

Carotid Stenosis Repair: *Which Patients Benefit?*



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Atherosclerotic disease of the extracranial internal carotid artery (ICA) is one of the common causes of ischemic stroke, along with embolism from the heart and penetrating brain arteriolar disease causing small, deep, lacunar brain infarcts. Extracranial carotid stenosis is nearly always located at or just beyond the common carotid artery bifurcation in the neck. Unstable plaques with endothelial ulceration or intraplaque hemorrhage can throw embolic material into the cerebral circulation, causing transient neurological deficits if the embolus fragments and allows reperfusion (transient ischemic attacks [TIAs]) or fixed deficits when the vessel does not reopen. TIAs are followed by stroke in up to 30% of patients, most occurring within several months. Warning TIAs precede about one-third of strokes resulting from carotid stenosis.

Asymptomatic carotid stenosis is detected by Doppler ultrasonography ordered to investigate a neck bruit, an episode of neurological symptoms not referable to the carotid distribution (such as syncope or dizziness), or simply performed as part of a cerebrovascular system work-up.

TIAs

Hemispheric TIAs are usually in the territory of the largest branch of the intracranial ICA receiving the majority of its blood flow, the middle cerebral artery (MCA), which supplies primary sensory and motor cortex and in the dominant hemisphere, speech areas. Given that face and hand control

John's case

John is a 69-year-old smoker who visits his doctor irregularly. He is taken to the hospital by ambulance after his wife finds him in his home workshop seemingly confused with right-sided face, arm and hand weakness. He has hypertension which has been treated with ramipril and elevated cholesterol in the past which has gone untreated. According to his wife, he has no history of neurological disease or symptoms.

On examination, John is in sinus rhythm and his BP is 160/100 mmHg. He is able to converse, but has difficulty in finding certain words. Although much of his weakness has resolved at this point, several hours from the onset of his illness, he still has persistent right face weakness, a right pronator drift and word-finding difficulties.

What is the probable diagnosis and what immediate treatment and investigations does John require?

For the correct answer, see page 14.

have a large amount of cortical representation, as does language, carotid distribution TIAs usually present as episodes of contralateral face and hand weakness, combined with dysphasia when the speech-dominant (usually left) hemisphere is affected (Table 1). TIAs last minutes and incomplete resolution after several hours usually signals an infarct in evolution rather than reversible ischemia. A second type of TIA is ocular and ipsilateral to the proximal carotid disease, where emboli pass via the ophthalmic artery into the

retina causing transient whole or partial monocular blindness (amaurosis fugax). This is characteristically described as a curtain being drawn down or across the vision of the affected eye, followed by gradual clearing.

When multiple, TIAs tend to be stereotypical and they can increase in intensity as well as duration (“crescendo TIAs”) or terminate as a fixed deficit, indicative of a stroke. Patients with relatively minor deficits not causing significant functional disability are treated in the same way as patients with TIAs, but more severe deficits managed by a stroke team within three hours of stroke onset are assessed for treatment with IV thrombolysis using recombinant tissue plasminogen activator (rt-PA).¹

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Risk factors for stroke

Recent symptoms of hemispheric ischemia are the most important signal of impending cerebral infarction resulting from carotid stenosis.⁴ The higher the risk of stroke in any individual patient with symptomatic carotid stenosis, the greater the need for carotid repair.

In asymptomatic patients with carotid stenosis, higher, long-term stroke risk is with higher degrees of stenosis or documented stenosis worsening over time, plaque ulceration and male gender. In addi-

Table 1

Symptoms and signs of TIAs in the carotid distribution

- Contralateral hand and upper limb weakness and clumsiness, pronator drift common
- Contralateral facial droop with widening of palpebral fissure and mouth sag sometimes resulting in dysarthria
- Speech difficulties, either receptive or motor, if the language-dominant (usually left) hemisphere is affected (sometimes mistaken as confusion)
- Numbness in the same distribution of body weakness, but numbness without any weakness usually does NOT represent a TIA
- Painless monocular blindness, partial or complete

TIA: Transient ischemic attack

tion, younger and otherwise relatively healthy, asymptomatic patients stand to benefit more from carotid repair in the long term.²

Investigation of suspected carotid stenosis

Following neurological and CV examinations, all patients presenting with suspected TIAs or minor stroke should undergo immediate CT scanning to rule out brain hemorrhage as well as mass lesions such as chronic subdural hematomas and brain tumours, both of which can sometimes present in a stroke-like fashion (Table 2). Electrocardiography rules out atrial fibrillation and the patient’s coagulation status should be checked in addition to routine blood investigations. If carotid stenosis is the most likely underlying cause of symptoms at this point then carotid ultrasonography is indicated and it should be performed as soon as possible, preferably within 24 hours. If symptomatic carotid

Table 2

Investigation of carotid distribution TIAs

- ECG to rule out dysrhythmias and MI
- Check coagulation status
- Chest x-ray to rule out metastatic disease
- CT scan of the brain to rule out/diagnose brain infarction and rule out/diagnose brain hemorrhage or mass lesion, such as chronic subdural hematoma or brain tumour, which can sometimes present in a stroke-like fashion.
- Carotid Doppler ultrasonography to detect "significant" (> 50%) internal carotid artery stenosis
- CTA to confirm results of ultrasound and provide additional pathoanatomical information, including location and precise severity of carotid stenosis, presence of arterial ulceration and condition of distal arteries

CTA: Computed tomographic angiography

FAQ

How useful is the finding of a carotid bruit on physical examination?

