Balloon Occlusion of the Internal Carotid Artery: A Successful Trial Prior to Arterial Ligation/Excision for an Infected Carotid Patch

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Treatment options for an infected carotid patch can be challenging, ranging from revision operations to internal carotid artery ligation, which can be associated with a high stroke rate. We report the successful use of balloon test occlusion of the internal carotid artery in a 62-year-old male who presented with an infected Dacron patch following left carotid endarterectomy. He subsequently had an uneventful ligation/excision of the left carotid arteries and removal of the infected patch.

Keywords: Infected carotid patch; Balloon occlusion; Internal carotid artery ligation/excision; Stroke.

Case Report

A 62-year-old man presented with a purulent discharge from the neck wound three years after undergoing a left carotid endarterectomy (CEA) with Dacron patch closure. The procedure was uneventful, with cefamandole 1 g IV used for antibiotic prophylaxis. He was on aspirin and clopidogrel, which were stopped on the day prior to the operation. A suction drain was left in situ. He was discharged on the second post-operative day without any complications. Routine outpatient follow-up, which included a duplex scan, did not reveal any complications including a haematoma. He was a non-diabetic ex-smoker with hypercholesterolaemia. Past surgical history included a total laryngectomy with permanent tracheostomy and radiotherapy for laryngeal carcinoma, and coronary artery bypass grafting (CABG).

Microbiological swabs taken for culture and sensitivity (C&S) did not reveal any organism. Both ultrasound (US) and computerised tomographic (CT) scans confirmed the presence of an 11 × 7 mm sinus tracking from the skin to the patch. He was empirically put on ciprofloxacin and rifampicin orally, as appropriate for film infections, on the microbiologist’s advice.

He underwent a balloon test occlusion (BTO) of the internal carotid artery (ICA), which was performed using a 7F guiding catheter navigated into the left ICA and positioned at the anterior genu of the carotid siphon. A HyperForm™ balloon (EV3, neurovascular division, 9775 Toledo Way, Irvine, CA, USA) was navigated into the left ICA and inflated such that antegrade flow within it, and also retrograde flow via the left ophthalmic artery had ceased, in order to minimise the effect of collateral flow from the external carotid artery (ECA) [Fig. 1]. He experienced no neurological symptoms following twenty minutes of occlusion (during which time the patient’s mean blood pressure ranged between 86-121 mmHg); this was taken to represent good flow from the contralateral side, and it was therefore decided to ligate/excise the carotid vessels on the affected side and remove the patch.

He subsequently underwent neck exploration under GA, which revealed the sinus tracking down to the patch, and a very friable suture line. The ICA was ligated above the patch. The common carotid artery (CCA), ECA, and ICA were excised along with the infected patch [Fig. 2]. He had no neurological deficit immediately post-operatively, but suffered transient oculomotor nerve palsy on the first post-operative day, manifesting as ptosis, mydriasis and...
diplopia due to a downward and outward strabismus. This resolved completely by day 4. He underwent a CT scan, which showed no midbrain lesion, or any vascular anomaly in the circle of Willis or the vertebrobasilar arterial system [Fig. 3]. C&S studies from the patch revealed growth of coagulase- negative \textit{Staphylococcus sp.} sensitive to rifampicin, which he was treated with. He was discharged on the seventh post-operative day and remains well on follow-up.

**Discussion**

The rate of infection following carotid endarterectomy (CEA) is less than 2%, but still remains an extremely undesirable complication.\(^1\) The management of the infected carotid patch is complex and potentially dangerous, with treatment options varying from redo surgery with replacement of the infected patch by a vein patch, or reversed long saphenous vein (LSV) bypass, with or without adjuncts such as gentamicin- impregnated sponge applied locally. This has a risk of blowing out or becoming infected. Measures such as abscess drainage or excision of the infected track or a sternomastoid flap have also been used in this scenario.\(^1\) Ligation of the carotid vessels has a high risk of stroke, approaching 50%.\(^2\) There seems to be insufficient data regarding the rate of cranial nerve palsies following redo surgery.

Redo surgery in this patient was potentially more complicated given that he had had prior neck radiotherapy, resulting in quite friable tissue including the arteries themselves, which were encased in a sheath of fibrous tissue. This precluded using LA given that there were no planes for the anaesthetic drug to track through. Furthermore, inhalational GA was conveniently administered via the tracheostomy.

The most sensitive method of assessing cerebral function during CEA remains clamping of the ICA in the awake patient, as practised during CEA under local anaesthesia (LA). This is superior to trans-cranial Doppler (TCD) studies, which has also been suggested as a means of predicting the outcome of carotid ligation.\(^1\) Other adjuncts used to assess cerebral function during carotid occlusion include single photon emission computerised tomography (SPECT) perfusion imaging, acetazolamide challenge with perfusion imaging.
CT imaging; others have applied intraoperative waking up during CEA.5 Other authors have described a negative BTO in a similar scenario, and it has also been applied to predict the result of ICA ligation or permanent balloon occlusion (PBO) prior to surgery for base of skull tumours. However, these authors do not detail exclusion of collateral ECA inflow, and have not clearly accounted for the presence of the skull base tumour and its subsequent treatment in adding to the stroke morbidity. One study has also shown that other studies that anatomically interrogate the Circle of Willis such as digital subtraction angiography (DSA) are not sensitive enough to show functional deficits, given that one patient failed BTO despite DSA showing complete angiographic collateralisation. Such imaging adjuncts may therefore be superfluous, given the precise method of the test performed here.

We believe that pre-operative assessment using a radiological approach by balloon occlusion recreates the on-table test-clamp scenario as practised during CEA under LA, and may be even more precise given that there is scope to exclude collateral flow from the ECA. This is particularly important in identifying false-negative BTOs. In addition, this technique may be of use where dealing with a Shamblin group III carotid body tumour, which may preclude a complicated reconstruction, allowing the surgeon to opt for ligation and excision of the carotid vessels instead.

Conclusion

Trial occlusion of the ICA by high intraluminal balloon occlusion equates to clamping in the awake patient in our opinion. We believe it can be used to predict neurological outcome where ICA ligation/excision is contemplated as a means of treating the patient with an infected carotid patch.

References

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