National Institute for Health and Care Excellence

Draft for consultation

Abdominal aortic aneurysm: diagnosis and management

Evidence review V: Postoperative surveillance after surgical repair of abdominal aortic aneurysms

NICE guideline <number>

Evidence reviews

May 2018

Draft for Consultation

Commissioned by the National Institute for Health and Care Excellence

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Postoperative surveillance after surgical repair of abdominal aortic aneurysms

Review questions

How frequently should people be monitored for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?

Is tailored surveillance more effective than generalised surveillance in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?

Introduction

Review question 27 aims to determine appropriate intervals for monitoring people who have undergone surgical repair of an abdominal aortic aneurysm (AAA); that is, how frequently people should be monitored to detect complications (endoleak, graft migration, graft kinking, incisional hernia, graft occlusion and aortic neck expansion), further aneurysm expansion and aneurysm rupture.

Review question 29 aims to determine whether tailored surveillance or generalised surveillance is more effective in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an AAA.

PICO tables

Table 1: Inclusion criteria for review question 27: frequency of postoperative monitoring

Parameter	Inclusion criteria
Population	People who have undergone surgical repair of an AAA Stratified by: age, sex, comorbidities, compliance with surveillance
Interventions	Varying intervals of monitoring/surveillance and defined protocols (also accounting for imaging technique and time since surgery)
Comparators	Each other
Outcomes	AAA rupture Further AAA growth/expansion Mortality; survival Need for additional intervention, including both emergency and elective surgical intervention Compliance Quality of life Adverse effects, including incidence of cancer, renal complications (contrast-induced nephrotoxicity) Lower limb, visceral and renal ischaemia Resource use and cost

Table 2: Inclusion criteria for review question 29: tailored or generalised postoperative surveillance

Parameter	Inclusion criteria
Population	People who have undergone surgical repair of an AAA
Interventions	Tailored / stratified / individualised / personalised surveillance
Comparators	Generalised / routine surveillance
Outcomes	AAA rupture Further AAA growth/expansion Mortality; survival Need for additional intervention, including both emergency and elective surgical intervention Compliance Quality of life Adverse effects, including incidence of cancer, renal complications (contrast-induced nephrotoxicity) Lower limb, visceral and renal ischaemia Resource use and cost

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in Appendix A.

Declarations of interest were recorded according to NICE's 2014 conflicts of interest policy.

A broad search strategy was used to gather all studies that examine the diagnosis, surveillance or monitoring of AAAs. This was a 'bulk' search that covered multiple review questions. The reviewer sifted the database to identify all studies that met the set of criteria outlined in Tables 1 and 2, with the full protocols given in Appendix A.

Study were considered for inclusion if they were systematic reviews, randomised controlled trials or quasi-randomised controlled trials comparing different intervals for monitoring postoperative outcomes of AAA repair or trials comparing tailored and generalised surveillance strategies for monitoring postoperative complications. In the absence of preferred study designs, non-randomised controlled trials and prospective cohort studies with sample sizes of 500 participants, or more, were included.

Studies were excluded if they:

- were not in English
- were not full reports of the study (for example, published only as an abstract)
- were not peer-reviewed

Clinical evidence

Included studies

An initial literature search produced a database of 12,786 abstracts. None were identified as being potentially relevant to review question 27 or 29.

An update search was conducted in December 2017, to identify any studies published during guideline development. The search found 2,598 abstracts; all of which were not considered relevant. As a result no additional studies were identified.

Excluded studies

No full text papers were retrieved. All studies were excluded at review of titles and abstracts.

Economic evidence

Included studies

A literature search was conducted jointly for all review questions in this guideline by applying standard health economic filters to a clinical search for AAA. This search returned a total of 5,173 citations. Following review of all titles and abstracts, 1 related to review question 27 was identified as being potentially relevant. Upon examination of the full study manuscript, this study was not considered relevant for inclusion. No studies were identified as being potentially relevant to review question 29.

An update search was conducted in December 2017, to identify any relevant health economic analyses published during guideline development. The search yielded 814 abstracts; all of which were not considered relevant. As a result no additional studies were identified.

Excluded studies

One study was excluded following full text review.

Evidence statements

No evidence was identified.

Recommendations

V1. Enrol people who have had endovascular aneurysm repair (EVAR) into a surveillance imaging programme.

V2. Base the frequency of surveillance imaging on the person's risk of graft-related complications.

