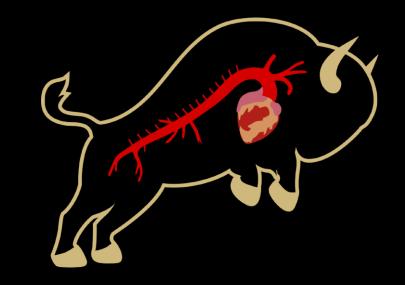
Forecasting Post-Operative Stroke Risk in Operative Management of Urgent and Emergent Type A Aortic Dissection

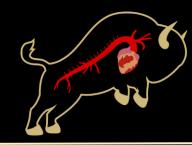
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No disclosures





Introduction

- Neuroprotective strategies during open aortic arch surgery have made advances, but there is still a significant risk of stroke
- Urgent and emergent type A dissection patients are at particular risk of stroke given patient acuity
- Determining risk factors that are predictive of stroke remains a topic of investigation
- Optimal cerebral protection strategy also remains a topic of investigation to mitigate stroke risk



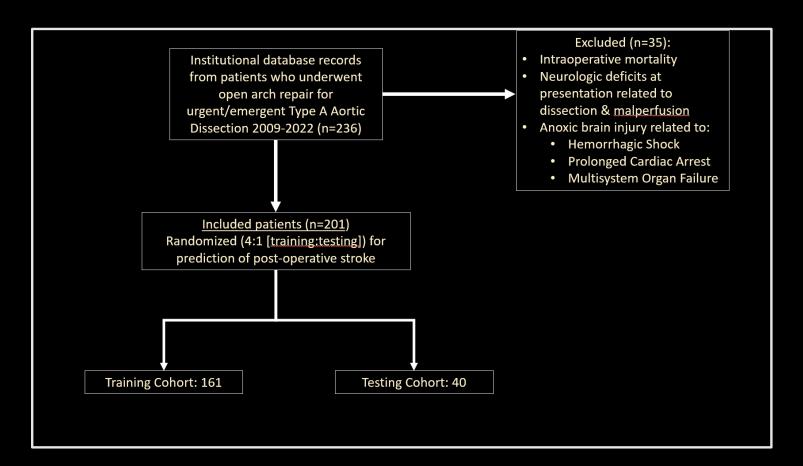
Aim

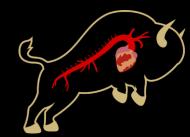
• To utilize a machine-learning logistic regression model to assess pre-operative comorbidities and operative strategies and their impact on stroke risk for patients undergoing arch replacement for urgent and emergent type A aortic dissection



<u>Methods</u>

- Retrospective review of institutional prospectivelymaintained aortic database from 2009-2022
- Identified patients who underwent urgent or emergent surgery for type A aortic dissection
- 201 patients were randomized at a 4:1 ratio into training and testing cohorts to develop logistic regression models to predict perioperative ICU stroke

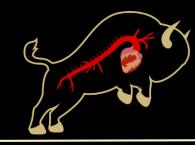




<u>Methods</u>

- From index hospitalization, extracted 29 input parameters including demographic, pre-operative, and intra-operative variables
 - Social vulnerability index was calculated by patient address
- Evaluation metric assessment of model performance:
 - Accuracy
 - Area under receiver-operating characteristic curve (AUC-ROC)
 - Area under precision-recall curve (AUC-PR, mean average precision)
- Calculated odds ratio for impact on risk of stroke, created Forest Plot to illustrate effect sizes, confidence intervals derived from logistic regression model

Demographics	
Age	60 ± 14
Male	138 (68.7%)
SVI ≥ 75%	49 (24.4%)
Comorbidities	
No Comorbidities	4 (2.0%)
HTN	162 (80.6%)
Smoking	56 (27.9%)
Diabetes	15 (7.5%)
CAD	10 (5.0%)
Surgical History	
No Hx CT Surgery	141 (70.1%)
Hx Sternotomy	27 (13.4%)
Aortic Presentation	
Malperfusion	76 (37.8%)
No Malperfusion	125 (62.2%)
CKD Category	
Baseline GFR	79 ± 26
Normal	78 (38.8%)
Mild	69 (34.3%)
Moderate	44 (21.9%)
Severe	10 (5.0%)
Procedure Type	
Hemiarch	115 (57.2%)
Total Arch	83 (41.3%)
Elephant Trunk	95 (47.3%)
Adjunctive Procedure	
No Adjunctive Procedure	50 (24.9%)
Root	77 (38.3%)
Mechanical Circulatory Support	4 (2.0%)
CABG	9 (4.5%)
Circulatory Arrest Protection	
Shaggy Protocol	27 (13.4%)
HCA Only	4 (2.0%)
Non-Shaggy RCP	10 (5.0%)
Non-Shaggy ACP	151 (75.1%)
Non-Shaggy ACP + RCP	7 (3.5%)



