NICE National Institute for Health and Care Excellence

NICE guideline

Abdominal aortic aneurysm: diagnosis and management

NICE guideline

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Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

This guideline replaces TA167.

Overview

This guideline covers diagnosing and managing abdominal aortic aneurysms. It aims to improve care by helping people who are at risk to get tested, specifying how often to monitor asymptomatic aneurysms, and identifying when aneurysm repair is needed and which procedure will work best.

Who is it for?

- Healthcare professionals
- Commissioners and providers
- People with an abdominal aortic aneurysm, and their families and carers

Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in 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

Identifying people at risk of abdominal aortic aneurysms

1.1.1 Inform all men aged 66 or over who have not already been screened about the NHS abdominal aortic aneurysm (AAA) screening programme, and advise them that they can self-refer.

1.1.2 Encourage men aged 66 or over to self-refer to the NHS AAA screening programme if they have not already been screened and they have any of the following risk factors:

- chronic obstructive pulmonary disease (COPD)
- coronary, cerebrovascular or peripheral arterial disease
- family history of AAA
- hyperlipidaemia
- hypertension
- they smoke or used to smoke.

1.1.3 Consider an aortic ultrasound for women aged 70 and over if AAA has not already been excluded on abdominal imaging and they have any of the following risk factors:

- COPD

- coronary, cerebrovascular or peripheral arterial disease
- family history of AAA
- hyperlipidaemia
- hypertension
- they smoke or used to smoke.

1.1.4 Be aware that people of European family origin are at a higher risk of an AAA.

Identifying asymptomatic abdominal aortic aneurysms

1.1.5 Offer an aortic ultrasound to people in whom a diagnosis of asymptomatic AAA is being considered if they are not already in the NHS screening programme.

- Refer people with an AAA that is 5.5 cm or larger to a regional vascular service, to be seen within 2 weeks of diagnosis.
- Refer people with an AAA that is 3.0 cm to 5.4 cm to a regional vascular service, to be seen within 12 weeks of diagnosis.

1.1.6 Offer an aortic ultrasound to people with a suspected AAA on abdominal palpation.

To find out why the committee made the recommendations on identifying people at risk of AAAs and identifying asymptomatic AAAs and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review A: risk factors for predicting presence of an abdominal aortic aneurysm and evidence review B: imaging techniques to diagnose abdominal aortic aneurysms.

Identifying symptomatic or ruptured abdominal aortic aneurysms

1.1.7 Think about the possibility of ruptured AAA in people with new abdominal and/or back pain, cardiovascular collapse, or loss of consciousness. Be aware that ruptured AAA is more likely if they also have any of the following risk factors:

- an existing diagnosis of AAA

- age over 60
- they smoke or used to smoke
- history of hypertension.

1.1.8 Be aware that AAAs are more likely to rupture in women than men.

1.1.9 Offer an immediate bedside aortic ultrasound to people in whom a diagnosis of symptomatic and/or ruptured AAA is being considered. Discuss immediately with a regional vascular service if:

- the ultrasound shows an AAA **or**
- the ultrasound is not immediately available or it is non-diagnostic, and an AAA is still suspected.

To find out why the committee made the recommendations on identifying symptomatic or ruptured AAAs and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review B: imaging techniques to diagnose abdominal aortic aneurysms and evidence review N: signs, symptoms and risk factors predicting ruptured or symptomatic unruptured aneurysms before arrival at the hospital, and in non-specialist hospital settings.

Imaging technique

1.1.10 When measuring aortic size with ultrasound, report the inner-to-inner maximum anterior-posterior aortic diameter, in accordance with the NHS AAA screening programme. Clearly document any additional measurements taken.

1.1.11 Offer thin-slice contrast-enhanced arterial-phase CT angiography to people who are being evaluated for elective AAA repair.

1.1.12 Consider thin-slice contrast-enhanced arterial-phase CT angiography for people with a suspected ruptured AAA who are being evaluated for AAA repair.

To find out why the committee made the recommendations on imaging technique and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review B: imaging techniques to diagnose abdominal aortic aneurysms.

Providing information to people with a diagnosed AAA

1.1.13 Give people with AAA of any size information explaining:

- what an AAA is
- that most AAAs do not cause any problems
- that AAAs can rupture, and what this means
- that AAAs are likely to get larger over time, and that larger AAAs are more likely to rupture
- that AAA may run in families, so they should tell close relatives that they may have an increased risk of AAA and may need assessment (see recommendations 1.1.2 and 1.1.3)
- what options for aneurysm repair are available, when repair should be considered and the potential benefits and risks (see recommendations 1.5.1 and 1.5.2), and when it might be better to not have repair (see recommendation 1.1.14)
- their risk of cardiovascular disease and how this risk can be reduced (see recommendation 1.4.6, and see the section on identifying and assessing cardiovascular disease risk in the NICE guideline on cardiovascular disease).

1.1.14 If AAA repair is not currently suitable for a person, explain why, based on their individual circumstances. For example:

- Small AAAs only have a very low chance of rupture and there are risks to aneurysm repair, so in this case people do not benefit from repair.
- AAA growth is unpredictable, so until their AAA meets the criteria in recommendation 1.5.1 it is not possible to know whether repair will be suitable for a particular person.

- On average, people with poor overall health do not benefit from AAA repair. There is no reliable way to assess whether a particular person will benefit or be harmed, so repair for people with poor overall health is an unnecessary risk even if their AAA meets the criteria in recommendation 1.5.1.

1.1.15 Check that people understand their options, and give them time for reflection and discussion. Encourage them to discuss the options with their family and friends.

1.1.16 For more guidance on providing information, see the section on enabling patients to actively participate in their care in the NICE guideline on patient experience in adult NHS services.

To find out why the committee made the recommendations on providing information to people with a diagnosed AAA and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review K: effectiveness of endovascular aneurysm repair, open surgical repair and non-surgical management of unruptured abdominal aortic aneurysms.

1.2 Monitoring and reducing the risk of rupture

Reducing the risk of rupture

1.2.1 Offer a referral to a stop smoking service to people with an abdominal aortic aneurysm (AAA) who smoke. For more guidance, see the NICE guideline on stop smoking interventions and services.

1.2.2 Ensure that people with an AAA who have hypertension receive care in line with the NICE guideline on hypertension in adults.

To find out why the committee made the recommendations on reducing the risk of rupture and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review C: risk factors associated with abdominal aortic aneurysm growth or rupture.

Monitoring the risk of rupture

1.2.3 Offer surveillance with aortic ultrasound to people with an asymptomatic AAA.

Use the same surveillance frequency as the NHS AAA screening programme.

1.2.4 See recommendation 1.1.5 on when to refer people to a regional vascular unit.

To find out why the committee made the recommendations on monitoring the risk of rupture and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review D: monitoring for abdominal aortic aneurysm expansion and risk of rupture.

1.3 Emergency transfer to regional vascular services

1.3.1 Be aware that there is no evidence that any single symptom, sign or prognostic risk assessment tool can be used to determine whether people with a suspected or confirmed ruptured abdominal aortic aneurysm (AAA) should be transferred to a regional vascular service.

1.3.2 When making transfer decisions, be aware that people with a confirmed ruptured AAA who have a cardiac arrest and/or have a persistent loss of consciousness have a negligible chance of surviving AAA repair.

1.3.3 For guidance on care of people with a ruptured AAA for whom repair is considered inappropriate, see the NICE guideline on care of dying adults in the last days of life.

1.3.4 When people with a suspected ruptured or symptomatic unruptured AAA have been accepted by a regional vascular service for emergency assessment, ensure that they leave the referring unit within 30 minutes of the decision to transfer.

