Abdominal Aortic Aneurysm

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Health Board
What is an aneurysm?

- **AAA defined**
  - aortic diameter > 3cm in the maximum anterior-posterior measurement
AAA

• Ruptured abdominal aortic aneurysm deaths
  – 2.1% of all deaths in men aged 65
  – 0.8% of all deaths in women aged 65

• mortality from rupture is high
  – a third die in the community before reaching hospital
  – the post-operative mortality rate is around 50%
  – overall case fatality after rupture 82%.

• Most abdominal aortic aneurysms are asymptomatic until they are on the point of rupturing

• 6000 deaths / year in England and Wales
• Prevalence aged 65-80
  – 7.6% in men
  – 1.3% in women
  – prevalence increases with age
Risk Factors

• Men (x 4-5)
• Smoking
  – risk is directly related to number of years smoking
  – risk decreases in the years following smoking cessation.
• Other medical conditions
  – coronary heart disease
  – peripheral vascular disease
• family history of abdominal aneurysm
  – Independent of known familial aneurysm diseases eg Marfan’s, Ehler’s Danlos etc
AAA presentation

• Emergency cases
  – Rupture
  – Tender aneurysms

• Elective (asymptomatic) cases
  – Serendipitous discovery
    • Clinical examination
    • Other imaging – ultrasound, CT, MR etc...

  – Size threshold - >5.5cm
UK small aneurysm trial

- 1991-98
- 2257 patients 79% M 21%
- Aneurysms 3-6 cm
- Annual rupture rate 2.2%
- 76% of ruptures in aneurysms > 5 cm
Annual rupture risk vs Size

<table>
<thead>
<tr>
<th>AAA Size (cm)</th>
<th>Growth rate (cm/yr)</th>
<th>Annual rupture risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0-3.9</td>
<td>0.39</td>
<td>0</td>
</tr>
<tr>
<td>4.0-4.9</td>
<td>0.36</td>
<td>0.5 - 5</td>
</tr>
<tr>
<td>5.0-5.9</td>
<td>0.43</td>
<td>3 - 15</td>
</tr>
<tr>
<td>6.0-6.9</td>
<td>0.64</td>
<td>10 - 20</td>
</tr>
<tr>
<td>&gt;=7.0</td>
<td>-</td>
<td>20 - 50</td>
</tr>
</tbody>
</table>
NCEPOD review of AAA treatment Feb-Mar 2004

- Total number of cases: 884
  - Operative: 805 (91%)
  - Palliative: 79 (9%)
    - Open procedure: 752 (93%)
      - Emergency: 264 (35%)
      - Elective: 434 (58%)
      - Unknown: 54 (7%)
• Who should operate?
Unit annual AAA activity

**Elective**

**Emergency**
## Outcome of emergency cases by volume of cases

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Volume of cases</th>
<th>Sub-total</th>
<th>Not answered</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died within 30 days</td>
<td>Low: 45, %: 40</td>
<td></td>
<td></td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>High: 32, %: 29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alive at 30 days</td>
<td>Low: 68, %: 60</td>
<td></td>
<td></td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>High: 77, %: 71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>109</td>
<td>42</td>
<td>264</td>
</tr>
</tbody>
</table>
Outcome of elective open repair

Overall mortality was 6.2%
Outcome after emergency admission with ruptured AAA, all patients

![Bar chart showing outcome after emergency admission]

- **Large**: 47% alive at 30 days, 54% died before 30 days
- **Intermediate**: 47% alive at 30 days, 54% died before 30 days
- **Remote**: 89% died before 30 days

Ncepod 2005
Outcome after emergency admission with unruptured AAA, all patients
Other published evidence

- Improved outcomes for unruptured AAA when higher volumes performed by:
  - surgeons
  - hospitals
- USA recommendation
  - hospitals should perform 50 cases/year
  - 19/181 hospitals in this study performed 50 or more cases/year
Elective AAA - Age vs outcome

- 40-49: 0% alive, 8% died
- 50-59: 8% alive, 0% died
- 60-69: 6% alive, 6% died
- 70-79: 0% alive, 6% died
- 80-89: 0% alive, 8% died

Legend:
- Green: Alive at 30 days
- Red: Died < 30 days

NCEPOD 2005
Risk factors for poor outcome – elective AAA repair

• Cardiac history and signs
• Increased risk of death
  – morbidly obese
  – cachectic patients
• Diabetes carried no additional risk of death
Postoperative complications within 30 days of surgery

- 21% had an infective complication, most commonly of the chest and wound

- 7% had a myocardial infarct, nearly half these patients died
Emergency AAA surgery
Age and outcome

![Bar graph showing the number of patients and their outcomes by age category.](image)
Emergency surgery outcomes

• Higher risk of death
  – cardiac disease
  – Diabetes
  – morbid obesity
  – cachexia

• Mortality increased if not conscious
  – 2/7 patients with GCS below 9 survived
Where should AAA be treated

• Larger units performing >50 AAA procedures per year
• The size of the unit is more critical than the number of operations per surgeon
• The whole ‘team’ need expertise & experience in treating AAA
Major mortality from AAA treatment is in treating emergency or ruptured AAA. Is a screening program viable?

