TREATMENT OF THE

ABDOMINAL AORTA ANEURYSM
When should we treat an AAA?
• Recommendation 22
• In men, the threshold for considering elective abdominal aortic aneurysm repair is recommended to be 5.5 cm diameter
• 1A
• Recommendation 23
• In women with acceptable surgical risk the threshold for considering elective abdominal aortic aneurysm repair may be considered to be 5.0 cm diameter
• 2b, C
• Recommendation 24
• When rapid abdominal aortic aneurysm growth is observed (1cm/year), fast track referral to a vascular surgeon with additional imaging should be considered
• 2a,C
• Recommendation 25
• Emergency referral to a vascular surgeon of patients with symptomatic abdominal aortic aneurysm is recommended
• 1, C
• Recommendation 7
• Ultrasonography is recommended for the first line diagnosis and surveillance of small abdominal aortic aneurysms
• 1B
Recommendation 10

Aortic diameter measurement with computed tomography angiography should be considered using dedicated post-processing software analysis in three perpendicular planes with a consistent calliper placement.
Which work up?
• Recommendation 27
• Routine referral for cardiac work up, coronary angiography and cardiopulmonary exercise testing is not recommended prior to abdominal aortic aneurysm repair

• 3 C
Recommendation 29

In patients with **stable** coronary artery disease, routine coronary revascularisation before elective abdominal aortic aneurysm repair is **not recommended**

Class 3, Level B
• Recommendation 34
• In all patients, pulmonary function testing with spirometry prior to elective abdominal aortic aneurysm repair should be considered
• Class 2a Level A
Recommendation 40

Routine screening for asymptomatic carotid stenosis prior to abdominal aortic aneurysm repair is not recommended

Class 3 Level A
• Recommendation 44
• Statins are recommended before (if possible, at least 4 weeks) elective abdominal aortic aneurysm surgery to reduce cardiovascular morbidity
• Class 1 Level A
• Recommendation 43
• Commencement of beta blockers is not recommended just before abdominal aortic aneurysm repair
• Class 3 Level A
• Recommendation 45
• An established monotherapy with aspirin or thienopyridines (e.g. clopidogrel) is recommended to be continued during the peri-operative period after open and endovascular abdominal aortic aneurysm repair
• Class 1 Level B
Which technique?
Advantages of endografts (EVAR)

• Less invasive
• No incision
• Can be done under local anesthesia
• No aortic clamping
• No bleeding
• Less post operative complications
• Reduced mortality
• No need for ICU
• Reduced LOS
Drawbacks of endografts (EVAR)

• Not applicable to all AAA (neck, access, tortuositites, angulation, calcifications..)

Endoleaks

Long term durability?
Table 4.4. Anatomical requirements for the most commonly used stent grafts according to the latest instruction for use available from the authors.

<table>
<thead>
<tr>
<th>Anatomical parameter</th>
<th>Endurant</th>
<th>Excluder</th>
<th>Zenith</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck length</td>
<td>$\geq 10$ mm$^a$</td>
<td>$\geq 15$ mm</td>
<td>$\geq 15$ mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>19–32</td>
<td>19–29</td>
<td>18–32</td>
</tr>
<tr>
<td>Suprarenal neck angulation ($\alpha$-angle)</td>
<td>$\leq 45^\circ$</td>
<td>$-$</td>
<td>$&lt; 45^\circ$</td>
</tr>
<tr>
<td>Infrarenal neck angulation ($\beta$-angle)</td>
<td>$\leq 60^\circ$</td>
<td>$\leq 60^\circ$</td>
<td>$&lt; 60^\circ$</td>
</tr>
<tr>
<td>Distal fixation site length</td>
<td>$\geq 15$ mm</td>
<td>$\geq 10$ mm</td>
<td>$&gt; 10$ mm</td>
</tr>
<tr>
<td>Distal fixation site diameter</td>
<td>8–25 mm</td>
<td>8–25 mm</td>
<td>7.5–20 mm</td>
</tr>
<tr>
<td>Additional criteria</td>
<td>No significant or circumferential calcification or thrombus in proximal and distal landing zone. No conical neck shape (&lt;2–3 mm increase in neck diameter for each centimetre of length) Adequate femoral access.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ $\geq 15$ mm with $>60^\circ$ to $\leq 75^\circ$ infrarenal and $>45^\circ$ to $\leq 60^\circ$ suprarenal neck angulation.
Contra indications for EVAR
Shaggy aorta, no neck, marked angulation
Poor access (external iliac <7mm)
Fenestrated or branched endografts
Pre op measurements; custom made grafts

