Circulatory Arrest Time Above 30 Minutes have Significantly Detrimental Effects on the Outcomes of Type A Aortic Dissection Repair

Anthony Lemaire (1), Sorasicha Nithikasem (2), Abhishek Chakraborty (3), Alex Rahimi (1), Mark Russo (4), Leonard Lee (5)(1) Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, (2) Rutgers Robert Wood Johnson Medical School, United States, (3) Le Bonheur Children's Hospital, Memphis, TN, (4) Robert Wood Johnson University Hospital, Green Village, NJ, (5) Robert Wood Johnson University Hospital, New Brunswick, NJ

(1) Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, (2) Rutgers Robert Wood Johnson Medical School, United States, (3) Le Bonheur Children's Hospital, Memphis, TN, (4) Robert Wood Johnson University Hospital, Green Village, NJ, (5) Robert Wood Johnson University Hospital, New Brunswick, NJ

Background - Type A Aortic Dissection and Repair

Aortic Dissection

- Acute aortic dissection of the ascending aorta is a life-threatening disease that poses a significant challenge for cardiovascular surgeons
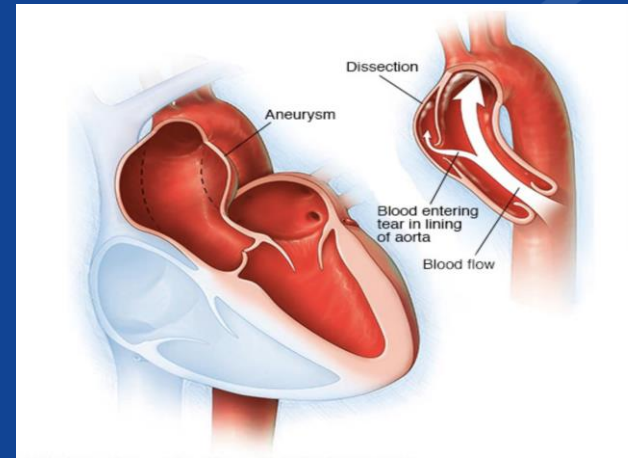- Dissection of the aorta typically occurs when the aortic media separates from the intima

Figure 1

Type A Aortic Repair

- Surgical repair is performed emergently and classically involves the use of <u>Hypothermic Circulatory Arrest</u> (HCA) for proximal aortic repair.
- The impact of circulatory arrest duration on postoperative outcomes is unclear with the critical arrest time leading to increased risk being controversial.
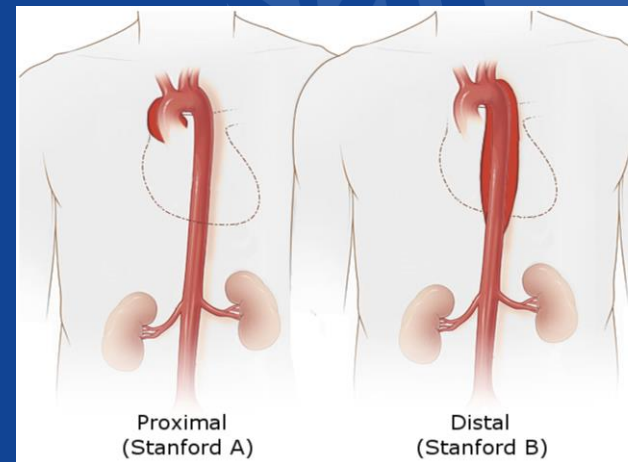

Figure 2

[1] "Aortic dissection," Mayo Clinic, https://www.mayoclinic.org/diseases-conditions/aortic-dissection/symptoms-causes/syc-20369496 (accessed Oct. 6, 2023). | [2] Aortic dissection - statpearls - NCBI bookshelf, https://www.ncbi.nlm.nih.gov/books/NBK441963/ (accessed Oct. 6, 2023).

Disclosures

- No Disclosures.

