**Keywords** Stroke/Transient ischaemic attack/FAST checklist/Brain/Imaging

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**In this article**

- Risk factors for stroke: behavioural, metabolic and environmental
- Lifestyle, pharmacological and surgical interventions for stroke prevention
- Tools for assessing the risk of stroke and appropriateness of treatment

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**Stroke 2: primary and secondary prevention strategies**

**Key points**

- Three quarters of the stroke burden is attributable to behavioural risk factors (smoking, poor diet, physical inactivity and alcohol consumption)
- The risk of stroke can be reduced by controlling modifiable risk factors, both behavioural and metabolic
- Diet modification, reduced alcohol intake and smoking cessation help for both primary and secondary stroke prevention
- A transient ischaemic attack is a warning sign of stroke, so must be treated quickly
- Atrial fibrillation increases the risk of ischaemic stroke and related disability and mortality

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**Abstract** The burden of stroke is thought to be linked mostly to modifiable risk factors. Controlling behavioural and metabolic risk factors through lifestyle changes could potentially prevent up to 75% of strokes. Health professionals have a crucial role to play in prevention, the first step being to determine an individual patient’s risk factors. This article, the second in our five-part series on stroke, discusses risk factors, risk assessment tools and prevention strategies.

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Stroke is a preventable and treatable disease, but it remains one of the most burdensome of all neurological disorders. It is a debilitating condition that leads to significant neurological dysfunction and can have a negative impact on an individual’s physical, mental and social health (Catangui, 2016; Moorley et al, 2016).

In England, over 900,000 people live with the effects of stroke and half of them rely on others for help with daily activities (Department of Health, 2007). This second article in our five-part series focuses on the primary and secondary prevention strategies to reduce the incidence of stroke.

**Risk factors and prevention**

Stroke is associated with numerous risk factors – some non-modifiable and others modifiable with education, training and counselling (Table 1). Risk factors can also be classified as behavioural, metabolic or environmental (Table 2). More than 90% of the stroke burden is linked to modifiable risk factors and three quarters is attributable to behavioural risk factors (Feigen et al, 2014). Controlling behavioural and metabolic risk factors through lifestyle changes could potentially prevent up to 75% of the global stroke burden.

Health professionals therefore have a pivotal role to play in stroke prevention. The aim is to control modifiable risk factors to reduce the risk of stroke occurring in the first place (primary stroke prevention), and to reduce the risk of recurrence after a stroke or a transient ischaemic attack (TIA) (secondary stroke prevention).

In the UK, the National Institute for Health and Care Excellence emphasises the importance of a comprehensive discussion, with patients, of the risks, benefits and side-effects of any intervention. Treatment and care must be underpinned by a person-centred approach (NICE, 2008).

**Primary stroke prevention**

Determining a person’s risk factors is crucial to reduce the possibility of stroke, and routine blood pressure monitoring is key to identify people who may be at risk. NICE recommends that everyone over the age of 40 undergoes regular cardiovascular disease (CVD) risk assessments (NICE, 2014) to identify people at high risk of CVD and put in place primary prevention strategies.
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Table 1. Modifiable and non-modifiable risk factors for stroke

<table>
<thead>
<tr>
<th>Modifiable risk factors</th>
<th>Non-modifiable risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Age</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>Gender</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Race</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>Ethnicity</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>Family history of stroke</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td></td>
</tr>
<tr>
<td>Illicit drug use</td>
<td></td>
</tr>
<tr>
<td>Lifestyle factors: obesity, lack of physical activity and poor diet</td>
<td></td>
</tr>
<tr>
<td>Oral contraceptive</td>
<td></td>
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<tr>
<td>Migraine</td>
<td></td>
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<tr>
<td>Atrial fibrillation</td>
<td></td>
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<tr>
<td>Transient ischaemic attack</td>
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</tbody>
</table>

NICE does not recommend any particular risk assessment tool. The online QRISK®³ risk calculator (https://qrisk.org/three) is the most recent version of the tool and is most commonly used in practice (Hippisley-Cox et al, 2017). The formula uses risk factors (Box 1) to generate a percentage risk of having a heart attack or stroke within the next 10 years.

Hypertension
Hypertension is a major risk factor for both ischaemic and haemorrhagic stroke. Implicated in 50% of all strokes, it is consistently cited as the single most important modifiable risk factor (Stroke Association; 2017; Royal College of Physicians, 2016; Di Legge et al, 2012). NICE recommends regular blood pressure screening, and treatment for people with hypertension that combines lifestyle modifications and pharmacological therapy. Patients with hypertension should be treated with medication to maintain blood pressure of <140/90mmHg (<150/90mmHg for those over the age of 80) (NICE, 2008).