MPRc

Left renal
• ENDOLEAKS
Type 1, 3, 4 endoleaks should be treated without delay.
Type 1 endoleak (completion angio)
Type II Endoleak – Natural history

- Predominantly benign
- 60% resolve within 6 months
- 5.5%-24% will promote sac enlargement
- low risk of rupture
• Recommendation 88
• Re-intervention for Type II endoleak after endovascular abdominal aortic aneurysm repair should be considered in the presence of significant aneurysm growth (>1cm)
• primarily by endovascular means
Type 2 endoleak from the IMA
IMA embolisation
Type 2 endoleak
Lumbar artery
Type 2 endoleak
Direct sac puncture and polymer injection
Type 3 endoleak, 10 years after EVAR
type 3 endoleak

2 years post op: normal control

5 years post op: Type 3
Follow up

• At least one DUS every year

• If more than 1cm enlargement: Angio CT
DURABILITY?
EVAR in 2011
Bilateral sub acute ischemia
### EVAR versus Surgery: RCTs

Table 4.5. Summary of randomised controlled trials comparing elective endovascular and open repair for abdominal aortic aneurysm.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Recruitment period</th>
<th>n of pts</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAR 1</td>
<td>UK</td>
<td>1999–2003</td>
<td>1082</td>
<td>Better peri-operative survival after EVAR (1.7% vs. 4.7%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Early survival benefit lost after 2 years, with similar long-term survival</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Higher aneurysm related mortality in the EVAR group after 8 years, mainly attributable to secondary aneurysm sac rupture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Higher re-intervention rate after EVAR</td>
</tr>
<tr>
<td>DREAM</td>
<td>The Netherlands and Belgium</td>
<td>2000–2003</td>
<td>351</td>
<td>Better peri-operative survival after EVAR (1.2% vs. 4.6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Early survival benefit was lost by the end of the first year, with similar long-term survival</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Higher re-intervention rate after EVAR</td>
</tr>
<tr>
<td>OVER</td>
<td>USA</td>
<td>2002–2008</td>
<td>881</td>
<td>Better peri-operative survival after EVAR (0.5% vs. 3%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Early survival benefit sustained to 3 years but not thereafter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in re-intervention rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in quality of life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in cost and cost effectiveness</td>
</tr>
<tr>
<td>ACE</td>
<td>France</td>
<td>2003–2008</td>
<td>316</td>
<td>No difference in peri-operative survival (1.3% vs. 0.6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in long-term survival up till 3 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Higher re-intervention rate after EVAR</td>
</tr>
</tbody>
</table>

JK = United Kingdom; USA = United States of America; EVAR = endovascular aneurysm repair.
EVAR 1

- 30-day operative mortality

- EVAR 11 of 614 1.8%

- Open repair 26 of 602 4.3% (1999)
More complications, more reinterventions

Figure 3: Kaplan-Meier curve of postoperative complications and reinterventions

*4-year point estimates for patients with complications or reinterventions.
Less invasive = less efficient?

= less durable?

• But our patients are also « less resistant » than before
Recommendation 60

In most patients with suitable anatomy and reasonable life expectancy, endovascular abdominal aortic aneurysm repair should be considered as the preferred treatment modality.