Research recommendations

RR11. What are the risks, benefits and cost implications of different surveillance protocols in people who have undergone EVAR?

RR12. Which device and patient related variables can be used in a risk model to inform amendments to surveillance frequencies and modalities in people who have undergone EVAR?

Rationale and impact

Why the committee made the recommendations

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

The committee noted 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 complication. This should maximise attention for those patients at greatest risk, and help to identify complications earlier.

Since there is a lack of evidence on surveillance programmes for people who have had EVAR, the committee recommended further research in this area.

Impact of the recommendations on practice

The recommendations on surveillance programmes and frequency of surveillance reflect current practice, so organisations are unlikely to need to change practice.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

The outcomes which matter most are all-cause morbidity and mortality, aneurysm-related morbidity and mortality, as well as resource use.

The quality of the evidence

The committee was unable to make recommendations on specific imaging surveillance intervals because there was no evidence from clinical trials. As a result, generic recommendations were made to highlight that it is important for clincians to consider each patient's level of risk of postoperative complications and adjust surveillance protocols accordingly.

The committee discussed whether a maximum surveillance duration should be specified in the recommendations. It was noted that there is a long-term incidence of complications and reintervention after 5 years, although the incidence is relatively small. Given the lack of evidence the committee decided not to specify a surveillance duration and leave it to the discretion of the clinician, while recommending further research to clarify the issue.

Benefits and harms

The committee discussed whether recommendations were needed if postoperative surveillance is already being performed. However it was highlighted that not enrolling people who had undergone EVAR into a surveillance programme would be considered bad clinical practice. Therefore, the committee thought it was important to make an informal consensus recommendation to ensure that this does not happen.

The committee discussed whether to specify which complications would warrant changing surveillance protocols. It was noted that endoleak was the main complication that clinicians would be mindful of; however, other potential risks included aneurysm neck angle, diameter, shape and length, graft kinks and the potential for graft slippage. The committee also acknowledged that comorbidities could lead to alterations to surveillance protocols. With so many situations in which surveillance protocols could be amended, it was agreed that it is not possible to make extensive recommendations on every possible scenario. The committee noted that various risk assessment tools could be used in clinical practice and felt a research recommendation would help establish what factors would inform the decision to adjust surveillance frequencies and modalities.

The committee discussed the potential risk of over-treating people who have minor-to-moderate postoperative complications with surgical or endovascular reintervention, which may cause further harm. The committee noted that overtreatment is an potential risk but that, in the absence of clear natural history data for some imaging-identified complications, it is not possible to identify all people who are at risk of overtreatment in advance. In general, it was considered that benefits of treating EVAR-related complications outweigh the risks, so surveillance is justified.

It was noted that postoperative surveillance may impact on the psychological health of people who have undergone EVAR: some people would feel reassured by being entered into a surveillance programme whereas others would feel stressed by a repeated reminder that complications could arise after surgery. As a result, it was considered important to encourage research exploring patients' attitudes and experiences after EVAR and comparing them with those who receive open surgical repair.

Cost effectiveness and resource use

The committee believed that recommending that postoperative surveillance intervals are amended in accordance with each patient's perceived level of risk is unlikely to impact on cost effectiveness. This is because the recommendations assert what is generally being done in clinical practice.

Other factors the committee took into account

The committee discussed whether there was a need to make recommendations about tailoring imaging modalities and agreed that it was not necessary as recommendations about postoperative monitoring are covered elsewhere in the guideline (see evidence review W). The committee recognised the general lack of experience dealing with complex aneurysm morphologies but felt unable to recommend specific surveillance frequencies given the wide variation in practice and lack of evidence.

The committee discussed whether different recommendations were appropriate for women compared with men. It was agreed that the same need to monitor postoperative complications applied to both groups. Furthermore, the committee agreed that surveillance intervals for women are just as variable as those for men. As a result, no specific recommendation was made in relation to women.

