NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Guideline

Subarachnoid haemorrhage caused by a ruptured aneurysm: diagnosis and management

Draft for consultation, February 2021

This guideline covers diagnosing and treating an aneurysmal (caused by a ruptured aneurysm) subarachnoid haemorrhage and its complications. It provides recommendations to improve the speed and accuracy of diagnosis and ensure that the most effective treatments are offered. It includes guidance on follow-up care and information for people (aged 16 and over) who have had an aneurysmal subarachnoid haemorrhage, their families and carers.

Who is it for?

- Healthcare professionals
- Commissioners and providers of healthcare services for people wih a suspected or confirmed subarachnoid haemorrhage caused by a ruptured aneurysm
- People with an aneurysmal subarachnoid haemorrhage, their families and carers

What does it include?

This draft guideline contains:

- the draft recommendations
- recommendations for research

- rationale and impact sections that explain why the committee made the recommendations and how they might affect practice
- the guideline context.

Information about how the guideline was developed is on the guideline's page on the NICE website. This includes the evidence reviews, the scope, details of the committee and any declarations of interest.

The recommendations in this guideline were largely developed before the COVID-19 pandemic. Please tell us if there are any particular issues relating to COVID-19 that we should take into account when finalising the guideline for publication.

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Contents

Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in NICE's information on making decisions about your care.

Making decisions using NICE guidelines explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

1.1 Diagnosis and assessment

Symptoms and signs

1.1.1 Be aware that:

- most people who have a subarachnoid haemorrhage present with a severe, sudden-onset ('thunderclap') headache, but most people with a 'thunderclap' headache do not have a subarachnoid haemorrhage
- other symptoms and signs of subarachnoid haemorrhage include, but are not limited to:
  - neck pain or stiffness
  - photophobia
  - vomiting
  - altered neurology (such as reduced consciousness, a seizure or a focal neurological deficit)
  - limited neck flexion on examination.

1.1.2 If a person with a possible subarachnoid haemorrhage finds it difficult to describe their symptoms, for example because of a learning disability, language problem or altered consciousness, ask anyone who witnessed the onset of symptoms for a description (without delaying referral).

1.1.3 Refer the person immediately for diagnostic investigations if clinical assessment suggests subarachnoid haemorrhage, even if the symptoms and signs listed in recommendation 1.1.1 are absent.

> For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on symptoms and signs.
>
> Full details of the evidence and the committee's discussion are in evidence review A: symptoms and signs.

Pain relief

1.1.4 Ensure that people with a suspected or confirmed subarachnoid haemorrhage are given effective pain relief, including opiate analgesia if needed.

1.1.5 Take account of the sedating effects of opiate analgesia when conducting a neurological assessment.

> For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on pain relief.
>
> Full details of the evidence and the committee's discussion are in evidence review D: medical management strategies.

Diagnosing a subarachnoid haemorrhage

1.1.6 Offer a non-contrast CT head scan as the first-line diagnostic investigation for a suspected subarachnoid haemorrhage.

1.1.7 Diagnose a subarachnoid haemorrhage if the non-contrast CT head scan shows blood in the subarachnoid space.

1.1.8 If a CT head scan done within 6 hours of symptom onset shows no evidence of a subarachnoid haemorrhage:

- do not routinely offer a lumbar puncture
- think about alternative diagnoses.

1.1.9 If a CT head scan done more than 6 hours after symptom onset shows no evidence of a subarachnoid haemorrhage, consider a lumbar puncture.

1.1.10 Allow at least 12 hours after symptom onset before doing a lumbar puncture to diagnose a subarachnoid haemorrhage.

1.1.11 Diagnose a subarachnoid haemorrhage if the lumbar puncture sample shows evidence of elevated bilirubin (xanthochromia) on spectrophotometry.

1.1.12 Think about alternative diagnoses if the lumbar puncture sample shows no evidence of elevated bilirubin (xanthochromia) on spectrophotometry.

Transfer to a specialist neurosurgical centre

1.1.13 Do not use a subarachnoid haemorrhage severity score in isolation to determine the need for, or timing of, transfer of care to a specialist neurosurgical centre.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on diagnosing a subarachnoid haemorrhage.

Full details of the evidence and the committee's discussion are in evidence review B: diagnostic accuracy of investigations and evidence review C: severity scoring systems.

Detecting an aneurysm

1.1.14 Offer CT angiography of the head to people with a confirmed diagnosis of subarachnoid haemorrhage to identify the cause of bleeding and guide treatment.

1.1.15 Diagnose an aneurysmal subarachnoid haemorrhage if:

- CT angiography of the head shows an intracranial arterial aneurysm and
- the pattern of subarachnoid blood is compatible with aneurysm rupture.

1.1.16 Seek specialist opinion from the neurovascular multidisciplinary team (MDT) straight away (do not delay until the next MDT meeting) if:

- CT angiography of the head shows an intracranial arterial aneurysm and
- the pattern of subarachnoid blood is not compatible with aneurysm rupture.

1.1.17 If CT angiography of the head does not identify the cause of the subarachnoid haemorrhage and an aneurysm is still suspected, consider digital subtraction angiography (DSA), or magnetic resonance angiography (MRA) if DSA is contraindicated.

1.1.18 Diagnose an aneurysmal subarachnoid haemorrhage if:

- DSA or MRA shows an intracranial arterial aneurysm and
- the pattern of subarachnoid blood is compatible with aneurysm rupture.

1.1.19 Consider alternative diagnoses if DSA or MRA does not show an intracranial arterial aneurysm.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on detecting an aneurysm.

Full details of the evidence and the committee's discussion are in evidence review K: diagnostic imaging strategies.