!! Importance of regular and long lasting follow-up

!! Risk of reinterventions
• Recommendation 61

• In patients with long life expectancy, open abdominal aortic aneurysm repair should be considered as the preferred treatment modality.
Thank you
TREATMENT OF THE
ABDOMINAL AORTA ANEURYSM
<table>
<thead>
<tr>
<th>RCT</th>
<th>Country</th>
<th>Recruitment period</th>
<th>n of pts</th>
<th>30 day mortality</th>
<th>Randomised to EVAR</th>
<th>Randomised to OSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nottingham 2006,434</td>
<td>UK</td>
<td>2002–2004</td>
<td>32</td>
<td>53%</td>
<td>53%</td>
<td></td>
</tr>
<tr>
<td>AJAX 2013,187</td>
<td>The Netherlands</td>
<td>2004–2011</td>
<td>116</td>
<td>28%</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>IMPROVE 2014,389</td>
<td>UK</td>
<td>2009–2013</td>
<td>613</td>
<td>35%</td>
<td>37%</td>
<td></td>
</tr>
<tr>
<td>ECAR 2015,399</td>
<td>France</td>
<td>2008–2013</td>
<td>107</td>
<td>18%</td>
<td>24%</td>
<td></td>
</tr>
</tbody>
</table>

n = number; pts = patients; EVAR = endovascular aneurysm repair; OSR = open surgical repair; RCT = randomized controlled trial.
Recommendation 57

For newer generations of stent grafts based on existing platforms, such as low profile devices, long-term follow up and evaluation of the durability in prospective registries is recommended

Class 1 Level
• Recommendation 59
• Laparoscopic abdominal aortic aneurysm repair is not recommended in routine clinical practice, outside highly specialised centres, registries or trials
• Class 3 Level C
• Recommendation 62
• In patients with limited life expectancy, elective abdominal aortic aneurysm repair is not recommended
• Class 3 Level
• Recommendation 70
• Selection of patients with ruptured abdominal aortic aneurysm for palliation based entirely on scoring systems or solely on advanced age is not recommended
• Class3 Level B
• Recommendation 74
• In patients with ruptured abdominal aortic aneurysm and suitable anatomy, endovascular repair is recommended as a first option
• Class I Level B
• Recommendation 66
• In patients with ruptured abdominal aortic aneurysm, a policy of permissive hypotension, by restricting fluid resuscitation, is recommended in the conscious patient
• Class 1 Level B
• Recommendation 67
• Local anaesthesia should be considered as the anaesthetic modality of choice for endovascular repair of ruptured abdominal aortic aneurysm whenever tolerated by the patient
• Class Level References
• IIa B [389,370,392]
• Recommendation 70
• Selection of patients with ruptured abdominal aortic aneurysm for palliation based entirely on scoring systems or solely on advanced age is not recommended
• Class Level References
  • III B [419,416,420,414,370,421,353,422,417,423,162,424-427,
Table 5.1. Comparison of peri-operative mortality figures between endovascular and open repair in administrative databases of patients with ruptured abdominal aortic aneurysm.

<table>
<thead>
<tr>
<th>Author</th>
<th>Publication year</th>
<th>Country</th>
<th>Study period</th>
<th>$n$ of patients (EVAR/OSR)</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greco,443</td>
<td>2006</td>
<td>USA</td>
<td>2000–2003</td>
<td>5798 (290/5508)</td>
<td>39%</td>
</tr>
<tr>
<td>Wanhainen,448</td>
<td>2008</td>
<td>Sweden</td>
<td>1994–2005</td>
<td>3516 (92/3424)</td>
<td>15%</td>
</tr>
<tr>
<td>Giles,442</td>
<td>2009</td>
<td>USA</td>
<td>2005–2007</td>
<td>567 (121/446)</td>
<td>24%</td>
</tr>
<tr>
<td>Holt,44</td>
<td>2010</td>
<td>UK</td>
<td>2003–2008</td>
<td>4414 (335/4079)</td>
<td>32%</td>
</tr>
<tr>
<td>Mani,8</td>
<td>2011</td>
<td>International</td>
<td>2005–2009</td>
<td>7040 (824/6216)</td>
<td>20%</td>
</tr>
<tr>
<td>Chen,440</td>
<td>2013</td>
<td>Taiwan</td>
<td>1998–2009</td>
<td>537 (39/498)</td>
<td>44%</td>
</tr>
<tr>
<td>Mohan,445</td>
<td>2014</td>
<td>USA</td>
<td>2001–2010</td>
<td>42,126 (8140/33,986)</td>
<td>26%</td>
</tr>
<tr>
<td>Trenner,44</td>
<td>2013</td>
<td>Germany</td>
<td>1999–2010</td>
<td>4859 (575/4284)</td>
<td>23%</td>
</tr>
<tr>
<td>Edwards,441</td>
<td>2014</td>
<td>USA</td>
<td>2001–2008</td>
<td>10,998 (1126/9872)</td>
<td>34%</td>
</tr>
<tr>
<td>Karthikesalingam,49</td>
<td>2014</td>
<td>England</td>
<td>2005–2010</td>
<td>6897 (569/6328)</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USA</td>
<td>2005–2010</td>
<td>19,174 (4003/15,171)</td>
<td>27%</td>
</tr>
<tr>
<td>Karthikesalingam,432</td>
<td>2016</td>
<td>England</td>
<td>2003–2012</td>
<td>12,467 (1184/11,283)</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweden</td>
<td>2003–2012</td>
<td>2829 (464/2365)</td>
<td>21%</td>
</tr>
<tr>
<td>Taylor,446</td>
<td>2016</td>
<td>New Zealand</td>
<td>2010–2014</td>
<td>285 (28/257)</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Summary data</strong></td>
<td></td>
<td></td>
<td></td>
<td>120,075</td>
<td>26.8%</td>
</tr>
</tbody>
</table>

