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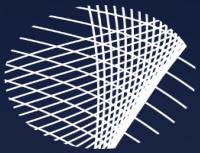
Endovascular aortic arch repair Ishimaru 0-3 is associated with cerebral microbleeds – Step registry

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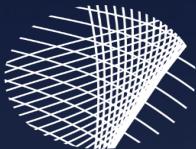




Disclosures



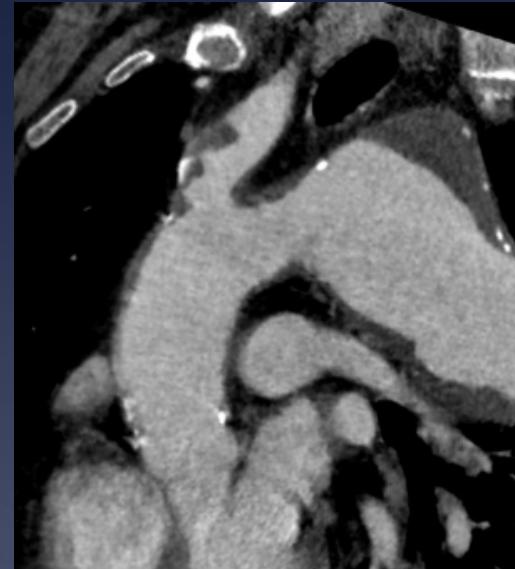
* None



INTRODUCTION



- * TEVAR is the primary repair technique for aneurysms of the descending thoracic aorta

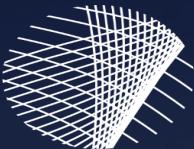


- * Stroke rates ≈ 5%

- * Silent events: **Cerebral microbleeds (CMBs)**
and Silent brain infarcts (SBI)



- * Poor data available concerning cerebral microbleeds after TEVAR



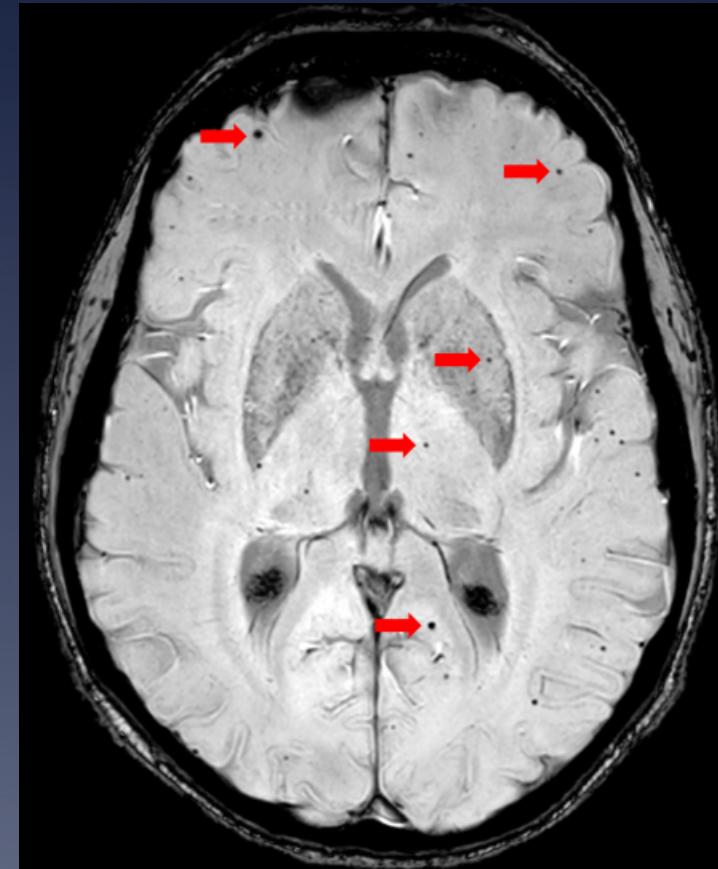
Cerebral microbleeds

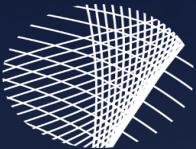


Cerebral microbleeds

- * Quantify
- * Evaluate the clinical impact
- * Identify predictive factors

STEP registry





METHODS STEP Registry



Multicentre, prospective study

- * Hospital Hamburg-Eppendorf (Hamburg, Germany)
- * Marie Lannelongue Hospital (Paris, France)