1.2 Managing a confirmed aneurysmal subarachnoid haemorrhage

Medical management

Nimodipine

1.2.1 Consider enteral nimodipine for people with a confirmed subarachnoid haemorrhage.

1.2.2 Only use intravenous nimodipine if enteral treatment is not suitable.

Short-course tranexamic acid

1.2.3 Be aware that a short course (24 to 72 hours) of intravenous tranexamic acid after an aneurysmal subarachnoid haemorrhage:

- is an option if treatment to secure the aneurysm by endovascular coiling or neurosurgical clipping is suitable but cannot be carried out within 24 hours of hospital admission
- should not delay interventional treatment to secure the aneurysm
- may reduce the risk of rebleeding but has not been shown to improve clinical outcomes.

Reducing the risk of venous thromboembolism

1.2.4 Manage the risk of venous thromboembolism in people with an aneurysmal subarachnoid haemorrhage in line with the NICE guideline on venous thromboembolism in over 16s.

Fluid therapy

1.2.5 For people with aneurysmal subarachnoid haemorrhage who need intravenous fluids refer to the NICE guideline on intravenous fluid therapy in adults in hospital.

For a short explanation of why the committee made these recommendations see the rationale section on medical management.

Full details of the evidence and the committee's discussion are in evidence review D: medical management strategies.

Managing the culprit aneurysm

1.2.6 A neuroradiologist and a neurosurgeon should discuss the options for managing the culprit aneurysm, taking into account the person's clinical condition, the characteristics of the aneurysm, and the amount and location of subarachnoid blood. They should document a proposed treatment plan based on the following options:

- endovascular coiling
- neurosurgical clipping
- medical management and monitoring to check for clinical improvement and reassess the options for treatment.

1.2.7 Do not use a subarachnoid haemorrhage severity score in isolation to determine the suitability of any management option.

1.2.8 If interventional treatment to secure the aneurysm is an option, offer:

- endovascular coiling or
- neurosurgical clipping if endovascular coiling is not suitable.

Discuss the proposed treatment plan and any alternative options with the person, and their family or carers if appropriate, then agree and document a final treatment plan.

1.2.9 If interventional treatment is planned, ensure that it is carried out at the earliest opportunity to prevent rebleeding.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on managing the culprit aneurysm.

Full details of the evidence and the committee's discussion are in evidence review L: interventions to prevent rebleeding, evidence review C: severity scoring systems and evidence review M: timing of interventions to prevent rebleeding.

Other NICE guidance on endovascular procedures for culprit aneurysms

We are not consulting on the guidance referenced in this section.

NICE's interventional procedures guidance on endovascular insertion of an intrasaccular wire-mesh blood-flow disruption device for intracranial aneurysms (published August 2019) supports use of this procedure with standard arrangements for clinical governance, consent and audit.

NICE's interventional procedures guidance on coil embolisation of ruptured intracranial aneurysms (published January 2005) supports use of this procedure with normal arrangements for consent, audit and clinical governance.

1.3 Monitoring and managing complications

Monitoring and investigating for deterioration

Transcranial doppler monitoring for deterioration

1.3.1 Do not use transcranial doppler monitoring to guide clinical management of an aneurysmal subarachnoid haemorrhage except in the context of clinical research.

Unexplained neurological deterioration

1.3.2 For people with unexplained neurological deterioration after a subarachnoid haemorrhage, offer a non-contrast CT head scan to investigate the cause.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on monitoring and investigating for deterioration.

Full details of the evidence and the committee's discussion are in evidence review E: monitoring for raised intracranial pressure and vasospasm

Hydrocephalus

1.3.3 Base a diagnosis of acute or chronic hydrocephalus on the person's symptoms and signs and on a comparison of current and previous CT or other brain imaging.

Acute hydrocephalus

1.3.4 Consider drainage or diversion of cerebrospinal fluid for people with neurological deterioration caused by acute hydrocephalus.

Chronic hydrocephalus

1.3.5 For people with persistent or progressive symptoms and a clinical diagnosis of chronic hydrocephalus, consider drainage or permanent diversion of cerebrospinal fluid. If there is uncertainty about the likely benefit of permanent diversion, consider a trial of temporary drainage to assess the need for permanent diversion.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on hydrocephalus.

Full details of the evidence and the committee's discussion are in evidence review G: detecting hydrocephalus and evidence review H: managing hydrocephalus.

Delayed cerebral ischaemia

1.3.6 Ensure euvolaemia (normal blood volume) in people with delayed cerebral ischaemia after an aneurysmal subarachnoid haemorrhage and consider treatment with a vasopressor if symptoms persist. Bear in mind that clinical improvement from vasopressor treatment may be temporary.

For a short explanation of why the committee made this recommendation see the rationale section on delayed cerebral ischaemia.

Full details of the evidence and the committee's discussion are in evidence review F: managing delayed cerebral ischaemia.

1.4 Follow-up care

Follow-up care plan

1.4.1 Develop and document a plan for follow-up care after an aneurysmal subarachnoid haemorrhage. Give a copy to the person (and their family or carers if appropriate) and include details of who to contact at the specialist centre for ongoing advice and support.

For a short explanation of why the committee made this recommendation see the rationale section on follow-up care plan.

Full details of the evidence and the committee's discussion are in evidence review S: patient information.

Rehabilitation

1.4.2 Offer rehabilitation after aneurysmal subarachnoid haemorrhage in line with the NICE guidelines on stroke rehabilitation in adults and rehabilitation after critical illness in adults.

Follow-up neuroimaging

1.4.3 Consider follow-up neuroimaging for people who have had an aneurysmal subarachnoid haemorrhage. Base the choice of imaging modality, and the frequency and duration of imaging follow-up, on the:

- type and outcome of any neurointervention or neurosurgery on the initial aneurysm
- presence of any non-culprit aneurysms

- estimated risk of further bleeding
- risks of planned investigations and any subsequent interventions
- the person's preference.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on follow-up neuroimaging.

Full details of the evidence and the committee's discussion are in evidence review O: imaging strategies for follow-up.

Managing non-culprit (unruptured) aneurysms

1.4.4 A multidisciplinary team (MDT) that includes a neuroradiologist and a neurosurgeon should evaluate the options for managing non-culprit (unruptured) aneurysms, including:

- endovascular coiling
- neurosurgical clipping
- conservative management and follow-up monitoring.

