Cerebral Protection with Deep Hypothermic Circulatory Arrest during Total Arch Replacement for Acute Aortic Dissection

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Cerebral protection with DHCA in the TAR for AAD

October 2009 – July 2022

Patients undergoing TAR with DHCA (Arch first technique)

Emergent TAR for AAD (n=109)

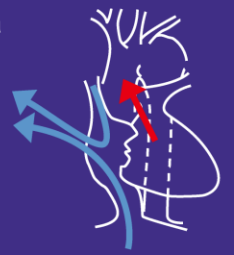
Scheduled TAR for Aneurysm (n=147)

1. Review for perioperative stroke and 30-day mortality

2. Analysis of effects of clinical and anatomical features on stroke after TAR for AAD

Cerebral protection with DHCA in the TAR for AAD

- SVC / IVC drainage controls blood pressure.
- Central cannulation in the ascending aorta resolves organ malperfusion.
- DHCA (17.5 ˚C at venous drainage and the pharyngeal temperature)
- Arch first technique
- Retrograde cerebral perfusion at the end of arch vessel-anastomosis is performed to flush out air, thrombi, and debris.



Clinical variables and outcomes

	AAD (n=109)	Aneurysm (n=147)	*P* value
Age	63 ± 11	74 ± 9	< 0.001
Gender, male	59 (54%)	121 (82%)	< 0.001
Comatose state	12 (11%)	0	< 0.001
CA time (min.)	37 ± 8	36 ± 6	0.122
New stroke	11 (10%)	3 (2%)	0.005
	Embolism 8	Embolism 3	
	Malperfusion 2		
	LOS 1		
30-day mortality	10 (9%)	2 (1%)	0.003

Risk factor analysis of stroke after TAR for AAD

	Univariable		Multivariable	
Variables	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Age	1.00 (0.94 - 1.05)	0.867	0.97 (0.90 - 1.06)	0.517
Gender, male	0.68 (0.19 - 2.38)	0.544	0.57 (0.12 - 2.78)	0.483
Comatose state	0.79 (0.09 - 6.79)	0.831	0.39 (0.03 -5.56)	0.487
Asc. Ao thorombi	0.60 (0.16 - 2.16)	0.431	1.51 (0.27 -8.55)	0.641
Dissected arch vessels				
Double-barreled	22.75 (5.34 - 96.92)	< 0.001	33.02 (4.33 - 252.1)	< 0.001
Thrombosed	0.26 (0.05 -1.27)	0.097	1.10 (0.14 -8.93)	0.926
CA time	1.02 (0.95 -1.11)	0.558	0.98 (0.88 - 1.09)	0.704
Perioperative LOS	0.72 (0.08 -6.11)	0.761	1.74 (0.13 - 24.08)	0.680

Cerebral protection with DHCA during TAR continues to be an option. Newly developed stroke after TAR for AAD appears to be associated with air emboli deriving from the double-barreled dissection in the arch vessels

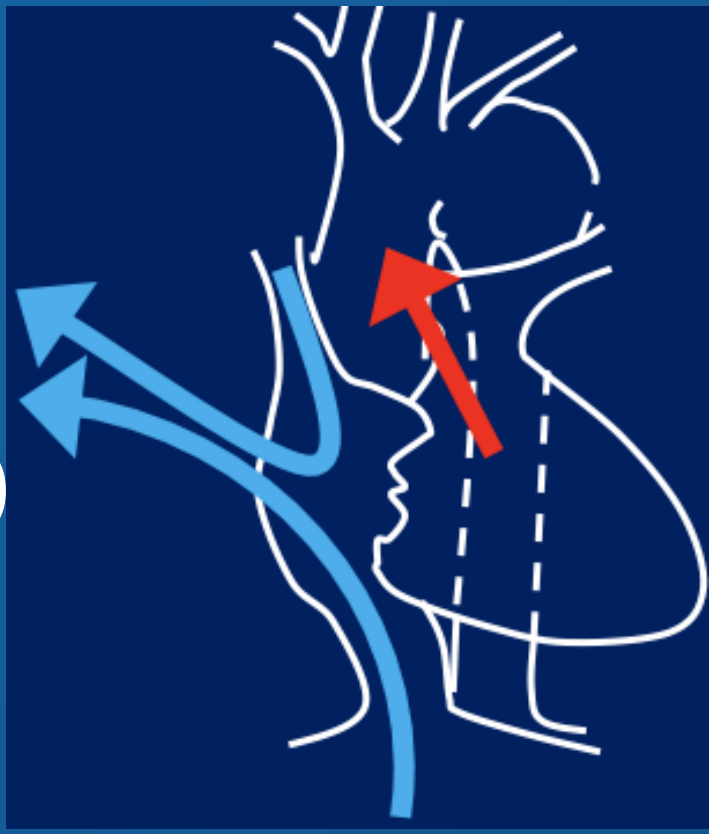
* DHCA, deep hypothermic circulatory arrest; TAR, total arch replacement; AAD, acute aortic dissection.