1 Appendices

2 Appendix A – Review protocols

3 Review protocol for how frequently people should be monitored to detect 4 complications

Review question 27	How frequently should people be monitored for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?
Objectives	To determine appropriate intervals for monitoring of people who have undergone surgical repair of an abdominal aortic aneurysm; that is, how frequently people should be monitored to detect complications (endoleak, graft migration, graft kinking, incisional hernia, graft occlusion and aortic neck expansion), further aneurysm expansion and aneurysm rupture)
Type of review	Intervention
Language	English
Study design	Systematic reviews of study designs listed below Randomised controlled trials Quasi-randomised controlled trials If insufficient evidence identified, non-randomised controlled trials and prospective cohort studies (n >500)
Status	Published papers only (full text) No date restrictions
Population	People who have undergone surgical repair of an abdominal aortic aneurysm Subgroup: age, sex, comorbidities, compliance with surveillance
Intervention	Varying intervals of monitoring/surveillance and defined protocols (also accounting for imaging technique and time since surgery)
Comparator	Each other
Outcomes	AAA rupture Further AAA growth/expansion Mortality; survival Need for additional intervention, including both emergency and elective surgical intervention Compliance Quality of life Adverse effects, including incidence of cancer, renal complications (contrast-induced nephrotoxicity) Lower limb, visceral and renal ischaemia Resource use and cost
Other criteria for inclusion / exclusion of studies	Exclusion: Non-English language Abstract/non-published (i only)
Baseline characteristics to be extracted in evidence tables	Age Sex Size of aneurysm Comorbidities Date of surgical intervention
Search strategies	See Appendix B

Review question 27	How frequently should people be monitored for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?
Review strategies	Appropriate NICE Methodology Checklists, depending on study designs, will be used as a guide to appraise the quality of individual studies. Data on all included studies will be extracted into evidence tables. Where statistically possible, a meta-analytic approach will be used to give an overall summary effect. All key findings from evidence will be presented in GRADE profiles and further summarised in evidence statements.
Key papers	None identified

Review protocol for risk factors for whether tailored surveillance or generalised surveillance is more effective in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair

Review question 29	Is tailored surveillance more effective than generalised surveillance in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?
Objectives	To determine whether tailored surveillance or generalised surveillance is more effective in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm.
Type of review	Intervention
Language	English
Study design	Systematic reviews of study designs listed below Randomised controlled trials Quasi-randomised controlled trials If insufficient evidence identified, non-randomised controlled trials and prospective cohort studies (n >500)
Status	Published papers only (full text) No date restrictions
Population	People who have undergone surgical repair of an abdominal aortic aneurysm
Intervention	Tailored / stratified / individualised / personalised surveillance
Comparator	Generalised / routine surveillance
Outcomes	AAA rupture Further AAA growth/expansion Mortality; survival Need for additional intervention, including both emergency and elective surgical intervention Compliance Quality of life Adverse effects, including incidence of cancer, renal complications (contrast-induced nephrotoxicity) Lower limb, visceral and renal ischaemia Resource use and cost
Other criteria for inclusion / exclusion of studies	Exclusion: Non-English language Abstract/non-published (i only)

Review question 29	Is tailored surveillance more effective than generalised surveillance in monitoring for postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm?
Baseline characteristics to be extracted in evidence tables	Age Sex Size of aneurysm Comorbidities Date of surgical intervention
Search strategies	To be developed
Review strategies	Appropriate NICE Methodology Checklists, depending on study designs, will be used as a guide to appraise the quality of individual studies. Data on all included studies will be extracted into evidence tables. Where statistically possible, a meta-analytic approach will be used to give an overall summary effect. All key findings from evidence will be presented in GRADE profiles and further summarised in evidence statements.
Key papers	None identified

1

Appendix B – Literature search strategies

Clinical search literature search strategy

Main searches

Bibliographic databases searched for the guideline

- Cumulative Index to Nursing and Allied Health Literature - CINAHL (EBSCO)
- Cochrane Database of Systematic Reviews – CDSR (Wiley)
- Cochrane Central Register of Controlled Trials – CENTRAL (Wiley)
- Database of Abstracts of Reviews of Effects – DARE (Wiley)
- Health Technology Assessment Database – HTA (Wiley)
- EMBASE (Ovid)
- MEDLINE (Ovid)
- MEDLINE Epub Ahead of Print (Ovid)
- MEDLINE In-Process (Ovid)

Identification of evidence for review questions

The searches were conducted between November 2015 and October 2017 for 31 review questions (RQ). In collaboration with Cochrane, the evidence for several review questions was identified by an update of an existing Cochrane review. Review questions in this category are indicated below. Where review questions had a broader scope, supplement searches were undertaken by NICE.

Searches were re-run in December 2017.

Where appropriate, study design filters (either designed in-house or by McMaster) were used to limit the retrieval to, for example, randomised controlled trials. Details of the study design filters used can be found in section 4.