Cigarette smoking
Tobacco smoking is a powerful independent risk factor for stroke. Evidence suggests that it doubles the risk of ischaemic stroke (Wolf et al, 1988). People are strongly advised to stop smoking and should be offered help to achieve this goal. The long-term health benefits are significant: five years of stopping smoking reduces the stroke risk of a smoker to that of a non-smoker. NICE has produced guidance on how to help people stop smoking (NICE, 2013).

Physical inactivity and obesity
Obesity can be linked to physical inactivity, unhealthy diet and hypertension. Although obesity is a risk factor for stroke, Lawrence et al (2011) report that there is little strong evidence that weight reduction alone can prevent stroke. However, regular physical activity not only improves overall wellbeing, it also helps maintain a healthy weight and control hypertension. Physical activity can reduce the risk of stroke by up to 30%, as well as lower the risk of mortality after a stroke (Kernan et al, 2014). Those at high risk of stroke should be encouraged to undertake regular, structured exercise programmes (NICE, 2008).

Diet
It is widely accepted that eating a healthy, balanced diet reduces the risk of CVD, including stroke. The UK government has initiated various campaigns to encourage people to eat at least five portions of fruit and vegetables per day as per World Health Organization recommendations. Some studies unequivocally link increased levels of salt, saturated fat and refined sugar to an increased risk of stroke (Hooper et al, 2011; Strazzullo, 2009; WHO, 2007). Patients should be advised to reduce their intake of sugar – particularly refined sugars – salt and saturated fat, and eat at least five portions of fruit and vegetables per day (NICE, 2014).

Diabetes
Goldstein et al (2006) have identified the link, which they label as being modifiable, between type 2 diabetes and stroke. Estimates have suggested that people with type two diabetes have between a 1.8 and almost six-fold increase in their risk of stroke.
Dyslipidaemia and hyperlipidaemia

Nelson (2013) has defined hyperlipidaemia as raised fasting blood cholesterol concentration with, or without, raised triglyceride concentrations. It is a complex issue. Dyslipidaemia can be defined as unbalanced cholesterol levels. The link between these and CVD has been well known since the Lipid Research Clinics Coronary Primary Prevention Trial in 1984 (Nelson, 2013).

There are two stages in the management of patients with high cholesterol:
- Patients should first be encouraged to make appropriate lifestyle changes;
- A statin should be prescribed after evaluation of these lifestyle changes.

Statins should not be viewed as a shortcut to lowering cholesterol, but as an adjunct to lifestyle changes. Prescribing a statin remains a recommended intervention, but patient education and support are crucial in mitigating the risk of stroke.

Patients with a total cholesterol concentration of more than 7.5mmol/l (or a non-high-density lipoprotein cholesterol concentration of more than 5mmol/l) should be offered a specialist appointment for an assessment. Patient’s who have a greater or equal to 10% risk of a stroke within the next 10 years should be offered atorvastatin (NICE, 2014). This risk should be calculated using the QRISK®2 calculator. Since 2014, an advanced QRISK®3 tool has been developed which practitioners might prefer to use, but it is included in the NICE recommendations.

Alcohol consumption

Although there is limited research investigating the complex relationship between alcohol consumption and risk of stroke, a direct correlation has been established (Lawrence et al, 2011; Rehm and Roerecke, 2017). This is in part because excessive alcohol consumption is linked to other modifiable risk factors for stroke: hypertension, obesity, diabetes and AF.

Information on safe levels of alcohol consumption for the general population can be confusing. Some studies have indicated that light-to-moderate alcohol consumption can protect against ischaemic stroke (Berger et al, 1999). The absolute stroke risk associated with different levels of alcohol consumption is yet to be established and further research is required.

For the time being, as a general rule, the DH’s safe limits of alcohol consumption should be followed: neither men nor women should drink more than 14 units per week and should abstain from alcohol for at least two or three days a week (DH, 2016).

Antiplatelet agents and aspirin

The use of aspirin, with its potential gastro side-effects, as general principle is not recommended in primary stroke prevention (NICE, 2008). For patients with other risk factors (hypertension for example) the benefits might begin to outweigh the risks; so some level of individualised care planning is necessary (Meschia, 2014).

Secondary stroke prevention

A stroke is a powerful predictor of a further cerebrovascular event and intervention within the first four days of a stroke is considered critical, as there is a 25% risk of a further event within three months (Royal College of Physicians (RCP), 2016). Many of the emergency interventions following an acute stroke are also, at the same time, secondary prevention measures.

An initial assessment of lifestyle risk factors should be undertaken for all patients who have had a stroke or a TIA and repeated on a yearly basis once patients have returned to a primary care setting.

