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The Issue of Stroke during TEVAR in the Arch: How Frequent, What Sources and How to Prevent?

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CONTROVERSES ET ACTUALITÉS EN CHIRURGIE VASCULAIRE
CONTROVERSIES & UPDATES
IN VASCULAR SURGERY

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Disclosures



- * Research-grants, travelling, proctoring speaking-fees, IP, royalties with Cook.
- * Consultant with Philips
- * Research, consulting, royalties with Vascutek.
- * Shareholder Mokita Medical

Stroke in TEVAR



- * Incidence
 - * in TEVAR: 3-11%
 - * in complex TEVAR: >10%
- * Anterior/posterior circulation
- * Mechanism of stroke unclear
- * Mortality 20%
- * Silent brain infarctions (SBI) up to 87%



Feezor et al. 2007; J Endovasc Ther 14:568-73

Ullery et al. 2012; J Vasc Surg 56:1510-7

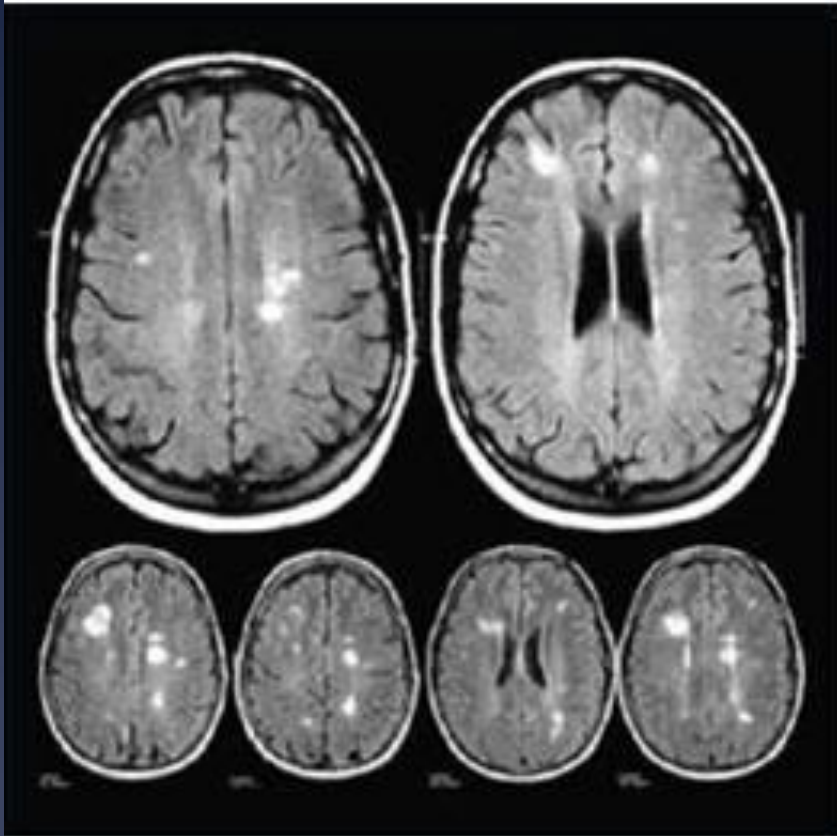
Alsafi et al. 2014; J Vasc Surg 60:1499-506