Search strategy review questions 27 and 29

Medline Strategy, searched 13th April 2016 **Database: Ovid MEDLINE(R) 1946 to March Week 5 2016** **Search Strategy:**
1 Aortic Aneurysm, Abdominal/
2 (aneurysm* adj4 (abdom* or thoracoabdom* or thoraco-abdom* or aort* or spontan* or juxtarenal* or juxta-renal* or juxta renal* or paraerenal* or para-renal* or para renal* or suprarenal* or supra renal* or supra-renal* or short neck* or short-neck* or shortneck* or visceral aortic segment*)).tw.
3 Aortic Rupture/
4 (AAA or RAAA).tw.
5 (endovascular* adj4 aneurysm* adj4 repair*).tw.
6 (endovascular* adj4 aort* adj4 repair*).tw.
7 (EVAR or EVRAR or FEVAR or F-EAVAR or BEVAR or B-EVAR).tw.
8 (Anaconda or Zenith Dynalink or Hemobahn or Luminex* or Memoth-erm or Wallstent).tw.
9 (Viabahn or Nitinol or Hemobahn or Intracoil or Tantalum).tw.
10 or/1-9
11 X-Rays/

Medline Strategy, searched 13th April 2016
Database: Ovid MEDLINE(R) 1946 to March Week 5 2016
Search Strategy:

12 (x-ray* or x ray* or xray* or x-radiation* or x radiation* or roentgen ray* or grenz ray* or radiograph*).tw.
13 Aortography/
14 aortograph*.tw.
15 Tomography, X-Ray Computed/ (
16 (cat scan* or ct scan* or cine ct or cine-ct or tomodensitomet*).tw.
17 ((computed or computer assisted or computeriz* or computeris* or electron beam* or axial*) adj4 tomograph*).tw.
18 Four-Dimensional Computed Tomography/
19 (4d ct or 4dct or 4-dimensional CT or four dimensional CT).tw.
20 exp Tomography, Spiral Computed/
21 ((helical or spiral) adj4 ct*).tw.
22 exp Magnetic Resonance Imaging/
23 (nmr tomograph* or mr tomograph* or nmr imag* or mri scan* or functional mri* or fmri* or zeugmatograph* or cine-mri* or cinemri*).tw.
24 (proton spin adj4 tomograph*).tw.
25 ((chemical shift or magnetic resonance or magneti* transfer) adj4 imag*).tw.
26 exp Angiography/
27 (angiograph* or arteriograph*).tw.
28 exp Ultrasonography/
29 (ultrasound* or ultrason* or sonograph* or echograph* or echotomograph*).tw.
30 exp Echocardiography/
31 echocardiograph*.tw.
32 Finite element analysis/
33 (finite adj4 element* adj4 analys*).tw.
34 (finite adj4 element* adj4 comput*).tw.
35 FEA.tw.
36 ((wall adj4 stress adj4 analys*) or (wall adj4 stress adj4 comput*)).tw.
37 exp Computer simulation/
38 Software/
39 Image interpretation, computer-assisted/ or Radiographic image interpretation, computer-assisted/
40 Imaging Three-Dimensional/
41 exp Image enhancement/
42 Stress, mechanical/
43 (stress* adj4 mechanical*).tw.
44 (scan* or imag*).tw.
45 Watchful waiting/
46 (watchful adj4 waiting*).tw.
47 Mass screening/
48 screen*.tw.
49 Population surveillance/
50 surveillan*.tw.
51 ((period* or test* or frequen* or regular* or routine* or rate or optimal* or optimis* or optimiz* or repeat* or interval*) adj4 (test* or monitor* or observ* or measur* or assess* or screen* or re-screen* or rescreen* or exam* or evaluat*)).tw.
52 ((aneursym* or sign* or diameter or risk*) adj4 (grow* or siz* or measur* or expan* or ruptur* or tear* or progress* or enlarg* or dilat* or bulg* or evaluat*)).tw.
53 Patient Selection/
54 ((patient or subject or criteria or treatment*) adj4 select*).tw.

Medline Strategy, searched 13th April 2016 **Database: Ovid MEDLINE(R) 1946 to March Week 5 2016** **Search Strategy:**
55 ((follow-up or follow up) adj4 (visit* or repeat* or monitor* or assess* or care*)).tw.
56 Aftercare/
57 (aftercare or after-care).tw.
58 Disease progression/
59 ((disease or illness or condition) adj4 (progress* or worsen* or exacerbat* or deterior* or course or duration or trajector* or improv* or recur* or relaps* or remission)).tw.
60 or/11-59
61 10 and 60
62 animals/ not humans/
63 61 not 62
64 limit 63 to english language
Note: RCT, Systematic Review and Observational study filters appended to strategy.