$n =$ number; EVAR = endovascular aneurysm repair; OSR = open surgical repair.

$^a$ After propensity score matching. Result not included in summary data.
<table>
<thead>
<tr>
<th>RCT</th>
<th>Country</th>
<th>Recruitment period</th>
<th>n of pts</th>
<th>30 day mortality</th>
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</thead>
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<tr>
<td>Nottingham 2006,434</td>
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<td>28%</td>
</tr>
<tr>
<td>IMPROVE 2014,389</td>
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<td>35%</td>
</tr>
<tr>
<td>ECAR 2015,399</td>
<td>France</td>
<td>2008–2013</td>
<td>107</td>
<td>18%</td>
</tr>
</tbody>
</table>

\[n = \text{number}; \text{pts} = \text{patients}; \text{EVAR} = \text{endovascular aneurysm repair}; \text{OSR} = \text{open surgical repair}; \text{RCT} = \text{randomized controlled trial}.\]
• Recommendation 74

• In patients with ruptured abdominal aortic aneurysm and suitable anatomy, endovascular repair is recommended as a first option

• Class I Level References
• I B [25,26,470]
Table 6.1. Long-term complications after open abdominal aortic aneurysm repair, and their incidence within 5 and 10–15 years.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Estimated frequency during 5 year follow up</th>
<th>Estimated frequency during 10 year follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Para-anastomotic aneurysm formation</td>
<td>1%</td>
<td>12% (15 years)</td>
</tr>
<tr>
<td>Limb occlusion</td>
<td>1%</td>
<td>5% (15 years)</td>
</tr>
<tr>
<td>Incisional hernia</td>
<td>5–12%</td>
<td>5–21%</td>
</tr>
<tr>
<td>Graft infection</td>
<td>0.5–5%</td>
<td></td>
</tr>
<tr>
<td>Secondary aorto-enteric fistula</td>
<td>&lt;1%</td>
<td></td>
</tr>
</tbody>
</table>

References: [492-494,310,311].
• Recommendation 82
• In any patient with an aortic prosthesis presenting with gastrointestinal bleeding, prompt assessment to identify a possible secondary aortoenteric fistula is recommended
• Class Level References
• I C [537,540]
• Recommendation 85
• In all patients after open repair for abdominal aortic aneurysm, imaging follow up of the aorta and peripheral arteries may be considered every five years
• Class Level References
• IIb C [549,548]
• Recommendation 86
• In patients with Type I endoleak after endovascular abdominal aortic aneurysm repair, re-intervention to achieve a seal, primarily by endovascular means, is recommended
• Class Level References
• I [554,553]
• Recommendation 87
• Expansion of sac diameter $\pm$1 cm detected during follow up
• after endovascular abdominal aortic aneurysm repair using
• the same imaging modality and measurement method may
• be considered as a reasonable threshold for significant growth
• Class Level References
• IIb C [499]
• Recommendation 89
• In patients with Type III endoleak after endovascular abdominal aortic aneurysm repair, re-intervention is recommended, primarily by endovascular means
• Class Level References
• I C [55
• Recommendation 90
• Significant aneurysm sac growth after endovascular
  abdominal aortic aneurysm repair, without visible endoleak
• on standard imaging, should be considered for further
• diagnostic evaluation with alternative imaging modalities
• to exclude the presence of an unidentified endoleak, and
• should be considered for treatment
• Class Level References
• Ila C
Table 6.3. Imaging techniques applicable to detection of endovascular aneurysm repair complications and used during follow-up. (Modified from Dellagrammaticas et al.\textsuperscript{586}).