Böckler et al. 2016; Eur J Vasc Endovasc Surg 51:791-800

Kahlert et al. 2014; Ann Thorac Surg 98:53-8

Perera et al. 2015; Br J Surg 102: s2: 5

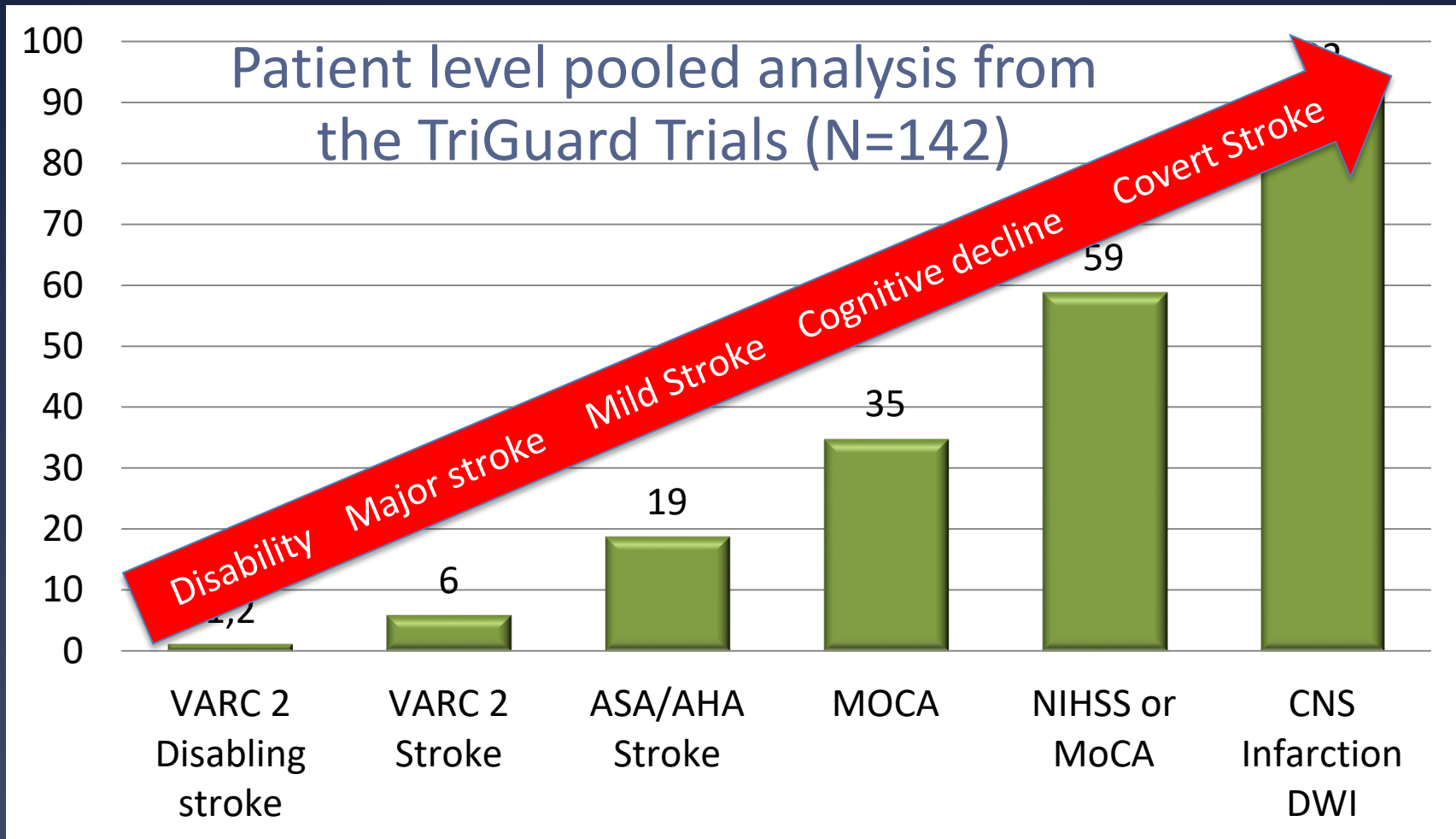
Stroke Definition



DWI: relevance and interpretation

DWI allows detection of ischemic injury from several minutes to days after an ischemic event, and is highly sensitive to acute and subacute ischemic insults when performed within 12 h of symptom onset (sensitivity 0.99). The image contrast in DWI is sensitive to the random motion of water molecules, and becomes hyperintense as cytotoxic edema restricts local water diffusion, representing tissue damage resulting from ischemia.^{36–38} Although the observed diffusion defects may resolve with time, virtually all DWI lesions represent permanent neuronal cell death and signify irreversible brain injury.^{39–41} False negative rates for DWI drop substantially after 35 h,⁴² and observed lesion volume is maximal at 5 to 7 days.⁴³ Because DWI lesions may begin to reverse intensity and/or shift through isointensity between 1 and 3 weeks, longer delays should be avoided. Therefore, 2 to 7 days is the recommended time window for acute or subacute imaging following cardiovascular procedures (Figure 2). Because measures of DWI visible lesion volumes may change rapidly over time, consistent timing of image acquisition in randomized trials is essential to avoid systematic bias.

What is Cerebral Injury ?





European Heart Journal (2017) **00**, 1–11
doi:10.1093/eurheartj/ehx037

CURRENT OPINION

Proposed Standardized Neurological Endpoints for Cardiovascular Clinical Trials

An Academic Research Consortium Initiative
Neurologic Academic Research Consortium: NeuroARC

Clinical Symptoms

Silent Brain
Infarction (SBI)

Lansky et al. 2017; JACC; 69: 679-91
Lansky et al. 2017; Eur Heart J; Epub

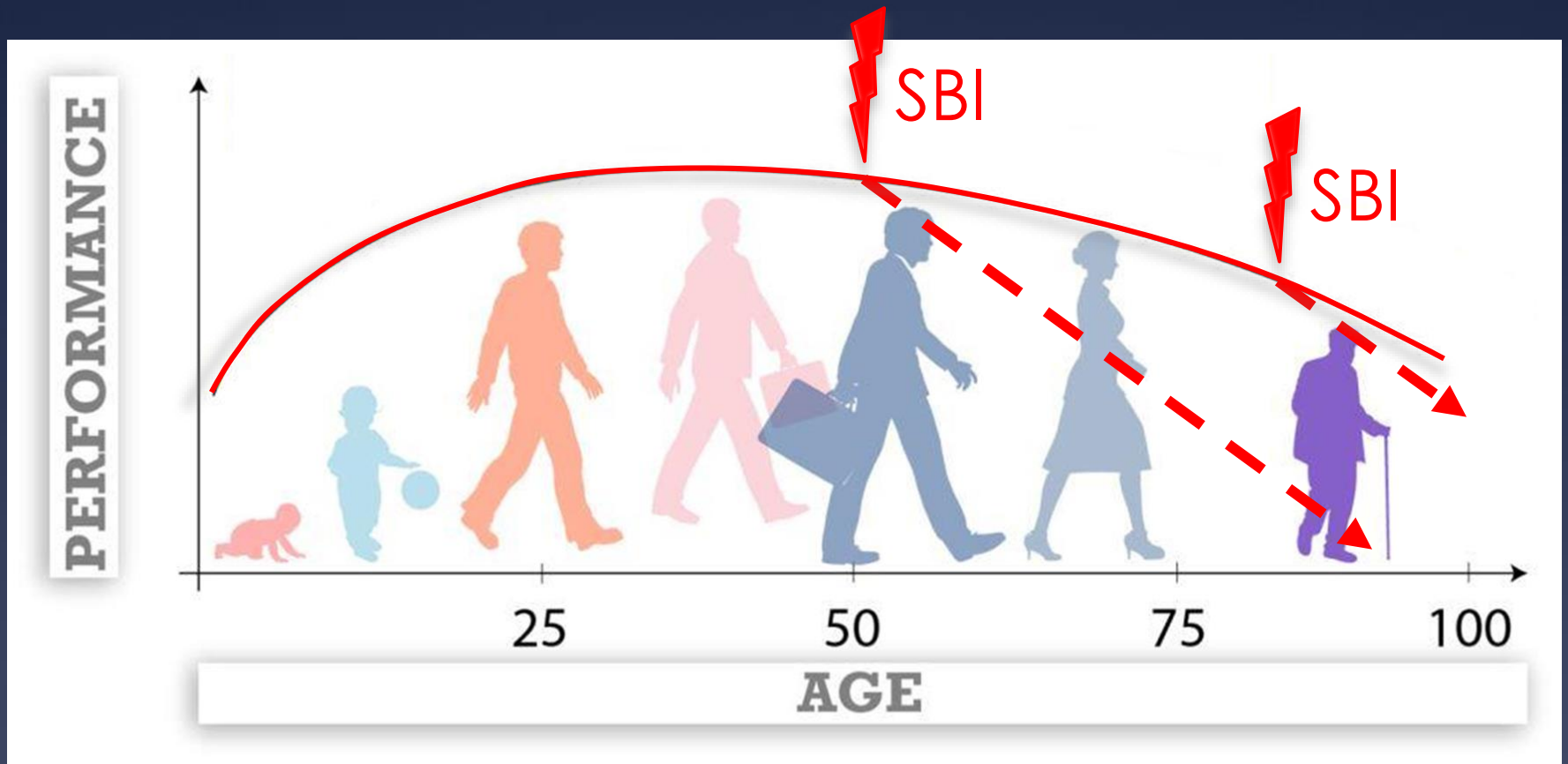
Clinical Impact of SBI



- * Postoperative confusion
- * Cognitive dysfunction
- * Impaired mobility
- * Depression
- * Dementia
- * Parkinson disease
- * Alzheimer disease



SBI-Impact on Mental Performance





Stroke in TEVAR

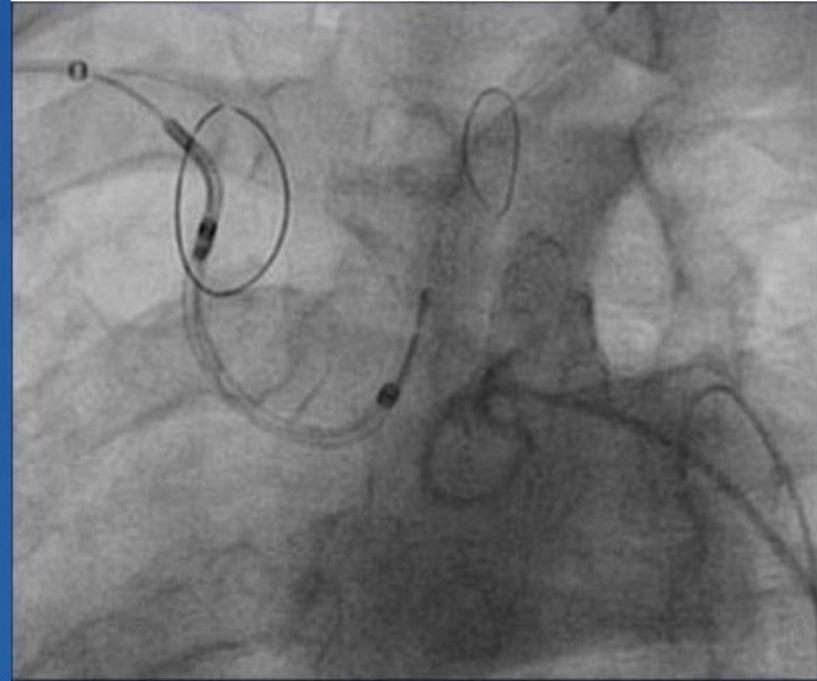


- * Particle embolism during wire manipulation and graft release
- * Air embolisation from stent-graft
- * Hemodynamic stroke

