

Effect of the Extent of Aortic Replacement on In-Hospital Mortality in patients with Type A Aortic Dissection with Distal Malperfusion

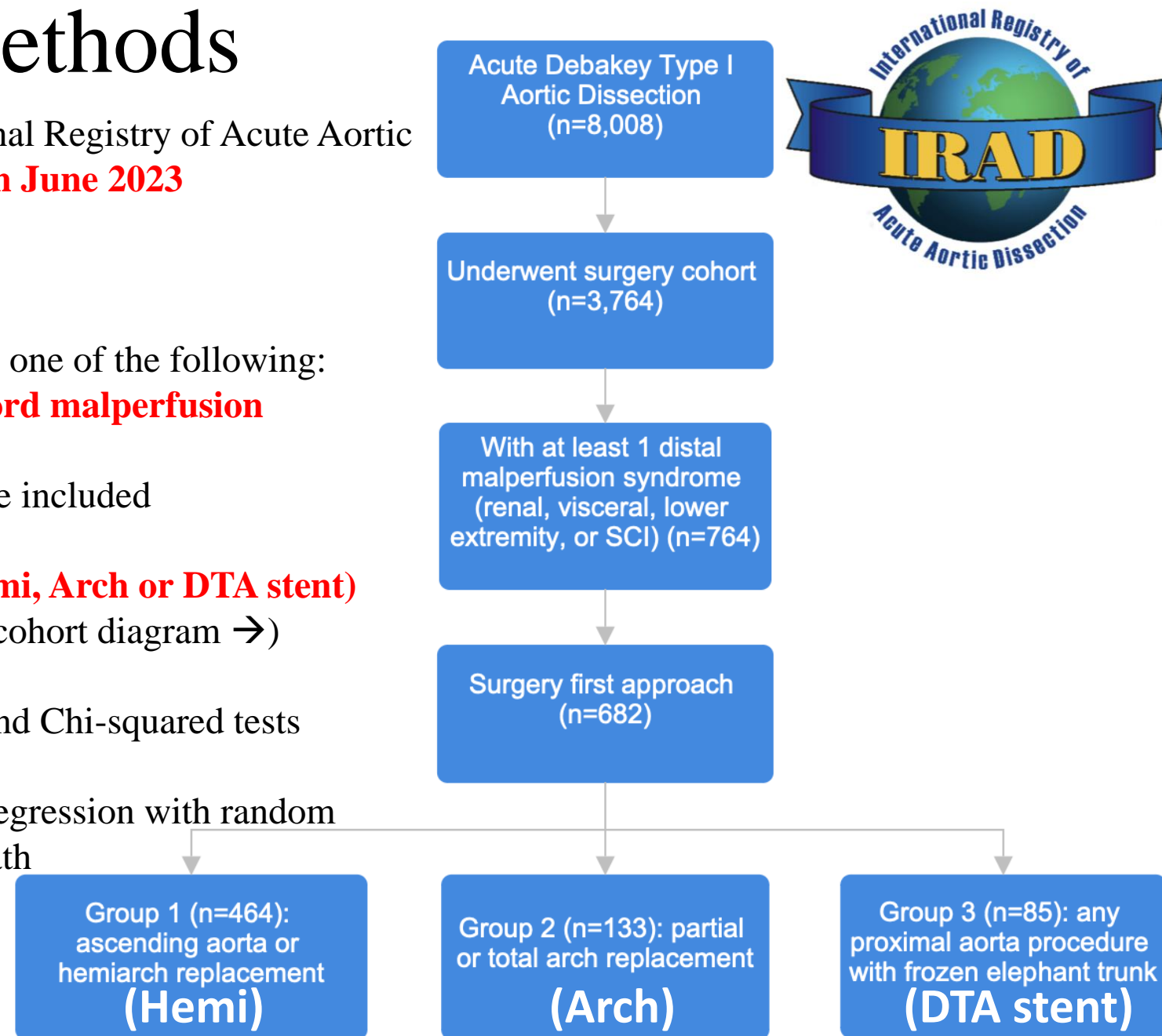


Objective

- The optimal extent of aortic resection at the time of acute Type A Aortic dissection (TAAD) repair is yet to be decided.
- While several studies have examined the impact of extended aortic resection for TAAD, few have examined this specifically for patients with distal malperfusion.
- We sought to determine if the extent of aortic replacement in TAAD patients with distal malperfusion syndrome(s) affects in-hospital mortality.