1.3.5 Emergency departments, ambulance services and regional vascular services should collaborate to:

- provide a protocol for the safe and rapid transfer of people with a suspected ruptured or symptomatic unruptured AAA who need emergency assessment at a regional vascular service
- train clinical staff involved in the care of people with a suspected ruptured or symptomatic unruptured AAA in the transfer protocol

- review the transfer protocol at least every 3 years.

To find out why the committee made the recommendations on emergency transfer to regional vascular services and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review O: signs, symptoms and risk factors indicating suitability for transfer to a regional vascular service and evidence review P: time period for transfer to regional vascular services.

Supporting people during transfer

1.3.6 Consider a restrictive approach to volume resuscitation (permissive hypotension) for people with a suspected ruptured or symptomatic AAA during emergency transfer to a regional vascular service.

To find out why the committee made the recommendation on supporting people during transfer and how it might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review Q: permissive hypotension during transfer of people with ruptured abdominal aortic aneurysm to regional vascular services.

1.4 Predicting and improving surgical outcomes

Predicting surgical outcomes for unruptured aneurysms

1.4.1 Consider cardiopulmonary exercise testing when assessing people for elective repair of an asymptomatic abdominal aortic aneurysm (AAA), if it will assist in shared decision making.

1.4.2 For guidance on other preoperative tests, see the NICE guideline on routine preoperative tests for elective surgery.

1.4.3 Do not use the following risk assessment tools to determine whether or not repair is suitable for a person with an asymptomatic unruptured AAA:

- British Aneurysm Repair score
- Carlisle Calculator
- Comorbidity Severity Score

- Glasgow Aneurysm Scale
- Medicare risk prediction tool
- Modified Leiden score
- Physiological and Operative Severity Score for enUmeration of Mortality (POSSUM)
- Vascular-POSSUM
- Vascular Biochemical and Haematological Outcome Model (VBHOM)
- Vascular Governance North West (VGNW) risk model.

To find out why the committee made the recommendations on predicting surgical outcomes for unruptured aneurysms and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review G: tests for predicting outcomes after repair of unruptured abdominal aortic aneurysms and evidence review H: risk assessment tools for predicting surgical outcomes of patients who undergo elective abdominal aortic aneurysm repair.

Predicting surgical outcomes for ruptured aneurysms

1.4.4 Do not use any single symptom, sign or patient-related risk factor to determine whether aneurysm repair is suitable for a person with a ruptured AAA.

1.4.5 Do not use patient risk assessment tools (scoring systems) to determine whether aneurysm repair is suitable for a person with a ruptured AAA.

To find out why the committee made the recommendations on predicting surgical outcomes for ruptured aneurysms and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review S: risk factors for predicting survival after abdominal aortic aneurysm rupture.

Improving surgical outcomes

1.4.6 Offer people with an AAA information, support and interventions for secondary prevention of cardiovascular disease. For more information refer to the NICE guidance on:

- stop smoking interventions and services
- diet, nutrition and obesity and exercise
- medicines optimisation
- lipid modification and statin therapy
- diabetes management
- hypertension diagnosis and management.

1.4.7 Do not routinely offer preoperative beta blockers to people having AAA repair.

1.4.8 Do not offer remote ischaemic preconditioning to people having AAA repair.

1.4.9 For guidance on preventing and treating surgical site infections and on preventing venous thromboembolism, see the NICE guidelines on surgical site infections and reducing the risk of venous thromboembolism.

To find out why the committee made the recommendations on improving surgical outcomes and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review J: pre- and postoperative interventions to optimise outcomes after abdominal aortic aneurysm repair.

1.5 Repairing unruptured aneurysms

When to consider repair

1.5.1 Consider aneurysm repair for people with an unruptured abdominal aortic aneurysm (AAA), if it is:

- symptomatic
- asymptomatic, larger than 4.0 cm and has grown by more than 1 cm in 1 year (measured inner-to-inner maximum anterior-posterior aortic diameter on ultrasound)
- asymptomatic and 5.5 cm or larger (measured inner-to-inner maximum anterior-posterior aortic diameter on ultrasound).

Discussing the benefits and risks of repair or conservative

management

1.5.2 When discussing aneurysm repair with people who have an unruptured AAA, explain the overall balance of benefits and risks with repair and with conservative management, based on their current health and their expected future health. The decision on whether repair is preferred over conservative management should be made jointly by the person and their clinician after assessment of a number of factors, including:

- aneurysm size and morphology
- the person's age, life expectancy, fitness for surgery, and any other conditions they have
- the risk of AAA rupture if they do not have repair
- the short- and long-term benefits and risks, and the other disadvantages of repair such as having to stay in hospital, the risks of the operation, the recovery period, the potential need for further procedures and the need for surveillance imaging appointments
- the uncertainties around estimates of risk for AAAs larger than 5.5 cm (measured inner-to-inner maximum anterior-posterior aortic diameter on ultrasound).

Open surgical repair, standard endovascular aneurysm repair or conservative management

1.5.3 Offer open surgical repair for people with unruptured AAAs meeting the criteria in recommendation 1.5.1, unless it is contraindicated because of their abdominal copathology, anaesthetic risks, and/or medical comorbidities.

1.5.4 Consider endovascular aneurysm repair (EVAR) for people with unruptured AAAs who meet the criteria in recommendation 1.5.1 and who have abdominal copathology, such as a hostile abdomen, horseshoe kidney or a stoma, or other considerations, specific to and discussed with the person, that may make EVAR the preferred option.

1.5.5 Consider EVAR or conservative management for people with unruptured AAAs meeting the criteria in recommendation 1.5.1 who have anaesthetic risks and/or medical comorbidities that would contraindicate open surgical repair.

Complex endovascular aneurysm repair

1.5.6 If open surgical repair and complex EVAR are both suitable options, only consider complex EVAR if:

- the following has been discussed with the person:
  - the risks of complex EVAR compared with the risks of open surgical repair
  - the uncertainties around whether complex EVAR improves perioperative survival or long-term outcomes, when compared with open surgical repair
- it will be performed with special arrangements for consent and for audit and research that will determine the clinical and cost effectiveness of complex EVAR when compared with open surgical repair, and all patients are entered onto the National Vascular Registry.

1.5.7 For people who have anaesthetic risks and/or medical comorbidities that would contraindicate open surgical repair, only consider complex EVAR if:

- the following has been discussed with the person:
  - the risks of complex EVAR compared with the risks of conservative management
  - the uncertainties around whether complex EVAR improves perioperative survival or long-term outcomes
- it will be performed with special arrangements for consent and for audit and research that will determine the clinical and cost effectiveness of complex EVAR when compared with conservative management, and all patients are entered onto the National Vascular Registry.

NICE amended recommendations 1.5.1 to 1.5.7, after the committee's proposed recommendations were reviewed by NICE's Board.

To find out why the recommendations on repairing unruptured aneurysms were made and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in:

- evidence review F: thresholds for abdominal aortic aneurysm repair
- evidence review K: effectiveness of endovascular aneurysm repair, open surgical repair and non-surgical management of unruptured abdominal aortic aneurysms
- evidence review K2: observational evidence on the effectiveness of endovascular aneurysm repair compared with open surgical repair of unruptured abdominal aortic aneurysms.

Anaesthesia and analgesia

1.5.8 Consider epidural analgesia in addition to general anaesthesia for people having open surgical repair of an unruptured AAA.

To find out why the committee made the recommendation on anaesthesia and analgesia for repair of unruptured aneurysms and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review L: anaesthesia and analgesia for people having surgical repair of an abdominal aortic aneurysm.

1.6 Repairing ruptured aneurysms

1.6.1 Consider endovascular aneurysm repair (EVAR) or open surgical repair for people with a ruptured infrarenal abdominal aortic aneurysm (AAA). Be aware that:

- EVAR provides more benefit than open surgical repair for most people, especially men over 70 and women of any age
- open surgical repair is likely to provide a better balance of benefits and harms in men under 70.