Sentinel Embolic Protection Device



- Dual-filter cerebral embolic protection device
- Filters placed in the innominate and left carotid arteries
- Designed to capture debris

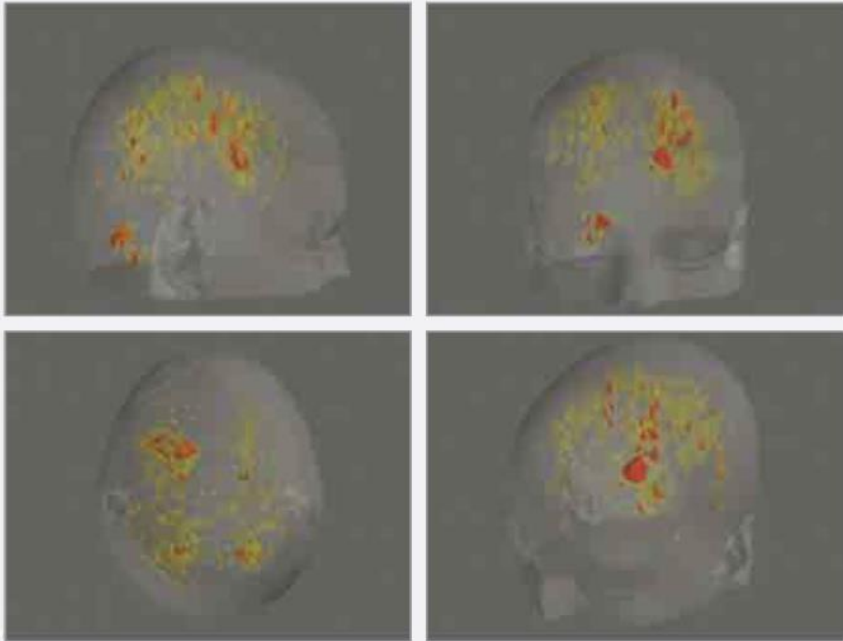


SBI in TAVI

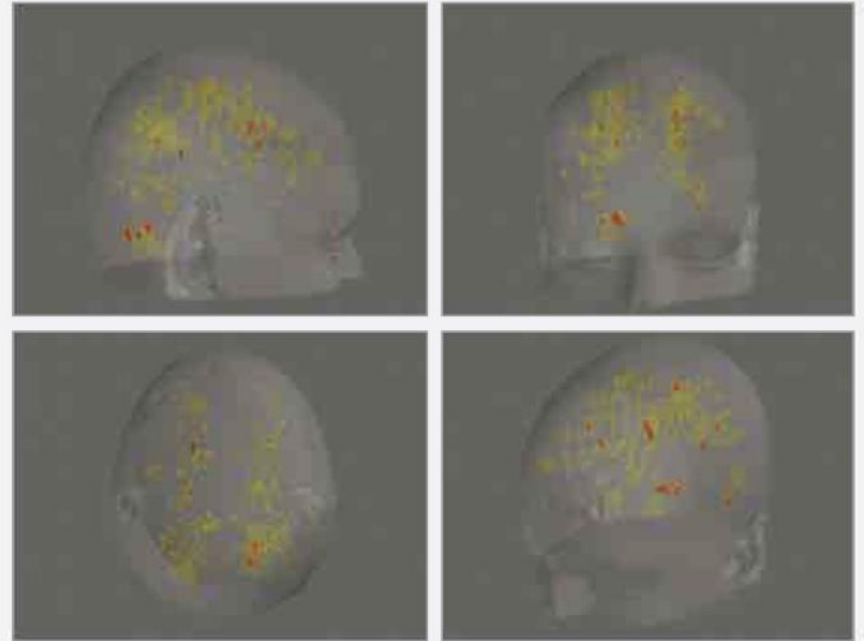


A Potentially protected areas

Control group (n=45)

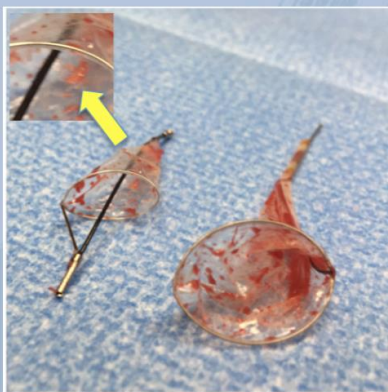


Filter group (n=49)

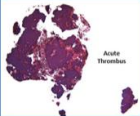

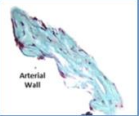






Embolic debris captured during TEVAR procedures



- Five cases of TEVAR using Claret Cerebral Protection System.
- Subsequently analyzed by team of Dr Virmani at CVPPath Institute
 - Debris includes acute thrombus, despite short procedures and high ACT, organized thrombus, artery tissue, and foreign material.
 - Debris characterization differs from TAVR, as expected, in lower rates of calcified debris.