Objective:

- **Stroke after total arch replacement (TAR) remains a serious complication.**
- **To prevent it, deep hypothermia has been used during TAR.**
- **We evaluate cerebral protection with deep hypothermic circulatory arrest (DHCA) during TAR, particularly for patients with acute aortic dissection (AAD).**

Cerebral protection with DHCA in the TAR for AAD

- **SVC / IVC drainage** controls blood pressure.
- **Central cannulation** in the ascending aorta resolves organ malperfuion.
- **DHCA** (17.5 ℃ at the pharyngeal temperature)
- **Arch first technique**
- **Retrograde cerebral perfusion** at the end of arch vessel-anastomosis is performed to flush out emboli.



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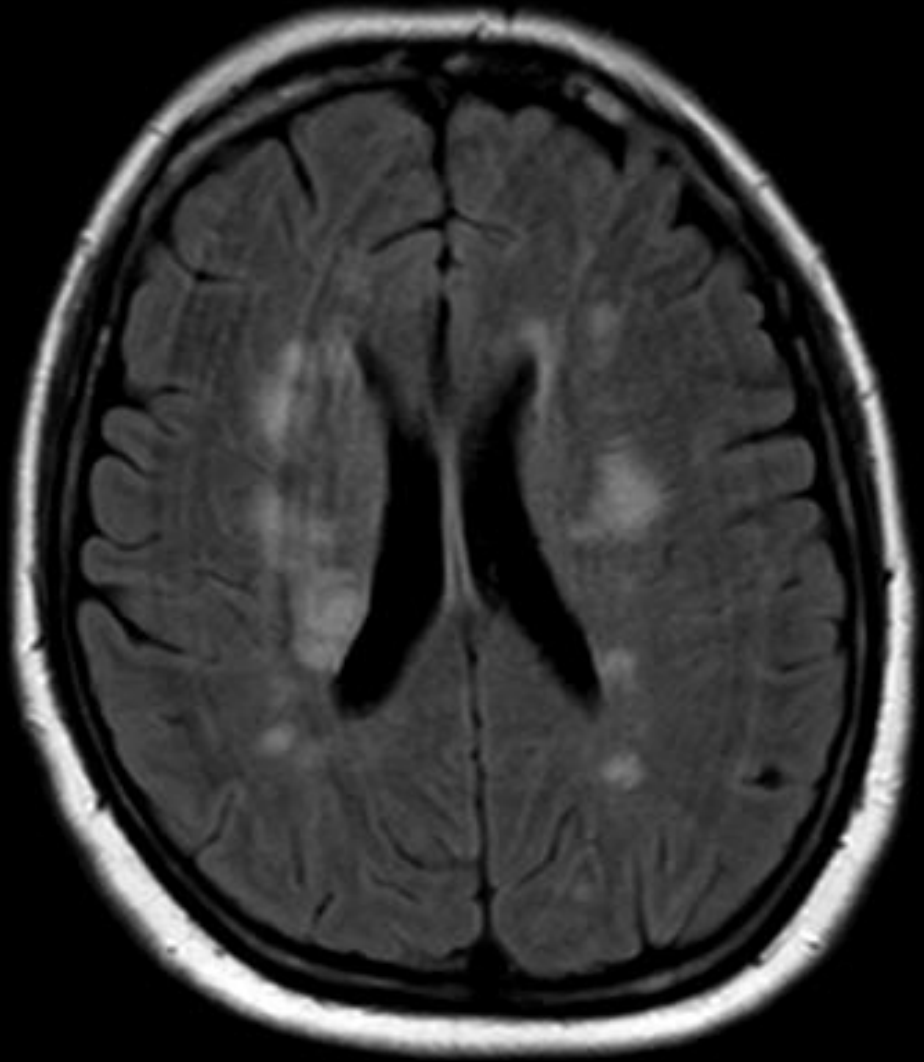
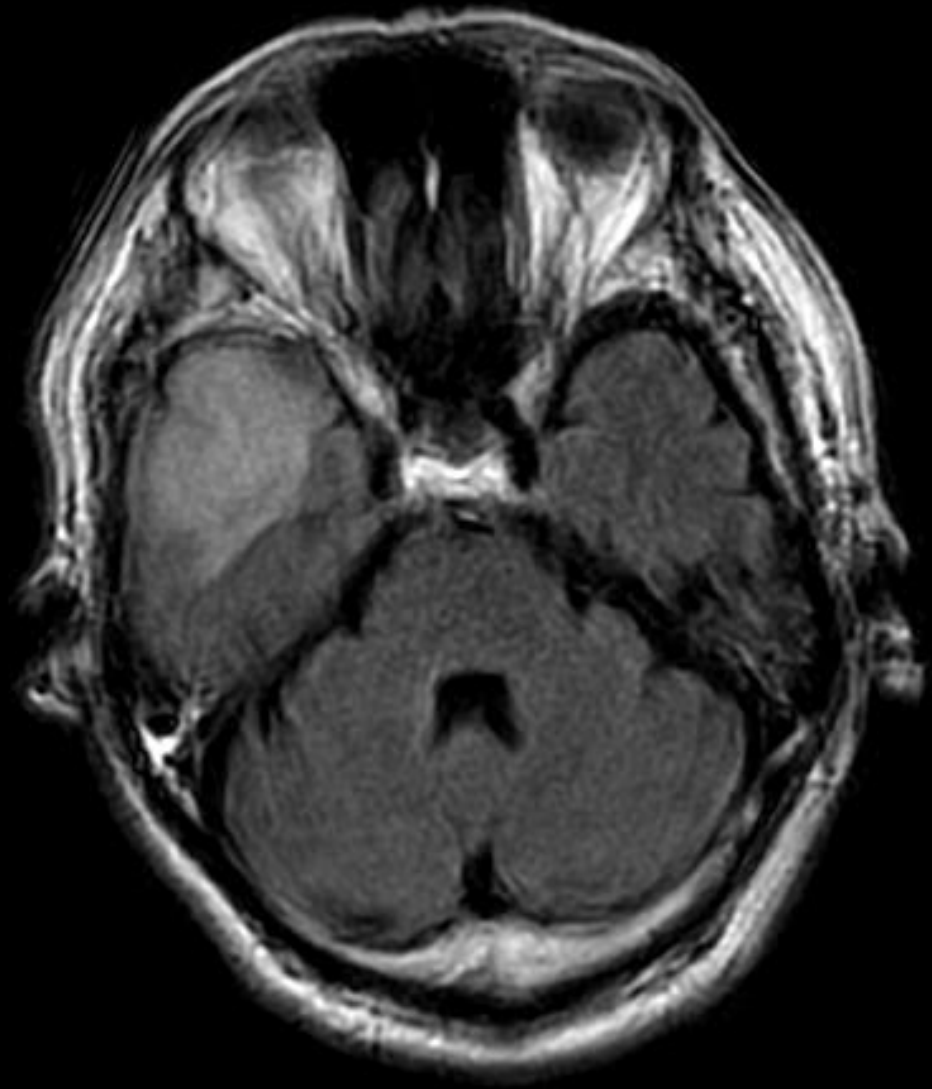
Clinical variables and outcomes