1.6.2 Consider open surgical repair for people with a ruptured AAA if standard EVAR is unsuitable.

1.6.3 Do not offer complex EVAR to people with a ruptured AAA if open surgical repair is suitable, except as part of a randomised controlled trial comparing complex EVAR with open surgical repair.

To find out why the committee made the recommendations on repairing ruptured aneurysms and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review T: effectiveness of endovascular aneurysm repair compared with open surgical repair of ruptured abdominal aortic aneurysms.

Anaesthesia and analgesia

1.6.4 Consider using local infiltrative anaesthesia alone for people having EVAR of a ruptured AAA.

To find out why the committee made the recommendation on anaesthesia and analgesia and how it might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review L: anaesthesia and analgesia for people having surgical repair of an abdominal aortic aneurysm.

Abdominal compartment syndrome

1.6.5 Be aware that people can develop abdominal compartment syndrome after EVAR or open surgical repair of a ruptured AAA.

1.6.6 Assess people for abdominal compartment syndrome if their condition does not improve after EVAR or open surgical repair of a ruptured AAA.

To find out why the committee made the recommendations on abdominal compartment syndrome and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review U: preventing abdominal compartment syndrome following repair of ruptured abdominal aortic aneurysm.

1.7 Monitoring for complications after endovascular aneurysm repair

1.7.1 Enrol people who have had endovascular aneurysm repair (EVAR) into a

surveillance imaging programme.

1.7.2 Base the frequency of surveillance imaging on the person's risk of EVAR-related complications.

1.7.3 Consider contrast-enhanced CT angiography or colour duplex ultrasound for assessing abdominal aortic aneurysm (AAA) diameter and EVAR device limb kinking.

1.7.4 Use contrast-enhanced CT angiography if an endoleak is suspected. If contrast-enhanced CT angiography is contraindicated, use contrast-enhanced ultrasound.

1.7.5 Do not exclude endoleaks based on a negative colour duplex ultrasound alone in people who have had EVAR.

To find out why the committee made the recommendations on monitoring for complications after endovascular aneurysm repair and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review V: postoperative surveillance after surgical repair of abdominal aortic aneurysms and evidence review W: accuracy of imaging techniques in identifying complications after surgery.

1.8 Managing endoleaks after endovascular aneurysm repair

1.8.1 Consider open, endovascular or percutaneous intervention for type 1 and type 3 endoleaks following endovascular aneurysm repair (EVAR).

1.8.2 Consider intervention for type 2 endoleaks in people who have abdominal aortic aneurysm (AAA) expansion following EVAR.

1.8.3 Consider further investigation of type 5 endoleaks following EVAR.

To find out why the committee made the recommendations on managing endoleaks after endovascular aneurysm repair and how they might affect practice, see rationale and impact.

Full details of the evidence and the committee's discussion are in evidence review X: managing complications after abdominal aortic aneurysm repair.

Terms used in this guideline

This section defines terms that have been used in a specific way for this guideline. For general definitions, please see the NICE glossary.

Standard and complex EVAR

Standard EVAR is defined as any EVAR procedure:

- using a standard infrarenal device (an unmodified off-the-shelf stent graft) **and**
- following the manufacturer's 'instructions for use' for the device used **and**
- without any adjunctive procedures (planned use of endo-anchors and planned permanent instrumentation of aortic branch vessels, such as 'chimney' or 'snorkel' procedures).

Any EVAR procedure that does not fit into the definition above is classed as 'complex EVAR'. Complex EVAR also covers fenestrated, branched, customised or internal iliac branch devices, and physician-modified stent grafts.

Endoleak

The persistence of blood flow outside an endovascular stent–graft but within the aneurysm sac in which the graft is placed. There are 5 types of endoleak:

- Type 1 – blood flowing into the aneurysm because of an incomplete or ineffective seal at either end of a stent–graft
- Type 2 – blood flowing into an AAA from side branches of the aorta
- Type 3 – blood flowing into an AAA through defects in the endograft
- Type 4 – blood flowing through the stent–graft fabric into an AAA
- Type 5 – continued AAA expansion without radiographic evidence of a leak site.

Hostile abdomen

An abdomen that is difficult to perform open surgery within, because of adverse anatomical features. For AAA repair, these features can include large abdominal wall defects or intra-abdominal adhesions. A hostile abdomen is most common in people who have had multiple previous episodes of intra-abdominal open surgery.

Infrarenal abdominal aortic aneurysm

An abdominal aortic aneurysm arising below the arteries that supply the kidneys.

Permissive hypotension

A method of fluid administration that aims to reduce bleeding by keeping a person's blood pressure within a lower-than-normal range.

Recommendations for research

The guideline committee has made the following recommendations for research.

Key recommendations for research

1 Monitoring frequencies and repair thresholds

What are the most effective and cost-effective frequencies for monitoring people with unruptured abdominal aortic aneurysms (AAA) of different diameters, and what is the optimal AAA threshold size (inner-to-inner maximum anterior-posterior diameter on ultrasound) for repair?

Why this is important

More frequent monitoring increases the chances of identifying aneurysms that have grown large enough to be considered for repair. However, monitoring requires resources and the absolute risk of AAA rupture is relatively low, so there are opportunity costs to consider. It is important to establish how often aneurysms should be monitored to keep the risk of rupture as low as possible while making the best use of NHS resources.

The optimal threshold for repair of an AAA is not clear. There is good evidence that in most cases people do not need repair for aneurysms measuring smaller than 5.5 cm (inner-to-inner maximum anterior-posterior aortic diameter) on ultrasound. However, for some people a threshold above 5.5 cm may be more appropriate.

2 Effectiveness of endovascular aneurysm repair and open surgical repair of complex unruptured and ruptured abdominal aortic aneurysms

What is the effectiveness and cost effectiveness of complex endovascular aneurysm repair (EVAR) versus open surgical repair in people for whom open surgical repair is suitable for:

- elective repair of an unruptured AAA **or**
- emergency repair of a ruptured AAA?

Why this is important

EVAR is a widely performed non-invasive alternative to open surgical repair. However, it is more expensive. Although standard EVAR has been shown to produce no long-term benefit over open surgical repair in people with an unruptured infrarenal abdominal aortic aneurysm, it is less clear whether this is the same in people with who would need complex EVAR to repair their AAA. The committee's view was that, because current practice is subject to strong prior beliefs about the relative benefits and harms of EVAR and open surgical repair for complex AAA, randomisation is critical to provide an unbiased estimate of comparative effectiveness.

3 Macrolides for slowing aneurysm growth and reducing the risk of rupture

What are the benefits and harms of macrolides (such as azithromycin) for reducing AAA growth rates and the risk of rupture?

Why this is important

Small AAAs are currently managed by monitoring, until the aneurysm reaches a diameter at which surgical repair is considered. There are currently no non-surgical interventions available to prevent AAAs from growing, and subsequently rupturing. A randomised controlled trial would be useful to determine whether macrolides reduce the rate of AAA growth and the risk of rupture.

4 Metformin for slowing aneurysm growth and reducing the risk of rupture

What are the benefits and harms of metformin for reducing AAA growth rates and the risk of rupture?

Why this is important

Observational study data suggest an association between diabetes and slower AAA growth, and it has been proposed that this may be due to the use of metformin. A randomised controlled trial is needed to determine whether metformin reduces the rate of AAA growth and the risk of rupture.

5 Tranexamic acid for preventing and treating excessive blood loss during EVAR or open surgical repair

Does tranexamic acid reduce blood loss and so improve survival in people who are having repair

(EVAR or open surgical repair) of a ruptured AAA?

