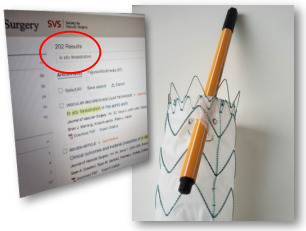
In Situ Fenestration For Endovascular Repair Of Aortic Arch Lesions: Does It Reduce Perioperative Strokes And How To Avoid Cerebral Ischemia During The Procedure

- Prof. Ralf Kolvenbach MD FEBVS, Director Vascular Surgery Department,Sana Hospital Group Duesseldorf, Germany
- Prof. Chang Shu, Director of Vascular Surgery Department Fuwai Hospital, Chinese Academy of Medical Sciences. China

Conflict of Interest: None

Current role of in situ fenestration ?

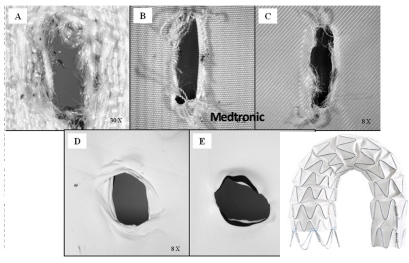
Are all grafts suitable for in situ fenestration ?



In Situ Fenestration: Implications for Endograft Durability

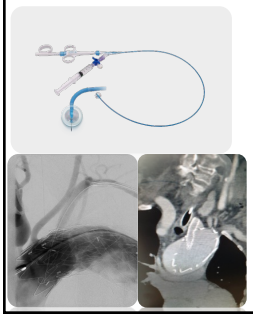
P. Antoni, Brussels, Belgium; T.V. Hoe, Liverpool, UK; P. L. Harris, Liverpool, UK; J. Brennan, Liverpool, UK; G. L. Gilling-Smith, Liverpool, UK; R. Verhelst, Brussels, Belgium; Richard G. McWilliams, MD, Liverpool, UK

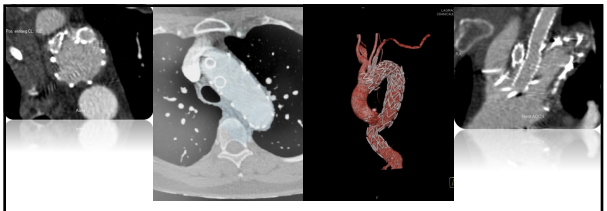
„ Static fabric testing of Fabric and PTFE suggests that in S. Fenestration does not result in a propagation of the fabric tear „



Double Layer e-PTFE dual membrane

Futhrough™ Endovascular Needle System



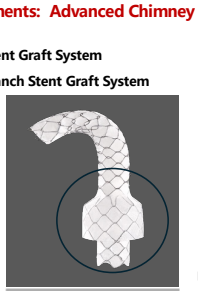


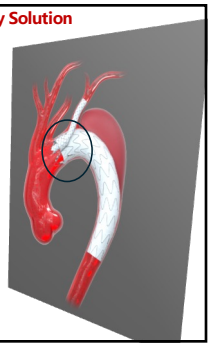
Reducing the Number of Chimney Grafts

New Developments and Improvements

New Developments: Advanced Chimney Solution

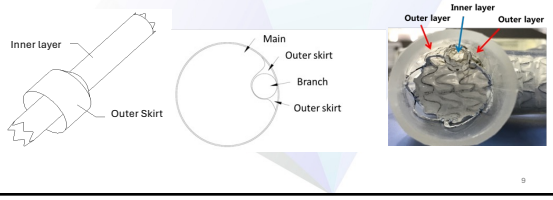
- Ankura™ pro Aorta Stent Graft System
- Longuette™ Aortic Branch Stent Graft System





Product Inventor-Chang Shu (Fuwai Hospital, CAMS&PUMC, China)

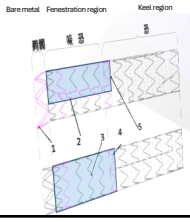
Longuette™ Aortic Branch Stent Graft System