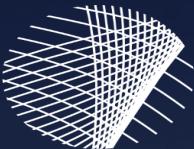
All endovascular arch procedures

- * Between September 2018 and January 2020
- * Endograft deployment in zone 0 to 3

Postoperative cerebral DW-MRI ≤ 7 days

Exclusion criteria

- * Missing preoperative CTA
- * MRI not performed inside the time window



METHODS - MRI

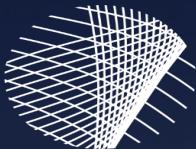


Reviewed by 2 radiologists (blinded to the study)

4 predefined vascular territories:

- * Anterior
- * Middle
- * Posterior
- * Vertebrobasilar

Number and location of all susceptibility artefacts (CMBs and SBI)



RESULTS



100 patients underwent an endovascular arch repair



9 excluded (Logistic: 5 Clinical instability: 4)

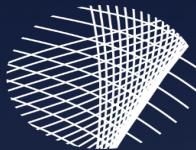
91 patients were included

*Age: 69 ± 11.2 years

*Men: 64%

*Previous ascending aortic surgery: 29%

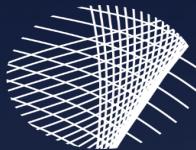
*Previous arch debranching: 32%



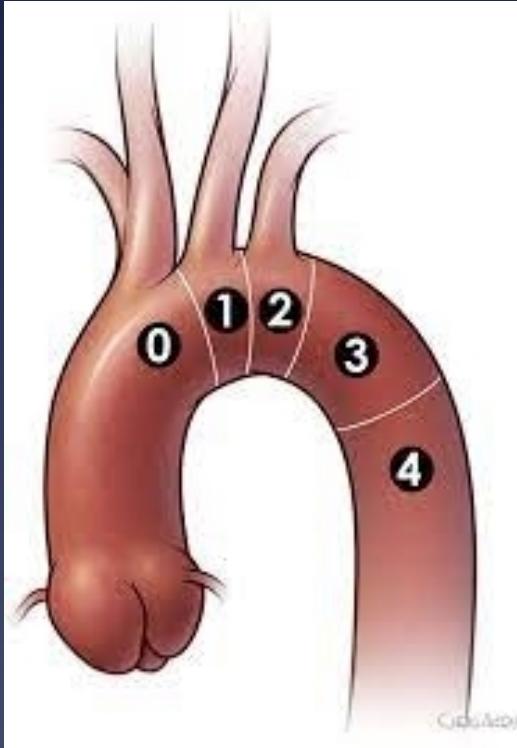
RESULTS - Procedural characteristics



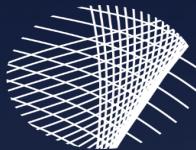
Characteristics	Overall (%)
URGENCY	
Elective	78
Urgent	22
INDICATION	
Degenerative aneurysm	37
Aortic dissection	48
Other	14



RESULTS - Procedural characteristics



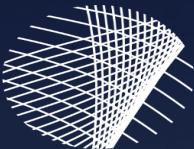
Characteristics	(%)
<u>ISHIMARU ZONE</u>	
0	<u>25</u>
1	<u>11</u>
2	<u>52</u>
3	<u>12</u>