Study Cohort and Methods

- Retrospective cohort analysis of the International Registry of Acute Aortic Dissection (**IRAD**) from **March 1996 through June 2023**
- Only Debakey type I included
- Distal malperfusion defined as presence of any one of the following: **Renal, visceral, lower extremity, or spinal cord malperfusion**
- Only patients who underwent surgery first were included
- **Patients were divided into three groups (Hemi, Arch or DTA stent)** based on the extent of aortic replacement (see cohort diagram →)
- Unadjusted comparisons using Kruskal-Wallis and Chi-squared tests
- Adjusted comparisons using generalized linear regression with random intercept model for the outcome of in-hospital death



Preoperative Characteristics

	Hemi (n=464)	Arch (n=133)	DTA stent (n=85)	P-value
Age (Mean ± Std)	59.9 ± 12.8	58.4 ± 12.2	57.7 ± 12.3	0.232
Male	328 (71%)	98 (74%)	62 (73%)	0.761
White race	311 (73%)	94 (78%)	43 (58%)	0.009
Atherosclerosis	50 (12%)	12 (11%)	7 (10%)	0.829
Hypertension	343 (79%)	87 (73%)	62 (78%)	0.360
Diabetes mellitus	59 (14%)	10 (9%)	6 (8%)	0.148
Bicuspid aortic valve	10 (2%)	4 (4%)	1 (1%)	0.634
Marfan syndrome	7 (2%)	2 (2%)	2 (3%)	0.825
Cocaine abuse	11 (3%)	5 (5%)	2 (3%)	0.579
Current smoker	129 (37%)	31 (34%)	26 (46%)	0.323
Ever smoked	196 (57%)	51 (57%)	34 (61%)	0.837
Known aortic aneurysm	49 (12%)	12 (10%)	8 (11%)	0.905
Chronic obstructive pulmonary disease	32 (8%)	10 (11%)	4 (6%)	0.555
Family history of aortic disease	27 (8%)	4 (5%)	5 (8%)	0.734
Peripheral arterial disease	17 (5%)	2 (2%)	2 (3%)	0.571
Chronic renal insufficiency	46 (12%)	6 (7%)	7 (11%)	0.306
Iatrogenic dissection	7 (2%)	1 (1%)	1 (1%)	0.788
Prior cardiac surgery *	38 (9%)	14 (12%)	7 (10%)	0.655

* includes coronary artery bypass grafting, aortic valve repair/replacement, mitral valve surgery, aortic aneurysm/dissection
 Percentages are corrected for missing data

No significant difference in patient demographics and medical history between the groups, except less white patients in the DTA stent group

Clinical presentation

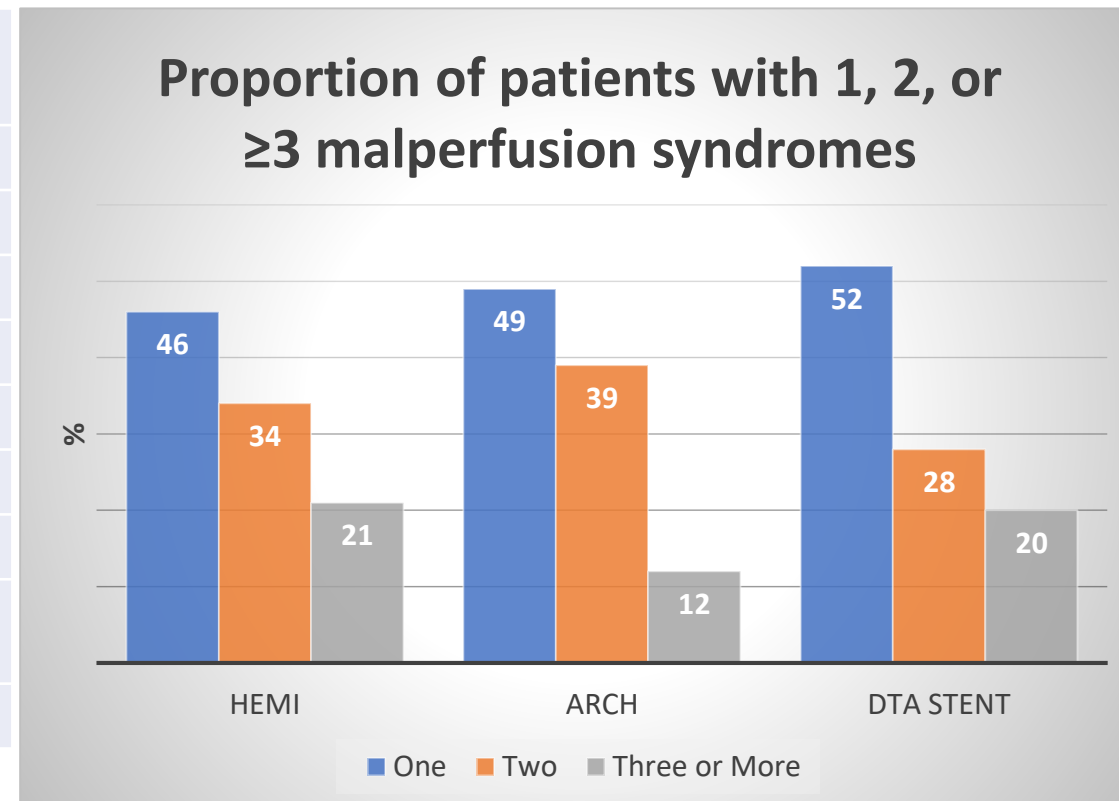
- Similar time to presentation and largely similar symptoms
- Arch group had a greater proportion of patients with right upper extremity pulse deficit
- DTA Stent group had greater proportion of spinal cord ischemia on presentation (12.7%) followed by Arch (10.7%) and then Hemi (5.2%)

