30-Day Results of the US IDE Pivotal Trial of the Nellix System for Endovascular Aneurysm Sealing (EVAS)

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Camden, NJ
Financial Disclosures

Consultant: Endologix, Inc.
Cook Medical
Hostile Anatomies (short necks and angulation)
Endoleaks (EL)
Migration
Aneurysm Sac Enlargement
Late Rupture
Reinterventions
Rehospitalizations
Lifetime Surveillance
Costs

EVAR with for Aneurysm Exclusion

- Gore
- Medtronic
- Cordis
- Vascutek
- Cook
- Endologix
- Trivascular
- Lombard
At least 1 in 8 Patients Treated w/ EVAR will undergo Secondary Intervention within 5 years\(^1\)\(^{-8}\)

<table>
<thead>
<tr>
<th>Study</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DREAM (2010), 173</td>
<td>25%</td>
</tr>
<tr>
<td>EVAR-2 (2010), 197</td>
<td>25%</td>
</tr>
<tr>
<td>EVAR-1 (2010), 626</td>
<td>26%</td>
</tr>
<tr>
<td>Verzini (2014), 882</td>
<td>13%</td>
</tr>
<tr>
<td>Al-Jubouri (2013), 558</td>
<td>14%</td>
</tr>
<tr>
<td>Abbruzzese (2009), 565</td>
<td>20%</td>
</tr>
<tr>
<td>Dias (2009), 279</td>
<td>23%</td>
</tr>
<tr>
<td>Conrad (2009), 832</td>
<td>13%</td>
</tr>
</tbody>
</table>
Endoleaks: Leading Cause of Re-interventions

66% of re-interventions after EVAR are due to Endoleaks¹.

Endoleak can lead to aneurysm sac expansion and possible rupture.

Type II endoleak most commonly reported endoleak type

Complications are more severe in patients with Type II EL.

<table>
<thead>
<tr>
<th></th>
<th>T2E</th>
<th></th>
<th>No T2E</th>
<th></th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>All complications</td>
<td>92</td>
<td>45.8</td>
<td>118</td>
<td>23.6</td>
<td></td>
</tr>
<tr>
<td>Rupture</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>.290</td>
</tr>
<tr>
<td>Conversion to open</td>
<td>12</td>
<td>6</td>
<td>18</td>
<td>3.6</td>
<td>.210</td>
</tr>
<tr>
<td>Endovascular conversion</td>
<td>7^a</td>
<td>3.5^a</td>
<td>10</td>
<td>2</td>
<td>.280</td>
</tr>
<tr>
<td>Aneurysm sac enlargement</td>
<td>81</td>
<td>40.3</td>
<td>84</td>
<td>16.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Reintervention</td>
<td>30</td>
<td>14.9</td>
<td>33</td>
<td>6.6</td>
<td>.002</td>
</tr>
</tbody>
</table>

Reinterventions for Type II EL are more common with newer generation devices

Reintervention after EVAR and Open Surgical Repair of AAA
A 15-Year Experience

Mustafa Al-Jubouri, MD, Anthony J. Comerota, MD, Subhash Thakur, MD, Faisal Aziz, MD, Steven Wanjiku, MSC, David Paolini, MD, John P. Pigott, MD, and Fedor Lurie, MD, PhD

<table>
<thead>
<tr>
<th>Intervention</th>
<th>First Generation (N=59)</th>
<th>Second Generation (N=235)</th>
<th>Third Generation (N=264)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancure, Vanguard, Lifepath, Talent</td>
<td></td>
<td>AneurRx</td>
<td>Excluder, Zenith, Powerlink, Endurant</td>
</tr>
<tr>
<td>All reinterventions</td>
<td>38.9% (23)</td>
<td>29.4% (69)</td>
<td>11.7% (31)</td>
</tr>
<tr>
<td>Reintervention for Type II EL</td>
<td>5.1%</td>
<td>13.2%</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

Reintervention Outcomes for Type II are suboptimal

“In this series, percutaneous endovascular intervention for type II endoleak with aneurysm sac growth does not appear to alter the rate of aneurysm sac growth, and the majority of patients display persistent / recurrent endoleak.”