RESULTS - Procedural characteristics

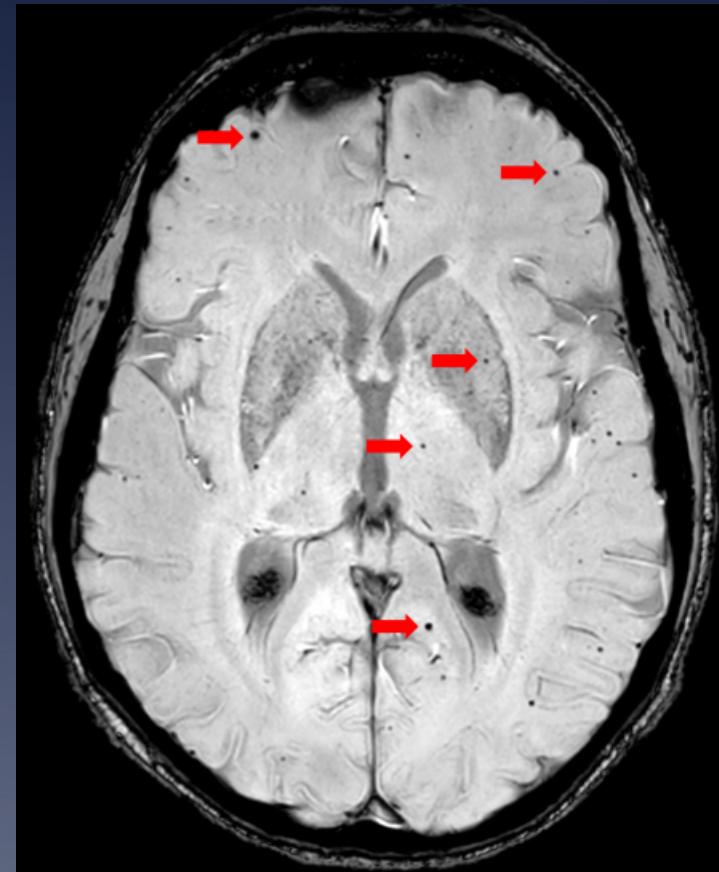


Characteristics	Overall (%)
ENDOPROSTHESIS TYPE	
Branched	25
Fenestrated	17
Tubular	58
LEFT CAROTID-SUBCLAVIAN BP or TP	
LENGTH OF PROCEDURE (min)	147.2 ± 79.2



Anatomic localisation of CMBs

Characteristics	Overall (n = 91)
Number of patients with at least 1 Lesion, n (%)	58 (63.7) 1531 lesions in 58 of total 91 patients
Total CMBs	
Number of CMBs, mean ± SD	26.4 ± 35.9
Hemisphere, n (%)	n (%)
Right alone	9 (15.5)
Left alone	3 (5.2)
<u>Bilateral</u>	46 (79.3)

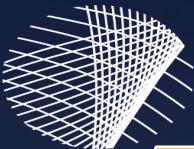


Comorbidities

COMORBIDITIES, n (%)	no CMB (n = 33)	CMB (n = 58)	P-value
Dyslipidemia	4 (12.1)	17 (29.3)	0.03
Hypertension	26 (78.8)	52 (90.0)	0.17
Diabetes mellitus	7 (21.2)	6 (10.3)	0.33
Chronic kidney disease	4 (12.1)	9 (15.5)	0.70
Coronary artery disease	7 (21.2)	6 (10.3)	0.58
Congestive heart failure	5 (15.2)	6 (10.3)	0.08
Cardiac arrhythmia	7 (21.2)	7 (12.1)	0.12
Chronic lung disease	5 (15.2)	6 (10.3)	0.66
Smoker	9 (27.3)	20 (34.5)	0.35
Peripheral vascular disease	4 (12.1)	2 (3.5)	0.46
Carotid artery disease	2 (6.1)	5 (8.6)	0.67
Stroke	4 (12.1)	8 (13.8)	0.92
<hr/>			
MEDICATION, n (%)			
Antiplatelets	14 (42.4)	27 (46.6)	0.41
Anticoagulation	6 (18.2)	9 (15.5)	0.86
Statin	14 (42.4)	30 (51.7)	0.76

