weighted MRI sequences after the procedure demonstrating small focal infarcts. (E–H) Axial MRI selective weighted angiography demonstrating no hemorrhagic conversion of the stroke.

Contributors AM contributed to the design of the work, performed the literature search, drafted the manuscript, revised it critically for intellectual content, and approved the final version for publication. PVP managed the case, had the idea for the article, drafted the manuscript, revised it critically for intellectual content, and approved the final version for publication. AJ guided the article towards its final draft, revised it critically for intellectual content, and approved the final version for publication. TJ managed the case, had the idea for the article, is the guarantor, and approved the final version for publication.

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