	Hemi (n=464)	Arch (n=133)	DTA stent (n=85)	P-value
Time from symptom onset to diagnosis (in hours) Median (IQR)	4.3 (2.4-10.1)	133	85	0.632
Presenting symptoms				
Chest pain	342 (78%)	89 (73%)	61 (75%)	0.445
Anterior	230 (66%)	54 (58%)	45 (64%)	0.347
Posterior	92 (26%)	19 (20%)	22 (31%)	0.270
Pain in head or neck	79 (20%)	23 (23%)	15 (21%)	0.770
Back pain	202 (50%)	47 (43%)	39 (53%)	0.337
Abdominal pain	149 (37%)	30 (28%)	24 (33%)	0.208
Leg pain	173 (44%)	44 (42%)	29 (41%)	0.939
Abrupt onset of pain	347 (88%)	102 (94%)	63 (90%)	0.207
Radiating pain	148 (40%)	39 (42%)	26 (38%)	0.906
Migrating pain	46 (12%)	12 (13%)	5 (8%)	0.511
Febrile	6 (2%)	2 (2%)	1 (1%)	0.869
Syncope	68 (17%)	23 (20%)	11 (14%)	0.537
Presenting signs of aortic dissection				
Congestive heart failure	33 (8%)	4 (4%)	5 (7%)	0.245
Presenting hemodynamic - shock	23 (6%)	7 (7%)	4 (6%)	0.961
Presenting hemodynamic - cardiac tamponade	15 (4%)	3 (3%)	0	0.290
Pulse deficits (any location)	188 (65%)	57 (72%)	39 (77%)	0.184
Right carotid	33 (15%)	17 (27%)	3 (10%)	0.055
Left carotid	28 (13%)	14 (22%)	3 (10%)	0.175
Right brachial	48 (20%)	24 (36%)	8 (22%)	0.036
Left brachial	43 (18%)	17 (25%)	3 (8%)	0.101
Right femoral	130 (46%)	42 (55%)	24 (50%)	0.443
Left femoral	114 (40%)	34 (44%)	27 (57%)	0.093
Ischemic spinal cord damage	20 (5%)	12 (11%)	9 (13%)	0.020
Abnormal ECG	227 (65%)	59 (68%)	33 (60%)	0.612

Prevalence and distribution of malperfusion syndromes

Malperfusion type	Hemi (n=464)	Arch (n=133)	DTA stent (n=85)	P-value
Coma	54 (12%)	21 (16%)	11 (14%)	0.410
Coronary	54 (25%)	17 (28%)	5 (19%)	0.688
Limb Ischemia	297 (65%)	84 (65%)	62 (77%)	0.111
Neurologic Deficit	93 (20%)	20 (16%)	14 (18%)	0.437
Renal	167 (38%)	48 (40%)	18 (24%)	0.053
Mesenteric	69 (16%)	13 (11%)	16 (22%)	0.155
Spinal cord	33 (7%)	14 (11%)	10 (13%)	0.175
Number of Syndromes (mean ± Std)	1.8 ± 0.9	1.7 ± 0.8	1.8 ± 1	0.626

Percentages are corrected for missing data



No difference in the distribution or mean number of malperfusion syndromes

No difference in the proportion of patients with 1, 2, or ≥3 malperfusion syndromes (p=0.65)

Postoperative Outcomes (unadjusted)