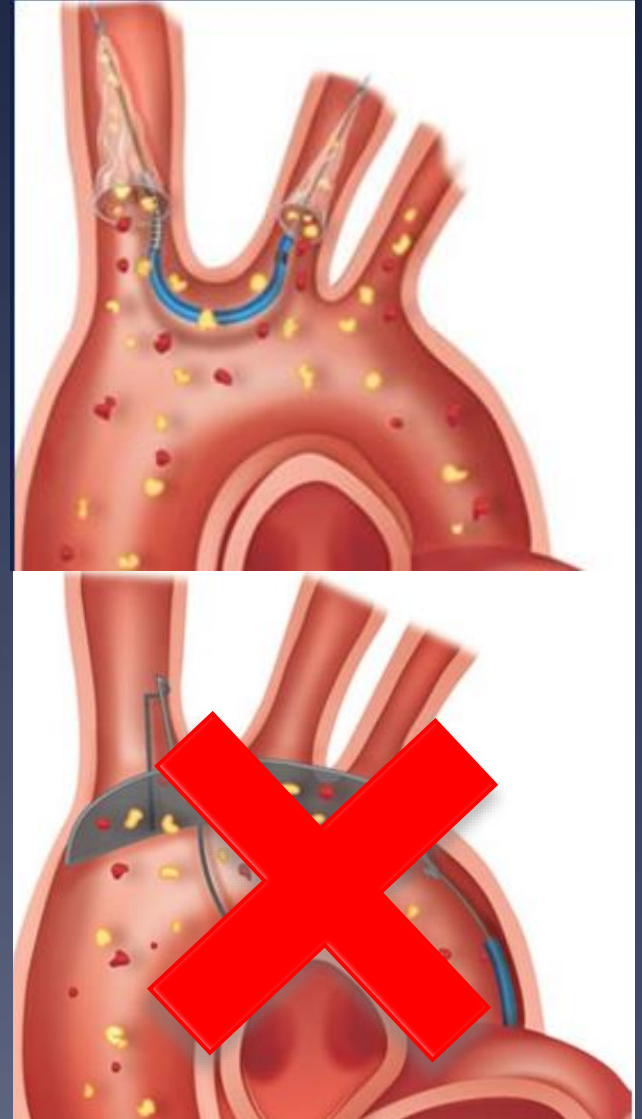
Type of Procedure, Center	# of patients in series	Any debris	Acute Thrombus 	Organizing Thrombus 	Arterial Wall 	Calcification 	Foreign Material 
TEVAR, West-German Heart and Vascular Center Essen	n=5	100%	100%	70%	80%	10%	80%

Note: percentages reflect percent of patients in the series in which each particular tissue type was captured. Some filters captured several types of debris, so percentages will not add to 100%

Protection Strategies



- * Patient selection
- * Minimize catheter/wire manipulation
- * Heparinization: ACT 250-350 sec.
- * Temporary occlusion of carotid arteries
 - * Vessel-loop
 - * Balloon
 - * Clamp
- * CEP-devices
 - * Filter devices, e.g. Sentinel by Claret Med.
 - * Deflectors, e.g. Triguard by Keystone Heart
 - * Other....
- * Carbondioxide flushing

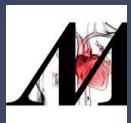
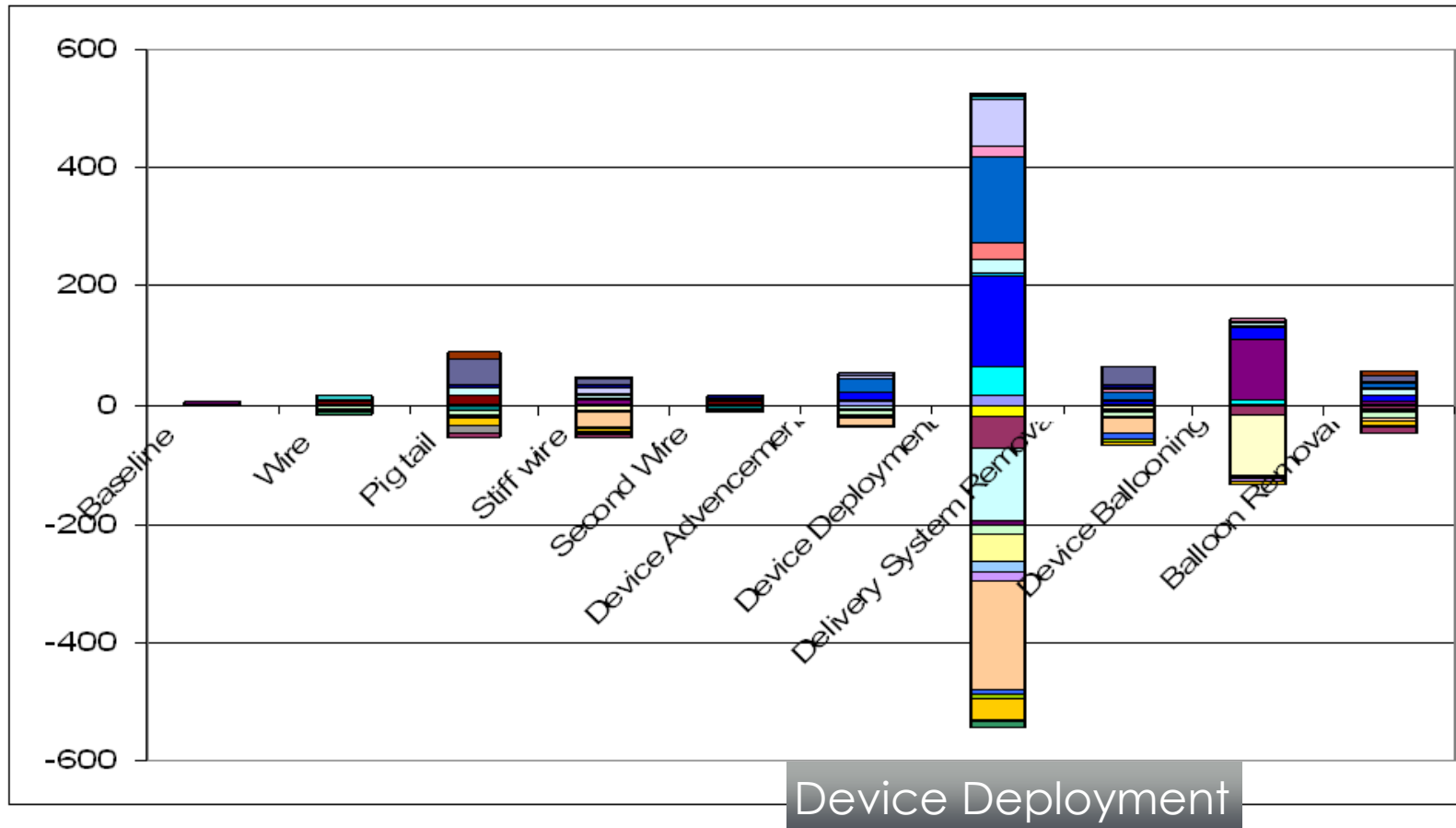


Air bubbles are released by thoracic endograft deployment: An in vitro experimental study