Nellix System Overview
**Procedural Steps**

- Evacuate Endobags and visualize anatomy
- Establish stent flow lumens
- Angiographically confirm seal; aspirate
- Angiographically confirm seal; remove delivery systems
IDE Study Design and Enrollment

• **Multicenter, Prospective, Single Arm Study**
  • 29 Sites in US (26) and Europe (3)
  • First patient enrolled per site = Roll-In cohort
  • Pivotal cohort $N = 150$, enrolled Feb 2014 – Nov 2014

• **Independent Controls:**
  - **CTA Scan Core Laboratory**
    - Screening
    - Follow-up Assessment
  - **Data Safety Monitoring Board**
    - Safety reviews
    - Protocol adequacy
  - **Clinical Events Committee**
    - Event adjudication
    - Device or procedure relatedness
Inclusion/Exclusion Criteria Summary

• **Vascular Criteria**
  • AAA diameter ≥5cm, or 4.5cm with ≥ 0.5cm growth in prior six months, or >1.5x normal aorta
  • Proximal neck 18-32mm diameter, ≥10mm length, ≤60°
  • Sac blood lumen diameter ≤6cm
  • Common iliac arteries lumen diameter 9-35mm

• **Exclusions**
  • Coagulopathy or bleeding disorder
  • Connective tissue disease
  • CVA or MI within prior three months
  • Serum Cr >2.0mg/dL
  • Ruptured, leaking, mycotic or thoracic aneurysms
  • Neck mural thrombus >5mm thickness over >50%
Primary Study Endpoints

• **Safety**
  • Major Adverse Events at 30 Days
    • All-cause death
    • Bowel ischemia
    • Myocardial infarction
    • Paraplegia
    • Renal failure
    • Respiratory Failure
    • Stroke
    • Procedural blood loss ≥1L
  • Comparison Rate: SVS Surgical Control 30-Day MAEs (56%)

• **Effectiveness**
  • Treatment Success at 1 Year
    • Procedural technical success
    • Absence of: aneurysm rupture, conversion, clinically significant migration, Type 1 or 3 endoleak at 1 year, aneurysm expansion, or secondary intervention for endoleak, occlusion, migration, AAA expansion, or device defect
  • Success Criterion: >80%
# Key Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Gender</td>
<td>142 (95%)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>140 (93%)</td>
</tr>
<tr>
<td>ASA Class 1</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>ASA Class 2</td>
<td>38 (25%)</td>
</tr>
<tr>
<td>ASA Class 3</td>
<td>92 (61%)</td>
</tr>
<tr>
<td>ASA Class 4</td>
<td>17 (11%)</td>
</tr>
</tbody>
</table>
## Key Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean ± SD (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum sac diameter (mm)</td>
<td>57.5 ± 6.2 (44, 82)</td>
</tr>
<tr>
<td>Non-aneurysmal neck length (mm)</td>
<td>31.2 ± 14.0 (10, 103)</td>
</tr>
<tr>
<td>Max neck diameter (mm)</td>
<td>25.2 ± 3.0 (19, 32)</td>
</tr>
<tr>
<td>Max right common iliac diameter (mm)</td>
<td>20.4 ± 5.8 (12, 50)</td>
</tr>
<tr>
<td>Max left common iliac diameter (mm)</td>
<td>20.1 ± 6.0 (11, 53)</td>
</tr>
<tr>
<td>Aortic Neck Angulation (°)</td>
<td>29.9 ± 14.2 (3, 59)</td>
</tr>
</tbody>
</table>
### Procedural/In-Hospital Outcomes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result (N=150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Implant Time</td>
<td>30 min</td>
</tr>
<tr>
<td>Fluoroscopy Time</td>
<td>10 min</td>
</tr>
<tr>
<td>Total Procedure Time</td>
<td>87 min</td>
</tr>
<tr>
<td>Anesthesia Time</td>
<td>187 min</td>
</tr>
<tr>
<td>Polymer Fill Volume</td>
<td>75 mL</td>
</tr>
<tr>
<td>Time to Hospital Discharge</td>
<td>1.2 days</td>
</tr>
</tbody>
</table>

Result shown as median.