<table>
<thead>
<tr>
<th>The condition should be an important health problem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>There should be a treatment for the condition.</td>
</tr>
<tr>
<td>Facilities for diagnosis and treatment should be available.</td>
</tr>
<tr>
<td>There should be a latent stage of the disease.</td>
</tr>
<tr>
<td>There should be a test or examination for the condition.</td>
</tr>
<tr>
<td>The test should be acceptable to the population.</td>
</tr>
<tr>
<td>The natural history of the disease should be adequately understood.</td>
</tr>
<tr>
<td>There should be an agreed policy on whom to treat.</td>
</tr>
<tr>
<td>The total cost of finding a case should be economically balanced in relation to medical expenditure as a whole.</td>
</tr>
<tr>
<td>Case-finding should be a continuous process, not just a “once and for all” project</td>
</tr>
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</table>
10-year Multicentre Aneurysm Screening Study (MASS)

• “The number of lives saved will greatly outweigh the number of post-elective surgery deaths”
  – Assumes
  • 80% attendance for screening
  • 5% post-elective surgery mortality
10-year Multicentre Aneurysm Screening Study (MASS)

• “240 men need to be invited (192 scanned) to save one AAA death over 10 years

• Each 2,080 men invited for screening (1,660 scanned) result in one extra post-elective surgery death

• over 10 years
  – for every 10,000 men scanned
  – 65 AAA ruptures will be prevented
  – save 52 lives
  – six post-elective surgery deaths
AAA screening

- Male only
- Single screening at age 65y
  - Ultrasound by trained technician
    - <3cm  – normal - discharged
    - 3.0 – 4.4cm  – annual surveillance
    - 4.5 - 5.4cm – 3 monthly surveillance
    - >5.5cm  – refer to vascular specialist

- Open surgery or endovascular repair
- Vascular centres need to submit data to national database
- The success of the screening programme is critically dependent on achieving the lowest possible morbidity and mortality from treatment

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<th>AAA Size</th>
<th>Growth rate</th>
<th>Annual rupture</th>
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Is Open Surgery the Gold standard?

- Open Surgery
- EVAR
**A**
- Aorta (cross-section)
- Abdominal aortic aneurysm
- Plaque
- Catheter inserted into leg artery
- Catheter needed for other side

**B**
- Blood flows through stent graft
- Endovascular stent graft in place

EVAR 1 & 2

• September 1999 - December 2003
• 34 centres registered
• 4799 patients considered for entry
• 3927 (82%) consented to have a CT scan
• 2132 (54%) were considered anatomically suitable for EVAR
EVAR 1

• 1082 of the 1423 who were eligible consented to randomisation into EVAR trial 1 (76%)

• **Baseline characteristics**
  – mean age 74 years (SD 6),
  – 91% males
  – median aneurysm diameter 6.2 cm [IQR 5.8-7.0].

• The median time from randomisation
  – open surgery 36 days
  – EVAR 43 days

• the median follow-up was 2.9 years
EVAR 1 - results

• **30-day operative mortality**
  – An ‘intention to treat’ analysis

<table>
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<tr>
<td>EVAR</td>
</tr>
<tr>
<td>Open surgery</td>
</tr>
</tbody>
</table>

– 30-day mortality and in-hospital mortality were two-thirds lower in the EVAR group
– adjustment for baseline covariates did not alter the benefit of EVAR
EVAR 1 - results

**EVAR Trial 1: Operative mortality**

<table>
<thead>
<tr>
<th></th>
<th>EVAR</th>
<th>Open repair</th>
<th>Crude hazard ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30-day</td>
<td></td>
<td>[95% CI]</td>
</tr>
<tr>
<td>mortality</td>
<td>mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-day</td>
<td>9/532 (1.7%)</td>
<td>25/518 (4.8%)</td>
<td>0.35 [0.16-0.77]</td>
</tr>
<tr>
<td>In-hospital</td>
<td>mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mortality</td>
<td>10/532 (1.9%)</td>
<td>33/518 (6.4%)</td>
<td>0.32 [0.16-0.64]</td>
</tr>
</tbody>
</table>

*By randomised group for those who received an operation Analyses using logistic regression*
Re-intervention

• By 4 years, the proportion of patients with at least one complication following AAA repair was
  – 41% in the EVAR group
  – 9% in the open repair group.

• Overall rates of complications were
  – 17.6 per 100 person years in the EVAR
  – 3.3 per 100 person years in the open repair group
    • hazard ratio (4.9)

• the proportion of patients with at least one re-intervention by 4 years
  – 20% in the EVAR group
  – 6% in the open repair group.

