Frequency of FU after EVAR
Purpose of Follow-up
Prevent a Complication by Identifying a “Problem”

Prerequisites
The “Problem”: Does Indeed Cause Rupture
Is Possible to Treat
Is Asymptomatic
Doesn’t Cause Rupture Immediately
Is Common Enough to Necessitate FU

The FU
Sensitive & Specific
Safe & Affordable
Tolerated
How Frequent Is Rupture Post EVAR?

EVAR 1 Trial (12.7 yrs FU)*

- Deaths from Rupture post EVAR: 31
- Rupture Frequency: ?

Perugia (8.3 yrs FU)**

- 3 Ruptures: 0.5%
- CT “Only in Patients with Complications”
  - 1 Early
  - 2 Mycotic
  - 1 Refused Tx

No Reason to Intensify FU!

*Patel R et al, Lancet 2016
**Verzini F et al, JVS 2017
Purpose of Follow-up

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- Sensitive & Specific
- Safe & Affordable
- Tolerated
Subgroups for Follow-up

Wide Neck (>30mm)*

Large AAA & CIA Diameter (St George’s model)**

Small & Tortuous Iliacs***

Patients Who Were Treated Outside IFU***

*Oliveira NF et al, JVS 2017
**Karthikesalingam A et al, BJS 2013
Purpose of Follow-up

Prevent a Complication by Identifying a “Problem”

Prerequisites

The “Problem”: Does Cause Rupture
- Is Treatable
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The FU
- Sensitive & Specific
- Safe & Affordable
- Tolerated
FU Needs to be Tolerated, Safe & Affordable

44% (12/27) of Ruptures post EVAR Occur in Octogenarians (UK)!*

22 / 29 Ruptures Post EVAR (76%) were lost to Follow-Up after the initial EVAR (USA)**

*Wyss TR, Ann Surg 2010
**Mehta M, JVS 2009
Purpose of Follow-up

Prevent a Complication by Identifying a “Problem”

Prerequisites

The “Problem”:
- Does Cause Rupture
- Is Treatable
- Is Asymptomatic
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The FU
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- Safe & Affordable
- Tolerated
Sojourn Time

Definition:
The asymptomatic window in which a problem might be detectable before clinical manifestation