Study Objective

Elucidate the pivotal circulatory arrest time that detectably increases surgical complications and leads to poor long term outcomes

Methods

- Retrospective Review of patients who underwent Type A Aortic Dissection Repair from 2016-20 at a high volume academic institution in New Jersey
- Circulatory arrest time groups were stratified by greater and less than 30 minutes
- Outcomes were analyzed using Pearson's Chi-squared, Multivariate Regression, Fisher's Exact, and pooled T-Tests, with significance set at $p < 0.05$

Demographics

- Age
- Gender
- Race
- Body Mass Index

Comorbidities

- Hypertension
- Hyperlipidemia
- Diabetes Mellitus
- Previous Cerebrovascular Accident
- Atrial Fibrillation
- Congestive Heart Failure
- Smoking History
- COPD / Smoking History

Methods

Primary Outcomes

- 30 Day Mortality
- 12 Month Mortality
- Length of Stay
- 30 Day Readmission

Secondary Outcomes

- Acute Kidney Injury
- Pericardial or Pleural Effusion
- Cerebrovascular Accident (CVA)
- Atrial Fibrillation

Perioperative Characteristics

- Cardiopulmonary Bypass Time
- Cross Clamp Time
- **Circulatory Arrest Time**
- Deep Hypothermia Temperature
- Cerebral Perfusion Technique

Outcomes Comparing Cerebral Perfusion Techniques

- 30 Day Mortality
- Acute Kidney Injury
- Pericardial/Pleural Effusion
- Cerebrovascular Accident (CVA)
- Atrial Fibrillation

Results

Table 1: Baseline Characteristics And Outcomes

Variable	Overall (n = 142)	Circulatory Arrest Less than 30 minutes (n= 117)	Circulatory Arrest Greater than 30 minutes (n= 25)	P -Value
Baseline Characteristics				
Age (years) (Median, IQR)	142	69 (56 – 79)	63 (56 – 71)	.032
Gender (male) n (%)	97 (68%)	81 (84%)	16 (17%)	.609
Gender (female) n %	45 (32%)	36 (80%)	9 (20%)	.609
Race (White) (Fisher's Exact) n %	58 (42%)	48 (82%)	10 (17%)	.764
Race (African American) n %	19 (14%)	14 (74%)	5 (26%)	.764
Race (Asian) n %	12 (9%)	11 (92%)	1 (8%)	.764
Race (Hispanic) n %	14 (10%)	12 (86%)	2 (14%)	.764
Race (Other)	36 (26%)	29 (81%)	7 (19%)	.764
Body Mass Index (Median, IQR)	28 (25 – 32)	28 (25 – 33)	27 (24 – 32)	.284
Comorbidities				
Hypertension n (%)	110 (78%)	90 82%)	20 (18%)	0.738
Hyperlipidemia n (%)	54 (38%)	45 (83%)	9 (17%)	0.794
Diabetes Mellitus Type I/II n (%)	35 (25%)	32 (91%)	3 (9%)	.496
Preoperative Atrial Fibrillation n (%)	35 (25%)	30 (86%)	5 (15%)	.42
Previous Cerebrovascular Accident n (%)	14 (10%)	9 (65%)	5 (36%)	.074
History of Congestive Heart Failure n (%)	14 (10%)	9 (64%)	5 (36%)	.069
History of Smoking n (%)	46 (33%)	42 (91%)	4 (9%)	**.045***
Diagnosis of COPD n (%)	11 (8%)	10 (91%)	1 (9%)	.423

Significant Results
- History of Smoking (p=.045)