Procedure Details I

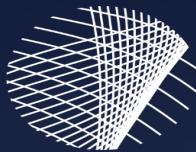
	no CMB (n = 33)	CMB (n = 58)	P-value
Zone0+1 (33pts)	6 (18.2)	27 (46.6)	0.01
Zone2+3 (58pts)	27 (81.8)	31 (53.4)	
Braned/Fenestrated (38pts)	9 (27.3)	29 (50.0)	0.05
Tubular (53pts)	24 (72.7)	29 (50.0)	
Elective (71pts)	25 (75.8)	46 (79.3)	0.88
Urgent (20pts)	8 (24.2)	12 (20.7)	
Aneurysm (34pts)	12 (36.4)	22 (37.9)	0.63
Dissection (44pts)	15 (45.5)	29 (50.0)	
Other (13pts)	6 (18.2)	7 (12.1)	
< 120 min surgery (39pts)	20 (60.6)	19 (32.8)	0.08
≥ 120 min surgery (52pts)	13 (39.4)	39 (67.2)	
< 40mm stent (50pts)	25 (75.8)	25 (43.1)	0.05
≥ 40mm stent and more (41pts)	8 (24.2)	33 (56.9)	



Univariate and multiple linear regression models for CMB



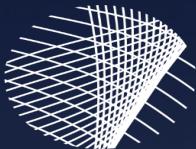
	Univariate models		Multiple model	
	$\beta \pm SE^*$	P-value	$\beta \pm SE^*$	P-value
Zone 0/1 vs 2/3	-1.435 ± 0.522	0.001	-1.322 ± 0.797	0.097
stent diameter ≥ 40mm	1.497 ± 0.485	0.002	1.312 ± 0.547	0.016
complaint balloon Yes/No	0.223 ± 0.434	0.607	1.207 ± 0.624	0.053
Unplanned reoperations	-1.099 ± 0.669	0.10	-3.423 ± 1.431	0.017
„SBIs”	0.342 ± 0.436	0.433	-0.54 ± 0.581	0.926
type of surgery	-1.143 ± 0.519	0.873	0.224 ± 0.668	0.737
>120 min surgery	1.050 ± 0.448	0.019	0.279 ± 0.567	0.622
Atheroma grade 4/5 vs 1-3	-1.143 ± 0.519	0.873	0.954 ± 0.563	0.090
Branched/fenestrated vs tubular	-1.057 ± 0.470	0.025	-0.458 ± 0.715	0.522



Multiple linear regression models with Firth correction



	$\beta \pm$	SE*	Lower.95.	Upper.95.	OR	Lower.95..1	Upper.95..1	P-value
(Intercept)	-0,375	1,123	-2,665	1,775	0,687	0,070	5,898	0,7252
<u>stent diameter ≥ 40mm</u>	1,924	0,816	0,501	3,728	6,851	1,651	41,590	0,0070
complaint balloon	0,662	0,784	-0,747	2,206	1,938	0,474	9,081	0,3598
<u>Fazekas-score_DWM</u>	0,962	0,529	0,054	2,069	2,618	1,056	7,917	0,0372
<u>Fazekas-score_PVWM</u>	-0,680	0,561	-1,770	0,290	0,507	0,170	1,337	0,1722
<u>unplanned_reoperations</u>	-2,302	1,146	-4,803	-0,313	0,100	0,008	0,731	0,0217
Spinal-cord ischemia	1,367	2,227	-2,057	6,709	3,922	0,128	819,754	0,4552



RESULTS – Clinical results

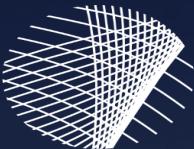


30-d mortality: 0%

Periprocedural stroke rate: 0%

TIA: 2%

Spinal cord ischemia: 3%



CONCLUSIONS



Largest cohort to evaluate cerebral microbleeds after TEVAR

First study to include:

- * Total endovascular arch repair (**42% of our cohort**)
- * CO₂ flushed devices as an embolic protection strategy