<table>
<thead>
<tr>
<th>Imaging modality</th>
<th>AXR</th>
<th>DUS</th>
<th>CE-DUS</th>
<th>CT</th>
<th>CTA</th>
<th>MRA</th>
<th>PET-CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVAR complication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aneurysm sac</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>enlargement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endoleak</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sealing zone and</td>
<td>Yes</td>
<td>Limited</td>
<td>Limited</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>component overlap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migration</td>
<td>Yes</td>
<td>Limited</td>
<td>Limited</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Limb kinking or</td>
<td>No</td>
<td>Yes</td>
<td>Limited</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Kinking</td>
</tr>
<tr>
<td>occlusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stentgraft infection</td>
<td>No</td>
<td>Limited</td>
<td>Limited</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ionizing radiation</td>
<td>None known</td>
<td>None known</td>
<td>Ionizing radiation</td>
<td>Ionizing radiation. Contrast nephropathy. Risk for nephrogenic systemic fibrosis if eGFR&lt;30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ionizing radiation</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Technical aspects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproducibility</td>
<td>No - combined with DUS/CE-DUS</td>
<td>No - combined with CT or AXR ± CE-DUS</td>
<td>No - combined with DUS/CE-DUS</td>
<td>No - combined with CT or AXR ± CE-DUS</td>
<td>Yes</td>
<td>No - as complement to CT/AXR + DUS/CE-DUS</td>
<td>No - only in case of suspected infection</td>
</tr>
<tr>
<td>difficult due to changes in patient position</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator and patient</td>
<td>As DUS</td>
<td>None</td>
<td>Timing of contrast administration important</td>
<td>Yes</td>
<td>Non-specific markers for inflammation/cell proliferation, risk of false positive findings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dependent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsuitable for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ferromagnetic stents &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pacemaker bearers. Artefacts.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suitable as sole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>modality for EVAR follow-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EVAR = endovascular aneurysm repair; AXR = abdominal X-ray; DUS = duplex ultrasound; CE-DUS = contrast enhanced duplex ultrasound; CT = computed tomography; CTA = CT angiography; MRA = magnetic resonance angiography; eGFR = estimated glomerular filtration rate.
Juxta renal

- In the most recent systematic review of 21 case series comprising 1575 patients, 30 day or in hospital mortality after open JRAAA repair was 4.1%.

- The main advantage f/bEVAR lies in the avoidance of aortic cross clamping and subsequent lower risk of renal dysfunction, less surgical trauma and faster recovery, which may be advantageous for patients at high risk of open surgery.

- In the review of highest quality 14 case series of fEVAR were included comprising 751 patients. The 30 day or in hospital mortality was 4.1%.

- Freedom from secondary interventions was 90%, 86%, and 70%, at one, two, and three years post-operatively, respectively.
Juxta renal

• Patel et al. found a difference in peri-operative mortality after f/bEVAR from 2% in patients with two fenestrations to 24% in patients with 4 fenestrations.636,637

• Most of the data has been collected in the PERICLES registry in which some 95% of the 517 patients had a JRAAA.643 The reported 30 day mortality for elective cases was 18 of 488 (3.7%).