Health Economics literature search strategy

Sources searched to identify economic evaluations

- NHS Economic Evaluation Database – NHS EED (Wiley) last updated Dec 2014
- Health Technology Assessment Database – HTA (Wiley) last updated Oct 2016
- Embase (Ovid)
- MEDLINE (Ovid)
- MEDLINE In-Process (Ovid)

Search filters to retrieve economic evaluations and quality of life papers were appended to the population and intervention terms to identify relevant evidence. Searches were not undertaken for qualitative RQs. For social care topic questions additional terms were added. Searches were re-run in September 2017 where the filters were added to the population terms.

Health economics search strategy

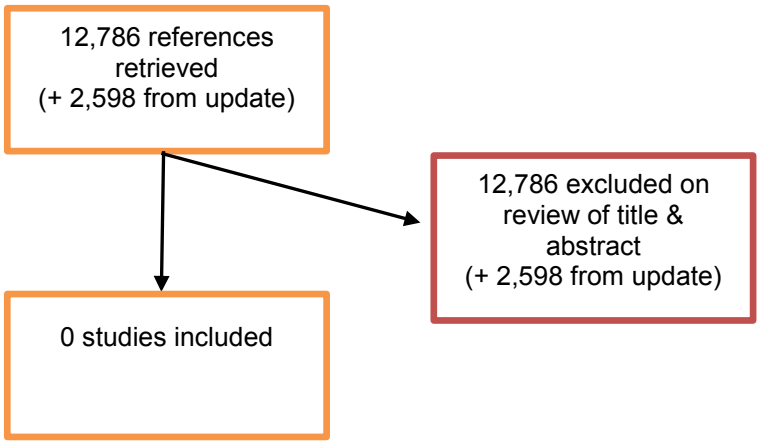
Medline Strategy
Economic evaluations
1 Economics/
2 exp "Costs and Cost Analysis"/
3 Economics, Dental/
4 exp Economics, Hospital/
5 exp Economics, Medical/
6 Economics, Nursing/
7 Economics, Pharmaceutical/
8 Budgets/
9 exp Models, Economic/
10 Markov Chains/
11 Monte Carlo Method/
12 Decision Trees/
13 econom*.tw.
14 cba.tw.
15 cea.tw.
16 cua.tw.

Medline Strategy

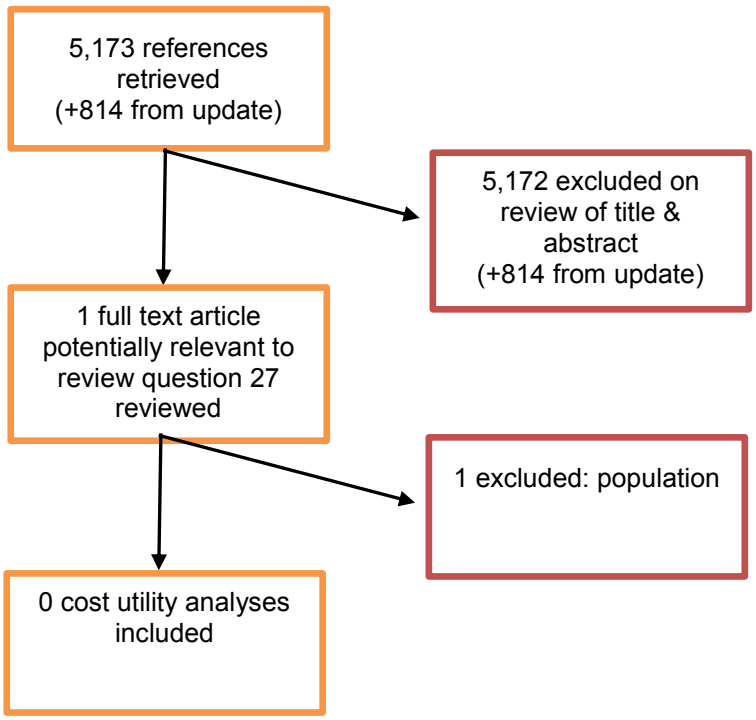
17 markov*.tw.
18 (monte adj carlo).tw.
19 (decision adj3 (tree* or analys*)).tw.
20 (cost or costs or costing* or costly or costed).tw.
21 (price* or pricing*).tw.
22 budget*.tw.
23 expenditure*.tw.
24 (value adj3 (money or monetary)).tw.
25 (pharmacoeconomic* or (pharmaco adj economic*)).tw.
26 or/1-25