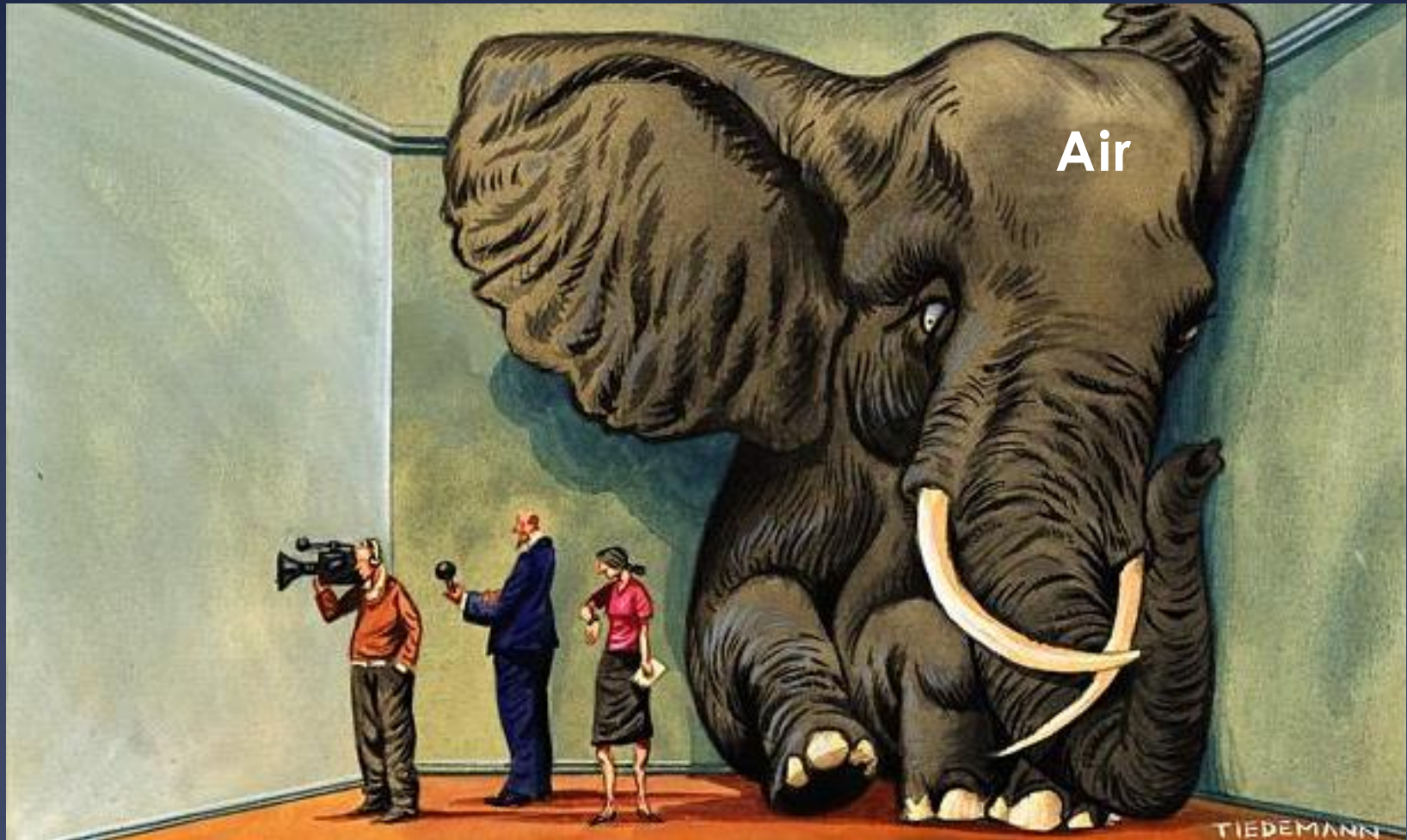
Kamuran Inci¹, Giasemi Koutouzi², Valery Chernoray³,
Anders Jeppsson⁴, Håkan Nilsson³ and Mårten Falkenberg²



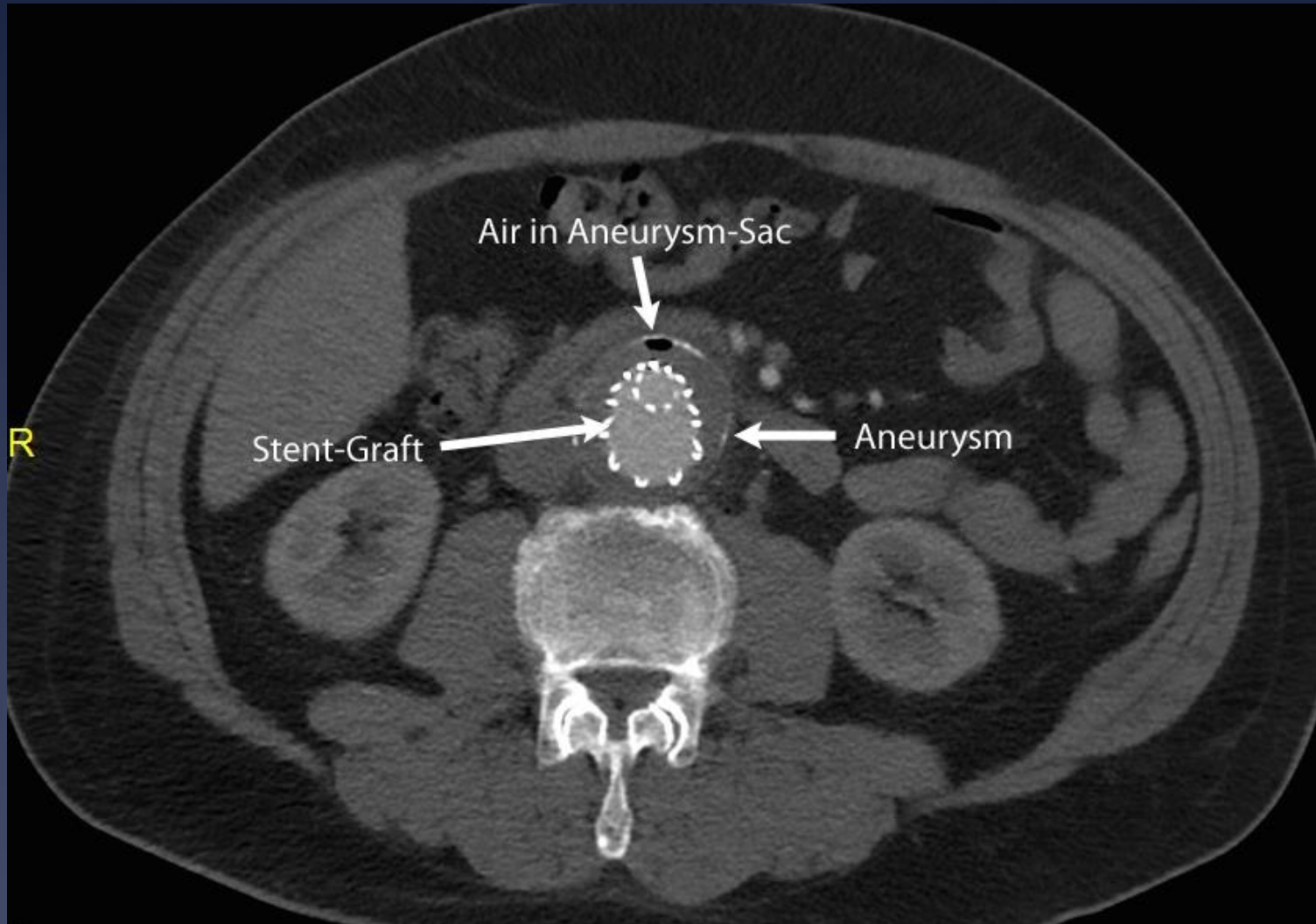
Total emboli counts (n=20)