Why this is important

Tranexamic acid is used to reduce blood loss in major trauma, postpartum bleeding and surgery. By slowing down blood loss from a ruptured AAA, the use of tranexamic acid may improve survival from ruptured AAA. A randomised controlled trial is needed to determine whether tranexamic acid improves survival in people having EVAR or open surgical repair of a ruptured AAA.

6 Prehabilitation (including preoperative exercise programmes) for improving the outcome of aneurysm repair

What is the clinical effectiveness and cost effectiveness of prehabilitation, including preoperative exercise programmes, for improving outcomes of people who are having repair of an AAA?

Why this is important

NHS providers have started devoting resources to prehabilitation programmes, based on a relatively small body of evidence. Research is needed to determine if prehabilitation is effective and the optimal form it should take.

Other recommendations for research

Direct oral anticoagulants after abdominal aortic aneurysm repair

What are the benefits of postoperative use of direct oral anticoagulants (DOACs) for improving outcomes after repair of AAA?

Permissive hypotension

Does permissive hypotension improve survival of patients undergoing repair of ruptured AAA?

Surveillance after endovascular aneurysm repair

What are the risks, benefits and cost implications of different surveillance protocols in people who have undergone EVAR?

Rationale and impact

Identifying asymptomatic abdominal aortic aneurysms

Why the committee made the recommendations

Recommendations 1.1.1 to 1.1.6

The committee were mindful that the NHS abdominal aortic aneurysm (AAA) screening programme does not cover men under 65 or women of any age. This means some men and all women who are at risk of AAA are not currently screened. The recommendations highlight these groups and specify risk factors significantly associated with AAA that could be used to help with opportunistic screening.

There are also men who have no risk factors for AAA and were not seen by the screening programme when they turned 65. As their risk of AAA is low, the committee only recommended informing them about the NHS AAA screening programme and how it works. Men can then self-refer if they feel screening is right for them. Evidence from cross-sectional studies also found that people of Hispanic, African-American and Asian family origin were individually less likely than people of European family origin to have an AAA, so the committee wished to raise awareness of this.

Aortic ultrasound is recommended because it is the standard technique used in clinical practice and in the screening programme. It has high diagnostic accuracy, and is associated with lower costs and fewer side effects than CT. People with an AAA diameter of 5.5 cm or larger (inner-to-inner maximum anterior-posterior aortic diameter on ultrasound) need to be seen by a regional vascular service within 2 weeks because their aneurysm is at higher risk of rupture. The committee recommended that people with aneurysms less than 5.5 cm in diameter are seen within 12 weeks of diagnosis because this is the timeframe set by the NHS AAA screening programme.

How the recommendations might affect practice

The recommendations outlining key risk factors will increase the number of people being screened and improve AAA diagnosis. The recommendations should also promote equal access to healthcare, because they provide guidance on when a potential AAA should be investigated in women, who are currently not covered by the NHS AAA screening programme.

Using aortic ultrasound to detect AAAs is good practice. The recommendations ensure that the time within which people with newly-identified aneurysms are seen by regional vascular services is proportional to the risk of rupture. These timings match the timeframe the NHS AAA screening programme uses for people they assess.

Full details of the evidence and the committee's discussion are in evidence review A: risk factors for predicting presence of an abdominal aortic aneurysm and evidence review B: imaging techniques to diagnose abdominal aortic aneurysms.

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Identifying symptomatic or ruptured abdominal aortic aneurysms

Why the committee made the recommendations

Recommendations 1.1.7 to 1.1.9

Based on their own experience, the committee highlighted the most important signs and symptoms of ruptured AAAs, because:

- non-specialists commonly fail to diagnose them
- improved diagnosis should increase the chance of survival
- urgent discussion of a suspected ruptured AAA with a regional vascular service will improve the chances of appropriate treatment and survival.

Aortic ultrasound is the standard technique for detecting the presence of AAA in a person with a suspected ruptured aneurysm. A ruptured AAA is a surgical emergency, and bedside ultrasound is the quickest reliable method to confirm the presence of an AAA. An immediate discussion with the regional vascular unit ensures appropriate management is started as soon as possible. The committee recognised that the sensitivity of aortic ultrasound is not 100% and several factors can make it difficult to visualise the aorta. Since AAA rupture is a life-threatening surgical emergency, they agreed that it would be safest to discuss any non-diagnostic ultrasound findings with the regional vascular unit.

How the recommendations might affect practice

There is variation in awareness of AAA among non-specialists. Implementing the recommendations should reduce this variation and increase the chance of ruptured AAA being diagnosed earlier.

Using bedside aortic ultrasound to detect AAAs is common practice. Preventing delays to repair through immediate discussions with a regional vascular unit should improve outcomes for people with ruptured AAAs.

Full details of the evidence and the committee's discussion are in evidence review B: imaging techniques to diagnose abdominal aortic aneurysms and evidence review N: signs, symptoms and risk factors predicting ruptured or symptomatic unruptured aneurysms before arrival at the hospital, and in non-specialist hospital settings.

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Imaging technique

Why the committee made the recommendations

Recommendations 1.1.10 to 1.1.12

The committee agreed that it was important to take consistent measurements of aneurysm size throughout the NHS, so that results are comparable. The NHS AAA screening programme specifies inner-to-inner maximum anterior-posterior aortic diameter on ultrasound, and the committee agreed this would be the most appropriate measurement on which to base practice across the whole NHS.

The committee recommended thin-slice contrast-enhanced arterial-phase CT angiography for imaging in people being evaluated for elective repair, because it is widely recognised as the gold standard technique for assessing aneurysm anatomy before repair. For suspected ruptured AAAs, CT angiography should also be considered. However, the committee recognised that some people will need immediate transfer for repair without waiting for a CT scan.

No evidence was found demonstrating whether or not post-processing techniques affected postoperative outcomes for people having elective or emergency AAA repair. As post-processing techniques are an established part of clinical practice, the committee agreed not to make recommendations in this area.

How the recommendations might affect practice

Implementing a consistent measurement method to be used across the NHS (and that matches the method used in the NHS AAA screening programme) will improve the reproducibility of results, improving surveillance for individuals with AAA and the ability to analyse data at the population level.

Thin-slice contrast-enhanced arterial-phase CT angiography is widely used for imaging in people being evaluated for AAA repair, so this recommendation is unlikely to make a major difference to current practice. The recommended timings reflect current standards within the NHS AAA screening programme.

As post-processing techniques are established in practice, a lack of recommendations on these will not have an impact.

Full details of the evidence and the committee's discussion are in evidence review B: imaging techniques to diagnose abdominal aortic aneurysms.

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Providing information to people with a diagnosed AAA

Why the committee made the recommendations

Recommendations 1.1.13 to 1.1.15

The committee agreed some consensus recommendations on what information should be provided to people who have been diagnosed with an AAA. In particular, the recommendations cover information for people who are not being considered for repair, either because their AAA is too small (data from the NHS screening programme show that the risk of rupture for an AAA below 5.5 cm is only 0.4% per year) or because their medical comorbidities mean the risks of repair outweigh the benefits. It is important to avoid making people anxious about not being offered repair, but also to avoid giving the impression that AAA repair is always beneficial if the aneurysm meets the criteria for treatment (see recommendation 1.5.1). Explaining how the decision to repair is made (based on the person's health at that particular time) and the uncertainties around this will help people to better understand the options available.

The committee emphasised that clinicians should ensure that people understand their options and the balance of risks they face. They noted that several clinic visits, including opinions from

specialists such as anaesthetists, geriatricians, and cardiologists, are likely to be needed.

Full details of the evidence and the committee's discussion are in evidence review K: effectiveness of endovascular aneurysm repair, open surgical repair and non-surgical management of unruptured abdominal aortic aneurysms.

