CASE REPORT

Cerebral hypoperfusion secondary to radiation arteritis presenting with recurrent syncope

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SUMMARY

Radiation arteritis can lead to significant extracranial carotid artery stenosis, affecting the circle of Willis. Cerebral hypoperfusion due to arterial insufficiency is often considered as a differential diagnosis in cases of syncope but rarely proven. We present a case of a 61-year-old man with repeated episodes of syncope-negative cardiac investigations. He had a history of cervical radiation therapy for tonsillar squamous cell carcinoma 15 years previously. Carotid duplex revealed bilateral carotid occlusive disease. MR angiography showed severe multilevel extracranial carotid stenosis bilaterally with occluded left vertebral artery. A diagnosis of cerebral hypoperfusion was performed following single-photon emission CT scan. The patient underwent a left subclavian to carotid bypass, which alleviated his symptoms.

BACKGROUND

Little is known about the relationship between radiation-induced carotid arteritis and cerebral hypoperfusion, with only one previous reported case.¹ This case is the first to describe cerebral hypoperfusion as a long-term complication of cervical radiation with a radiologically confirmed diagnosis.

Radiation arteritis following neck irradiation as a treatment for head and neck malignancy has been well documented.^{2–8} The long-term sequelae of radiation exposure of the carotid arteries may take years to manifest clinically, and extracranial carotid artery stenosis is a well-recognised vascular complication. These carotid lesions should not be regarded as benign and should be treated in the same manner as standard carotid stenosis.⁵ Previous studies have noted increased cerebrovascular events such as stroke in this cohort of patients as a result of high-grade symptomatic carotid stenosis resulting in emboli.^{9 10}

CASE PRESENTATION

A 61-year-old man presented to the emergency department with three episodes of syncope in the 48 h prior to presentation and a history of similar episodes in the preceding 3 months. These episodes were associated with urinary and faecal incontinence. The patient had no associated history of headaches, loss of consciousness or seizures. He did not have any focal neurological signs on presentation.

He had a medical history of hypertension, hypercholesterolaemia, rheumatoid arthritis, hypothyroidism and squamous cell carcinoma resected

from the lip 20 years previously. He received radiation therapy to the neck as treatment for tonsillar squamous cell carcinoma 15 years previously which followed block resection of nodal disease right side of neck. Serological investigations which included urea, creatinine, electrolytes and full blood count were all within normal ranges on admission.

INVESTIGATIONS

A CT noted minor age-related atrophic changes in his frontal lobes. He also had a normal ECG and echocardiogram. A carotid duplex scan showed bilateral internal carotid artery (ICA) stenosis of >80%. MR angiography (MRA) confirmed high-grade focal stenosis in ICA and complete occlusion of the left vertebral artery ([figure 1](#)). MRI of the brain demonstrated reduced perfusion in the right posterior parietal lobe superiorly. Single-photon emission CT (SPECT) was obtained following acetazolamide administration which showed moderate to severe symmetrical decrease in perfusion to frontal, parietal and temporal regions of the brain bilaterally which led to the diagnosis of cerebral hypoperfusion ([figure 2](#)).

DIFFERENTIAL DIAGNOSIS

A differential diagnosis of carotid sinus hypersensitivity was considered; however, carotid sinus massage is considered to be contraindicated in the presence of high-grade carotid stenosis; moreover, the investigations favoured a diagnosis of cerebrovascular insufficiency.

TREATMENT

Following multidisciplinary discussion the patient was scheduled for left subclavian to ICA bypass (left side was favoured due to previous right side neck dissection). Surgical access was via two incisions: a supraclavicular incision to access the subclavian artery and a second neck incision to access the carotid bifurcation. A Dacron graft was anastomosed end to side to the subclavian artery and end to end to the ICA after disconnecting the latter above the level of the stenosis ([figure 3](#)).

OUTCOME AND FOLLOW-UP

The patient recovered well and was discharged on the third postoperative day. There was significant cranial nerve injury with a mild neuropraxia affecting the left hypoglossal nerve which resolved spontaneously within a 2-week period, however, a 10th nerve neuropraxia was missed initially and was diagnosed at follow-up due to persistent hoarseness and mild swallowing difficulties which had

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Figure 1 MR angiography showing bilateral multilevel high-grade stenosis in extracranial carotid arteries and a fully occluded left vertebral artery.

improved after the first 6 weeks and the patient took 3 months to recover fully. The patient has been free of syncopal episodes since discharge at 6-month follow-up and reports improved cognitive function. An MRA at 6 months confirmed restored blood flow to left ICA (figure 4).