1.4.5 When evaluating the options for managing a non-culprit aneurysm, the MDT should take into account:

- the size and location of the aneurysm
- the estimated lifetime risk of the aneurysm rupturing
- the estimated risk of each treatment option
- any comorbidities
- the person's preferences.

1.4.6 Discuss the proposed management plan and any alternative options with the person (and their family or carers as appropriate). Base the discussion on the factors listed in recommendation 1.4.5. Agree and document a final management plan.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on managing non-culprit (unruptured) aneurysms.

Full details of the evidence and the committee's discussion are in evidence review P: non-culprit aneurysms.

Other NICE guidance on endovascular procedures for non-culprit (unruptured) aneurysms

We are not consulting on the guidance referenced in this section.

NICE's medical technologies guidance on the Pipeline Flex embolisation device with Shield Technology for the treatment of complex intracranial aneurysms (published May 2012; updated January 2019) supports use of this device.

NICE's interventional procedures guidance on coil embolisation of unruptured intracranial aneurysms (published January 2005) supports use of this procedure with normal arrangements for audit and clinical governance.

See also the reference to NICE's interventional procedures guidance on endovascular insertion of an intrasaccular wire-mesh blood-flow disruption device for intracranial aneurysms.

Managing other conditions

Hypertension

1.4.7 Manage blood pressure in people aged 18 and over who have had an aneurysmal subarachnoid haemorrhage in line with the NICE guideline on hypertension in adults.

Conditions treated with an antiplatelet or anticoagulant

1.4.8 Balance the risks and benefits of treatment with an antiplatelet or anticoagulant, taking into account specialist assessment of the risk of a future subarachnoid haemorrhage.

1.4.9 Do not withhold treatment with antiplatelets or anticoagulants solely on the basis of an aneurysmal subarachnoid haemorrhage if the culprit aneurysm has been secured by coiling or clipping.

Smoking

1.4.10 Encourage people who smoke to stop, and consider smoking cessation support as set out in the NICE guideline on stop smoking interventions and services.

Headaches

1.4.11 Assess, diagnose and manage headaches in people who have had an aneurysmal subarachnoid haemorrhage in line with the NICE guideline on headaches in over 12s.

1.4.12 Be aware that headaches in people with a history of aneurysmal subarachnoid haemorrhage:

- are common and generally benign
- may be due to chronic hydrocephalus if the person has features of raised intracranial pressure.

Seizures

1.4.13 Manage seizures in people who have recovered from an aneurysmal subarachnoid haemorrhage in line with the NICE guideline on epilepsies.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on managing other conditions.

Full details of the evidence and the committee's discussion are in evidence review Q: long-term medicines to reduce the risk of subsequent subarachnoid haemorrhage and evidence review R: long-term medicines for managing the consequences of subarachnoid haemorrhage.

Investigations to detect aneurysms in relatives

1.4.14 Explain to people (and their families if approriate) who have had an aneurysmal subarachnoid haemorrhage and are concerned about possible aneuryisms in their relatives that:

- routine testing to check for aneurysms in relatives has not been shown to save lives or prevent aneurysmal subarachnoid haemorrhages
- testing for relatives is based on an assessment of the relative's own risk
- testing is usually limited to people with at least 2 first-degree relatives who have had an aneurysmal subarachnoid haemorrhage.

Tell people where they can find more information about testing for relatives, such as the NHS webpage on diagnosis of brain aneurysm.

For a short explanation of why the committee made this recommendation see the rationale section on investigations to detect aneurysms in relatives.

Full details of the evidence and the committee's discussion are evidence review T: detecting aneurysms in relatives of people with subarachnoid haemorrhage

1.5 Information and support

1.5.1 Follow the recommendations on communication, information and shared decision making in the NICE guideline on patient experience in adult NHS services when providing information to people with an aneurysmal subarachnoid haemorrhage (and their family or carers if appropriate).

1.5.2 When making decisions for people who lack capacity, or supporting decision making by people who have capacity, follow the NICE guideline on decision making and mental capacity.

1.5.3 Adapt written and verbal information about aneurysmal subarachnoid haemorrhage to the needs and preferences of the person (and their family or carers if appropriate).

At diagnosis

1.5.4 Explain to the person (and their family or carers if appropriate) what an aneurysmal subarachnoid haemorrhage is and what the treatment options are, including their benefits and risks.

During the hospital stay

1.5.5 Give the person (and their family or carers if appropriate) information about complications that can happen after an aneurysmal subarachnoid haemorrhage, such as:

- a build-up of fluid on the brain (hydrocephalus)
- a reduced supply of blood to the brain (delayed cerebral ischaemia)
- speech or communication difficulties
- physical disabilities
- seizures.

1.5.6 Tell the person (and their family or carers if appropriate) that common symptoms reported by people who have had a subarachnoid haemorrhage include:

- headaches, fatigue and sleep disturbances
- anxiety, low moods and increased irritability
- problems with memory and cognitive function
- changes to smell, taste, hearing or vision.

Give the person details of local and national support groups.

1.5.7 Give people who wish to receive it (and their family or carers if appropriate) information about their estimated future risk of another subarachnoid haemorrhage. Base the information on specialist assessment by the multidisciplinary team of the person's medical circumstances, including:

- the effectiveness of the treatment of the ruptured aneurysm
- the presence and growth of additional aneurysms
- their smoking status.

1.5.8 Give the person advice on returning to their usual activities including work, exercise, driving and sexual activity.

At discharge

1.5.9 Check that the person has been given advice about wound care and medicines, a copy of their follow-up care plan and details of who to contact at their specialist centre if they have questions or concerns.

At follow-up

1.5.10 Discuss the person's return to their usual activities (see recommendation 1.5.8).

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on information and support.

Full details of the evidence and the committee's discussion are in evidence review S: patient information and evidence review N: risk of subsequent subarachnoid haemorrhage.

Recommendations for research

The guideline committee has made the following recommendations for research.