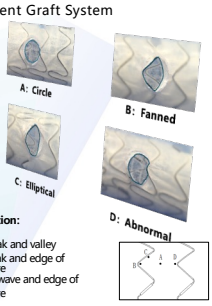


9

Ankura™ Plus Aortic Arch Stent Graft System

Special designed fenestration region





Fenestration postion:

A:between the peak and valley
B:Inner side of peak and edge of nickel titanium wire
C:Straight part of wave and edge of nickel titanium wire
D: Peak location

The Issue of brain protection in Arch manipulation

Stroke Rate After Endovascular Aortic Interventions

Retrospective review of the Vascular Quality Initiative database

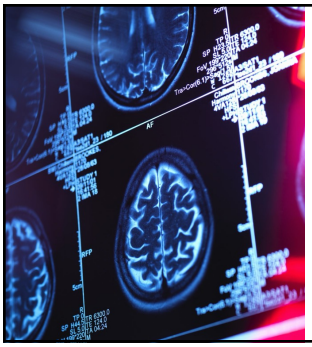
	EVAR N=41,540	Complex EVAR* N=1,371	TEVAR N=4,600
Stroke	0.1%	0.9%	2.9%
Predictors of stroke	• AAA diameter >6.5cm • Proximal extension cuff	• Arm access • Left subclavian artery involvement	• Proximal landing zones

*Fevar, Chimney EVAR

JVS Journal of Vascular Surgery

Swerdlow et al. *J Vasc Surg November 2020*

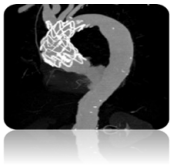
„ Simple „ TEVAR Zone II Landing Zone



Background

- There are a limited range of endovascular solutions for arch repair, and they continue to be associated with relatively high stroke rates
- **Post-operative stroke after TEVAR leads to a 35.4% mortality (Hu et al, JVS 2017)**

Neurological outcomes



- Comparative data for other published data
  - *Spear 2016 EIVES* Cook branched system **11.1%** early stroke rate plus two non-permanent paraplegias
  - *Ferrer 2017 JVS* Terumo Relay 25% of patients had CVAs, with **50% experiencing a major stroke.**
  - *Czerny 2021 EJCTS* Terumo Relay branch system reported a **26%** stroke rate

Aorta and Major Branches

Eur J Vasc Endovasc Surg (2021) 61, 239–245

Silent Brain Infarction After Endovascular Arch Procedures: Preliminary Results from the STEP Registry

Philippe Charbonneau [a], Tilo Kölbel [b], Fiona Rohlffs [b], Wolf Eilenberg [b], Olivier Planche [c], Matthias Bechstein [d], Robin Rixt [b], Roger Greenhalgh [e], Stephan Haulon [a,*], on behalf of STEP collaborators

[a] Aortic Centre, Hôpital Marie Lannelongue, Groupe Hospitalier Paris Saint Joseph, Université Paris Saclay, Paris, France
[b] German Aortic Centre, Department of Vascular Medicine, University Heart and Vascular Centre, Hamburg, Germany
[c] Radiology Department, Hôpital Marie Lannelongue, Groupe Hospitalier Paris Saint Joseph, Paris, France
[d] Vascular Surgical Research Group, Imperial College, London, UK
[e] Department of Diagnostic and Interventional Neuroradiology, University Hospital Hamburg-Eppendorf, Germany

WHAT THIS PAPER ADDS
This is the largest study to evaluate the incidence and distribution of silent cerebral infarction (SBI) following endovascular repair for disease of the aortic arch. It is also the first cohort to include total endovascular arch repair and devices flushed with carbon dioxide (CO_2). Post-operative diffusion weighted magnetic resonance imaging demonstrated a SBI incidence of 50%.

Silent Brain Infarcts Affect 50%: Understanding the Long-term Impacts is Vital!