• In a systematic literature review of JRAAA repair the incidence of post-operative Type Ia endoleaks was 7.6% after chEVAR, compared with 3.7% after fEVAR64

• There are no direct comparisons of the outcomes of OSR, fEVAR, and chEVAR, and it is unlikely that a randomised comparative study will ever be performed.
• Recommendation 95

• In patients with juxtarenal abdominal aortic aneurysm, open repair or complex endovascular repair should be considered based on patient status, anatomy, local routines, team experience, and patient preference

• Class Level References

• IIa

• C

• [650,651]
• Recommendation 96
• In complex endovascular repair of juxtarenal abdominal aortic aneurysm, endovascular repair with fenestrated stent grafts should be considered the preferred treatment option when feasible
• Class Level References
• IIA
• C
• [619]
• Recommendation 102

• The threshold for elective repair of isolated iliac artery aneurysm (common iliac artery, internal iliac artery and external iliac artery, or combination thereof) may be considered at a minimum of 3.5 cm diameter

• Class Level References

• IIb

• C

• [665,671-673,659,658]
Recommendation 104

Preserving blood flow to at least one internal iliac artery during open surgical and endovascular repair of iliac artery aneurysms is recommended

Class Level References

I

B

[683]
mycotic

• Table 9.1. Suggested diagnostic criteria of mycotic aortic aneurysm.688

• Combination of the following factors:
  • Clinical Abdominal/back pain presentation Fever
  • Sepsis/shock
  • Laboratory C-reactive protein [ and culture Leucocytes [ ]
  • Positive blood culture or aortic tissue culture
  • Radiologic findings on CT
  • Saccular/multi-lobular/eccentric Peri-aortic gas/soft tissue mass
  Rapid expansion (days) and/or rupture Atypical location (e.g. para-visceral)
  or multiple aneurysms in different locations
Van himst

• Recommendation 108
• Mycotic aneurysm repair is recommended irrespective of aneurysm size
• Class Level References
  • I
  • C
  • [710,690]
• InflAAAs are associated with a higher frequency of aneurysm related symptoms (65e90%) than ordinary degenerative AAAs and have a triad of chronic pain (50e 80% abdomen, back, pelvic), weight loss (20e50%), and moderately elevated inflammatory markers (ESR and CRP 60e90%). Clinical examination may reveal a tender pulsatile AAA (15e71%).717-720

• Recommendation 111

• All patients with symptomatic inflammatory abdominal aortic aneurysms should be considered for medical anti- inflammatory treatment

• Class Level References

• IIa

• C

• [717,719,738,732]
Cas remenent et esambo

- Recommendation 112
- In patients with inflammatory abdominal aortic aneurysm with a threshold diameter of 5.5 cm and suitable anatomy, endovascular repair should be considered as a first option
- Class Level References
  - Ila
  - C
  - [739,738,720]
• trials on newly initiated beta blockers within 24 h of vascular surgery either demonstrated no advantage in low risk patients (POBBLE trial,249 MaVS study250), or showed increased all cause mortality, hypotension and stroke, despite reduced rates of peri-operative myocardial infarction (POISE trial251).
• Recommendation 49
• Intra-operative cell salvage and re-transfusion should be considered during open abdominal aortic aneurysm repair
• Class 2a Level
• Recommendation 52

• In selected cases of suspected insufficient perfusion of pelvic organs with risk of colonic ischaemia, reimplantation of the inferior mesenteric artery may be considered during open abdominal aortic aneurysm repair

• Class 2b Level
Table 5.1. Comparison of peri-operative mortality figures between endovascular and open repair in administrative databases of patients with ruptured abdominal aortic aneurysm.

