Three or four chimneys: is it too much?

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Disclosure

Speaker name:

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I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☒ I do not have any potential conflict of interest
Complex Abdominal Aortic Aneurysm disease poses a technical and anatomic challenge for *endovascular* repair.
Comparison of fenestrated endovascular aneurysm repair and chimney graft techniques for pararenal aortic aneurysm

Hiroshi Banno, MD, PhD, Frédéric Cochennec, MD, Jean Marzelle, MD, and Jean-Pierre Becquemin, MD, FRCS, Créteil, France
ALTERNATIVE SOLUTIONS
Introduction – Parallel Grafts

Widely used as an adjunct to expand indications for EVAR and TEVAR

- 94-100% technical success
- 84-100% 1 year-parallel stent patency
- 0-38% early Type Ia (gutter) endoleak
- No standard configuration, sizing
- Variable combinations of grafts, stents, CG orientation
Worldwide experience reflects the absence of a standardized, homogeneous use of devices based on in vitro and finally in vivo studies.

Nowadays .......... That’s changing
The PERICLES Registry

The PROTAGORAS study / Endurant stent graft

ASCEND Registry (Aneurysm Sealing for Complex AAA: Evaluation of Nellix Durability)
Collected World Experience About the Performance of the Snorkel/Chimney Endovascular Technique in the Treatment of Complex Aortic Pathologies: The PERICLES Registry

Donas KP, Lee JT, Lachat M, Torsello G, Veith FJ; PERICLES Investigators

Annals of Surgery Volume 262, Number 3, September 2015

- 517 Snorkel EVAR (US 119, 398 Europe)
- 898 Chimney grafts -692 RA, 156 SMA, 50 CA (49.2% BE, 39.6% SE)
- 17.1 months FU
- Primary patency 94%
- Type 1a Endoleak 7.9%
- 79% survival
# The PERICICLES Registry

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total chimney grafts, n</td>
<td>898</td>
</tr>
<tr>
<td>Right renal</td>
<td>342</td>
</tr>
<tr>
<td>Left renal</td>
<td>316</td>
</tr>
<tr>
<td>Accessory renal</td>
<td>34</td>
</tr>
<tr>
<td>SMA</td>
<td>156</td>
</tr>
<tr>
<td>Celiac</td>
<td>50</td>
</tr>
</tbody>
</table>

**Snorkel/chimney neck length, mean ± SD:** 21.1 ± 12.7
Related to both the literature and our experience, suggesting that the number of snorkels per case has an impact on the type Ia endoleaks. What is the maximum number? Two? Three? Four?
The PERICLES Registry / Debate

Responses:

01 snorkel graft works nearly perfectly every time.

02 snorkels are probably the maximum that the approach consistently works well.

In our series and others, the overall complication rate with 3 and 4 was higher both in the immediate term and in the follow-up compared to 1 or 2 snorkels.
Identification of optimal device combinations for the chimney endovascular aneurysm repair technique within the PERICLES registry and Palo Alto, Calif


Journal of Vascular Surgery July 2018

Take Home Message: In the PERICLES registry, the risk of chimney graft occlusion and type IA endoleak was similar for all combinations of balloon-expandable covered stents and endografts, but chimney graft occlusion increased by 1.8 for each additional stent used, and survival was decreased in patients with some endograft/chimney combinations.
128 pts, 178 CG’s
Medtronic Endurant and iCAst stents
100% technical success
95.7% CG patency
1.6% Type Ia endoleak
The PROTAGORAS study / Endurant stent graft

<table>
<thead>
<tr>
<th>Chimney Count</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 chimney</td>
<td>82</td>
<td>64.1%</td>
</tr>
<tr>
<td>2 chimneys</td>
<td>36</td>
<td>28.1%</td>
</tr>
<tr>
<td>3 chimneys</td>
<td>8</td>
<td>6.3%</td>
</tr>
<tr>
<td>4 chimneys</td>
<td>1</td>
<td>0.8%</td>
</tr>
<tr>
<td>5 chimneys</td>
<td>1</td>
<td>0.8%</td>
</tr>
<tr>
<td>No chimney</td>
<td>6</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

Postoperative proximal neck length, mm  \[18.7 \pm 6.3 \text{ (6-58)}\]

PROTAGORAS study 128 patients were treated with a more standardized technique. In this study, 100% technical success was obtained.
CONCLUSIONS:

Use of the Endurant stent graft as the main abdominal device in combination with a BECS is associated with successful midterm clinical and radiologic outcomes in 128 patients. Standardization of device combinations, creation of a new proximal neck length of >15 mm, and meticulous follow-up seem to be the keys to achieving durable results for patients with pararenal diseases treated by ch-EVAR. Reproducible experience from other centers is needed to establish this total endovascular alternative therapeutic option.
Early Experience With Endovascular Aneurysm Sealing in Combination With Parallel Grafts for the Treatment of Complex Abdominal Aneurysms: The ASCEND Registry

Matt Thompson, MD, FRCS¹, Marwan Youssef, MD², Rudolf Jacob, MD³, Sebastian Zerwe, MD⁴, Michel Reijnen, MD, PhD⁴, Piotr Szopinski, MD⁴, Patrick Berg, MD⁴, Grzegorz Orszynski, MD, PhD⁴, and Andrew Holden, MBChB, FRANZCR, EBIR⁵

Table 1. Demographics and Procedural Details.

<table>
<thead>
<tr>
<th></th>
<th>All Patients (n=154)</th>
<th>Single (n=62)</th>
<th>Double (n=54)</th>
<th>Triple (n=27)</th>
<th>Quadruple (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>72±3.7</td>
<td>72±3.7</td>
<td>72±3.7</td>
<td>71±2.5</td>
<td>71±2.5</td>
</tr>
<tr>
<td>Men</td>
<td>124 (80.5)</td>
<td>51 (82.3)</td>
<td>42 (77.8)</td>
<td>23 (85.2)</td>
<td>8 (77.8)</td>
</tr>
<tr>
<td>Height, cm</td>
<td>171±9.14</td>
<td>172±8.8</td>
<td>173±0.7</td>
<td>168±4.3</td>
<td>170±4.9</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>83±18.0</td>
<td>87±21.5</td>
<td>81±15.3</td>
<td>77±13.6</td>
<td>81±13.0</td>
</tr>
<tr>
<td>eGFR, mL/min</td>
<td>71±23.2</td>
<td>72±23.3</td>
<td>71±25.0</td>
<td>69±18.9</td>
<td>69±22.8</td>
</tr>
<tr>
<td>ASA 3 and 4</td>
<td>86</td>
<td>84</td>
<td>85</td>
<td>89</td>
<td>100</td>
</tr>
<tr>
<td>MI</td>
<td>37/154 (24.0)</td>
<td>16/62 (25.8)</td>
<td>14/54 (25.9)</td>
<td>5/27 (18.5)</td>
<td>2/11 (18.2)</td>
</tr>
<tr>
<td>COPD</td>
<td>44/154 (28.6)</td>
<td>16/62 (25.8)</td>
<td>16/54 (29.6)</td>
<td>8/27 (29.6)</td>
<td>4/1 (36.4)</td>
</tr>
<tr>
<td>AAA diameter, mm</td>
<td>61.7±12.4</td>
<td>60±14.8</td>
<td>61±10.1</td>
<td>65±11.6</td>
<td>62±19.0</td>
</tr>
<tr>
<td>AAA location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrarenal</td>
<td>0/152 (0)</td>
<td>0/62 (0)</td>
<td>0/54 (0)</td>
<td>0/26 (0)</td>
<td>0/10 (0)</td>
</tr>
<tr>
<td>Juxtarenal (left)</td>
<td>79/152 (51.9)</td>
<td>28/62 (45.2)</td>
<td>34/54 (63.0)</td>
<td>16/26 (61.5)</td>
<td>1/10 (10)</td>
</tr>
<tr>
<td>Juxtarenal (right)</td>
<td>72/152 (47.4)</td>
<td>24/62 (38.7)</td>
<td>33/54 (61.1)</td>
<td>14/26 (53.8)</td>
<td>1/10 (10)</td>
</tr>
<tr>
<td>Suprarenal</td>
<td>20/152 (13.2)</td>
<td>4/62 (6.5)</td>
<td>3/54 (5.6)</td>
<td>5/26 (19.2)</td>
<td>8/10 (80)</td>
</tr>
<tr>
<td>Supra-SMA</td>
<td>4/152 (2.6)</td>
<td>0/62 (0)</td>
<td>0/54 (0)</td>
<td>2/26 (7.7)</td>
<td>2/10 (20)</td>
</tr>
<tr>
<td>Supra-celiac</td>
<td>4/152 (2.6)</td>
<td>0/62 (0)</td>
<td>0/54 (0)</td>
<td>2/26 (7.7)</td>
<td>2/10 (20)</td>
</tr>
<tr>
<td>Proximal neck length, mm</td>
<td>22.5±14.6 (0.0, 890)</td>
<td>15.9±13.7 (0.0, 890)</td>
<td>28.0±14.2 (3.0, 80.3)</td>
<td>29.5±11.1 (16.0, 53.0)</td>
<td>18.6±13.2 (0.0, 40.0)</td>
</tr>
<tr>
<td>Proximal neck diameter, mm</td>
<td>27.5±5.6 (16.2, 54.2)</td>
<td>26.2±5.9 (17.0, 54.2)</td>
<td>27.0±4.5 (16.2, 43.0)</td>
<td>29.0±5.1 (20.0, 38.0)</td>
<td>33.3±6.8 (23.5, 44.1)</td>
</tr>
<tr>
<td>Chimney distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 LRA, 29 RRA, 1 SMA, 1 NS</td>
<td>2 BRA, 2 SMA, LRA, 1 BRA, 2 SMA, CA</td>
<td>11 BRA, SMA, CA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seal zone length, mm</td>
<td>15.9±13.7</td>
<td>28.0±14.2</td>
<td>29.5±11.1</td>
<td>18.6±13.2</td>
<td></td>
</tr>
<tr>
<td>Procedure duration, min</td>
<td>216.3±84.4 (74, 474)</td>
<td>161.4±47.1 (74, 250)</td>
<td>209.8±76.9 (90, 450)</td>
<td>280.7±86.1 (150, 474)</td>
<td>299.5±56.6 (210, 390)</td>
</tr>
<tr>
<td>Fluoroscopy duration, min</td>
<td>40.0±30.4 (8, 152)</td>
<td>26.3±17.7 (9, 76)</td>
<td>35.5±27.4 (8, 145)</td>
<td>63.5±43.3 (13, 152)</td>
<td>61.2±23.8 (29, 96)</td>
</tr>
<tr>
<td>Contrast volume, mL</td>
<td>222.8±114.2 (25, 600)</td>
<td>217.0±108.2 (80, 550)</td>
<td>203.0±109.2 (66, 600)</td>
<td>198.4±96.8 (34, 385)</td>
<td>313.7±142.9 (25, 520)</td>
</tr>
<tr>
<td>Blood loss, mL</td>
<td>338.8±225.7 (0, 1500)</td>
<td>280.5±182.0 (700)</td>
<td>261.1±149.4 (650)</td>
<td>475.3±297 (100, 1500)</td>
<td>519.4±199.5 (200, 800)</td>
</tr>
<tr>
<td>Polymere volume, mL</td>
<td>101.5±60.7</td>
<td>111.8±61.8</td>
<td>98.0±57.9</td>
<td>97.1±71.2</td>
<td>71.7±27.6</td>
</tr>
<tr>
<td>Polymere fill pressure, mm Hg</td>
<td>197.2±15.4</td>
<td>192.8±39.6</td>
<td>193.2±26.3</td>
<td>194.1±13.1</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AAA, abdominal aortic aneurysm; acc, accessory; ASA, American Society of Anesthesiologists; BRA, bilateral renal arteries; CA, celiac artery; COPD, chronic obstructive pulmonary disease; LRA, left renal artery; MI, myocardial infarction; NS, not specified; RRA, right renal artery; SMA, superior mesenteric artery.