Key recommendations for research

1 Timing of CT head scans

What is the relative accuracy of CT head scans at different time intervals, for example 12 hours or 24 hours after symptom onset, to diagnose subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on diagnosing a subarachnoid haemorrhage.

Full details of the evidence and the committee's discussion are in evidence review B: diagnostic accuracy and diagnostic strategies.

2 Predictors of death and disability

What variables predict death or disability for people with aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on diagnosing a subarachnoid haemorrhage.

Full details of the evidence and the committee's discussion are in evidence review C: severity scoring systems.

3 Nimodipine

What is the clinical and cost effectiveness of nimodipine in the management of aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on nimodipine.

Full details of the evidence and the committee's discussion are in evidence review D: medical management strategies.

4 Novel endovascular interventions

What is the clinical and cost effectiveness of novel endovascular techniques and devices such as coated coils, endoluminal flow diverters, and intrasaccular devices to treat aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on managing the culprit aneurysm.

Full details of the evidence and the committee's discussion are in evidence review L: interventions to prevent rebleeding.

5 Risk stratification tool to estimate risk of recurrence

What is the utility of a risk stratification tool to estimate the risk of subsequent aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on information and support.

Full details of the evidence and the committee's discussion are in evidence review N: risk of subsequent subarachnoid haemorrhage.

Other recommendations for research

Interventions for aneurysmal subarachnoid haemorrhage in people with major neurological deficit

What is the best intervention for people with major neurological deficit caused by aneurysmal subarachnoid haemorrhage (for example, an aneurysmal subarachnoid haemorrhage that results in the person being unconscious or needing a ventilator for more than 48 hours)?

For a short explanation of why the committee made this recommendation see the rationale and impact section on managing the culprit aneurysm.

Full details of the evidence and the committee's discussion are in evidence review L: interventions to prevent rebleeding.

Managing acute hydrocephalus

What is the most clinically and cost effective method of cerebrospinal fluid drainage or diversion (for example shunt surgery, external ventricular drain surgery or lumbar drain) for symptomatic acute hydrocephalus?

> For a short explanation of why the committee made this recommendation see the rationale and impact section on hydrocephalus.
>
> Full details of the evidence and the committee's discussion are in evidence review H: managing hydrocephalus.

Transcranial doppler monitoring

What is the clinical and cost effectiveness of routine transcranial doppler monitoring to guide clinical management of aneurysmal subarachnoid haemorrhage?

> For a short explanation of why the committee made this recommendation see the rationale and impact section on monitoring and investigating for deterioration.
>
> Full details of the evidence and the committee's discussion are in evidence review E: monitoring for raised intracranial pressure and vasospasm.

Intracranial hypertension

What is the clinical and cost effectiveness of interventions to monitor and reduce intracranial pressure in people with aneurysmal subarachnoid haemorrhage who are unconscious or ventilated and whose poor clinical condition is attributed at least partly to raised intracranial pressure?

> For a short explanation of why the committee made this recommendation see the rationale section on intracranial hypertension.

Full details of the evidence and the committee's discussion are in evidence review I: detecting intracranial hypertension and evidence review J: managing intracranial hypertension.

Intra-arterial therapies to manage delayed cerebral ischaemia

What is the clinical and cost effectiveness of intra-arterial therapies to manage delayed cerebral ischaemia in people with aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale section on delayed cerebral ischaemia.

Full details of the evidence and the committee's discussion are in evidence review F: managing delayed cerebral ischaemia.

Vasopressors to manage delayed cerebral ischaemia

What is the clinical and cost effectiveness of vasopressors to manage delayed cerebral ischaemia in people with aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale section on delayed cerebral ischaemia.

Full details of the evidence and the committee's discussion are in evidence review F: managing delayed cerebral ischaemia.

Blood pressure targets

What is the clinical and cost effectiveness of a lower blood pressure treatment target relative to the standard blood pressure treatment target for people with aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale and impact section on managing other conditions.

Full details of the evidence and the committee's discussion are in evidence review Q: long-term medicines to reduce the risk of subsequent subarachnoid haemorrhage.

Investigations for relatives

What is the clinical and cost effectiveness of investigations to detect intracranial arterial aneurysms in first-degree relatives of people who have had an aneurysmal subarachnoid haemorrhage?

For a short explanation of why the committee made this recommendation see the rationale section on investigations to detect aneurysms in relatives.

Full details of the evidence and the committee's discussion are in evidence review T: investigations for relatives.

Rationale and impact

These sections briefly explain why the committee made the recommendations and how they might affect practice.

Symptoms and signs

Recommendations 1.1.1 to 1.1.3

Why the committee made the recommendations

There was limited evidence on specific symptoms or signs that indicate subarachnoid haemorrhage. The committee agreed, based on their experience, that a severe 'thunderclap' headache is a presenting symptom in most people. However, they noted that 'thunderclap' headache is a common presentation in emergency departments and only around 10% of people with this symptom are diagnosed with subarachnoid haemorrhage. The committee also agreed that other symptoms and signs are commonly seen in subarachnoid haemorrhage. These can be used, together with clinical judgement, to guide decisions on further diagnostic investigations. The committee pointed out that the absence of these symptoms and

signs should not deter further investigation if clinical suspicion of subarachnoid haemorrhage remains.

Evidence on decision tools, including the Ottawa Subarachnoid Haemorrhage Rule for Headache Evaluation, showed that these tools have a high level of accuracy in ruling out subarachnoid haemorrhage, but are less accurate at ruling it in, with a large number of false positive identifications. Although these tools are beneficial in ensuring that no cases are missed, over-reliance on them risks harm from unnecessary imaging and invasive investigations. The committee noted that the tools use a broad range of symptoms and signs that are not specific to subarachnoid haemorrhage.

How the recommendations might affect practice

The recommendations may be useful for non-specialist clinicians, but are not expected to lead to significant changes in practice.