	Hemi (n=464)	Arch (n=133)	DTA stent (n=85)	P value
In-hospital mortality	98 (21%)	39 (30%)	21 (25%)	0.121
Cause of death (among in-hospital mortality)				
Neurologic	7 (7%)	8 (21%)	0	0.015
Cardiac	29 (30%)	1 (3%)	2 (10%)	0.001
Bleeding	5 (5%)	4 (10%)	0	0.241
Rupture	5 (5%)	7 (18%)	1 (5%)	0.039
Tamponade	1 (1%)	0	0	0.735
Visceral ischemia	12 (12%)	3 (8%)	1 (5%)	0.496
Multi-organ failure	24 (25%)	8 (21%)	9 (43%)	0.147
Other/Unknown	15 (15%)	8 (21%)	8 (38%)	0.057
Postoperative complication				
Neurological deficit				
CVA	45 (11%)	18 (16%)	6 (9%)	0.267
Coma	15 (4%)	4 (4%)	2 (3%)	0.977
Spinal cord ischemia	13 (3%)	9 (8%)	0	0.013
Myocardial infarction	7 (2%)	3 (3%)	1 (2%)	0.680
Mesenteric ischemia/infarction	36 (9%)	6 (6%)	8 (12%)	0.332
Acute renal failure	194 (45%)	59 (52%)	31 (46%)	0.362
Requiring dialysis (among all patients)	82 (21%)	21 (24%)	18 (27%)	0.442
Extension of dissection	7 (2%)	10 (10%)	0	<.0001
Cardiac tamponade	47 (11%)	12 (12%)	7 (12%)	0.997
Limb ischemia	62 (15%)	12 (12%)	11 (16%)	0.638
Respiratory insufficiency	132 (38%)	26 (37%)	22 (39%)	0.974
Bleeding requiring re-operation	46 (14%)	9 (14%)	9 (16%)	0.926
Transfusion required (among all patients)	145 (52%)	28 (68%)	31 (55%)	0.152

- **No significant difference in in-hospital mortality**
- Cause of death for those with in-hospital mortality:
 - Arch group had highest proportion with neurologic complications and rupture as causes of death
 - Hemi group had highest proportion of cardiac cause of death
- There was no new spinal cord ischemia in the DTA stent group, but 8% in the Arch group and 3% in the Hemi groups

Adjusted Predictors of Mortality*

	Odds ratio	Lower CI	Upper CI	P- value
Arch (vs Hemi)	1.71	1.03	2.84	0.039
With Descending (vs Hemi)	1.31	0.71	2.41	0.385
Age \geq 70 years	1.71	1.08	2.71	0.023
Male (vs female)	0.83	0.54	1.28	0.399
Period 2 (vs 1)[#]	0.48	0.29	0.78	0.004
Period 3 (vs 1)[#]	0.56	0.34	0.94	0.027
Marfan syndrome	0.85	0.20	3.60	0.826
Current smoker	1.31	0.80	2.13	0.287
Chronic obstructive pulmonary disease	1.22	0.58	2.57	0.604
Peripheral arterial disease	1.44	0.63	3.28	0.383
Chronic renal insufficiency	1.76	0.94	3.28	0.078
Prior aortic dissection	0.42	0.11	1.68	0.222
Prior cardiac surgery	1.23	0.67	2.28	0.506
Presenting hypotension	0.73	0.41	1.31	0.297
Abrupt onset of chest pain	0.64	0.34	1.22	0.172
Preoperative coronary malperfusion	1.28	0.75	2.18	0.364
Preoperative coma	2.15	1.24	3.71	0.006

Increased odds of in-hospital mortality for:

- Arch compared to Hemi
- Age \geq 70 years
- Coma

Decreased odds of in-hospital mortality for:

- Period 2 and 3 compared to period 1

* = Adjusted for all variables in this table. # = three periods by dividing patients into tertiles

Limitation and planned further analysis

- Retrospective study without opportunity for collection of additional data
- Patient selection
- Future analyses to compare this cohort to patients without malperfusion syndromes

Discussion

- **Ascending/hemiarch replacement remains the commonest operation for TAAD patients with distal malperfusion syndromes**
 - **Descending aortic stent grafting is infrequently performed**
- **Mortality rate for patients with distal malperfusion remain high regardless of the extent of aortic replacement**
- **Compared to Ascending/ Hemiarch alone:**
 - **Increased mortality for extensive arch replacement without concomitant descending aortic stent**
 - **No difference in in-hospital mortality when a descending aortic stent is added**
- **Age ≥ 70 years and preoperative coma were significant predictors of in-hospital mortality.**
- **Future analysis with comparison in patients without malperfusion will provide additional perspective regarding the risks/ benefits of extended aortic repair in patients with TAAD and malperfusion syndromes**