There is a wealth of guidance on secondary stroke prevention, including:
- The National Clinical Guideline for Stroke published by the RCP (RCP, 2016);
- The Scottish Intercollegiate Guidelines Network guidelines (SIGN, 2008);
- The guidelines of the American Heart Association/American Stroke Association (Kernan et al, 2014).

Carotid artery assessment

Individuals who have experienced a TIA or stroke should be offered an ultrasound to establish whether there is carotid artery stenosis, which is a feature of atherosclerotic disease. In carotid artery stenosis, atherosclerotic plaques narrow the lumen or interior width of the carotid artery, a key blood vessel supplying the brain. If the lumen is found to be reduced by 50% or more, patients should be offered a second non-invasive test to confirm the finding (Rothwell, 2005).

If that repeat test is positive, patients should be offered endarterectomy (surgical removal of the atherosclerotic plaques from the carotid artery). Alternatively, a stent can be inserted. This involves threading a tube through the arterial system to the carotid artery where, if required, a mesh cylinder can be inserted to permanently dilate the lumen (Saw, 2014). Treatment should be given as soon as possible after the presence of carotid artery stenosis has been confirmed (Saw, 2014).

Blood pressure management

Blood pressure management is crucial in people who have sustained a stroke or a TIA. The RCP recommends the goal of systolic blood pressure of 130 mm/Hg. People aged less than 55 years should be prescribed an angiotensin converting enzyme (ACE) inhibitor such as enalapril. For people of African or Caribbean origin (a high-risk group) and those over 55 years, treatment with a long-acting dihydropyridine calcium channel blocker (amlodipine or nifedipine) or a thiazide diuretic (indapamide or chlorothalidone) is recommended (RCP, 2016).

Lipid modification

After a stroke or a TIA, it is normally accepted that people should take a high-intensity statin. Atorvastatin (20–80mg daily) is the drug of choice (NICE, 2008). This should be reviewed after three months.

Antithrombotic management

In contrast to primary stroke prevention, antiplatelet therapy is recommended in secondary stroke prevention. Clopidogrel (75mg daily) is the first-line management, aspirin (75mg daily) or dipyridamole (200mg twice a day) being alternatives (RCP, 2016).

Anticoagulant therapy is not recommended in secondary prevention, with one exception: if the stroke is associated with thrombus formation (which usually means it is linked to atrial fibrillation (AF)), anticoagulants are vital to prevent further thromboembolic events.

Lifestyle management

Contrary to previous thinking, people who have sustained a stroke or TIA should exercise. However, the RCP recommends a structured exercise regimen, starting with low-level activity and gradually building up (RCP, 2016). The aim is to do 150 minutes
or more of moderate-intensity physical activity per week in 10-minute sessions. The other lifestyle measures (diet modification, reduced alcohol intake and smoking cessation) are essentially the same in primary and secondary stroke prevention.

**Stroke prevention after a TIA**

Individuals who have experienced a TIA are at increased risk of having a stroke. According to the Stroke Association (2016) one in 12 people who have had a TIA will have a stroke within one week. For that reason, TIAs are sometimes referred to as warning strokes.

Quickly assessing and treating patients who have had a TIA reduces the risk of stroke and potential neurological dysfunction. After a TIA, NICE recommends using the ABCD2 assessment tool (NICE, 2008; a new version, ABCD3-I, has been recommended by Kelly et al, 2016), which calculates the risk of stroke by allocating points to key clinical and vascular risk factors (Table 3). The maximum score is 7 points and patients with a score of 4 or more are considered at high risk.

After a TIA, NICE recommends using the ABCD2 assessment tool (NICE, 2008; a new version, ABCD3-I, has been recommended by Kelly et al, 2016), which calculates stroke risk by allocating points to clinical and vascular risk factors (Table 3). Validation studies have not consistently shown that the ABCD2 assessment tool has good predictive value. However, because of its simplicity and ease of use, it remains the most commonly used tool to evaluate the risk of stroke in TIA patients.

NICE suggests a series of clinical interventions to reduce the risk of stroke following a TIA. These involve a detailed assessment in a TIA clinic, medication and secondary prevention measures (NICE 2008).

**Stroke prevention in AF**

AF is associated with ischaemic strokes. Research shows that AF results in a five-fold increase in the risk of ischaemic stroke and that 20-35% of all patients with ischaemic stroke have AF (Gattellari et al, 2011; Ferguson et al, 2014).