Return to recommendations

Reducing the risk of rupture

Why the committee made the recommendations

Recommendations 1.2.1 and 1.2.2

The committee focused on modifiable risk factors that could influence the management of people with known AAAs. There was some evidence that high blood pressure increases the chance of AAA growth and rupture, and the committee knew from their own experience that people with an AAA do not always receive appropriate management for high blood pressure. There is also evidence that smoking increases the risk of AAA rupture. As a result, the committee referred to the NICE guidelines on these topics.

The committee agreed that there was not enough high-quality evidence to make clinical recommendations on non-surgical interventions for slowing aneurysm growth and reducing the risk of rupture. In light of this, they made research recommendations on 2 drug interventions that might reduce aneurysm growth and rupture risk.

How the recommendations might affect practice

The NICE guidelines on hypertension and stop smoking services cover current practice, so organisations are unlikely to need to change practice.

Non-surgical interventions for small AAAs are not usually used outside of clinical trials, so a lack of recommendations will have little impact on practice.

Full details of the evidence and the committee's discussion are in evidence review C: risk factors associated with abdominal aortic aneurysm growth or rupture.

Return to recommendations

Monitoring the risk of rupture

Why the committee made the recommendations

Recommendations 1.2.3 and 1.2.4

The committee recommended ultrasound surveillance because ultrasound is current practice and no evidence was found for other imaging techniques. They recommended that monitoring frequency should be in line with the NHS AAA screening programme to ensure consistency across the whole NHS. The screening programme surveillance intervals are based on evidence on risk of rupture, depending on the size of the AAA. This means that people with larger aneurysms are monitored more frequently, offering the best balance between benefits and costs.

The committee are aware that the NHS AAA screening programme may change the surveillance intervals it uses in the future. If this happens, the committee agreed that regional vascular services should change to match the new intervals, to ensure that they continue to provide care based on best practice.

How the recommendations might affect practice

Changing monitoring intervals to reflect those used in the NHS AAA screening programme will maintain a consistent standard across the NHS, and ensure that the most effective imaging intervals are used.

Full details of the evidence and the committee's discussion are in evidence review D: monitoring for abdominal aortic aneurysm expansion and risk of rupture.

Return to recommendations

Emergency transfer to regional vascular services

Why the committee made the recommendations

Recommendations 1.3.1 to 1.3.5

There was no evidence on symptoms, signs or risk assessment tools for deciding whether people with ruptured aneurysms are likely to survive transfer to a regional vascular service. Based on their own experience, the committee highlighted specific circumstances (cardiac arrest and persistent loss of consciousness) in which people are unlikely to survive transfer and subsequent aortic repair.

This will help reduce the number of people being given ineffective and invasive treatment at the end of life.

The committee referred to the NICE guideline on care of dying adults in the last days of life to ensure that appropriate and compassionate care is given to people with a ruptured AAA when the decision has been made not to operate.

There was also no evidence on how quickly people with ruptured AAA should be transferred to regional vascular units. In the absence of evidence, the committee adapted recommendations from the NICE guideline on service delivery for major trauma. They agreed, based on their experience of emergency transfer, that the timing specified for people with major trauma was appropriate for people with ruptured AAA and manageable for referring units.

How the recommendations might affect practice

The recommendations on assessing people for transfer will raise awareness among emergency staff, but will have little resource impact on clinical practice. The recommendations on transfer speed will improve practice by minimising variation in transfer times across the NHS. The timeframe recommended is the same as for major trauma, and the committee agreed that this is a reasonably similar situation.

The NICE guideline on care of dying adults cover current practice, so organisations are unlikely to need to change practice.

Full details of the evidence and the committee's discussion are in evidence review O: signs, symptoms and risk factors indicating suitability for transfer to a regional vascular service and evidence review P: time period for transfer to regional vascular services.

Return to recommendations

Supporting people during transfer

Why the committee made the recommendation

Recommendation 1.3.6

As there was no evidence specific to the use of permissive hypotension during transfer of people with ruptured or symptomatic AAA, the committee agreed that a consensus recommendation was needed in this important clinical area. As a result the committee adapted recommendations from

the NICE guideline on assessment and initial management for major trauma.

How the recommendation might affect practice

The recommendation will reduce the likelihood of inappropriate fluid administration during transfer of people with ruptured AAA. This, in turn, will improve the outcomes of endovascular aneurysm repair and open surgical repair procedures. The recommendation is in line with NICE recommendations on fluid administration for other major trauma, and the committee agreed that this was appropriate for ruptured AAA.

Full details of the evidence and the committee's discussion are in evidence review Q: permissive hypotension during transfer of people with ruptured abdominal aortic aneurysm to regional vascular services.

Return to recommendations

Predicting surgical outcomes in unruptured aneurysms

Why the committee made the recommendations

Recommendations 1.4.1 and 1.4.3

There was limited evidence that cardiopulmonary exercise testing can help predict outcomes following endovascular aneurysm repair (EVAR) and open surgical repair. While the evidence was limited, the committee agreed that cardiopulmonary exercise testing could have a useful role in shared decision-making between healthcare professionals and patients when the benefits and harms of surgery are uncertain.

There are other tests for assessing people before surgery, but there was no evidence available for them. One study found that higher estimated glomerular filtration rate (eGFR) was associated with improved outcomes after elective EVAR, but it did not give clear eGFR thresholds that could be used in decision-making. In the absence of evidence, the committee referred to the NICE guideline on routine preoperative tests for elective surgery. Some of the studies reviewed for that guideline focused on people having elective AAA repair.

The evidence highlighted that none of the risk assessment tools had a high enough predictive accuracy at predicting postoperative outcomes. The specific tools listed are the ones for which evidence was available. This evidence led the committee to conclude that these tools would not improve decision-making and could potentially lead to inappropriate decisions about patient

management. They agreed that this could lead to harm, and therefore advised that risk assessment tools should not be used.

How the recommendations might affect practice

The use of cardiopulmonary exercise testing will have limited impact on practice as it is only recommended in situations where it will help in shared decision-making.

Risk assessment tools are not widely used outside the context of research on AAA. Therefore, the recommendations will have little impact on practice.

Full details of the evidence and the committee's discussion are in evidence review G: tests for predicting outcomes after repair of unruptured abdominal aortic aneurysms and evidence review H: risk assessment tools for predicting surgical outcomes of patients who undergo elective abdominal aortic aneurysm repair.

Return to recommendations

Predicting surgical outcomes for ruptured aneurysms

Why the committee made the recommendations

Recommendations 1.4.4 and 1.4.5

There is evidence that some risk factors and risk assessment tools are associated with poor postoperative outcomes. However, it is not clear how any particular factor or combination of factors could be used to decide if aneurysm repair is suitable for a person with a ruptured AAA. The committee emphasised that there is a potential for harm if clinicians base their decision to repair solely on risk assessment tools and scores, because some people would be inappropriately offered or denied repair.

How the recommendations might affect practice

The recommendations will have a beneficial impact, by ensuring decisions about care are not made based on inappropriate factors or tools. This, in turn, should prevent inappropriate decisions being made about whether or not to offer repair.

Full details of the evidence and the committee's discussion are in evidence review S: risk factors for predicting survival after abdominal aortic aneurysm rupture.

Return to recommendations

Improving surgical outcomes

Why the committee made the recommendations

Recommendations 1.4.6 to 1.4.9

The committee made a recommendation on cardiovascular disease because it is common in people with AAA and it is best practice to reduce the risk of problems in people who have it. The other NICE guidelines that are referenced include recommendations to help reduce this risk.

The evidence showed that giving beta blockers just before surgery is not beneficial, and may be harmful by lowering low blood pressure and heart rate. The committee noted that some people with AAA may need to take beta blockers for other conditions (such as atrial fibrillation). As a result, they recommended against routine use before AAA repair, rather than recommending against beta blockers altogether.