Results

Outcomes				
30-Day Mortality n (%)	25 (18%)	14 (12%)	11 (44%)	**<.001***
Postoperative Length of Stay (Days) (Median, IQR)	6 (4 – 12)	6.5 (4 – 12.75)	6 (1.5 – 12.5)	.412
30- Day Readmission n (%)	30 (21%)	25 (22%)	5 (21%)	.938
12 Month Postoperative Mortality n (%)	19 (13%)	11 (9%)	8 (32%)	**.002***
Perioperative Characteristics				
Cardiopulmonary Bypass Time (minutes)	135 (105 – 191)	125 (99.5 – 170)	208 (167 – 248)	**< .001***
Circulatory Arrest Time (minutes) (Median, IQR)	20 (16 – 27)	19 (15 – 23)	47 (38 – 55)	**< .001***
Cross-clamp Time (minutes) (Median, IQR)	85 (64 – 120)	80 (59 – 110.5)	117 (81.5 – 170.5)	**.036***
Deep Hypothermia Temperature (Median, IQR)	25 (24 - 25)	25 (24 - 26)	25 (22 – 25.5)	**.009***
Anterograde Circulatory Arrest Cerebral Perfusion n (%)	102 (73%)	83 (81%)	19 (19%)	.946
Retrograde Circulatory Arrest Cerebral Perfusion n (%)	18 (13%)	15 (83%)	3 (17%)	.946
No Circulatory Arrest Cerebral Perfusion n (%)	19 (14%)	16 (84%)	3 (16%)	.946
Postoperative Complications				
Acute Kidney Injury n (%)	27 (19%)	21 (18%)	6 (24%)	.497
Postoperative Pericardial/Pleural Effusion n (%)	54 (39%)	45 (39%)	9 (36%)	.770
Postoperative Cerebrovascular Accident n (%)	19 (14%)	10 (9%)	9 (36%)	**<.001***
Postoperative Atrial Fibrillation n (%)	41 (29%)	33 (29%)	8 (32%)	.723

Significant Results

- 30 Day Mortality (p < .001)
- 12 Month Mortality (p=.002)
- Cardiopulmonary Bypass Time (p < .001)
- Cross Clamp Time (p=.036)

- Circulatory Arrest Time (p < .001)
- Deep Hypothermic Temperature (p=.009)
- Postop CVA (p < .001)

Results

Cerebral Perfusion Technique And Postoperative Outcomes				
Variable	No Perfusion	Anterograde	Retrograde	
30-Day Mortality n (%)	6 (33%)	12 (12%)	7 (37%)	**.006***
Acute Kidney Injury n (%)	4 (22%)	20 (20%)	3 (16%)	.881
Postoperative Pericardial/Pleural Effusion n (%)	6 (35%)	34 (33%)	12 (68%)	**.015***
Postoperative Cerebrovascular Accident n (%)	1 (6%)	13 (13%)	5 (27%)	.161
Postoperative Atrial Fibrillation n (%)	4 (22%)	31 (30%)	4 (21%)	.594
*Indicates significance at $p < 0.05$, p values reported from Pearson's Chi Square Test unless noted otherwise				

Significant Results
- 30 Day Mortality (p=.006)
- Postop Pericardial/Pleural Effusion (p=.015)

Conclusions

Main Findings

- Circulatory Arrest Times above 30 minutes increase the postoperative risk of
  - Cerebrovascular Accident
  - 30 Day Mortality
  - 12 Month Mortality
- Preoperative Criteria that increase the risk for a Circulatory Arrest Time above 30 Minutes Include
  - History of Smoking
- Neuroprotectant Strategies were not found to be associated with reduced incidence of postoperative CVA in this study
- Retrograde Perfusion is associated with increased risk of 30 day mortality and pericardial/pleural effusion compared to Anterograde Perfusion

Future Directions

- Further investigation into evaluating these patients long term is needed
- Comparison of outcomes using different neuroprotectant techniques during circulatory arrest should be performed
- Evaluate additional risk factors that increase risk for longer circulatory arrest duration

Surgeons should make every attempt to minimize circulatory arrest times, preferably under 30 minutes. Strategies to prevent postoperative cerebrovascular accident should be further explored.

Limitations

- Retrospective nature of study