<table>
<thead>
<tr>
<th>Author</th>
<th>Publication year</th>
<th>Country</th>
<th>Study period</th>
<th>n of patients (EVAR/OSR)</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EVAR</td>
</tr>
<tr>
<td>Greco</td>
<td>2006</td>
<td>USA</td>
<td>2000–2003</td>
<td>5798 (290/5508)</td>
<td>39%</td>
</tr>
<tr>
<td>Wanhainen</td>
<td>2008</td>
<td>Sweden</td>
<td>1994–2005</td>
<td>3516 (92/3424)</td>
<td>15%</td>
</tr>
<tr>
<td>Giles</td>
<td>2009</td>
<td>USA</td>
<td>2005–2007</td>
<td>567 (121/446)</td>
<td>24%</td>
</tr>
<tr>
<td>Holt</td>
<td>2010</td>
<td>UK</td>
<td>2003–2008</td>
<td>4414 (335/4079)</td>
<td>32%</td>
</tr>
<tr>
<td>Mani</td>
<td>2011</td>
<td>International</td>
<td>2005–2009</td>
<td>7040 (824/6216)</td>
<td>20%</td>
</tr>
<tr>
<td>Chen</td>
<td>2013</td>
<td>Taiwan</td>
<td>1998–2009</td>
<td>537 (39/498)</td>
<td>44%</td>
</tr>
<tr>
<td>Mohan</td>
<td>2014</td>
<td>USA</td>
<td>2001–2010</td>
<td>42,126 (8140/33,986)</td>
<td>26%</td>
</tr>
<tr>
<td>Trenner</td>
<td>2013</td>
<td>Germany</td>
<td>1999–2010</td>
<td>4859 (575/4284)</td>
<td>23%</td>
</tr>
<tr>
<td>Edwards</td>
<td>2014</td>
<td>USA</td>
<td>2001–2008</td>
<td>10,998 (1126/9872)</td>
<td>34%(^a)</td>
</tr>
<tr>
<td>Karthikesalingam</td>
<td>2014</td>
<td>England</td>
<td>2005–2010</td>
<td>6897 (569/6328)</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USA</td>
<td>2005–2010</td>
<td>19,174 (4003/15,171)</td>
<td>27%</td>
</tr>
<tr>
<td>Karthikesalingam</td>
<td>2016</td>
<td>England</td>
<td>2003–2012</td>
<td>12,467 (1184/11,283)</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweden</td>
<td>2003–2012</td>
<td>2829 (464/2365)</td>
<td>21%</td>
</tr>
<tr>
<td>Taylor</td>
<td>2016</td>
<td>New Zealand</td>
<td>2010–2014</td>
<td>285 (28/257)</td>
<td>18%</td>
</tr>
<tr>
<td>Summary data</td>
<td></td>
<td></td>
<td></td>
<td>120,075</td>
<td>26.8%</td>
</tr>
</tbody>
</table>

\(^n\) = number; EVAR = endovascular aneurysm repair; OSR = open surgical repair.

\(^a\) After propensity score matching. Result not included in summary data.
EVAR 2: evar versus conservative treatment in frail patients

- There has been only one randomised trial to assess whether EVAR provided a survival benefit for patients too physically compromised to undergo OSR, the EVAR 2 trial.

- This trial showed that in these physically frail patients although EVAR prevented death from aneurysm rupture, operative mortality was high (7%) and it did not offer any benefit in terms of overall survival out to 12 years, with two thirds of both randomised groups being dead within five years.
Covered stent in target vessels
EVAR : anatomical criterias
2019
Lombotomie
Levels of evidence.

- Level of evidence A
  - Data derived from multiple randomised clinical trials or meta-analyses.

- Level of evidence B
  - Data derived from a single randomized clinical trial or large non-randomised studies

- Level of evidence C
  - Consensus of opinion of the experts and/or small studies, retrospective studies, registries.
Classes of recommendations

• Class I
  • Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective

• Class II
  • Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.
    • Class IIa
      • Weight of evidence/opinion is in favour of usefulness/efficacy.
    • Class IIb
      • Usefulness/efficacy is less well established by evidence/opinion.

• Class III
  • Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.
• Recommendation 28
• In patients with poor functional capacity (defined as 4 metabolic equivalents) or with significant clinical risk factors (such as unstable angina, decompensated heart failure, severe valvular disease, and significant arrhythmia), referral for cardiac work up and optimisation is recommended prior to elective abdominal aortic aneurysm repair
• Class 1, Level C
• Recommendation 30
• In patients with unstable coronary artery disease or considered to be at high risk of cardiac events following abdominal aortic aneurysm repair, prophylactic pre-operative coronary revascularisation should be considered
• Class 2a, Level B
• Recommendation 33
• In patients on dual antiplatelet therapy after interventional coronary revascularisation, delaying abdominal aortic aneurysm repair until reduction to monotherapy, may be considered. Alternatively, if AAA repair becomes necessary, EVAR may be considered under dual antiplatelet therapy
• Class 2b Level C
• Recommendation 41
• Patients with abdominal aortic aneurysms and concomitant symptomatic carotid stenosis within the last 6 months should be considered for carotid intervention before aneurysm repair
• Class 2a Level A
• Recommendation 42
• Routine prophylactic carotid intervention for asymptomatic carotid stenosis prior to abdominal aortic aneurysm repair is not recommended
• Class 3 Level C
• Recommendation 86
• In patients with Type I endoleak after endovascular abdominal aortic aneurysm repair, re-intervention to achieve a seal, primarily by endovascular means, is recommended
# Leaks