Return to recommendations

Pain relief

Recommendations 1.1.4 and 1.1.5

Why the committee made the recommendations

Although there was limited evidence on the use of specific analgesia or sedation, the committee agreed that pain in adults with aneurysmal subarachnoid haemorrhage should be managed with analgesics in line with standard clinical practice. Headache is usually treated with simple analgesics such as paracetamol, escalating to opiates as needed. The committee agreed that the sedative effect of opiate analgesics should be taken into account when doing a neurological assessment, but should not preclude their use.

How the recommendations might affect practice

The recommendations generally reflect current practice and are not likely to result in changes.

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Diagnosing a subarachnoid haemorrhage

Recommendations 1.1.6 to 1.1.13

Why the committee made the recommendations

The committee looked at evidence on non-contrast CT head scans, lumbar puncture and magnetic resonance imaging (MRI). There was good evidence showing that CT head scans done within 6 hours of symptom onset have a high diagnostic accuracy. If the CT head scan is done more than 6 hours after symptom onset, the evidence showed that diagnostic accuracy is reduced and false negative results are more likely. Taking into account the invasive risks of lumbar puncture, the inability to monitor patients during MRI, and the costs of both procedures, the committee concluded that these procedures should not be routinely offered if a CT head scan done within 6 hours of symptom onset shows no evidence of a subarachnoid haemorrhage.

There was limited evidence on the relative accuracy of non-contrast CT head scanning at various time intervals greater than 6 hours after symptom onset, so the committee made a recommendation for research on timing of CT head scans.

When lumbar puncture is indicated, the committee agreed that it should be done at least 12 hours after symptom onset, when bilirubin formation is sufficient to be detected reliably. The committee considered that the diagnostic accuracy of earlier lumbar puncture (to detect blood in the cerebrospinal fliuid) is likely to be low because it can take several hours for blood to appear in the lumbar subarachnoid sac.

Transfer to a specialist neurosurgical centre

Although evidence on a number of severity scores showed an association with morbidity and mortality, there was inconsistency across the scores and the evidence was not sufficient to recommend the use of any score on its own. The committee agreed that, although severity scoring can be a useful clinical descriptor, decisions on transfer should be based on a holistic patient assessment rather than a severity score on its own, to avoid inappropriate withholding of specialist neurosurgical care from people whose score indicates a poor clinical condition.

The committee noted that evidence to support the prognostic accuracy of the severity scores was weak and made a recommendation for research on predictors of death and disability.

How the recommendations might affect practice

Non-contrast CT head scans are the usual first-line investigation in current practice and this is not expected to change. Centres that routinely perform lumbar puncture after a negative CT head scan may see a reduction in the use of lumbar puncture in people with an early negative CT head scan. Reliance on severity scoring to determine transfer to specialist centres may reduce, leading to more people appropriately being transferred for treatment.

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Detecting an aneurysm

Recommendations 1.1.14 to 1.1.19

Why the committee made the recommendations

Evidence showed that CT angiography has a high level of accuracy in identifying aneurysms causing subarachnoid haemorrhage but evidence for the diagnostic accuracy of MRA was less compelling. CT angiography is the quickest to perform, is non-invasive, does not usually necessitate sedation or general anaesthesia and is available in most centres. MRA and DSA are more complex and time-consuming procedures that need specialist input and have a higher risk of complications. DSA is regarded as the ‘gold standard’ investigation and is currently commonly carried out when CT angiography is negative but there is a high suspicion of aneurysmal subarachnoid haemorrhage, whereas the complexities involved in obtaining high-quality MRA images make this less beneficial. The committee agreed that DSA should be reserved for instances when CT angiography has not detected a suspected aneurysm.

How the recommendations might affect practice

The recommendations largely reflect current practice and are not expected to lead to changes.

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Medical management

Recommendations 1.2.1 to 1.2.5

Why the committee made the recommendations

Nimodipine

Although limited evidence showed some reductions in mortality, rebleeding, disability and delayed cerebral ischaemia with nimodipine, these studies were mainly carried out in people who had neurosurgical clipping rather than endovascular coiling. In addition, the neurosurgical clipping was often delayed until 3 weeks after diagnosis. The committee had reservations about the applicability of this evidence to current practice, in which endovascular coiling is routinely used and carried out within 48 hours of diagnosis. They agreed that nimodipine could be considered in the acute management of aneurysmal subarachnoid haemorrhage, and made a recommendation for research on nimodipine to determine its place in current practice.

Most of the evidence related to the use of oral nimodipine but some was drawn from studies that included intravenous nimodipine. The committee were aware that intravenous nimodipine has a high cost and were uncertain whether it is likely to be cost effective in patients who are unconscious or ventilated, or unable to swallow. The committee were also aware that some clinicians recommend administration of crushed nimodipine tablets to these patients via a nasogastric tube to avoid the need to use intravenous nimodipine. The committee noted that intravenous nimodipine may be useful for patients in whom poor absorption of the drug is suspected, and intra-arterial nimodipine is used to treat cerebral arterial spasm during percutaneous interventions. Based on these observations and their experience, the committee agreed that intravenous nimodipine should be reserved for patients in whom enteral administration is not suitable.

Short-course tranexamic acid

Evidence on tranexamic acid in the management of aneurysmal subarachnoid haemorrhage was mixed, and most was from small studies dating from the 1970s

and 1980s. Some of the evidence suggested that short courses of intravenous tranexamic acid (less than 72 hours) started immediately after diagnosis in people suitable for intervention reduce the risks of rebleeding, but have not been shown to reduce death or disability.

The committee were aware that short-course tranexamic acid is occasionally used in current clinical practice in people considered suitable for an intervention to secure a ruptured intracranial arterial aneurysm if timely intervention is not available. However, the committee wanted to ensure that tranexamic acid is not used to delay interventional treatment, and agreed that it its use should be limited to situations in which interventional treatment cannot be carried out within 24 hours of hospital admission.

Reducing the risk of venous thromboembolism

The committee noted that NICE's guideline on reducing the risk of hospital-acquired venous thromboembolism applies to people with a subarachnoid haemorrhage and agreed to include a cross reference to it.

