

Deep Hypothermic Circulatory
Arrest in the Repair of
Descending and
Thoracoabdominal Aortic
Aneurysms: Is It Safe?

Objective:

- Deep hypothermic circulatory arrest (DHCA) in patients undergoing descending thoracic aortic aneurysm (DTAA) or thoracoabdominal aneurysm (TAA) repair is traditionally associated with increased complications and mortality.
- Patients with pathology extending into the arch or for whom cross-clamping isn't feasible may require DHCA
- We present our short-term outcomes for patients undergoing DTAA or TAA repair under DHCA.

Methods

- Between May 1998 and October 2022, a total of 267 consecutive patients underwent open surgical repair of DTAA and TAAs
- 51 patients (19.1%) undergoing aneurysm repair using the clamp-and-sew technique were excluded
- Patients were identified from a prospectively maintained aortic registry containing demographic, clinical, operative, and follow-up data, and their data were studied retrospectively.

Preoperative Characteristics

Table 1: Preoperative Characteristics

Variable	DHCA (n=81)	non-DHCA (n=135)	Total (n=216)	Mean 95% CI
Age (years)	60 ± 12	63 ± 12	62 ± 12	(-3.7 - 0.2)
Male sex	48 (59.26%)	83 (61.48%)	131 (60.65%)	(-0.17 - 0.12)
Hypertension	71 (87.65%)	127 (94.07%)	198 (91.67%)	(-0.16 - 0.03)
Former or current smoker	61 (75.3%)	90 (66.7%)	151 (70.2%)	(-0.25 - 0.006)
DM	9 (11.11%)	31 (22.96%)	40 (18.52%)	(-.23 - -0.01)
HLD	15 (18.52%)	30 (22.22%)	45 (20.83%)	(-0.16 - 0.08)
COPD	26 (32.1%)	46 (34.07%)	72 (33.33%)	(-0.16 - 0.12)
Renal insufficiency	10 (12.35%)	21 (15.56%)	31 (14.35%)	(-0.14 - 0.07)
Dialysis	3 (3.7%)	8 (5.93%)	11 (5.09%)	(-0.09 - 0.04)
CHF	10 (12.35%)	12 (8.89%)	22 (10.19%)	(-0.06 - 0.13)
Prior stroke	4 (4.94%)	5 (3.7%)	9 (4.17%)	(-0.05 - 0.08)
BMI	29.5 ± 6.8	27.3 ± 6.7	28.2 ± 6.8	(0.12 - 4.07)
Previous aortic repair	27 (33.33%)	47 (34.81%)	74 (34.26%)	(-0.16 - 0.13)
Urgent or emergent	42 (51.85%)	57 (42.22%)	99 (45.83%)	(-0.05 - 0.24)

Preoperative characteristics cont.

Indication for surgery

Chronic dissection	52 (64.2%)	57 (42.22%)	109 (50.46%)	(0.08 - 0.36)
Acute dissection	4 (4.94%)	2 (1.48%)	6 (2.78%)	(-0.03 - 0.09)
Rupture	9 (11.11%)	19 (14.07%)	28 (12.96%)	(-0.13 - 0.07)
Degenerative	8 (9.88%)	42 (31.11%)	50 (23.15%)	(-0.33 - -0.07)
Atherosclerotic	11 (13.58%)	24 (17.78%)	35 (16.2%)	(-0.15 - 0.07)
Other	6 (7.41%)	10 (7.41%)	16 (7.41%)	(-0.07 - 0.07)

Extent of replacement

DTAA	32 (39.51%)	51 (37.78%)	83 (38.43%)	(-0.13 - 0.16)
Extent I TAAA	27 (33.33%)	35 (25.93%)	62 (28.7%)	
ii	14 (17.28%)	16 (11.85%)	30 (13.89%)	
iii	7 (8.64%)	27 (20%)	34 (15.74%)	
iv	0 (0%)	7 (5.19%)	7 (3.24%)	
CSF drainage	67 (82.72%)	115 (85.19%)	182 (84.26%)	(-0.14 - 0.09)