Quality of life
1 "Quality of Life"/
2 quality of life.tw.
3 "Value of Life"/
4 Quality-Adjusted Life Years/
5 quality adjusted life.tw.
6 (qaly* or qald* or qale* or qtime*).tw.
7 disability adjusted life.tw.
8 daly*.tw.
9 Health Status Indicators/
10 (sf36 or sf 36 or short form 36 or shortform 36 or sf thirtysix or sf thirty six or shortform thirtysix or shortform thirty six or short form thirtysix or short form thirty six).tw.
11 (sf6 or sf 6 or short form 6 or shortform 6 or sf six or sfsix or shortform six or short form six).tw.
12 (sf12 or sf 12 or short form 12 or shortform 12 or sf twelve or sftwelve or shortform twelve or short form twelve).tw.
13 (sf16 or sf 16 or short form 16 or shortform 16 or sf sixteen or sfsixteen or shortform sixteen or short form sixteen).tw.
14 (sf20 or sf 20 or short form 20 or shortform 20 or sf twenty or sftwenty or shortform twenty or short form twenty).tw.
15 (euroqol or euro qol or eq5d or eq 5d).tw.
16 (qol or hql or hqol or hrqol).tw.
17 (hye or hyes).tw.
18 health* year* equivalent*.tw.
19 utilit*.tw.
20 (hui or hui1 or hui2 or hui3).tw.
21 disutili*.tw.
22 rosser.tw.
23 quality of wellbeing.tw.
24 quality of well-being.tw.
25 qwb.tw.
26 willingness to pay.tw.
27 standard gamble*.tw.
28 time trade off.tw.
29 time tradeoff.tw.
30 tto.tw.
31 or/1-30

Appendix C – Clinical evidence study selection



Appendix D – Economic evidence study selection



Appendix E – Excluded studies

Clinical studies

No full text papers were retrieved. All studies were excluded at review of titles and abstracts.

Economic studies

Short Title	Title	Reason for exclusion
Post et al. (2004)	Optimal follow-up strategies after aorto-iliac prosthetic reconstruction: a decision analysis and cost-effectiveness analysis. Eur J Vasc Endovasc Surg; 28: 287-95.	Population: results not reported for abdominal aortic aneurysm sub-population.

Appendix F – Research recommendations

Surveillance protocols for monitoring postoperative outcomes

Research recommendation	What are the risks, benefits and cost implications of different surveillance protocols in people who have undergone EVAR?
Population	People who have undergone surgical repair of an abdominal aortic aneurysm o Stratified by: age, sex, comorbidities, compliance with surveillance
Intervention(s)	Varying intervals of surveillance and defined protocols, accounting for imaging technique and time since surgery.
Comparator(s)	Each other
Outcomes	• AAA rupture • Further AAA growth/expansion • Mortality; survival • Need for additional intervention, including both emergency and elective surgical intervention • Adverse effects, including incidence of cancer, renal complications (contrast-induced nephrotoxicity) • Lower limb, visceral and renal ischaemia • Compliance • Quality of life • Resource use and cost
Study design	Systematic review and statistical modelling

Potential criterion	Explanation
Importance to patients, service users or the population	Well conducted RCTs comparing different surveillance intervals and imaging modalities, would enable more specific and individually tailored treatment choices to be made in the future.
Relevance to NICE guidance	Medium priority: the research would fill relevant gaps in the evidence base, but it is possible to make generic recommendations for amending postoperative surveillance based on clinical expertise.
Current evidence base	No evidence was found that explored which surveillance intervals or tailored surveillance approaches were most effective in monitoring postoperative complications, further aneurysm expansion and aneurysm rupture after EVAR or open repair of an abdominal aortic aneurysm.
Equality	No specific equality concerns are relevant to this research recommendation.
Feasibility	The clinical data to produce a systematic review or populate a health economic model in this area is already available, and therefore no further primary data collection is likely to be necessary in order to conduct an economic evaluation.