- **100% procedural technical success**
  - Three (2.0%) device-related SAEs
  - One (0.7%) secondary procedure (renal stenosis)
Concomitant Iliac Aneurysm Exclusion
# 30-Day Safety Summary

## MAJOR ADVERSE EVENTS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result (N=150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pts with ≥1 MAE</td>
<td>4 (2.7%)</td>
</tr>
<tr>
<td>All-Cause Death</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Bowel Ischemia</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Respiratory Failure</td>
<td>2 (1.4%)</td>
</tr>
<tr>
<td>Paraplegia</td>
<td>0</td>
</tr>
<tr>
<td>Procedural Blood Loss ≥1L</td>
<td>0</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>0</td>
</tr>
<tr>
<td>Stroke</td>
<td>0</td>
</tr>
</tbody>
</table>

## OTHER RESULTS

- No Ruptures
- No Conversions

Result shown as n (% of 150). Death on day 4 secondary to cardiac arrest.
30-Day Core Lab Observations

- **Endoleaks**
  - Type 1A: 1 (0.7%)
  - Type 1B: None
  - Type 2: 8 (5.4%) 0.1-0.4mL volume (all lumbar)
  - Type 3: None
  - Type 4: None

- **No Stent Fracture**
- **No Lumen Thrombosis or Occlusion**
Summary

• Nellix Procedural Feasibility Demonstrated
  • 100% procedural technical success

• Safety Endpoint Achieved
  • MAE rate (2.7%)

• Low morbidity and mortality

• Low Endoleak Rate (6%)

• No Occlusions

• No Stent Fractures

• No Ruptures

• No Conversions

• Study Primary Results at 1 Year Expected End-2015
# Sites Enrolled

## United States

- **Allegheny General Hospital**
  - Satish Muluk, MD

- **Baylor Heart Hospital**
  - Javier Vasquez, MD

- **Baylor Scott & White Healthcare**
  - Clifford Buckley, MD

- **Bay State Medical Ctr**
  - Neal Hadro, MD

- **Carolinanas Healthcare**
  - Stephen Lalka, MD

- **Christiana Healthcare**
  - Ralph Ierardi, MD

- **Cleveland Clinic**
  - Daniel Clair, MD

- **Cooper University Hospital**
  - Jose Trani, MD

- **Froedert Memorial Lutheran Hospital (Medical College of WI)**
  - Cheong Jun Lee, MD

- **Inova Fairfax Hospital**
  - Homayoun Hashemi, MD

- **Maine Medical Ctr**
  - Christopher Healey, MD

- **MedStar Health Research Inst**
  - Nelson Bernardo, MD

- **Miami Vascular Inst**
  - James Benenati, MD

- **Nebraska Heart Inst**
  - Steve Tyndall, MD

- **Ohio Health Research Inst**
  - Mitchell Silver, DO

- **Providence Sacred Heart Med Ctr**
  - Stephen Murray, MD

- **Sacred Heart Hospital**
  - Stuart Harlin, MD

- **San Diego VA Hospital**
  - John Lane, MD

- **Spectrum Health**
  - Robert Cuff, MD

- **St. Elizabeth’s Medical Ctr**
  - Nikhil Kansal, MD

## Europe

- **University Hospital Heidelberg**
  - Dittmar Böckler, MD, PhD

- **Addenbrooke’s Hospital**
  - Cambridge, UK
  - Paul Hayes, MD

- **Rijnstate Hospital**
  - Arnhem, Netherlands
  - Michel Reijnen, MD, PhD

- **St. Luke’s Medical Ctr**
  - Zvonimir Krajcer, MD

- **St. Vincent Healthcare**
  - Kevin Bruen, MD

- **St. Vincent Heart Center of IN**
  - Sajjad Hussain, MD

- **Tucson Medical Ctr**
  - Luis Leon, MD

- **UPMC Heart and Vascular Inst**
  - Michel Makaroun, MD

- **Yale University**
  - Jeffery Indes, MD
Device Related SAE’s (N=3)

- Inadvertent coverage of renal artery
  - Unsuccessful attempt at rescue by PTA/stent

- Aspiration of blood during endobag vacuum test
  - Procedure completed successfully with filling of single endobag

- Disruption of AAA sac during endobag test fill
  - Procedure completed uneventfully
Type 1A Endoleak
Type 2 Endoleaks