	AAD (n=109)	Aneurysm (n=147)	*P* value
Age	63 ± 11	74 ± 9	< 0.001
Gender, male	59 (54.1%)	121 (82.3%)	< 0.001
Comatose state	6 (5.5%)	0	0.004
CA time (min.)	37 ± 8	36 ± 6	0.122
Pump time (min.)	269 ± 76	210 ± 34	< 0.001
Stroke	11 (10.1%)	3 (2.0%)	0.005
	Embolism 8	Embolism 3	
	Malperfusion 2		
	LOS 1		
30-day mortality	10 (9.2%)	2 (1.4%)	0.003

Stroke after TAR



Embolism



Malperfusion

Patients with stroke after TAR for AAD

	Age/ Gender	Couse of stroke	Laterality of stroke	Preope. Coma	Asc. Ao thorombi	Dissected arch vessels	CA (min.)	Periope. LOS	GCS	MMT	Outcome
1	57, M	Embolism	bilateral	-	-	Double barreled	48	-	14	2	Transfer
2	60, M	Embolism	bilateral	-	-	Double barreled	43	-	14	4	Transfer
3	79, F	Embolism	bilateral	-	-	Double barreled	31	-	14	4	Transfer
4	53, M	Embolism	bilateral	-	-	Double barreled	44	-	14	4	Transfer
5	66, F	Embolism	right	-	-	Double barreled	23	-	15	4	Transfer
6	48, F	Embolism	bilateral	-	+	Double barreled	46	-	3	0	Transfer
7	61, F	Embolism	bilateral	-	+	none	28	-	11	2	Transfer
8	68, M	Embolism	bilateral	-	+	Double barreled	35	-	2	0	Transfer
9	78, F	Malperfusion	right	+	-	Thrombosed	28	-	12	2	Transfer
10	68, F	Malperfusion	bilateral	-	-	Thrombosed	29	-	3	0	Dead
11	55, M	LOS	left	-	-	Double barreled	48	+	10	4	Transfer

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Comments:

- **Stroke after TAR for AAD was mainly associated with embolism deriving from the arch vessels or ascending aorta.**
- **In the multivariable analysis, double-barreled dissection in the arch vessels was the only significant risk predictor of newly developed stroke after TAR.**
- **Air emboli in the blind end of the double-barreled dissection after arch repair appears to cause stroke after TAR for AAD.**

Conclusions:

- **Cerebral protection with DHCA during TAR continues to be an option, particularly for patients with aneurysm (stroke 2.0%, 30-day mortality 1.4%).**
- **Newly developed stroke in patients undergoing TAR for AAD appears to be associated with air emboli deriving from the double-barreled dissection in the repaired arch vessels.**