Fluid therapy

The evidence on fluid therapy for people with an aneurysmal subarachnoid haemorrhage was not sufficient to support a recommendation for this population. The committee agreed that fluid therapy should be managed in line with the NICE guideline on intravenous fluid therapy in over 16s.

How the recommendations might affect practice

Nimodipine

The recommendation is not expected to substantially change the current practice of giving nimodipine after an aneurysmal subarachnoid haemorrhage, but may over time lead to a reduction in the use of nimodipine.

Short-course tranexamic acid

Tranexamic acid is not a widely used treatment for people with aneurysmal subarachnoid haemorrhage and this recommendation may lead to an increase in its use. However, this is likely to be mitigated by the general change in practice to

reduce the time between hospital admission and the delivery of interventional treatment to secure the aneurysm.

Reducing the risk of venous thromboembolism

The recommendation is not expected to change current practice

Fluid therapy

The recommendation is not expected to change current practice.

Return to recommendations

Managing the culprit aneurysm

Rcommendations 1.2.6 to 1.2.9

Why the committee made the recommendations

The committee noted that around half of people who survive an aneurysmal subarachnoid haemorrhage will have a second bleed from the culprit aneurysm within weeks, and the mortality from a second bleed exceeds 50%. Interventional treatment with endovascular coiling or neurosurgical clipping, if suitable, can secure the aneurysm and prevent rebleeding.

The committee acknowledged that interventional treatment is not suitable for some people who have a major neurological deficit after an aneurysmal subarachnoid haemorrhage, and that the costs of long-term nursing care or rehabilitation can be considerable. Very little evidence was found for this group so the committee made a recommendation for research on interventions for aneurysmal subarachnoid haemorrhage in people with major neurological deficit.

Severity scoring systems might help clinicians identify people for whom intervention is likely to be justified, but none of the severity scoring systems currently in use reliably predicts morbidity and mortality in people with aneurysmal subarachnoid haemorrhage. In addition, the committee agreed that clinical state and severity score can vary over time, especially soon after symptom onset. Decisions on clinical management should therefore be based on a holistic patient assessment rather than solely on a severity score.

The evidence was not sufficient to determine the clinical effectiveness of endovascular coiling compared with neurosurgical clipping, although a small amount of evidence suggested that endovascular coiling might be more beneficial. Endovascular coiling is less invasive and potentially safer, so the committee agreed that it should be offered as the first option, taking factors such as aneurysm characteristics and the amount and location of subarachnoid blood into account. The committee agreed that neurosurgical clipping should be considered if endovascular coiling is not a suitable treatment option. They stressed that any procedure to secure the aneurysm should be performed without delay to minimise the risk of rebleeding.

Newer, more expensive interventional technologies are being used but there is little evidence on their effectiveness so the committee made a recommendation for research on novel endovascular interventions.

How the recommendations might affect practice

Endovascular coiling accounts for around 75% of interventions done in current practice and the recommendation is not expected to change this. Most interventions are carried out within 48 hours of admission although this may vary according to the availability of interventional neuroradiologists and vascular neurosurgeons, and the capacity of neurosurgical centres. For people admitted during weekends, endovascular coiling should be available from the same interventional neuroradiology teams who will provide thrombectomy for stroke, in line with the recommendations on thrombectomy in the NICE guideline on stroke and transient ischaemic attack in over 16s. However, provision of neurosurgical clipping during weekends may necessitate changes to services such as the setting up of appropriate networks.

Return to recommendations

Monitoring and investigating for deterioration

Recommendations 1.3.1 and 1.3.2

Why the committee made the recommendations

There was no evidence on the routine use of direct intracranial pressure monitoring for raised intracranial pressure. Very limited evidence from 1 study on transcranial

doppler monitoring for vasospasm suggested an increase in mortality, morbidity and length of hospital stay compared with no transcranial doppler monitoring. The committee agreed that these outcomes were unlikely to be directly caused by the transcranial doppler monitoring. However, they were concerned that such monitoring might influence subsequent decisions, for example about investigations or interventions, and thus indirectly affect outcomes. They therefore agreed that transcranial doppler monitoring should only be used in the context of clinical research. The committee noted that there is increasing enthusiasm for the use of this modality and made a recommendation for research on transcranial doppler monitoring.

There was no evidence on the investigation of unexplained neurological deterioration in people with aneurysmal subarachnoid haemorrhage. The committee agreed that in current practice people with unexplained neurological deterioration are initially investigated with a non-contrast CT scan, which can indicate the cause of deterioration including ventricular enlargement suggestive of hydrocephalus, cerebral ischaemia, intracranial haematoma, or evidence of rebleeding.

How the recommendations might affect practice

In current practice the use of transcranial doppler monitoring varies widely. The recommendation is likely to stop this type of monitoring in centres that use it in routine practice. CT head scans are used to investigate unexplained neurological deterioration in current practice and the recommendation will not affect this.

Return to recommendations

Hydrocephalus

Recommendations 1.3.3 to 1.3.5

Why the committee made the recommendations

Acute hydrocephalus

There was no evidence on diagnosing acute hydrocephalus. Based on their experience, the committee agreed that hydrocephalus is suspected on the basis of symptoms and signs of raised intracranial pressure such as altered level of

consciousness or neurological deterioration, and that the diagnosis should be confirmed by comparing a CT head scan with previous CT or other head scans to show an increase in the size of the ventricular system. The committee agreed that MRI offers no advantage over CT for diagnosing hydrocephalus in people with aneurysmal subarachnoid haemorrhage, is more expensive and is a difficult procedure for people who are unwell.

The committee noted that acute hydrocephalus can lead to severe disability or death if not treated promptly by drainage or diversion of cerebrospinal fluid. There was no evidence on the effectiveness of different techniques for drainage or diversion in acute hydrocephalus. The committee agreed that either drainage or diversion could be considered. They also made a recommendation for research on managing acute hydrocephalus.