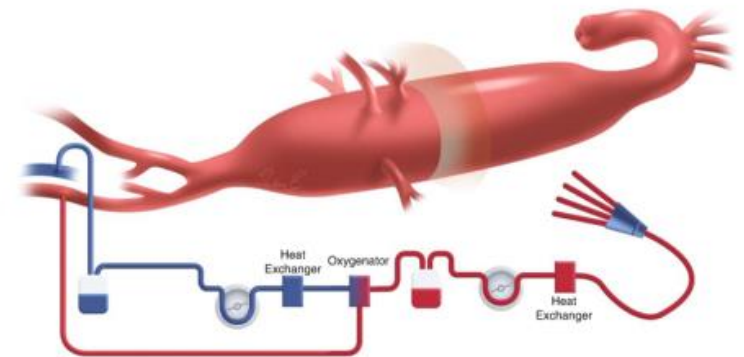
Operative Data

Table 2: Operative Outcomes

Variable	DHCA (n=81)	non-DHCA (n=135)	Total (n=216)	Mean 95% CI
CPB time (min)	214 ± 50	54 ± 37	112 ± 88	(22.3 - 26.3)
Circulatory arrest time (min)	29 ± 9	0	29 ± 9	
Cold perfusion	24 (29.63%)	31 (22.96%)	55 (25.46%)	(-0.07 - 0.20)
Intercostal anastomosis	25 (30.86%)	44 (32.59%)	69 (31.94%)	(-0.16 - 0.12)
Any Reimplantation	49 (60.49%)	80 (59.26%)	129 (59.72%)	(-0.13 - 0.16)
Reimplantation directly	34 (41.98%)	67 (49.63%)	101 (46.76%)	(-0.22 - 0.07)
Reimplantation with interposition	23 (28.4%)	29 (21.48%)	52 (24.07%)	(-0.06 - 0.20)
PRBCs	4 [1-8]	3.5 [0-6]	4 [0-6]	(-0.73 - 3.2)
FFP	2 [0-4]	1 [0-3]	2 [0-4]	(0.34 - 4.3)
Platelets	1 [0-3]	1 [0-2]	1 [0-2]	(-0.68 - 3.3)
<u>Cryo</u>	0 [0-2]	0 [0-0]	0 [0-0]	(-0.10 - 3.9)

Operative technique

- A cerebrospinal fluid (CSF) catheter placed day prior
- Distal aortic perfusion is established through partial left heart bypass (LHB) using atrial-femoral cannulation or partial cardiopulmonary bypass (CPB) using femoral-femoral cannulation
- When proximal cross-clamping is not feasible, full CPB followed by deep hypothermic circulatory arrest (DHCA) using femoral-femoral cannulation is initiated
- Somatosensory-evoked potentials (SSEPs) and motor-evoked potentials (MEPs) were routinely implemented
- Upper intercostal arteries down to T6 are routinely ligated.
- T7-L1 reimplanted using an island technique depending on patency and level of back bleeding
- Visceral vessels reattached when appropriate



Outcomes

Table 3: Postoperative Outcomes

Variable	DHCA (n=81)	non-DHCA (n=135)	Total (n=216)	Mean 95% CI
30-day mortality	5 (6.17%)	8 (5.93%)	13 (6.02%)	(-0.07 - 0.07)
In hospital mortality	10 (12.35%)	10 (7.41%)	20 (9.26%)	(-0.04 - 0.14)
Pneumonia	14 (17.28%)	16 (11.85%)	30 (13.89%)	(-0.05 - 0.16)
Tracheostomy	10 (12.35%)	18 (13.33%)	28 (12.96%)	(-0.11 - 0.09)
Postop bleeding	5 (6.17%)	10 (7.41%)	15 (6.94%)	(-0.09 - 0.07)
Renal insufficiency	13 (16.05%)	10 (7.41%)	23 (10.65%)	(-0.01 - 0.19)
Permanent dialysis	3 (3.7%)	9 (6.67%)	12 (5.56%)	(-0.10 - 0.04)
Length of stay (days)	19 [11-29]	12 [10-19]	14 [10-22]	(0.81 - 4.8)
ICU stay (days)	5.5 [3-19.75]	6 [4-10]	6 [3-12.25]	(0.20 - 4.2)
Stroke	4 (4.94%)	5 (3.7%)	9 (4.17%)	(-0.05 - 0.08)
TIA	1 (1.23%)	3 (2.22%)	4 (1.85%)	(-0.05 - 0.03)
Paraplegia	2 (2.47%)	2 (1.48%)	4 (1.85%)	(-0.04 - 0.06)
Paraparesis	1 (1.23%)	0 (0%)	1 (0.46%)	(-0.02 - 0.05)
Ventilation duration	48 [24-168]	47 [24-69.5]	47 [24-96]	(-0.08 - 3.9)
Prolonged ventilatory support >48 hrs	38 (46.91%)	49 (36.3%)	87 (40.28%)	(-0.04 - 0.25)
Low CO	1 (1.23%)	2 (1.48%)	3 (1.39%)	(-0.04 - 0.03)
Sepsis	13 (16.05%)	18 (13.33%)	31 (14.35%)	(-0.08 - 0.14)

Results

- DHCA associated with longer bypass time and more utilization of FFP.
- No meaningful difference found for operative mortality, stroke, or paraplegia.
- DHCA associated with increased LOS and ICU stay days.

Conclusions

- DHCA is not associated with increased operative mortality despite longer hospital and ICU stay
- In patients with aneurysmal disease extending into the arch or in whom cross-clamping is not possible, DHCA is feasible.