Mean Maximum Sojourn Time: 4 Months*

*Karthikesalingam A et al, BJS 2013
Sojourn Time

EL-I

July 2014

2.5 yrs
Sojourn Time

Postop (2014) 66 x 67

2.5 yrs 69 x 70
### Ruptures in EVAR 1&2 Trials

<table>
<thead>
<tr>
<th>No.</th>
<th>Patient</th>
<th>Age, yr</th>
<th>Sex</th>
<th>Diameter, cm</th>
<th>Diameter, cm</th>
<th>Comments</th>
<th>Time until Rupture</th>
<th>Procedure in Rupture</th>
<th>30d Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Perioperative ruptures</td>
<td>1</td>
<td>84</td>
<td>F</td>
<td>8.0</td>
<td>2.3</td>
<td>No complication</td>
<td>0d</td>
<td>OR</td>
<td>Alive</td>
</tr>
<tr>
<td>2</td>
<td>77</td>
<td>M</td>
<td>6.4</td>
<td>3.0</td>
<td>No complication</td>
<td>3d</td>
<td>OR</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>3*</td>
<td>79</td>
<td>F</td>
<td>6.5</td>
<td>2.3</td>
<td>Graft not deployed because of technical difficulties</td>
<td>5d</td>
<td>OR</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>84</td>
<td>M</td>
<td>9.5</td>
<td>2.1</td>
<td>No complication</td>
<td>8d</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>81</td>
<td>M</td>
<td>6.0</td>
<td>3.4</td>
<td>Short mid-term limb, waiting for extension</td>
<td>8d</td>
<td>OR (amput)</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>B. Late ruptures without prior complications</td>
<td>6</td>
<td>81</td>
<td>M</td>
<td>7.8</td>
<td>2.5</td>
<td>Rupture just before 1-mo follow-up scan</td>
<td>32d</td>
<td>--</td>
<td>Dead</td>
</tr>
<tr>
<td>7</td>
<td>79</td>
<td>M</td>
<td>7.5</td>
<td>2.5</td>
<td>Attended a follow-up scan within 12 mo before rupture, 1.5 cm sac shrinkage after 1 yr</td>
<td>1.3y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>76</td>
<td>M</td>
<td>6.0</td>
<td>2.5</td>
<td>Attended a follow-up scan within 12 mo before rupture, 1.6 cm sac shrinkage after 2 yr</td>
<td>2.9y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>67</td>
<td>M</td>
<td>6.7</td>
<td>2.3</td>
<td>Attended all suggested follow-up scans, 1.0 cm sac shrinkage after 2 yr</td>
<td>3.1y</td>
<td>Endovascular (limb extension)</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>89</td>
<td>F</td>
<td>6.2</td>
<td>2.5</td>
<td>Missed the 2-yr follow-up scan, 0.1 cm sac shrinkage after 2 yr</td>
<td>3.6y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>C. Late ruptures with prior complications</td>
<td>11</td>
<td>66</td>
<td>M</td>
<td>7.3</td>
<td>2.0</td>
<td>EL 1b, no intervention, resolved, sac growth</td>
<td>1.6y</td>
<td>--</td>
<td>Dead</td>
</tr>
<tr>
<td>12</td>
<td>77</td>
<td>F</td>
<td>5.5</td>
<td>2.0</td>
<td>EL 2, intervention (thrombin injection), not resolved, sac growth</td>
<td>2.4y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>89</td>
<td>M</td>
<td>6.4</td>
<td>2.4</td>
<td>EL 1a, migration, intervention (cuff), resolved, sac growth</td>
<td>2.5y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>78</td>
<td>M</td>
<td>8.2</td>
<td>2.7</td>
<td>Migration, intervention (cuff), resolved, shrinkage</td>
<td>3y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>89</td>
<td>M</td>
<td>5.9</td>
<td>2.3</td>
<td>Retained follow-up CT scans, EI of undefined origin detected on duplex ultrasonography, no intervention, not resolved</td>
<td>3y</td>
<td>Endovascular (cuff)</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>84</td>
<td>M</td>
<td>5.9</td>
<td>2.1</td>
<td>Sac growth, no intervention, not resolved, sac growth, EI 2, not resolved</td>
<td>3.3y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>79</td>
<td>M</td>
<td>6.0</td>
<td>2.4</td>
<td>Sac growth, EI 2, resolved</td>
<td>3.4y</td>
<td>Endovascular (cuff)</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>79</td>
<td>M</td>
<td>7.4</td>
<td>2.6</td>
<td>EL 2, sac growth, no intervention, not resolved</td>
<td>3.5y</td>
<td>OR</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>64</td>
<td>M</td>
<td>5.7</td>
<td>2.2</td>
<td>EL 1a, sac growth, intervention (cuff), resolved, sac growth</td>
<td>3.6y</td>
<td>OR</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>79</td>
<td>M</td>
<td>6.3</td>
<td>2.8</td>
<td>EL 1b, sac growth, intervention (limb extension), resolved, sac growth</td>
<td>3.7y</td>
<td>OR</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>82</td>
<td>M</td>
<td>6.5</td>
<td>2.3</td>
<td>EL 1b, intervention (limb extension), resolved, EI 2, not resolved, sac growth</td>
<td>4.5y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>81</td>
<td>M</td>
<td>6.5</td>
<td>2.4</td>
<td>Left limb kink, intervention (stent), resolved, EL 3, not resolved, sac growth</td>
<td>4.7y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>23*</td>
<td>77</td>
<td>M</td>
<td>6.7</td>
<td>2.5</td>
<td>EL 1b, intervention (limb extension), not resolved, ongoing EL 1, sac growth</td>
<td>4.8y</td>
<td>Endovascular (limb extension)</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>81</td>
<td>F</td>
<td>6.5</td>
<td>2.2</td>
<td>EL 2, no intervention, sac growth, ongoing EL 2, intervention (second V graft), ongoing sac growth, EL 2, no OR because of &quot;other blood vessels,&quot; sac growth</td>
<td>4.8y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>73</td>
<td>M</td>
<td>8.4</td>
<td>2.5</td>
<td>EL 1b, intervention (limb extension), resolved, sac growth, no intervention</td>
<td>4.9y</td>
<td>Endovascular (limb extension)</td>
<td>Alive</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>71</td>
<td>M</td>
<td>6.9</td>
<td>2.3</td>
<td>Sac growth, no intervention, not resolved</td>
<td>5.0y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>83</td>
<td>M</td>
<td>6.4</td>
<td>2.2</td>
<td>Sac growth, intervention (straight graft), resolved, missed 6-mo follow-up scan</td>
<td>6.1y</td>
<td>--</td>
<td>Dead</td>
<td></td>
</tr>
</tbody>
</table>

*EVAR trial 1 patients. Perioperative, <30 days; Late, >30 days. Age and diameters at baseline. EL indicates endoleak.*

Wyss et al Ann Surg 2010;252
Ruptures in EVAR 1&2 Trials

27 Ruptures
EVAR 1 (n=25)
EVAR 2 (n=2)

6 ≤ One Month

17 Sac Growth

4 Not Sac Growth

0.5%

Wyss et al Ann Surg 2010;252
Malmö Elective EVAR (Zenith)

>5 yrs FU

Ruptures: 8 (2.7%)
Time: 6 yrs (2.5-8.9)

Refused / unfit: 5
Expanding: 2

>90% EVAR!
Purpose of Follow-up

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Is Common Enough to Necessitate FU

The FU: Sensitive & Specific
Safe & Affordable
Tolerated
"How Many Routine CT’s Are Needed to Indicate a Re-intervention that Would Have Been Missed by US?"

Is There a Benefit of Frequent CT Follow-up After EVAR?

N.V. Dias*, L. Riva, K. Ivancev, T. Resch, B. Sonesson, M. Malina
18 Expanding AAAs

9 CT Findings in Non-expanding Aneurysms:

- Kinks in a Limb

5 CTs Identified Potentially Lethal Complications

1.167 Routine CT Scans in 279 Patients

27 Asymptomatic Complications Treated

232 Replacable by US (NNT)

1 / 233 CTs "Important"

9 CT Findings in Non-expanding Aneurysms:

- 4 Kinks in a Limb

5 CTs Identified Potentially Lethal Complications
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The FU
Sensitive & Specific
Safe & Affordable
Conclusion
Frequency of FU after EVAR

Prevention of Late Rupture Is Main Purpose of FU

Most Ruptures Had Sac Expansion
(Detectable by Simple US Diameter Measurements)

Hundreds of Routine CT’s Needed to Find a Serious Lesion Missed by US

FU by US Adequate in Uncomplicated Cases
(Ruptures Are Rare even when >90% AAAs Tx by EVAR!)
Conclusion

Frequency of FU after EVAR

Optimum Frequency of FU Unknown

Yearly US Seems Pragmatic
(Ruptures Are Rare even when >90% EVAR!)

Individualised FU Recommended

Complicated Cases
Patient Condition and Age
The Shard
London

Turning Torso
Malmö
Frequency of FU after EVAR