Chronic hydrocephalus

There was little evidence to inform recommendations on diagnosing and managing chronic hydrocephalus. Based on their experience, the committee agreed that chronic hydrocephalus is uncommon and typically presents several weeks or months after an aneurysmal subarachnoid haemorrhage, with reduced consciousness, gait disturbance or other neurological symptoms. As with acute hydrocephalus, the committee agreed that chronic hydrocephalus is suspected based on symptoms and signs and a diagnosis should be confirmed based on a comparison of current CT head scans with previous CT or other head scans.

In current clinical practice most people with persisting or progressive symptoms and radiological evidence of ventricular dilatation are offered drainage of cerebrospinal fluid, which improves symptoms in the majority. If the likelihood of symptom improvement is uncertain, some clinicians advocate a trial of temporary drainage before considering permanent diversion of cerebrospinal fluid. The committee agreed with this approach.

The committee discussed making a research recommendation on chronic hydrocephalus but concluded that research in this area might not be feasible within a reasonable timeframe and have little impact on clinical practice.

How the recommendations might affect practice

The recommendations reflect current practice.

Return to recommendations

Intracranial hypertension

Recommendation for research

Why the committee did not make a recommendation

There was little evidence on diagnosing and treating intracranial hypertension. The committee agreed that the diagnostic accuracies of transcranial doppler and ultrasound measurement of optic nerve sheath diameter are too low for reliable detection of intracranial hypertension when compared with direct intracranial pressure measurement. The committee also acknowledged that there is no evidence that interventions to lower intracranial pressure improve clinical outcome.

The committee agreed that raised intracranial pressure is common in people with aneurysmal subarachnoid haemorrhage, but intracranial hypertension that impedes blood flow to the brain and contributes to brain injury is generally only seen in the most severely ill. These people are usually unconscious or need ventilation in an intensive care unit. They are a heterogeneous population and management varies widely, with some clinicians advocating routine monitoring of intracranial pressure to guide intervention (such as drainage of cerebrospinal fluid, hypertonic saline or vasopresor therapy) to lower intracranial pressure and maintain cerebral perfusion. Other clinicians favour management without intracranial pressure monitoring.

Intracranial pressure can be monitored by inserting an intracranial pressure bolt or using an external ventricular drain inserted to manage acute hydrocephalus. The committee acknowledged that insertion of a pressure bolt is associated with risk, and monitoring of intracranial pressure will only improve outcome if it leads to effective intervention.

The committee debated the variation in current practice and were not able to reach a consensus on the role of interventions to diagnose and treat intracranial

hypertension. They made a recommendation for research on intracranial hypertension.

Return to recommendations

Delayed cerebral ischaemia

Recommendation 1.3.6

Why the committee made the recommendation

There was not enough evidence on which to base recommendations on delayed cerebral ischaemia. The committee agreed that, in their experience, current practice for managing delayed cerebral ischaemia is to increase cerebral blood flow to prevent or limit cerebral infarction. Intravenous fluid is usually given to ensure euvolaemia and if symptoms persist a vasopressor is administered to raise systemic blood pressure. The committee agreed with this approach, but noted that the improvements seen after these measures may be temporary, and there was no evidence of impact on longer-term outcomes. Treatment for people whose condition is not improved by vasopressor therapy varies widely. Some clinicians recommend cerebral angiography and intra-arterial therapies, including intra-arterial vasodilators and angioplasty.

The committee made recommendations for research on vasopressors and intra-arterial therapies to manage delayed cerebral ischaemia.

How the recommendation might affect practice

The recommendation reflects current practice.

Return to recommendations

Follow-up care plan

Recommendation 1.4.1

Why the committee made the recommendation

Evidence from surveys and interviews with people who had an aneurysmal subarachnoid haemorrhage showed that those who did not receive clear information about their medical care after discharge felt anxious and ‘abandoned’. Those who

were given this information, together with details of who to contact for ongoing advice, said they felt more supported.

How the recommendation might affect practice

The amount and quality of information given to people about follow-up care after an aneurysmal subarachnoid haemorrhage varies. This recommendation can be expected to improve the provision of this information.

Return to recommendations

Follow-up neuroimaging

Recommendation 1.4.3

Why the committee made the recommendation

No clinical evidence was found on follow-up neuroimaging. Based on their knowledge and experience, the committee agreed that there is a risk of aneurysm recurrence, progression of non-culprit aneurysms and formation of new aneurysms. They agreed that follow-up imaging should be considered, based on the person's clinical situation and risk factors.

How the recommendation might affect practice

The recommendation reflects current practice.

Return to recommendations

Managing non-culprit (unruptured) aneurysms

Recommendations 1.4.4 to 1.4.6

Why the committee made the recommendations

There was not enough good evidence to enable the committee to recommend a preferred management option for non-culprit aneurysms. Based on their experience, the committee agreed that the probability of a non-culprit aneurysm rupturing is low, so interventional treatment of all non-culprit aneurysms is unlikely to be a cost-effective strategy. They agreed that conservative management usually includes monitoring of the aneurysm with magnetic resonance angiography to detect changes in the aneurysm's size or shape. The committee were in agreement that the

frequency of monitoring should be based on a balance between the risks of aneurysm rupture and the risks of interventional treatment, and take into account MDT, neuroradiological and neurosurgical opinion, and the person's preferences.

The committee's experience was that people with unruptured aneurysms who are offered conservative management are often anxious about the possibility of a future rupture. They therefore recommended that all treatment options be discussed with the person.

How the recommendations might affect practice

Current management of unruptured aneurysms varies. The recommendations are not expected to lead to substantial changes in practice.

Return to recommendations

Managing other conditions

Recommendations 1.4.7 to 1.4.13

Why the committee made the recommendations

Hypertension

Uncontrolled hypertension is recognised to be a risk factor for aneurysmal subarachnoid haemorrhage and may pose a greater risk to people with a history of this type of stroke. The committee agreed that blood pressure should be controlled in line with the NICE guideline on hypertension.