Product Name	Supra-aortic branches Endo	Hybrid / Endo	Delivery System (OD)	Supply Convenience	Complexity	Any Stroke 30d	Mortality 30d
NEXUS[1]	Single Branch (BCT Only)	HybridRCCA-LCCA-LSCA	20F	Off-the-Shelf	High level endo not required	3.6%	7.1%
NEXUS DUO	Double Branch Choice LCCA or LSA	HybridLCCA - LSCA	20F	CMD4 weeks	High level endo not required Micro puncture LCCA or LSA	Based on NEXUS technology	Based on NEXUS technology
Relay CMD[2,3]	Double Branch	Hybrid LCCA-LSCA	24-25F	CMD Only. Started FDA Trial	Requires carotid cannulation	12.5% - 50%+	9%–17%
Zenith CMD[2,3]	1. Double Branch 2. Triple Branch	1. Hybrid LCCA- LSCA 2. Nil – Total endo	24F	CMD Only No Trial initiated	Multi vessel cannulation – technique – advanced endo	11.1% - 15.8%	0%–13.2%

[1] Planer et al. - NEXUS Arch: A Multicenter Study Evaluating the Initial Experience with a Novel Aortic Arch Stent Graft System. Ann Surg. (2021)
[2] Spear et al. - Subsequent Results for Arch Aneurysm Repair with Inner Branched Endografts - Eur J Vasc Endovasc Surg (2016)
[3] Haulon et al. - Global Experience with an Inner Branched Arch Endograft - The Journal of Thora- cic and Cardiovascular Surgery (2016)
[4] Patton et al. - Italian Registry of Double Inner Branch Stent Graft for Aortic Pathology One Thoracic Hospital. J Vasc Surg (2019)

Combined Experience in situ fenestration

Chinese – German Registry

patients	Dissection	Arch and descending Aneurysm	Elective	Emergency
75	21 (28 %)	54 (72 %)	51 (68 %)	24 (32 %)

In situ fenestration LSA	In situ fenestration LSA +left Carotid	In situ fenestration +scallop carotid	In situ fenestration + carotid chimney	In situ fenestration +2 chimneys
43 (57,3%)	3 (4 %)	20 (26,6%)	8 (10,6%)	1 (1,3%)

Combined Experience in situ fenestration

Follow up: 24 months

Endoleak Type I a	Endoleak Type II	Endoleak Type III	Branch Occlusion
2 Patients (2,6%)	2 Patient from LSA (2,6%)	3 Patients (4%)	1 Patient 1,3%
Conservative 1 TXT 1		TXT 1	

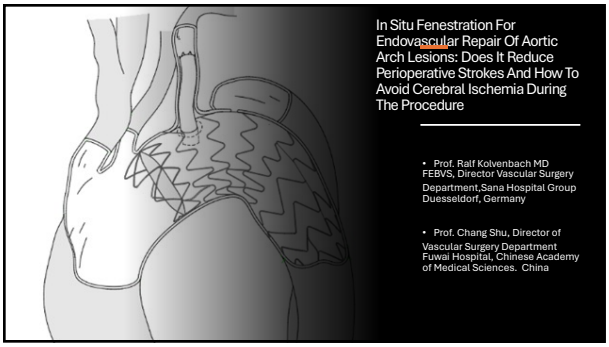
Perioperative Stroke : 0	Late Stroke 1
1 TIA	1 after 13 months (1,3 %)

Subclavian branch thrombosis	1	1%
TIA	1	1%
Type Ia endoleak	1	1%
Type II Leak	2	3%
Type II complication originated from the LSA	1	1%
Type III leak	1	1%
Type III endoleak	2	3%

No clinical consequences

Conclusion

- In situ fenestration appears to provide good medium-term results.
- It is a straightforward technique with a short learning curve.
- The manipulation of the aortic arch is significantly reduced, which seems to lower the incidence of neurological events compared to other endovascular arch techniques.



In Situ Fenestration For Endovascular Repair Of Aortic Arch Lesions: Does It Reduce Perioperative Strokes And How To Avoid Cerebral Ischemia During The Procedure

- Prof. Ralf Kolvenbach MD FEBVS, Director Vascular Surgery Department,Sana Hospital Group Duesseldorf, Germany
- Prof. Chang Shu, Director of Vascular Surgery Department Fuwai Hospital, Chinese Academy of Medical Sciences. China