Effective thromboprophylaxis is available to prevent thrombus formation in people with AF. However, screening and diagnosis can be challenging: often, the signs and symptoms of AF fluctuate and are subtle and silent (Ferguson et al, 2014). According to Freeman et al (2011), 75% of all patients with AF exhibit no symptoms.

AF is thought to be present in 1-2% of the general population and 10% of those aged over 75 (Hobbs, 2015). Despite the increasing prevalence of AF and the related risks, there is no national screening programme in the UK. The self-reporting of symptoms (such as palpitations, dizziness and fainting) followed by an electrocardiogram is common. According to Hobbs (2015), this opportunistic screening is valuable in identifying individuals with AF. Once the diagnosis is confirmed, treatment with thromboprophylactic drugs must be considered.

Numerous risk assessment tools are available to quantify the risk of stroke in people with AF (Ferguson et al, 2014). The CHA2DS2-VASc risk assessment tool gauges the long-term risk of stroke in patients with AF (NICE, 2008). Simple to use and well-validated, it allocates points to risk factors (Table 4). The maximum score is 9; a score of 0 indicates a low risk of stroke, 1 low-to-medium risk, and 2 or more, moderate-to-high risk.

Once the individual risk has been established, pharmacological interventions should be considered. There are many drugs available to prevent stroke in AF. Treatment must be individually tailored, taking into account their wishes alongside current evidence and clinician expertise.

If anticoagulation therapy is indicated, it is important to assess the risks and benefits of treatment. The HAS-BLED risk stratification tool (Table 5) is used to assess the risk of bleeding in patients with AF prescribed anticoagulants. A high HAS-BLED score (≥3) does not preclude the use of anticoagulants, but patients require

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**Table 3. ABCD2 ABCD3-I assessment tools**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>ABCD2</th>
<th>ABCD3-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>≥60 years</td>
<td>1</td>
</tr>
<tr>
<td>BP</td>
<td>≥ 140/90 mmHg</td>
<td>1</td>
</tr>
<tr>
<td>Unilateral Weakness</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Speech disturbance only</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Duration of symptoms (minutes)</td>
<td>1-59</td>
<td>1</td>
</tr>
<tr>
<td>≥60</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>History of diabetes</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>TIA seven days previously</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Imaging</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Ipsilateral ≥50% stenosis present</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Acute diffusion-weighted imaging</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Total score</td>
<td>0-7</td>
<td>0-13</td>
</tr>
</tbody>
</table>

**Table 4. CHA2DS2-VASc risk assessment tool**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>C: Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>H: Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>A: Age ≥75 years</td>
<td>2</td>
</tr>
<tr>
<td>S: Stroke, TIA or thromboembolism</td>
<td>2</td>
</tr>
<tr>
<td>V: Vascular disease</td>
<td>1</td>
</tr>
<tr>
<td>Sc: Sex category (female)</td>
<td>1</td>
</tr>
<tr>
<td>Total score</td>
<td>Up to 9</td>
</tr>
</tbody>
</table>
Role of nurses

Nurses have a pivotal role in both primary and secondary stroke prevention. Current guidelines for stroke management indicate that all patients should receive information and advice regarding lifestyle and health-related behaviours (RCP, 2016; NICE, 2008). As part of the wider multidisciplinary team in primary and secondary care, nurses are well-placed to provide that information and educate and support patients.

Studies continue to indicate that health promotion for patients at risk of stroke is scarce, limited and often inadequate. Lawrence et al (2011) showed that nurses had inadequate knowledge and understanding of secondary lifestyle interventions following stroke in many areas, including diet and alcohol consumption. Better training is key to enable them to help patients make healthy lifestyle choices.

Conclusion

Considerable progress has been made in identifying and mitigating the risk factors for stroke. Key to this is understanding the uniqueness of an individual person’s risk of stroke. Achieving a balance between holistic, person-centred care and clinician-led decision making remains a challenge. However, the aim for all concerned is clear: reduce the stroke burden through effective preventive strategies. NT

References

Department of Health (2016) UK Chief Medical Officer’s Uptake of Smoking Guidelines. Bit.ly/CMOsmokingGuidelines

Table 5. HAS-BLED risk stratification tool

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Point</th>
<th>Up to 2</th>
<th>Up to 2</th>
<th>Up to 2</th>
<th>Up to 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>H: Hypertension</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A: Abnormal renal or liver function (1 point each)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S: Stroke</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B: Bleeding</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>L: Labile INRs</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E: Elderly (&gt;65 years)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D: drugs or alcohol (1 point each)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>Up to 9</td>
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</table>

Note: A score of 1 indicates a patient is at low risk and is appropriate for a primary care setting. A score of 3 or more indicates a patient is at intermediate to high risk and may require referral to a stroke unit or secondary care setting.