

The impact of flushing the aortic stentgraft with high-volume heparinized saline to minimize air emboli on stroke rates after thoracic endovascular aortic repair

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Disclosure

Speaker name: Dr. Med. T. Lautenschläger

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

Stroke rate in TEVAR

- 3 - 11%
- Aortic Arch Procedures > 10%
- Strokes have a high mortality rate > 20%



Feezor et al. 2007 J Endovasc Ther 14:568–573
Ullery et al. 2012 J Vasc Surg 56:1510-7
Melissano et al. 2012 Eur J Vasc Endovasc Surg 43:269e275
Kahlert et al. 2014 Ann Thorac Surg 98:53-8
Böckler et al. 2016 Eur J Vasc Endovasc Surg 51:791-800
Allmen et al. 2017 Eur J Vasc Endovasc Surg. 53(2):176-184

Causes of stroke in TEVAR

Central embolism due to

- Plaque rupture
- Wire / catheter manipulation in the aortic arch
- Air embolism

[SAGE Open Med](#). 2016 Dec 7;4:2050312116682130. eCollection 2016.

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

[Inci K¹](#), [Koutouzi G²](#), [Chernoray V³](#), [Jeppsson A⁴](#), [Nilsson H³](#), [Falkenberg M²](#).

[Gutsche et al. 2007 Ann Thorac Surg 84:1195–200](#)

[Ullery et al. 2012 J Vasc Surg 56:1510-7](#)

[Melissano et al. 2012 Eur J Vasc Endovasc Surg 43:269e275](#)


[Inci et al. 2016 Sage Open Med 4:1-5](#)

How to prevent strokes during / after TEVAR

- Reduced manipulation with wire / catheter
- Cerebral protection e.g. Sentinel Device
- CO2-flushing of the graft
- Perfluorocarbon and CO2-flushing of the graft

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

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Journal of Endovascular Therapy
2016, Vol. 23(2) 393–395
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DOI: 10.1177/1526602816633705
www.jevt.org


Alternative method to prevent strokes caused by air embolism during TEVAR

- Flushing the aortic stentgraft with high-volume heparinized saline

- Single center
- Retrospective analysis of prospective collected data 10/2014 – 05/2019
- Method:
 - Usage of 20ml Luer-Lock syringes
 - Flushing with 140 – 160ml heparinized saline (high-volume)
 - E.g.: COOK – at least 60ml volume to flush the graft (IFU)

Patient-collective 10/2014 – 05/2019

Variables		N	%
Total	Interventions	177	
	Patients	161	
Sex	Male	110	62,1
	Female	67	37,9
Age	Mean +/- SD	66,9 +/-12,9	
	Median (Range)	69 (30-92)	
Hypertension		165	93,2
DM		32	18,1
KHK		47	26,6
Smoker		54	30,5
COPD		24	13,6
PAOD		39	22,0
HLP		101	57,1
Renal Insufficiency before TEVAR			
	GFR<60	59	33,3
	Mean +/- SD	71,7 +/- 26,9	
BMI	Mean +- SD	27,2 +-5,2	
	Median (Range)	26,6 (19,4 - 42,6)	

Characteristics and pathologies

Aneurysm characteristics			N	%
Diameter preOP (mm)	Mean +- SD	65 +- 11,2		
	Median (Range)	64 (50 - 95)		
Type of aortic Pathology				
TAA			24	13,6
TAAA Crawford I + II			34	19,2
PAU			39	22,0
TBAD			70	39,5
IMH			4	2,3
Aorto-esophageal fistula			6	3,4

Urgency of Pathology		N	%
symptomatic		56	31,6
Aortic rupture		33	18,6
	aneurysmatic	30	
	Post-traumatic	3	
Aorto-esophageal fistula		6	3,4

Complexity of treatment and used grafts

Landing zone	N	%
Zone 0	3	1,7
Zone 1	14	7,9
Zone 2	42	23,7
Zone 3	118	66,7
Total	177	

Used Grafts	N	%
Cook	118	65,9
Gore	5	2,8
Endurant	32	17,9
Jotec	4	2,2
Ankura	6	3,4
Bolton	14	7,8
Total	179	



Treatment of left subclavian artery in complex pathologies of the aortic arch

Landing Zone	Total	subclavian Coverage		Surgical revascularisation of subclavian artery		Fenestration for subclavian artery		Occluded subclavian artery	
		N	%	N	%	N	%	N	%
	177								
Total	59	53	29,9	18	10,2	6	3,4	35	19,7
Zone 0	3	3	1,7	1	0,6	0	0	2	1,1
Zone 1	14	13	7,3	8	4,6	1	0,6	5	2,8
Zone 2	42	37	20,9	9	5,1	5	2,8	28	15,8

Outcome

Complications	N	%
Stroke	2	1,1
SCI	3	1,7
Death	15	9,3
Aortic rupture	10	
symptomatic	2	
Aortoesophageal fistula	2	
chronic	1	

Stroke Patient Characteristics

	Age	M	Type of Pathology	Landing Zone	Subclavian Coverage	Graft Brand	Clinical manifestation of stroke	Remission
Pt. 1	59	1	TBAD	3	0	Ankura	central facial paresis	Complete until discharge
Pt. 2	64	1	TBAD	3	0	Endurant	lacunar infarction left hemisphere with paresthesia	Complete until discharge

Outcome

- Minor stroke in 2 patients (1,1%) with complete remission after discharge
- No stroke in complex TEVAR (Implantation of the graft in Zone 0 – 2 of the aortic arch)
- No stroke in elective TEVAR procedures

Conclusion

Flushing the thoracic stentgraft with high-volume of heparinized saline may reduce the rates of stroke during / after TEVAR

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