Remote ischaemic preconditioning was not recommended because there was evidence that it does not improve outcomes and that it can cause problems such as an irregular heartbeat.

The committee recommended further research because there was not enough evidence to make recommendations on prehabilitation (including exercise programmes before surgery), or on any interventions after AAA repair.

How the recommendations might affect practice

Providing support to reduce the risk of problems from cardiovascular disease is already current practice. In addition, beta blockers and routine ischaemic preconditioning are not currently in routine use before AAA repair, so these recommendations should have a minimal impact on practice.

Full details of the evidence and the committee's discussion are in evidence review J: pre- and postoperative interventions to optimise outcomes after abdominal aortic aneurysm repair.

Return to recommendations

Repairing unruptured aneurysms

Why NICE made the recommendations

Recommendations 1.5.1 to 1.5.7

When to consider repair

A number of factors should be considered before treating asymptomatic aneurysms, one of which is size.

It is standard practice to repair large aneurysms (over 5.5 cm in diameter on ultrasound, measured using an anterior-posterior diameter inner-to-inner), and to monitor smaller aneurysms (less than 4 cm in diameter) until they become larger. Repair is sometimes offered for aneurysms below 5.5 cm if they are growing rapidly, or if they are symptomatic. However, data from the NHS screening programme show that, for aneurysms below 5.5 cm, the risk of rupture remains very low (0.4% per year). It is clear from the evidence that there is no benefit to repairing aneurysms that are below 5.5 cm, asymptomatic and not growing rapidly. Based on this evidence, we highlighted factors that would help healthcare professionals decide when to repair aneurysms.

Given the risks and other disadvantages of AAA repair, conservative management is sometimes a better option. Because of this, healthcare professionals need to explain the balance of benefits and risks to people with AAAs, so they can make an informed decision.

Open surgical repair, standard endovascular aneurysm repair or conservative management

The evidence showed that, compared with open surgical repair for people with an unruptured infrarenal abdominal aortic aneurysm, elective EVAR has medium- and long-term harms that outweigh its short-term benefits. EVAR is associated with fewer perioperative deaths, and less time in hospital in general (and critical care in particular). But it also has worse long-term survival than open surgical repair, and more long-term complications, leading to further procedures.

Even when taking the short-term benefits of EVAR into account, all plausible cost-effectiveness estimates show that EVAR either:

- has higher net costs and lower net benefits than open surgical repair **or**

- is substantially above the range NICE normally considers to be a cost-effective use of NHS resources.

There is a small group of people who have abdominal copathology or other considerations that mean open surgical repair is unsuitable. Examples of copathologies include people who have internal scar-tissue from previous abdominal surgery (a so-called hostile abdomen), people who have a single, fused kidney that is wrapped around the aorta ('horseshoe kidney'), and people who have a stoma. Although there was no evidence on this population, EVAR is a potential option for these people, as the risks of open surgical repair may be much higher for them. This recommendation should not be used to extend EVAR to people who could reasonably have open surgical repair.

Open surgical repair is contraindicated for some people with an unruptured AAA because of anaesthetic risks and/or medical comorbidities. For these people, the risk of their AAA rupturing if no repair is attempted has to be balanced against:

- the perioperative risks and long-term complications of EVAR
- the uncertainty around whether they will benefit from EVAR
- the large costs of EVAR.

With all this in mind, it is clear that practice needs to be rebalanced. Conservative management is a better option than EVAR for many people. However, NICE also acknowledged stakeholder comments highlighting the importance of individualised care. For some people, EVAR may be appropriate. Clinicians should discuss the risks of EVAR and conservative management with people with AAAs, taking into account the uncertainty that EVAR will provide a benefit.

People who are not offered repair may be anxious about having an AAA but not receiving treatment for it. However, a better explanation of the risks they face, in the context of their other life-limiting comorbidities, can help with anxiety. To help with this, the committee made consensus recommendations (see recommendations 1.1.13 to 1.1.14) on the information to cover when discussing repair with people who have an AAA.

Complex endovascular aneurysm repair

The evidence for complex EVAR was limited in quantity and quality. However, complex EVAR grafts and procedures are much more expensive than standard EVAR, so the difference in cost between EVAR and open surgical repair is likely to be even greater than for infrarenal AAAs. In addition, using standard EVAR stent grafts for complex AAA usually violates the manufacturer's 'instructions

for use'.

Although there is currently no evidence that complex EVAR has better outcomes than open surgical repair, people with complex AAAs have higher perioperative mortality rates than people with infrarenal AAAs. Because of this, an increased perioperative survival benefit may be more important for them, and may justify the use of complex EVAR. This would differentiate complex EVAR from standard EVAR, which clearly does not provide enough short-term benefits to outweigh the worse long-term outcomes or the increased cost (when compared with open surgical repair).

Open surgical repair is contraindicated for some people with an unruptured AAA because of anaesthetic risks and/or medical comorbidities. For these people, the risk of their AAA rupturing if no repair is attempted has to be balanced against:

- the perioperative risks and long-term complications of complex EVAR
- the uncertainty around whether they will benefit from complex EVAR
- the large costs of complex EVAR.

With all this in mind, it is clear that conservative management is a better option than complex EVAR for many people. However, NICE also acknowledged stakeholder comments highlighting the importance of individualised care. For some people, complex EVAR may be appropriate. Clinicians should discuss the risks of complex EVAR and conservative management with people with AAAs, taking into account the uncertainty that complex EVAR will provide a benefit.

As with standard EVAR, NICE acknowledged that in the face of the evidence reviewed, practice needs to be rebalanced towards open surgical repair in this scenario as well. But, because of the limited evidence for complex EVAR and the importance of individualised care, NICE concluded that it is important for clinicians and people with AAA to discuss the uncertainties and weigh up the risks and benefits of repair, in order to make an informed decision.

More evidence on this procedure would be helpful, and NICE has made a recommendation for research comparing complex EVAR with open surgical repair.

EVAR and complex EVAR for specific subgroups of people

For each of the recommendations, NICE considered whether there were any specific groups that would benefit from standard or complex EVAR for unruptured AAAs. We explored groups defined by age, sex, AAA diameter and life expectancy, but it was not possible with the current evidence to identify any specific groups in which the benefits would outweigh the harm and costs.

Other evidence sources

The key randomised controlled trials (RCTs) in this area are relatively old. NICE looked at more recent observational evidence, to see if changes in surgical and endovascular techniques and technology have led to different outcomes. The observational studies are at high risk of bias, but their findings are broadly in line with the RCTs. They show that, while outcomes from EVAR have improved over the last 15 years, outcomes from open surgical repair have also improved by roughly the same amount. This means the difference in outcomes between the two has remained fairly constant.

Registries like the National Vascular Registry can provide a useful snapshot of current practice, and the analyses that informed NICE's decision-making made use of data from them. However, they are not designed to evaluate the comparative benefits and harms of different surgical approaches, such as EVAR and open surgical repair. Therefore, they cannot be considered a reasonable alternative to RCT data. In addition, an analysis using the registry data showed that EVAR still did not provide greater long-term benefits than open surgical repair, and that it still has higher net costs.

Implementation challenges

NICE acknowledged the need to rebalance practice towards open repair and identified the possible implementation challenges.

- **Possible increased perioperative mortality with open surgical repair:** Improvements in practice since the RCTs were published have led to better standards for open surgical repair and EVAR alike. In addition, the NHS AAA screening programme means that AAAs are more likely to be diagnosed earlier than in the past, so people can have repair when they are younger and healthier. For these reasons, open surgical repair of unruptured AAAs can be provided with a low incidence of morbidity and mortality.
- **The risk that vascular units will have trouble meeting an increased demand for open surgical repair:** All vascular surgeons should be competent to perform open surgical repair of AAAs, and the Intercollegiate Surgical Curriculum Programme's Vascular surgery curriculum puts more emphasis on open surgical repair than on EVAR. This means that future surgeons should be well prepared to provide open surgical repair with a low incidence of morbidity and mortality.