• The rate of at least one re-intervention
  – 6.9 per 100 person years in the EVAR group
  – 2.4 per 100 person years in the open repair group
    • hazard ratio for at least one intervention 2.7
Complications/re-interventions

![Graph showing the proportion of patients without complications or re-interventions over time since randomisation.](Image)

- **Complications for EVAR group**: 6%*
- **Complications for open repair group**: 9%*
- **Reinterventions for EVAR group**: 20%*
- **Reinterventions for open repair group**: 41%*

*Percentages indicate the proportion of patients who have not experienced complications or re-interventions at the specified time points.
<table>
<thead>
<tr>
<th>Condition</th>
<th>EVAR (interventions)</th>
<th>Open repair (interventions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graft rupture</td>
<td>9 (3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Graft infection</td>
<td>1 (1)</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Graft migration</td>
<td>12 (7)</td>
<td></td>
</tr>
<tr>
<td>Type 1 endoleak</td>
<td>27 (17)</td>
<td></td>
</tr>
<tr>
<td>Type 3 endoleak</td>
<td>8 (4)</td>
<td></td>
</tr>
<tr>
<td>Graft kinking</td>
<td>6 (2)</td>
<td></td>
</tr>
<tr>
<td>Endotension</td>
<td>6 (0)</td>
<td>1 (0)</td>
</tr>
<tr>
<td>Type 2 endoleak</td>
<td>79 (17)</td>
<td>1 (0)</td>
</tr>
<tr>
<td>Deployment problems/other</td>
<td>6 (6)</td>
<td></td>
</tr>
<tr>
<td>Other common problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrombosis, stenosis, distal embolisation, renal infarction, anastomotic aneurysm, iliac dilatation, other exploratory surgery</td>
<td>32 (24)</td>
<td>40 (36)</td>
</tr>
</tbody>
</table>
Is Open Surgery the Gold standard?

- **Open Surgery**
  - 4.8% 30-day mortality
  - Equivalent 10-year survival
  - 6% reintervention rate @ 4 years

- **EVAR**
  - 1.7% 30-day mortality
  - 20% reintervention rate @ 4 years
Summary

• AAA kills significant numbers
• Elective treatment much safer than emergency Rx
• Screening programs justified & developing
• Safe Rx in larger dedicated units with multi-disciplinary teams and robust governance
• EVAR is used in the majority of cases
EVAR – second generation

• EVAR for acute rupture AAA
• Iliac branch devices
  – Preserve internal iliac artery patency
• Fenestrated Devices
  – To allow coverage of the renal & mesenteric arteries in short necks
• New approaches
  – Novel branch devices
  – Endobags
Thank You
Radiology Availability

Day

Night
Interventional radiology on-call rotas
Mode of admission

- Elective
- Emergency
- Elective transfer
- Emergency transfer
- Not answered

Legend:
- Not answered
- Alive at 30 days
- Died < 30 days

- Elective: 6%
- Emergency: 36%
- Elective transfer: 0%
- Emergency transfer: 28%
- Not answered: 0%
AAA treatment

• Preoperative
  – All patients should undergo standard preoperative assessment and risk scoring, including cardiac, respiratory, renal, diabetes, peripheral vascular disease, as well as CT angiography to determine their suitability for EVAR
  – Defined pathways for the correction of significant medical risks (cardiology/renal/respiratory) before intervention
  – Pre-assessment by an anaesthetist with experience in elective vascular anaesthesia.
  – All elective procedures should be reviewed preoperatively in a multi-disciplinary team that includes Surgeon(s) and Radiologist(s) as a minimum + ideally a Vascular Anaesthetist

• Operation
  – Interventions should be undertaken (or supervised) by Consultant Surgeon/Radiologist with training and expertise in elective vascular procedures and a routine clinical practice in this specialty
  – Open AAA repair should include the following components: normothermia, cell salvage, rapid infuser, easy access to blood products (within one hour) and availability of haemostatic agents including glue
  – EVAR should only be undertaken in a sterile environment of theatre standard, with optimal imaging facilities. A range of rescue stents and devices should be immediately available, together with the expertise to deploy them

• Facilities
  – Elective AAA repair should only be undertaken in hospitals where:
    – There is a 24/7 on-call rota for vascular emergencies covered by Consultant Vascular Surgeons
    – critical care facility with ability to undertake mechanical ventilation and renal support and with 24-hour on-site anaesthetic cover
  – A minimum number of AAA procedures are undertaken
    • It is recommended that hospitals undertaking fewer than 20 elective AAA interventions per year (60 over three years) should not continue to offer these procedures (6)
  – Specialists undertaking aortic intervention should submit all their procedures to the National Vascular Database and undertake regular review of their practice and outcomes (morbidity and mortality meetings)
Left kidney in normal position

Right kidney in abnormal position

I mean \textit{VERY BIG} haematoma

\textit{BIG} haematoma

Left kidney in normal position
The aortic lumen

The leak