Patient and device-related factors that may affect postoperative surveillance decisions

Research recommendation	Which device and patient related variables can be used in a risk model to inform amendments to surveillance frequencies and modalities in people who have undergone EVAR?
Population	People who have undergone surgical repair of an abdominal aortic aneurysm ○ Stratified by: age, sex, comorbidities, compliance with surveillance
Factors of interest	• Graft-related complications (including endoleak, graft migration, graft kinking, incisional hernia, graft occlusion, aortic neck expansion • Aneurysm size (before and after surgery surgery) • Pre- or postoperative rate of aneurysm expansion • AAA wall stress • Vessel asymmetry • Growth of intraluminal thrombus • Other surgery, particularly abdominal or urological • Stiffness of the aorta (pulse wave velocity = surrogate marker) • Age • Sex • Ethnicity • BMI/weight/obesity • Smoking status • Other cardiovascular disease (existing or previous) – other aneurysms, atherosclerotic disease, vascular claudication • Inflammatory disease • Blood pressure/hypertension • Diabetes
Endpoints	• Changes to surveillance frequency • Changes to duration of surveillance • Changes to imaging modality
Study	Prospective observational studies that employ multivariate analysis

Potential criterion	Explanation
Importance to patients, service users or the population	Various risk assessment tools for evaluating operative risk are available; however, it is unclear whether these tools are suitable for determining whether patients need more or less frequent surveillance, or which tools would help establish what imagining modality should be used when performing postoperative surveillance. For this reason, the committee agreed that development of a risk model, which incorporates both device- and patient-related variables, would inform decisions on postoperative surveillance intervals and durations, as well as imaging modalities.
Relevance to NICE guidance	High priority: the research would fill notable gaps in the evidence base as no risk models dedicated to postoperative surveillance are currently available.
Current evidence base	No evidence was found that explored which combination of patient- and device-related factors influenced the decision to amend postoperative surveillance intervals.
Equality	No specific equality concerns are relevant to this research recommendation.
Feasibility	There is a sufficiently large and well defined population available that large prospective observational studies, which employ multivariate analysis, should be feasible.

Appendix G – Glossary

Abdominal Aortic Aneurysm (AAA)

A localised bulge in the abdominal aorta (the major blood vessel that supplies blood to the lower half of the body including the abdomen, pelvis and lower limbs) caused by weakening of the aortic wall. It is defined as an aortic diameter greater than 3 cm or a diameter more than 50% larger than the normal width of a healthy aorta. The clinical relevance of AAA is that the condition may lead to a life threatening rupture of the affected artery. Abdominal aortic aneurysms are generally characterised by their shape, size and cause:

- Infrarenal AAA: an aneurysm located in the lower segment of the abdominal aorta below the kidneys.
- Juxtarenal AAA: a type of infrarenal aneurysm that extends to, and sometimes, includes the lower margin of renal artery origins.
- Suprarenal AAA: an aneurysm involving the aorta below the diaphragm and above the renal arteries involving some or all of the visceral aortic segment and hence the origins of the renal, superior mesenteric, and celiac arteries, it may extend down to the aortic bifurcation.

Abdominal compartment syndrome

Abdominal compartment syndrome occurs when the pressure within the abdominal cavity increases above 20 mm Hg (intra-abdominal hypertension). In the context of a ruptured AAA this is due to the mass effect of a volume of blood within or behind the abdominal cavity. The increased abdominal pressure reduces blood flow to abdominal organs and impairs pulmonary, cardiovascular, renal, and gastro-intestinal function. This can cause multiple organ dysfunction and eventually lead to death.

Cardiopulmonary exercise testing

Cardiopulmonary Exercise Testing (CPET, sometimes also called CPX testing) is a non-invasive approach used to assess how the body performs before and during exercise. During CPET, the patient performs exercise on a stationary bicycle while breathing through a mouthpiece. Each breath is measured to assess the performance of the lungs and cardiovascular system. A heart tracing device (Electrocardiogram) will also record the hearts electrical activity before, during and after exercise.

Device migration

Migration can occur after device implantation when there is any movement or displacement of a stent-graft from its original position relative to the aorta or renal arteries. The risk of migration increases with time and can result in the loss of device fixation. Device migration may not need further treatment but should be monitored as it can lead to complications such as aneurysm rupture or endoleak.

Endoleak

An endoleak is the persistence of blood flow outside an endovascular stent - graft but within the aneurysm sac in which the graft is placed.

- Type I – Perigraft (at the proximal or distal seal zones): This form of endoleak is caused by blood flowing into the aneurysm because of an incomplete or ineffective seal at either end of an endograft. The blood flow creates pressure within the sac and significantly increases the risk of sac enlargement and rupture. As a result, Type I endoleaks typically require urgent attention.