- **Potential shortage of beds in the NHS:** As people who have open surgical repair spend more time in hospital immediately after the procedure, there may be a small, short-term increase in waiting times for AAA repair. However, an analysis comparing waiting times showed that open surgical repair would still provide greater benefit than EVAR for a lower cost even with a substantial increase in waiting times for open surgical repair.
- **The possibility that reducing the number of EVAR procedures performed for unruptured aneurysms will make it difficult to provide EVAR for ruptured aneurysms:** There are a number of ways this implementation issue might be addressed:
  - vascular services could be centralised further (for example by establishing aortic units)
  - in line with the recommendations, EVAR can be offered in certain situations.

Goal-directed therapy

The evidence did not show any benefit from goal-directed therapy for people having repair of an unruptured AAA. Goal-directed therapy covers a broad range of different haemodynamic monitoring and management practices, some of which are routinely performed during major surgery. The committee recognised that it was not possible to specify which practices should or should not be performed and agreed that drafting recommendations would be too prescriptive.

How the recommendations might affect practice

The recommendation on when to repair unruptured aneurysms is unlikely to impact on current clinical practice because it reflects what is already being done within the NHS. Data from the NHS AAA screening programme indicate that the risk of rupture for AAAs that are smaller than 5.5 cm is very low.

The recommendations on EVAR could have a large impact on practice and will also affect the timing and type of information about treatment options given to patients. In light of the evidence reviewed, practice needs to be rebalanced towards open surgical repair for infrarenal aneurysms. The recommendations will minimise harm by reducing long-term mortality and the need for re-intervention as a result of the problems with EVAR. The reduction in EVAR, and so EVAR-related re-interventions, will result in significant cost savings for the NHS.

A lack of recommendations on goal-directed therapy will not impact on practice. Basic haemodynamic management is routinely performed during most surgical procedures, but goal-directed therapy is not widely adopted during AAA surgery.

Full details of the evidence and the committee's discussion are in:

- evidence review F: thresholds for abdominal aortic aneurysm repair
- evidence review K: effectiveness of endovascular aneurysm repair, open surgical repair and non-surgical management of unruptured abdominal aortic aneurysms
- evidence review K2: observational evidence on the effectiveness of endovascular aneurysm repair compared with open surgical repair of unruptured abdominal aortic aneurysms.

Return to recommendations

Anaesthesia and analgesia during unruptured aneurysm repair

Why the committee made the recommendation

Recommendation 1.5.8

The committee noted that there was some evidence that adding an epidural to general anaesthesia reduced the need for further analgesia for people having open surgical repair of an unruptured AAA. This was consistent with their own clinical experience of better pain control and reduced postoperative respiratory complications with an epidural. Adding an epidural is fairly widespread in current practice, and the committee agreed that it should be recommended as an option.

No evidence was found on anaesthesia and analgesia for people undergoing EVAR for unruptured AAA. The committee agreed that no recommendations were needed in this area because they had recommended that EVAR should not be used to treat unruptured infrarenal abdominal aortic aneurysm, except in clinical trials or for people for whom open surgical repair is unsuitable because of abdominal copathology.

How the recommendations might affect practice

The use of an epidural in addition to general anaesthesia for people having open surgical repair of an unruptured AAA is already fairly widespread in current practice. Therefore the overall impact of the recommendation is likely to be small, although it may reduce existing variation.

Full details of the evidence and the committee's discussion are in evidence review L: anaesthesia and analgesia for people having surgical repair of an abdominal aortic aneurysm.

Return to recommendations

Repairing ruptured aneurysms

Why the committee made the recommendations

Recommendations 1.6.1 to 1.6.3

Which technique to use

The evidence showed that, compared with open surgical repair, a strategy that uses EVAR (where anatomically possible) to repair ruptured infrarenal abdominal aortic aneurysm provides a reasonable balance of benefits and costs.

As the average cost-effectiveness results for EVAR were favourable, the committee discussed whether they should recommend EVAR whenever it is possible. They decided not to, for 2 reasons.

Firstly, there is uncertainty in the evidence for EVAR from the IMPROVE trial. People who had EVAR for a ruptured AAA in this trial were followed up for at most 7 years. People who had EVAR for an unruptured AAA in the EVAR-1 trial were followed up for 15 years, and the committee noted that these data indicate that EVAR leads to increasingly worse survival when compared with open surgical repair, because follow-up duration increases (see why NICE made the recommendations on repairing unruptured aneurysms). The medium-term survival data from the IMPROVE trial give some indication that a similar long-term pattern may develop in trials of ruptured AAA, with the survival curves converging as follow-up gets longer. Therefore, it is possible that longer-term data would show EVAR to be worse than open surgical repair for people with ruptured AAA as well.

Secondly, there was evidence that the balance of benefits and costs for EVAR varies between different groups of people with ruptured AAAs. In particular, most women have better short-term survival after EVAR, whereas the evidence favours open surgical repair for younger men. Therefore, the committee recommended that either EVAR or open surgical repair can be considered, and provided detail on the groups for which each approach is likely to be best.

Complex EVAR is only recommended within the context of an RCT because there is currently no evidence to support it as an option for people with ruptured complex AAA. Open surgical repair of these aneurysms is recommended as the only approach that should be used in people for whom emergency repair is suitable until the safety and effectiveness of complex EVAR has been established in this setting.

Tranexamic acid

No evidence on the use of tranexamic acid in people with a ruptured AAA was identified. The committee was aware that tranexamic acid is included in some major haemorrhage protocols and some patients, without major trauma, may receive it before undergoing surgery. In the committee's experience, tranexamic acid is not routinely used in people with a ruptured AAA, so it agreed to recommend research in this area.

Goal-directed therapy

There was no evidence on goal-directed therapy for people having repair of a ruptured aneurysm. Goal-directed therapy covers a broad range of different haemodynamic monitoring and management practices; some of which are routinely performed during major surgery. The committee recognised that it was not possible to specify which practices should or should not be performed and agreed that drafting recommendations would be too prescriptive.

How the recommendations might affect practice

The recommendations will have little impact on current practice, as both standard EVAR and open surgical repair are currently offered to people with ruptured infrarenal AAAs. In relation to complex EVAR, the recommendation not to use it outside of RCTs will limit the use of a technically complex and expensive procedure in people for whom open surgery is a safe and suitable option.

Because the guideline recommends that fewer EVAR procedures should be performed for unruptured aneurysms (see the section on repairing unruptured aneurysms), surgical teams may have less opportunity to develop the skills they need to provide EVAR in emergency cases. The committee were mindful of this issue, but were convinced by the evidence showing that, overall, people with AAAs would be worse off if EVAR procedures were performed for unruptured aneurysms just to maintain EVAR expertise. Elective EVAR will still be available in certain circumstances and centralisation of aortic services may maintain expertise. However, neither training nor service models were in the scope of this guideline, so the committee did not review any evidence and were unable to make any specific recommendations in these areas.

A lack of recommendations on goal-directed therapy will not impact on practice. Basic haemodynamic management is routinely performed during most surgical procedures, but goal-directed therapy is not widely adopted during AAA surgery.

A lack of recommendations on tranexamic acid will have little impact on practice. Tranexamic acid is used in varying degrees across the NHS, but it is not standard practice for people with ruptured or

symptomatic AAAs who are being transferred before surgery.

Full details of the evidence and the committee's discussion are in evidence review T: effectiveness of endovascular aneurysm repair compared with open surgical repair of ruptured abdominal aortic aneurysms.