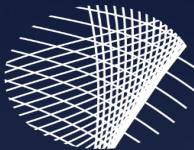
50% of patients presented silent cerebral infarcts and 60% CMBs

- * No short-term associated neurologic deficit

DW-MRI lesions factors:

- * Ishimaru zone 0 - 1
- * Branched or fenestrated endograft
- * Proximal stent diameter $\geq 40\text{mm}$
- * Urgent procedure and complaint balloon

Further scientific validation and cerebral protection strategy development are required



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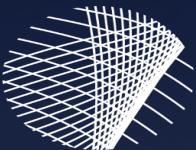
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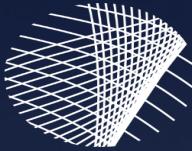




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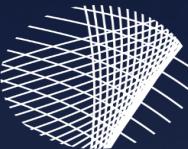


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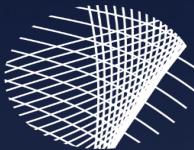


Thank you for your attention!

Background



brain infarction (stroke)	Small or large vessel occlusion	<p>MRI characteristics:</p> <p><u>acute</u>= intracellular edema</p> <ul style="list-style-type: none">„diffusion restriction“ = <u>DWI lesion</u>0.5-4h <p><u>subacute</u>= +extracellular edema</p> <ul style="list-style-type: none">DWI lesion + FLAIR hyperintensity4h-10 days <p><u>old ischemic lesion</u> = glial scar</p> <ul style="list-style-type: none">no DWI lesion, only FLAIR hyperintensity>10 days
Brain bleed (hemorrhage)	Small or large vessel rupture	<p>MRI characteristics:</p> <p>Detection of tissue blood products, which distort the local magnetic field („susceptibility artefact“ = „SWI lesion“) → Desoxyhemoglobin, Ferritin, Hemosiderin, Calcium</p> <p>Differential diagnosis of micro-susceptibility artefacts:</p> <ul style="list-style-type: none">- Microbleed (no information about lesion age)- Microcavernoma- Microcalcifications- Intravasal location: clot, air <p>Accumulation of subcortical microbleeds: often sign of amyloidangiopathy</p>



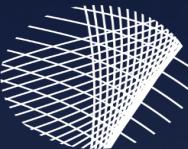
Background cerebral small vessel disease („Cerebral Microangiopathy“), microbleeds



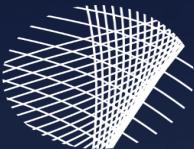
- ❖ term cerebral small vessel: pathological small arteries, arterioles, venules, and capillaries of the brain, predominantly in lenticostriatal location .
- ❖ Age-related and hypertension-related small vessel diseases and cerebral amyloid angiopathy are the most common forms. Other risk factors: smoking, diabetes
- ❖ located in the subcortical structures:
Small infarcts „lacunar infarcts“ and (less often) „microbleeds“ → tissue scar (gliosis)
→ „white matter lesions“ → encephalopathy („vascular dementia“)
- ❖ describe the parenchyma lesions rather than the underlying small vessel alterations.
- ❖ classification, restricts the definition of small vessel disease to ischaemic lesions leading cause of cognitive decline and functional loss in elderly;
- ❖ Small vessel disease → main target for preventive and treatment strategies, all types of presentation and complications should be taken into account!!!

Leonardo Pantoni, Lancet Neurol. 2010

Background

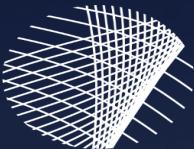


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The **Fazekas scale** is used to simply quantify the amount of **white matter T2 hyperintense lesions**; usually attributed to microangiopathy, chronic small vessel ischemia;

- ❖ periventricular white matter (PVWM)
 - 0 = absent
 - 1 = “caps” or pencil-thin lining
 - 2 = smooth “halo”
 - 3 = irregular periventricular signal extending into the deep white matter
- ❖ deep white matter (DWM)
 - 0 = absent
 - 1 = punctate foci
 - 2 = beginning confluence
 - 3 = large confluent areas



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