- Type II – Retrograde or collateral (mesenteric, lumbar, renal accessory): These endoleaks are the most common type of endoleak. They occur when blood bleeds into the sac from small side branches of the aorta. They are generally considered benign because they are usually at low pressure and tend to resolve spontaneously over time without any need for intervention. Treatment of the endoleak is indicated if the aneurysm sac continues to expand.

- Type III – Midgraft (fabric tear, graft dislocation, graft disintegration): These endoleaks occur when blood flows into the aneurysm sac through defects in the endograft (such as graft fractures, misaligned graft joints and holes in the graft fabric). Similarly to Type I endoleak, a Type III endoleak results in systemic blood pressure within the aneurysm sac that increases the risk of rupture. Therefore, Type III endoleaks typically require urgent attention.

- Type IV– Graft porosity: These endoleaks often occur soon after AAA repair and are associated with the porosity of certain graft materials. They are caused by blood flowing through the graft fabric into the aneurysm sac. They do not usually require treatment and tend to resolve within a few days of graft placement.

- Type V – Endotension: A Type V endoleak is a phenomenon in which there is continued sac expansion without radiographic evidence of a leak site. It is a poorly understood abnormality. One theory that it is caused by pulsation of the graft wall, with transmission of the pulse wave through the aneurysm sac to the native aneurysm wall. Alternatively it may be due to intermittent leaks which are not apparent at imaging. It can be difficult to identify and treat any cause.

Endovascular aneurysm repair

Endovascular aneurysm repair (EVAR) is a technique that involves placing a stent –graft prosthesis within an aneurysm. The stent-graft is inserted through a small incision in the femoral artery in the groin, then delivered to the site of the aneurysm using catheters and guidewires and placed in position under X-ray guidance.

- Conventional EVAR refers to placement of an endovascular stent graft in an AAA where the anatomy of the aneurysm is such that the ‘instructions for use’ of that particular device are adhered to. Instructions for use define tolerances for AAA anatomy that the device manufacturer considers appropriate for that device. Common limitations on AAA anatomy are infrarenal neck length (usually >10mm), diameter (usually ≤30mm) and neck angle relative to the main body of the AAA

- Complex EVAR refers to a number of endovascular strategies that have been developed to address the challenges of aortic proximal neck fixation associated with complicated aneurysm anatomies like those seen in juxtarenal and suprarenal AAAs. These strategies include using conventional infrarenal aortic stent grafts outside their ‘instructions for use’, using physician-modified endografts, utilisation of customised fenestrated endografts, and employing snorkel or chimney approaches with parallel covered stents.

Goal directed therapy

Goal directed therapy refers to a method of fluid administration that relies on minimally invasive cardiac output monitoring to tailor fluid administration to a maximal cardiac output or other reliable markers of cardiac function such as stroke volume variation or pulse pressure variation.

Post processing technique

For the purpose of this review, a post-processing technique refers to a software package that is used to augment imaging obtained from CT scans, (which are conventionally presented as axial images), to provide additional 2- or 3-dimensional imaging and data relating to an aneurysm's, size, position and anatomy.

Permissive hypotension

Permissive hypotension (also known as hypotensive resuscitation and restrictive volume resuscitation) is a method of fluid administration commonly used in people with haemorrhage after trauma. The basic principle of the technique is to maintain haemostasis (the stopping of blood flow) by keeping a person's blood pressure within a lower than normal range. In theory, a lower blood pressure means that blood loss will be slower, and more easily controlled by the pressure of internal self-tamponade and clot formation.

Remote ischemic preconditioning

Remote ischemic preconditioning is a procedure that aims to reduce damage (ischaemic injury) that may occur from a restriction in the blood supply to tissues during surgery. The technique aims to trigger the body's natural protective functions. It is sometimes performed before surgery and involves repeated, temporary cessation of blood flow to a limb to create ischemia (lack of oxygen and glucose) in the tissue. In theory, this "conditioning" activates physiological pathways that render the heart muscle resistant to subsequent prolonged periods of ischaemia.

Tranexamic acid

Tranexamic acid is an antifibrinolytic agent (medication that promotes blood clotting) that can be used to prevent, stop or reduce unwanted bleeding. It is often used to reduce the need for blood transfusion in adults having surgery, in trauma and in massive obstetric haemorrhage.