Return to recommendations

Anaesthesia and analgesia during ruptured aneurysm repair

Why the committee made the recommendation

Recommendation 1.6.4

No evidence was identified on the optimal use of anaesthesia and analgesia in people having open surgical repair or EVAR of a ruptured AAA. The committee agreed, based on their knowledge and experience, that general anaesthesia alone is widely accepted as best practice for open surgical repair, so did not make a recommendation on this. The committee made a recommendation on the use of local infiltrative anaesthesia alone in people having EVAR for ruptured AAA because it was considered that increased awareness of this option was needed.

How the recommendation might affect practice

The committee agreed that the potential impact of this recommendation on practice is unclear, because it is difficult to predict the proportion of people for whom EVAR under local infiltrative anaesthesia might be an option. The main aim of this recommendation is to raise awareness of this option.

Full details of the evidence and the committee's discussion are in evidence review L: anaesthesia and analgesia for people having surgical repair of an abdominal aortic aneurysm.

Return to recommendation

Abdominal compartment syndrome

Why the committee made the recommendations

Recommendations 1.6.5 and 1.6.6

There was no evidence relating to preventing or managing abdominal compartment syndrome in people who are having AAA repair. The committee agreed it was important to raise awareness of this potentially life-threatening condition, and made recommendations to highlight that it can occur after both endovascular aneurysm repair and open surgical repair.

How the recommendations might affect practice

The recommendations will ensure that clinicians are aware of abdominal compartment syndrome in people who have undergone repair of ruptured AAA. This may result in better postoperative assessment and management.

Full details of the evidence and the committee's discussion are in evidence review U: preventing abdominal compartment syndrome following repair of ruptured abdominal aortic aneurysm.

Return to recommendations

Monitoring for complications after endovascular aneurysm repair

Why the committee made the recommendations

Recommendations 1.7.1 to 1.7.5

Imaging surveillance is needed after EVAR, because there is a risk that people will develop complications from the procedure or need another operation. These risks are lower after open surgical repair, so surveillance is not standard practice and in this case the committee did not recommend it.

The committee noted that the frequency of EVAR surveillance is highly variable in practice. In the absence of evidence on how often imaging should be done, the committee agreed a recommendation to tailor surveillance to the perceived risk of complications. This should focus attention and resources on the people at greatest risk, and help to identify complications earlier.

In practice, identifying complications after EVAR usually involves sequential imaging, with ultrasound frequently used as the first-line test and other imaging modalities used to detect specific complications. Imaging modalities may be complimentary, and the clinical significance of some imaging findings remains unclear, which makes identifying a true reference standard difficult.

Contrast-enhanced CT angiography was widely used as a gold standard in the evidence that was reviewed. However, this has led to some abnormalities that are detected on other imaging modalities, but not on CT, being defined as false positives (for that modality, rather than as false negatives for CT). This may have introduced bias, and makes it difficult to rely on CT as a reference standard.

The evidence showed that colour duplex ultrasound was highly accurate at identifying changes in sac size when compared with contrast-enhanced CT angiography. Increases in sac size are often believed to indicate an endoleak even if no leak can be seen on the ultrasound. There was little evidence on graft kinking, but the committee agreed based on their experience that colour duplex ultrasound and CT angiography were equally as effective at detecting this type of complication.

In the evidence reviewed, contrast-enhanced ultrasound was the only imaging technique that had acceptable accuracy for directly identifying endoleaks when compared with contrast-enhanced CT angiography. Importantly, other imaging techniques had unacceptably high rates of false-negative results. For this reason, the committee agreed that in situations where the definitive exclusion (or identification) of endoleak is important (for example where endoleak is suspected) either contrast-enhanced CT angiography or contrast-enhanced ultrasound should be used. Contrast-enhanced ultrasound was not recommended for assessing other complications because the evidence for its use only covered endoleaks.

The committee agreed that it is particularly important not to falsely exclude an endoleak, so the sensitivity of a diagnostic test is more important than its specificity. While colour duplex ultrasound is highly accurate at identifying changes in sac size (which may indicate an endoleak), the available evidence shows that it has suboptimal sensitivity for directly detecting type I and III endoleaks. In addition, the accuracy of ultrasound was shown to be dependent on the operator, so its accuracy may be variable in practice. This variability in diagnostic accuracy, and resultant potential for harm if an endoleak is missed, led the committee to recommend that colour duplex ultrasound alone should not be used to confirm or exclude the presence of endoleaks.

How the recommendations might affect practice

There is variation in which imaging techniques are used for surveillance. Some centres use

ultrasound only, and some use contrast-enhanced CT angiography and ultrasound. Colour duplex ultrasound is widely used, but contrast-enhanced ultrasound is not. These recommendations are not likely to alter surveillance regimens substantially because many centres use imaging tests in a complementary fashion, often relying on sac size as a trigger for further investigation if necessary. Sonographers will need training in administering contrast agents if contrast-enhanced ultrasound is to be more widely adopted.

Full details of the evidence and the committee's discussion are in evidence review V: postoperative surveillance after surgical repair of abdominal aortic aneurysms and evidence review W: accuracy of imaging techniques in identifying complications after surgery.

Return to recommendations

Managing endoleaks after endovascular aneurysm repair

Why the committee made the recommendations

Recommendations 1.8.1 to 1.8.3

Endoleaks following EVAR are common. They can have a negative impact on patient prognosis and long-term quality of life, and further interventions are frequently needed to repair them. In the absence of evidence, the committee made recommendations based on their experience because:

- it is good practice to repair type I and III endoleaks and some type II endoleaks
- healthcare professionals are not all aware that type II endoleaks without sac expansion can be managed conservatively
- there are circumstances when sac expansion occurs without imaging evidence of a leak site (called type V endoleak), and these situations need further investigation.

How the recommendations might affect practice

The recommendations will have minimal impact on current practice because it is common practice to intervene for type I and type III endoleaks, and type II endoleaks if there is evidence of aneurysm sac expansion.

Full details of the evidence and the committee's discussion are in evidence review X: managing

complications after abdominal aortic aneurysm repair.

Return to recommendations

Context

Abdominal aortic aneurysms develop when the wall of the aorta in the abdomen weakens, causing it to bulge and form a balloon-like expansion. When the abdominal aorta reaches a diameter at least 1.5 times the normal size, or greater than 3 cm in total, it is called an abdominal aortic aneurysm (AAA).

The increased stress on the aortic wall may eventually cause the AAA to rupture (burst). The subsequent internal bleeding is frequently fatal before emergency repair can be attempted. When people have emergency repair for rupture, up to half will not survive to leave hospital.

There is a long period of growth before an AAA ruptures. The rate of growth may depend on a number of factors, including increasing age, smoking, blood pressure and a family history of aneurysm.

Most AAAs are asymptomatic, and they are often diagnosed opportunistically during clinical examination or investigation for another condition. Because of this it is difficult to establish their prevalence. There is a national screening programme which enrols men at age 65 and suggests a prevalence of about 1.3% in this population. The prevalence is falling.

The prevalence of AAAs is approximately 6 times lower in women, but the rate of aneurysm rupture is significantly higher. The guideline committee carefully considered the impact of their recommendations on women during guideline development.

Finding more information and resources

You can see everything NICE says on this topic in the NICE Pathway on abdominal aortic aneurysm.

To find out what NICE has said on topics related to this guideline, see our web page on aortic aneurysms.

For full details of the evidence and the guideline committee's discussions, see the evidence reviews. You can also find information about how the guideline was developed, including details of the committee.

NICE has produced tools and resources to help you put this guideline into practice. For general help and advice on putting NICE guidelines into practice, see resources to help you put guidance into practice.

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