DISCUSSION

Radiation therapy to head and neck is a risk factor for severe extra-cranial arteritis and has been established in several case-control studies.^{11–13} It is believed to be due to a combination of direct vessel wall injury resulting in intimal proliferation,

Figure 2 Single-photon emission CT demonstrating moderate to severe symmetrical decrease in perfusion to frontal, parietal and temporal regions of the brain bilaterally.

Figure 3 Intraoperative photograph demonstrating completed subclavian to carotid bypass graft in situ.

necrosis of media and fibrosis around the adventitia resulting in accelerated progression of normal atherosclerosis pathophysiology.^{14–16} A study by Cheng *et al*¹⁴ of 240 patients who had radiation to the head and neck with a mean interval of 72 months noted that 28 (11.7%) patients had significant stenosis in the ICA or common carotid artery (CCA). On logistic regression analysis the interval from irradiation (>5 years) was found to be an independent significant ($p < 0.05$) predictor of 70% or greater ICA/CCA stenosis. Cheng *et al*⁵ reviewed 96 consecutive patients who had cervical radiotherapy with a mean post-RT interval of 78 months, and they found that 15 patients (16%) had critical stenosis of greater than 70%. Similarly Lam *et al*¹⁷ studied 40 patients who received a minimum of 5500 cGy cervical radiotherapy, and they reported a 40% incidence of carotid stenosis of 50% or more.

Many patients with significant carotid stenosis secondary to radiotherapy will be asymptomatic. In those who develop symptomatic carotid stenosis, previous cervical radiotherapy raises considerable difficulties for the vascular surgeon and the anaesthetic team. Many patients have had previous neck surgery or a

tracheostomy, which can make intubation and dissection challenging as well as adding a risk of cranial nerve injury or infection from the stoma.⁷

Cerebral hypoperfusion is a rare complication of radiotherapy. To the best of our knowledge, there has been only one case report in the peer-reviewed literature with postradiation arteritis of right common carotid and both vertebral arteries in a patient presenting with symptoms of dizziness.¹ Confirming cerebral hypoperfusion radiologically presents a challenge. Use of MRI has been proven to produce high-quality images in assessing cerebrovascular disorders, especially for large vessel patency with accuracy nearly matching angiography in cases of complete occlusion or significant stenosis.^{18 19} In cases of cerebral hypoperfusion, a challenge test using a vasodilator such as acetazolamide combined with MRI or SPECT scan will evaluate if cerebral blood flow (CBF) is being maintained through autoregulatory vasodilation. The distal perfusion pressure and CBE may remain normal if collateral circulatory pathways are adequate. In cases of severely reduced CBF the autoregulatory mechanisms would be exhausted and CBF maintained on arterial blood pressure. In those patients, CBF alone may not be sufficient to measure haemodynamic compromise, and acetazolamide nuclear scans can be used to measure haemodynamic reserve by showing altered enhancement due to reduced CBF response to vasodilatory stimuli.^{20 21}

The choice of surgical treatment for patients with significant extracranial radiation arteritis remains controversial and debatable with some surgeons preferring a less invasive approach by performing carotid artery stenting (CAS), whereas others may prefer a carotid endarterectomy (CEA). Increased restenosis rates post-CAS in those with previous cervical radiotherapy must be considered. Clinton *et al* reported a significantly increased restenosis rate in patients who had cervical radiotherapy, with 3 years freedom from stenosis of 20% compared with 74% in patients with atherosclerotic occlusive disease but without history of radiotherapy.⁶

Recently, a systematic review of CAS versus CEA in patients with carotid stenosis after previous radiation therapy assessed 27 studies comprising 533 patients. Late outcome showed rates

Figure 4 Postoperative MR angiography showing restored blood flow through the left subclavian-to-internal carotid bypass graft.

of cerebrovascular event favouring CEA ($p=0.014$). The rate of restenosis $>50\%$ was significantly higher in patients treated with CAS compared with CEA ($p<0.003$).²² Given the relative infrequency of subclavian to carotid bypass surgery there are no randomised controlled trials comparing outcome in this cohort of patients in relation to those undergoing CAS or CEA.

Learning points

- Radiation arteritis is a recognised complication of cervical radiotherapy.
- In rare cases this can present with symptoms of cerebral hypoperfusion.
- Extra-cranial carotid lesions following radiotherapy should be managed similarly to standard lesions.
- Use of nuclear imaging such as single-photon emission CT scans and MRI with a vasodilator agent such as acetazolamide can prove useful in confirming the diagnosis.

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Competing interests None.

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