There was no evidence on long-term blood pressure control specifically for people with a history of aneurysmal subarachnoid haemorrhage so the committee made a recommendation for research on blood pressure targets.

Conditions treated with an antiplatelet or anticoagulant

There was little evidence about the effect of an antiplatelet or anticoagulant on the risk of recurrent intracranial bleeding. The committee agreed that, in their experience, these medicines are safe for people with a secured aneurysm following an aneurysmal subarachnoid haemorrhage. For people with a higher risk of

recurrence, specialist advice should be sought to judge the balance between the risk of recurrent or new intracranial bleeding and the risk of athero-embolic events.

Smoking

The committee noted that smoking can be a risk factor for an initial subarachnoid haemorrhage. They agreed that smoking cessation interventions, in addition to benefiting general health, may also reduce the risk of recurrent subarachnoid haemorrhage.

Headaches

The committee agreed, based on their experience, that people who develop heachaches after recovering from an aneurysmal subarachnoid haemorrhage can become anxious and worry that their headache indicates new aneurysmal bleeding or a complication of the treatment they had for their aneurysm. This can lead to morbidity, multiple presentations to healthcare professionals and unnecessary investigations. There was no evidence on specific long-term medicines to relieve headaches as a consequence of subarachnoid haemorrhage. The committee agreed that headache should be assessed, diagnosed and managed in line with NICE's guideline on headaches in over 12s.

The committee agreed, based on their experience, that headaches are common and generally benign in people who have had a subarachnoid haemorrhage, but in some people may indicate chronic hydrocephalus.

Seizures

The committee agreed that people who have had an aneurysmal subarachnoid haemorrhage have an increased risk of seizures and epilepsy. There was no evidence on the use of long-term long-antiepileptic medicines to prevent or relieve seizures in this population. They agreed that seizures after an aneurysmal subarachnoid haemorrhage should be treated in line with NICE's guidance on diagnosing and managing epilepsies.

How the recommendations might affect practice

The recommendations on hypertension, smoking, headaches and seizures are not expected to change practice. The recommendations on managing conditions treated

with antiplatelets or anticoagulants may reduce delays in prescribing these medicines for people who have had a successfully treated aneurysmal subarachnoid haemorrhage. Although specialist input may be needed, this is not expected to have a large impact on services.

Return to recommendations

Investigations to detect aneurysms in relatives

Recommendation 1.4.14

Why the committee made the recommendation

No evidence was found on investigating relatives for intracranial aneurysms. The committee recognised that first-degree relatives of people who have had an aneurysmal subarachnoid haemorrhage are at higher risk of intracranial arterial aneurysm than the general population. The committee agreed that investigating for aneurysms in first-degree relatives may produce health benefits but could also lead to harm, including unnecessary anxiety and a consequent increase in visits to GPs and emergency departments. Moreover, the optimal timing and frequency of investigations to detect and monitor intracranial aneurysms in first-degree relatives is unknown.

The committee were aware that the NHS does not currently support routine screening for intracranial arterial aneurysms in relatives and any change in NHS policy could have a significant resource impact.

The committee acknowledged that in current practice investigation is typically only recommended for people thought to have a significant risk of having a brain aneurysm that could rupture at some point in the future, and this would usually only apply to people with 2 or more first-degree relatives who have had an aneurysmal subarachnoid haemorrhage. This reflects the advice given on the NHS website on screening for brain aneurysms.

The committee agreed that the lack of evidence for routine testing of relatives and current practice on testing should be explained to people who have had a subarachnoid haemorrhage, and their families as appropriate. Given the importance

of this issue and the lack of evidence, the committee made a recommendation for research on investigations for relatives.

How the recommendation might affect practice

The recommendation is not expected to lead to a change in practice.

Return to recommendations

Information and support

Recommendations 1.5.1 to 1.5.10

Why the committee made the recommendations

Evidence from studies using surveys and interviews with people who have had an aneurysmal subarachnoid haemorrhage showed that they value information that is clear, concise and tailored to their own needs. Participants in the studies highlighted how difficult it was to remember information given to them verbally at the time of hospital admission and the need to have this information in a written form that they can take home at discharge. They also stressed the importance of information about their medical care and what to expect after discharge, including common symptoms, possible complications and where they can get advice and support.

The committee used their experience to agree topics that should be included, as a minimum, in the information given. They highlighted the importance of ease of access to information for people throughout their care pathway.

In the committee's experience, some people want information about the risk of recurrence of subarachnoid haemorrhage and some do not. They agreed that discussions should include the effect of individual variables on the person's risk of recurrence. The committee discussed the lack of a validated risk tool to inform estimates of individual risk and made a recommendation for research on a risk stratification tool to estimate risk of recurrence.

How the recommendations might affect practice

The content, delivery and quality of information given to people with aneurysmal subarachnoid haemorrhage varies widely. The recommendations are expected to encourage discussion that is tailored to the person's preferences.

Return to recommendations

Context

Subarachnoid haemorrhage is a bleed into the fluid-filled subarachnoid space around the brain and spinal cord. It causes 5% of all strokes and is estimated to occur in 2 to 20 people per 100,000 per year. In around 80% of people the bleed arises from rupture of an intracranial arterial aneurysm.

Subarachnoid haemorrhage is slightly more common in women than men, and can occur across a wide range of ages with a median age at presentation between 50 and 60. The main symptom is a sudden and severe ‘thunderclap’ headache. There may also be neck stiffness, altered consciousness or seizures.

Although outcomes for people with subarachnoid haemorrhage have slowly improved, the risk of death remains high and those who survive are often severely disabled. This guideline aims to improve the speed and accuracy of diagnosis and the effectiveness of treatment. It provides recommendations based on current evidence covering initial assessment, diagnostic investigations, treatment options, management of complications and follow-up care. It also identifies areas where evidence is lacking and recommends research to help inform future guidance.

Finding more information and committee details

To find NICE guidance on related topics, including guidance in development, see the NICE webpage on cranial aneurysms.

For details of the guideline committee see the committee member list.