While a carotid bruit is a marker for cerebrovascular disease, only about one-half of neck bruits are due to a significant internal carotid artery stenosis and only about one-half of significant ICA stenoses cause an audible cervical bruit. A carotid bruit is not a reliable indicator of underlying carotid stenosis.

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artery stenosis is the provisional diagnosis after sudden-onset carotid distribution neurological deficits, patients should remain in hospital until investigations are complete.

It is unclear if patients with carotid bruits or indeed any asymptomatic patient should undergo carotid artery screening, including those patients scheduled for major vascular operations such as aortocoronary artery bypass. Persons with some combination of atherosclerotic risk factors, cervical bruit and noncarotid neurological symptoms comprise the majority of asymptomatic patients referred for carotid repair.

Significant carotid stenosis detected by Doppler ultrasonography is usually confirmed by more direct vascular imaging—the modality of choice presently being computed tomographic angiography (CTA). Less invasive and expensive than catheter angiography, CTA also provides more anatomical information than magnetic resonance angiography, including:

- precise stenosis location and severity,
- plaque surface characteristics and
- the presence of plaque calcification.³

Treatment

Patients with symptomatic carotid stenosis require immediate and ongoing antiplatelet treatment (ASA if tolerated, clopidogrel if not) and consideration of carotid artery repair. Carotid endarterectomy (CEA) is appropriate management of severe symptomatic carotid stenosis between 70% and 99% providing the patient is both neurologically and medically stable. The risk of stroke over two years is reduced from between 20% and 30% to < 10% when surgery is added to medical treatment.⁴ The immediate perioperative stroke and death risk associated with CEA has been reduced to several per cent in dedicated stroke centers.⁵ CEA is also an option for the management of patients



Figure 1. CTA showing a critical stenosis of the left ICA at its origin from the common carotid artery.

with moderate symptomatic stenosis between 50% and 70%. The stroke risk reduction is not as great for this range, but remains significant.⁶ In this moderate range, higher degree and ulcerated stenosis, male gender and minor strokes (as opposed to TIAs) are among a list of features correlating with a greater benefit from carotid repair.² For maximum benefit, CEA should be carried out as soon as possible.

Severe asymptomatic carotid stenosis is a reasonable indication for CEA in selected patients. When performed with a low perioperative stroke risk, it can halve the five-year stroke risk from roughly 12% to 6%, a statistically significant reduction.^{7,8} Careful patient selection ensures maximum benefit from surgery, targeting those who are younger with high-grade stenosis.

Except for specific and fairly uncommon clinical circumstances, such as carotid stenosis difficult to repair surgically (*e.g.*, anatomically high, radiation-induced or recurrent carotid stenosis) and patients at high risk of surgery due to unstable cardiac disease, carotid angioplasty and stenting (CAS) remains a procedure still under investigation. Completed randomized trials comparing CAS

FAQ

What factors are associated with a higher stroke risk from a carotid stenosis?

- Recent symptoms of ischemia
- Male gender
- Age > 75
- Motor (hemispheric) vs. ocular (amaurosis fugax) symptoms
- Multiple and longer TIA events
- Lingering signs of ischemia on examination indicative of a minor stroke as opposed to TIA
- Contralateral carotid occlusion
- Presence of plaque ulceration
- Presence of intracranial atherosclerosis

Recent symptoms of hemispheric ischemia are the most important signal of impending cerebral infarction resulting from carotid stenosis.

FAQ

Should patients with carotid stenosis be referred for carotid angioplasty and stenting (CAS)?

Selected patients with anatomically difficult stenosis may be more safely treated with CAS than with Carotid endarterectomy (CEA), but for the majority of patients CAS is unproven and CEA remains the treatment of choice.

More on John...

Three hours after the onset of his “brain attack,” John still has some evidence of neurological deficit and therefore might be experiencing a minor stroke rather than a “TIA” of his left cerebral hemisphere. An ECG shows sinus rhythm and a brain CT scan rules out hemorrhage and a mass lesion such as subdural hematoma or brain tumour presenting in a “stroke-like” fashion. John has mild weakness rather than paralysis so his neurological condition is not severe enough to warrant consideration of IV thrombolytic treatment. Since carotid artery to artery thromboembolism is suspected, he is given ASA and a carotid Doppler ultrasound is ordered for the same day. An IV is started and John’s neurological and vital signs are checked hourly.

The carotid Doppler indicates a 70% to 90% left ICA stenosis and John remains stable.


Discussion

John has suffered a minor, improving ischemic stroke due to a severe left ICA stenosis, now confirmed by CTA done following his abnormal Doppler ultrasound (Figure 1). A small hypodensity is now seen in the left frontal lobe, indicating a small infarct. ASA treatment has been started.

A carotid surgeon should be consulted to discuss early CEA with John.

to CEA have been either inconclusive or suggest CEA is superior to CAS.^{9,10,11} The largest randomized controlled trial is ongoing.¹²

Conclusion

In properly selected patients, surgical carotid stenosis repair is a powerful, stroke-reducing measure. Medical follow-up and ongoing treatment of risk factors will maximize the benefit from surgery. Studies currently in progress will determine the relative efficacy of CAS. 

Take-home message

- The best candidates for carotid repair have suffered either a carotid TIA or minor stroke due to significant carotid artery stenosis confirmed by CTA, are otherwise medically stable and have accepted the risks of the procedure.
- Asymptomatic patients should be very carefully selected for surgical consideration, with men < 70 years-of-age who are otherwise healthy, but with severe or ulcerated stenosis benefiting most.
- CEA remains the proven and first choice for carotid repair in the majority of patients.

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