Elephant in the Room

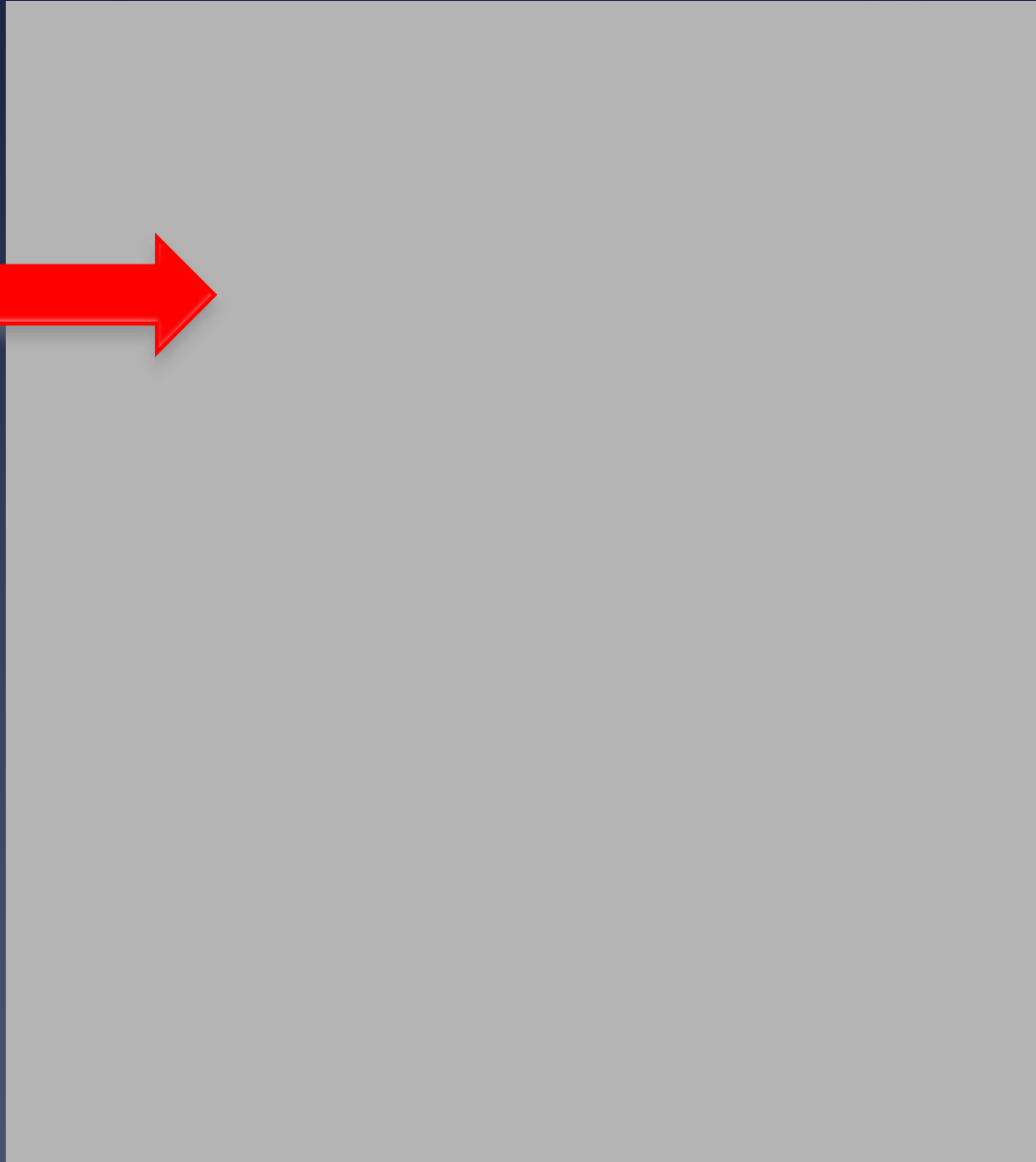


Air Embolism in EVAR

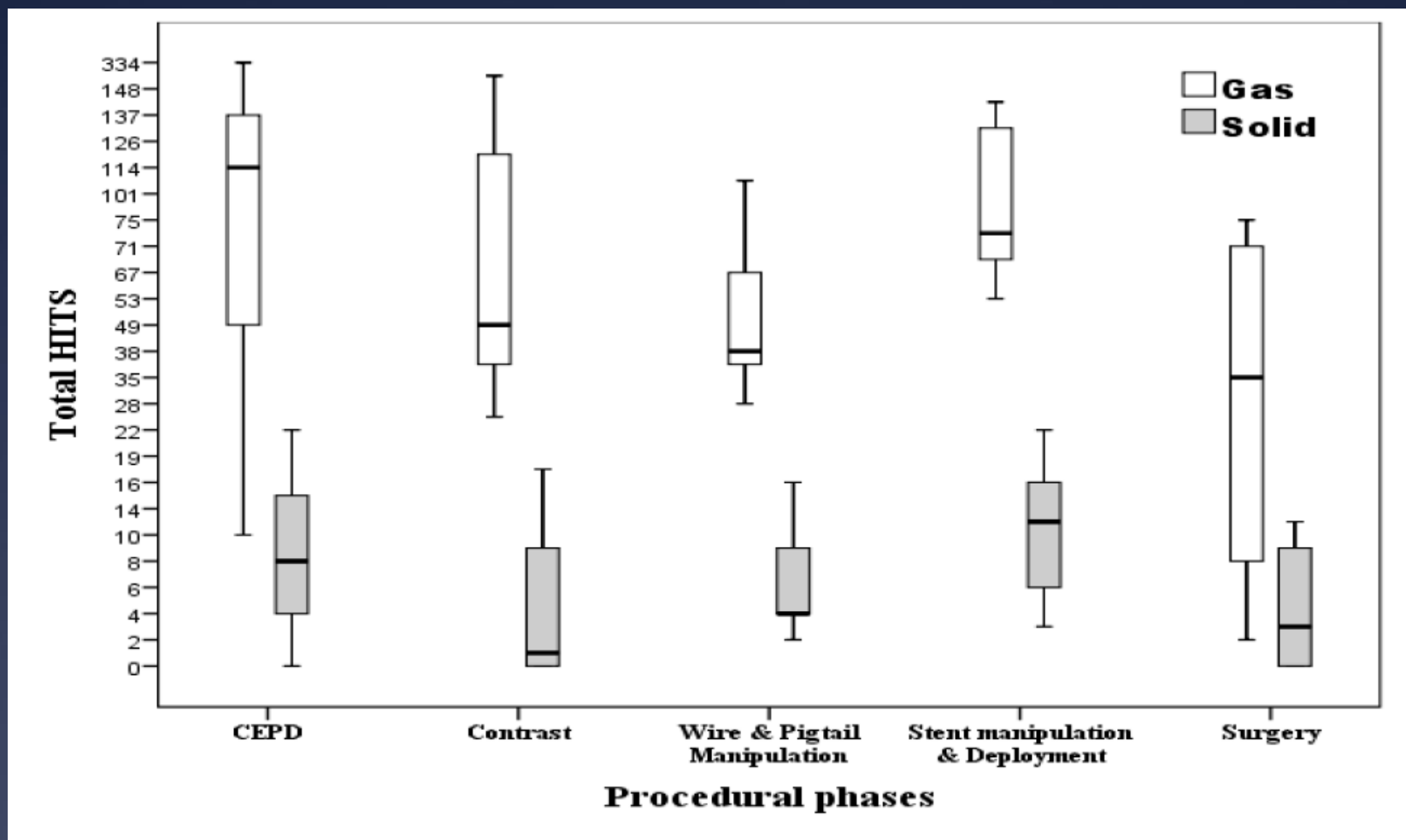


5 days after Standard EVAR

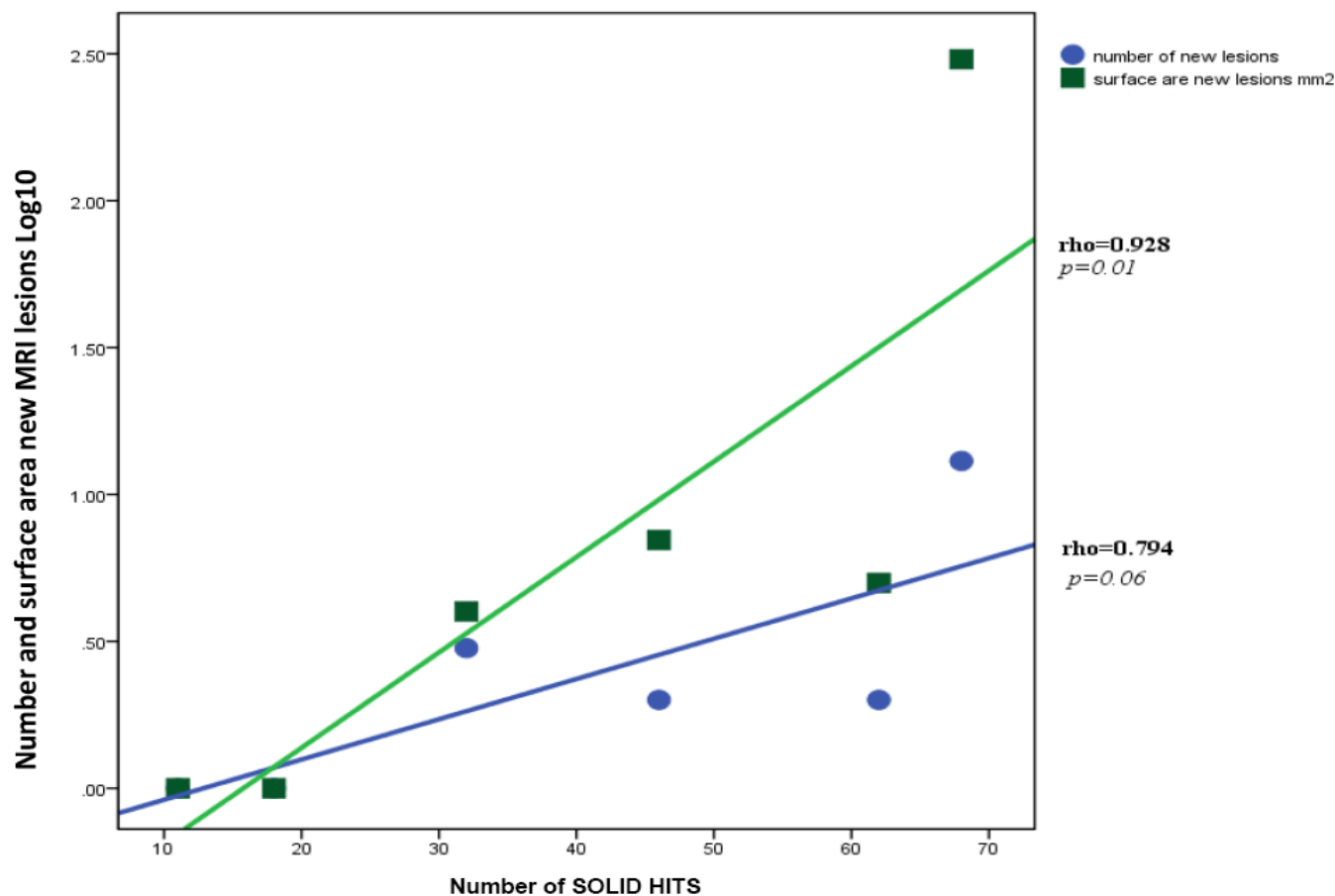
Air-Embolism in TEVAR



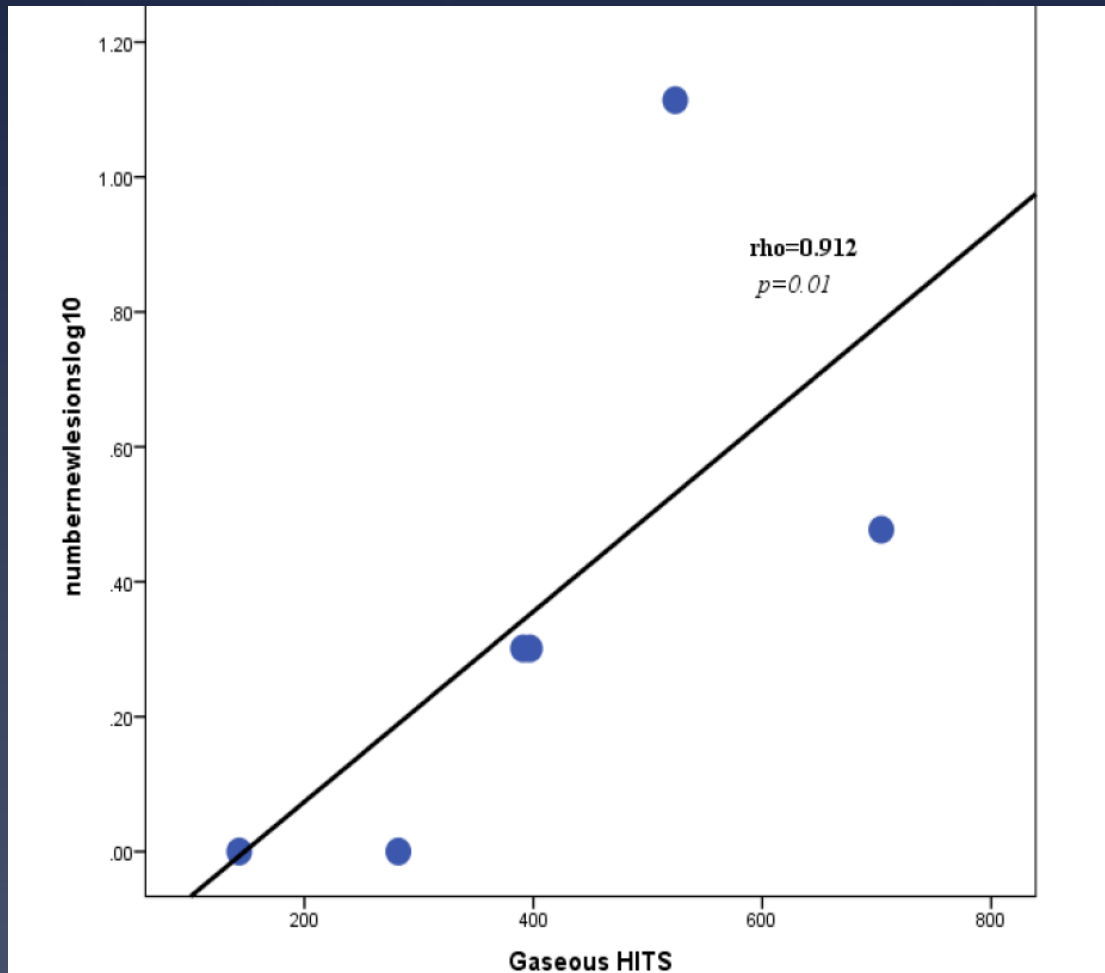
HITs during TEVAR: 90% Gas



Number and surface area of new MRI lesions vs solid HITS



MR-lesions associated with gaseous HITs



Heparin and Air Filters Reduce Embolic Events Caused by Intra-Arterial Cerebral Angiography