<table>
<thead>
<tr>
<th>Complications</th>
<th>Definition</th>
<th>Estimated frequency during 5 year follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I endoleak</td>
<td>Peri-graft flow occurring from attachment sites</td>
<td>5%</td>
</tr>
<tr>
<td>A</td>
<td>proximal end of stent graft</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>distal end of stent graft</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>iliac occluder</td>
<td></td>
</tr>
<tr>
<td>Type II endoleak</td>
<td>Perigraft flow occurring from collateral branches to the aneurysm; inferior mesenteric artery (IIA) and lumbar arteries (IIB)</td>
<td>20–40%, 10% persistent at 2 years</td>
</tr>
<tr>
<td></td>
<td>Categorised as early or late/delayed (before or after 12 months) and as transient or persistent (resolved or not resolved ≤6 months)</td>
<td></td>
</tr>
<tr>
<td>Type III endoleak</td>
<td>Peri-graft flow occurring from stent graft defect or junction sites</td>
<td>1–3%</td>
</tr>
<tr>
<td>A</td>
<td>leak from junctions or modular disconnection</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>fabric holes</td>
<td></td>
</tr>
<tr>
<td>Type IV endoleak</td>
<td>Peri-graft flow occurring from stent graft fabric porosity &lt;30 days after placement</td>
<td>1%</td>
</tr>
<tr>
<td>Endotension</td>
<td>AAA sac enlargement without visualised endoleak</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Migration</td>
<td>Movement of the stent graft in relation to proximal or distal landing zone</td>
<td>1%</td>
</tr>
<tr>
<td>Limb kinking and occlusion</td>
<td>Graft thrombosis or stenosis</td>
<td>4–8%</td>
</tr>
<tr>
<td>Infection</td>
<td>Stent graft infection</td>
<td>0.5–1%</td>
</tr>
<tr>
<td>Rupture</td>
<td>Aortic rupture</td>
<td>1–5%</td>
</tr>
</tbody>
</table>

AAA = abdominal aortic aneurysm.

References: [495, 496, 47, 497, 498, 1, 499, 500].
Figure 6.1. This figure offers an example of follow up algorithm post-endovascular aneurysm repair with patient stratification based on initial imaging. All patients should be offered lifelong follow up, including a CT scan at least every 5 years. If necessary more frequent imaging may be performed with CT or duplex ultrasound, and will depend on the aim of the imaging (evaluation of seal length and stent graft integrity requires CT, evaluation of endoleak and sac size can be performed with duplex ultrasound). DUS = duplex ultrasound; 30 d = within 30 days postoperatively; CTA = computed tomography angiography.
Figure 6.1. This figure offers an example of follow up algorithm post-endovascular aneurysm repair with patient stratification based on initial imaging. All patients should be offered lifelong follow up, including a CT scan at least every 5 years. If necessary more frequent imaging may be performed with CT or duplex ultrasound, and will depend on the aim of the imaging (evaluation of seal length and stent graft integrity requires CT, evaluation of endoleak and sac size can be performed with duplex ultrasound). DUS = duplex ultrasound; 30 d = within 30 days postoperatively; CTA = computed tomography angiography.
Limitations of the study

• First generation devices
• Preop imaging
• Follow up protocol?
• Aggressiveness of reintervention?
All cause mortality benefit lost at 2 years

EVAR1 results at 4 years

Figure 2: Kaplan-Meier curve of survival and survival free from aneurysm-related death

*Mortality 4-year point estimates.

Aneurysm related mortality benefit maintained
Indication to relining
TREATMENT OF THE

ABDOMINAL AORTA ANEURYSM

Prof R VERHELST
UCL