*Continuous data are presented as the mean ± standard deviation (interquartile range if applicable); categorical data are given as the count (percentage).
Patients treated with a single chimney had an average seal zone length 15.9±13.7 mm; the longest seal zone was observed in patients with triple chimneys (29.5±11.1 mm).
Conclusions: ChEVAS is an effective treatment of juxtarenal abdominal aortic aneurysms, particularly for those patients with aneurysms unsuitable for fenestrated EVAR or those requiring urgent treatment. These data form part of the international, multicenter Aneurysm Study for Complex AAA: Evaluation of Nellix Durability (ASCEND) registry, results from which will allow us to determine the long-term efficacy of this new approach.
Medtronic Launches ENCHANT Study to Evaluate ChEVAR Parallel Graft Technique with the Endurant(TM) II/IIs Stent Graft System

January 24, 2018 7:00 AM CT

Medtronic

Clinical Study to Investigate the Performance of the ChEVAR Technique in AAA Patients with Short Aortic Necks

DUBLIN - January 24, 2018 - Medtronic plc (NYSE: MDT) today announced the launch of the ENCHANT (ENdurant CHEVAR New Indication Trial) study. The post-market, non-interventional, multi-center, non-randomized, single-arm study will enroll approximately 150 patients across 25 sites in Europe and Russia, and will evaluate the safety and performance of a ChEVAR procedure using the Endurant(TM) II/IIs stent graft system in a real-world setting. The first enrollment at St. Franziskus Hospital in Munster, Germany, was led by Professor Giovanni B. Torsello, M.D., chief of Vascular Surgery and principal investigator for the ENCHANT study.
Inclusion Criteria:

• Subject is ≥18 years old
• Subject is scheduled for primary treatment of the juxtarenal aortic aneurysm with a short infrarenal neck (i.e. no revision subjects)
• Subject is able and willing to comply with the protocol and to adhere to the follow-up requirements
• Subject has provided written informed consent
• Subject is an eligible candidate according to the currently available Endurant II/IIs instructions for use for ChEVAR

• Subject has a juxtarenal aortic aneurysm with a short infrarenal neck (definition of juxtarenal aortic aneurysm with a short infrarenal neck will be in accordance with commercially available Endurant II/IIs instructions for use for ChEVAR).

Exclusion Criteria:

• Subject is participating in a concurrent study which may confound study results
• Subject has a life expectancy ≤1 year
• Subject has an aneurysm that is:
  • Suprarenal or pararenal
  • Isolated iliofemoral
  • Mycotic
  • Inflammatory
  • Pseudoaneurysm
• Subject requires emergent aneurysm treatment, for example, trauma or rupture
• Subject has previously undergone surgical treatment for abdominal aortic aneurysm
• Subject is a female of childbearing potential in whom pregnancy cannot be excluded
• Subject has a known hypersensitivity or contraindication to anticoagulants, anti-platelets, or contrast media, which is not amenable to pre-treatment
• Subject has a creatinine level >2.0 mg/dl (or >176.8 μmol/L) and/or is on dialysis
Oversizing of 30% of aortic stent graft
Donas et al have looked back at the PERICLES registry to understand the effects of both oversizing and undersizing of these procedures. Defining undersizing as < 20% and oversizing as > 30%.

New sealing zone of 20mm

Use of suitable combinations between aortic devices and chimney stent-graft

Perform single or maximum double chimneys
**Natural history of gutter-related type Ia endoleaks after snorkel/chimney endovascular aneurysm repair**

Brant W. Ullery, MD,\textsuperscript{a} Kenneth Tran, MD,\textsuperscript{b} Nathan K. Itoga, MD,\textsuperscript{b} Ronald L. Dalman, MD,\textsuperscript{b} and Jason T. Lee, MD,\textsuperscript{c} \textit{Portland, Ore; and Stanford, Calif}

Gutters endoleaks are benigne

95% dissapeared in the follow up

Therapy depends on the pattern of endoleak

What about three chimneys?
Juxtarenal or Pararenal Chimney Graft

You should follow some rules:

- Covered Stents (CS): Options in Size and Length
- 1mm bigger than the Target Vessel (self expandable)
- 2cm inside the Target Vessel
- Overall w/ 50mm in length
- The CS proximal end above the celiac axis is advisable
You should follow some rules:

- First: Endograft deployment.
- Second: Latex balloon accommodation.
- Third: Covered stent deployment (if you have used a self-expandable one).
- Fourth: Bare-metal self-expandable stent deployment inside of the covered stent (if you have used a self-expandable one).


You should follow some rules:

- One Chimney: 20% Endograft oversizing.
- Two and three Chimneys: 30% Endograft oversizing.
- Four Chimneys: it is NOT advisable.
- Proceed to one renal with Sandwich Periscope.
Juxtarenal or Pararenal Chimney Graft

You should follow some rules:

- One ChG: needs a health neck of 1.5cm in length.
- Two ChG: need a health neck of 2.0cm in length.
- Three ChG: need a health neck of 2.5cm in length.
- Four ChG: it is NOT advisable (3 ChG and 1 SG)
  Proceed to one renal with Sandwich Periscope.

RECOMMENDATION
Three chimneys: is it too much?

Answer is No

- Aneurysms unsuitable for fenestrated EVAR.
- Aneurysms requiring urgent treatment.
- Progress in technology has provided favorable solutions for challenging aortic neck anatomy.
- Aortic device and stentgraft combination is recommended to achieve optimal outcomes.
- Ch-evar is a viable alternative in high risk patients with limited options and a pararenal aneurysm.
FINAL CONSIDERATIONS

Three chimneys: is it too much? Answer is No

These findings and next studies should inform endovascular surgeon considering chEVAR with Three chimneys, in the FUTURE, for elective treatment of juxtarenal and pararenal aortic disease. Improved patient and device selection can occur to achieve optimal outcomes.
Three or four chimneys: is it too much?

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