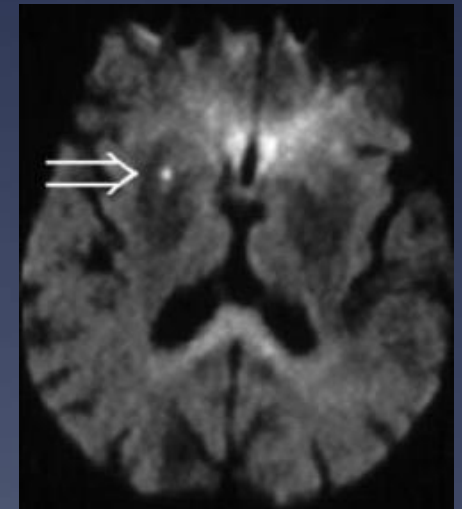
A Prospective, Randomized Trial

Martin Bendszus, MD; Martin Koltzenburg, MD, FRCP; Andreas J. Bartsch, MD; Roland Goldbrunner, MD; Thomas Günthner-Lengsfeld, MD; Franz X. Weilbach, MD;

TABLE 3. Median Single MES Count, Median Duration of MES Showers (ms), and Number of Ischemic Lesions on DW-MRI

	Heparin	Air Filter	Control
Median single MES, n (range)	44 (2–165)	29 (0–112)	66 (4–286)
Median MES shower, s (range)	40 (0–177)	5 (0–52)	57 (4–198)
Ischemic lesions on DW-MRI, n	4	4	17

Median number and range of single MES count (top), median duration and range (ms) of the MES showers (middle), and overall number of ischemic lesions (bottom) in the heparin, air filter, and control groups.

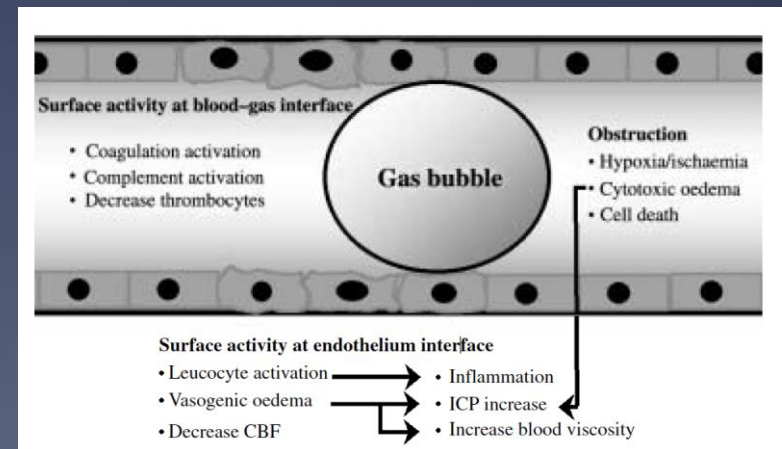
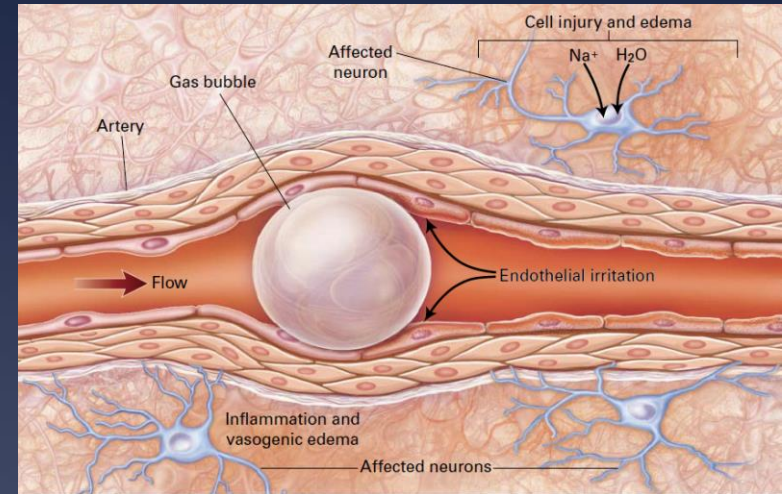


Conclusions—Air filters and heparin both reduce the incidence of silent ischemic events detected by DW-MRI after intra-arterial cerebral angiography and can potentially lower clinically overt ischemic complications. This may apply to any intra-arterial angiographic procedure. (Circulation. 2004;110:2110-2115.)

Pathophysiology




- * Ischemia by arterial blockage
- * Shear-stress of passing bubbles
- * Inflammatory response
- * Brain metabolism ↓
- * Nerval function ↓
- * Blood-brain barrier damage
- * Cerebral blood flow ↓
- * Disturbance of blood distribution
- * Intracranial pressure ↑



Muth et al. 2000; N Engl J Med 342: 476-82
 vHulst et al. 2003; Clin Physiol Funct Imaging 23: 237-46
 Furlow et al. 1982; Stroke 13: 847-52

Carbon Dioxide Flushing Technique to Prevent Cerebral Arterial Air Embolism and Stroke During TEVAR

Journal of Endovascular Therapy
1-3
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DOI: 10.1177/1526602816633705
www.jevt.org


- * 2014-2015: n=36
- * All complex arch and ascending TEVAR:
 - * Branched arch
 - * Fenestrated arch
 - * Ascending TEVAR
- * All zone 0 -1
- * Stroke: 1/36 (3%)
 - * minor non-disabling stroke



Conclusion



- * Stroke during TEVAR is relevant and needs to be avoided.
- * The source of stroke and SBI during TEVAR appears multifactorial.
- * Silent brain infarctions (SBI) during TEVAR are a frequent finding (80%) and associated with neurologic symptoms and cognitive dysfunction.
- * Air-embolism may play a significant role in stroke and SBI during TEVAR.



Welcome to Essen!



5th AORTIC LIVE SYMPOSIUM

SAVE
THE DATE



AORTIC
LIVE

2018

October 29-30, 2018

Congress Center Essen, Germany

In 2018 Aortic Live Symposium will return to Essen, Germany again.
We are looking forward to welcoming you again next year!