<u>Results</u>

					
Demographics					
Age	60 ± 14	-			Odds Ratios
Male	138 (68.7%)	Demographics Age ≥ 65			1.46 (1.36, 1.58)
SVI ≥ 75%	49 (24.4%)	Age < 65	H		0.68 (0.63, 0.74)
Comorbidities		Male	H H		0.68 (0.63, 0.73)
No Comorbidities	4 (2.0%)	Female SVI ≥ 75%			1.47 (1.37, 1.58) 1.17 (1.10, 1.26)
HTN	162 (80.6%)	5∨1≥75%			1.17 (1.10, 1.20)
Smoking	56 (27.9%)	Comorbidities			
Diabetes	15 (7.5%)	HTN			1.73 (1.63, 1.84) 1.39 (1.30, 1.49)
CAD	10 (5.0%)	Smoking Diabetes			1.39 (1.30, 1.49) 1.25 (1.21, 1.30)
Surgical History		CAD		т. н е н	1.76 (1.70, 1.81)
No Hx CT Surgery	141 (70.1%)				
Hx Sternotomy	27 (13.4%)	Surgical History Hx Aortic Surgery		•• •	1.10 (1.02, 1.17)
Aortic Presentation		Hx Sternotomy		H e H	1.19 (1.14, 1.24)
Malperfusion	76 (37.8%)				
No Malperfusion	125 (62.2%)	Aortic Presentation Malperfusion		→→ →	1.57 (1.46, 1.70)
CKD Category	120 (02.270)	No Malperfusion	H e H		0.64 (0.59, 0.69)
Baseline GFR	79 ± 26				
Normal	78 (38.8%)	CKD Category Normal	H		0.86 (0.80, 0.93)
Mild	69 (34.3%)	Mild	H a H (0.66 (0.61, 0.71)
Moderate	44 (21.9%)	Moderate	H H		0.82 (0.77, 0.87)
Severe	10 (5.0%)	Severe		⊷	2.16 (2.09, 2.23)
Procedure Type	10 (0.070)	Procedure Type			
Hemiarch	115 (57.2%)	Hemiarch	++ +		0.81 (0.75, 0.88)
Total Arch	83 (41.3%)	Total Arch Elephant Trunk	H A H	-	 2.31 (2.14, 2.49) 0.75 (0.69, 0.81)
Elephant Trunk	95 (47.3%)				0.75 (0.05, 0.01)
Adjunctive Procedure	95 (47.5%)	Adjunctive Procedure			
No Adjunctive Procedure	50 (24.9%)	Root MCS			1.50 (1.39, 1.62) 1.43 (1.40, 1.47)
	, , ,	CABG			0.98 (0.95, 1.00)
Root	77 (38.3%)				
Mechanical Circulatory Support	4 (2.0%)	Circulatory Arrest Protection			0.56 (0.53, 0.59)
CABG	9 (4.5%)	Shaggy Protocol HCA only	· · ·		0.84 (0.83, 0.86)
Circulatory Arrest Protection	07 (40, 40()	Non-Shaggy RCP		⊷ 1	1.27 (1.23, 1.32)
Shaggy Protocol	27 (13.4%)	Non-Shaggy ACP		H - H	1.47 (1.38, 1.58)
HCA Only	4 (2.0%)	Non-Shaggy ACP + RCP		HOH	1.17 (1.13, 1.21)
Non-Shaggy RCP	10 (5.0%)				
Non-Shaggy ACP	151 (75.1%)	0.	0 0.5 1	.0 1.5 2.0	2.5 3.0
Non-Shaggy ACP + RCP	7 (3.5%)			Odds Ratio (with 95% CI)	
Figure: Patient Character	istics and Fo	rest Plot illustrating the	effect sizes and	d confidence interva	als from the final

Figure: Patient Characteristics and Forest Plot illustrating the effect sizes and confidence intervals from the final logistic regression model. Each variable is represented by a point estimate and a horizontal line indicating the 95% confidence interval. Values are mean ± SD or n (%).

- Post-operative stroke occurred in 18.9% of patients (38/201)
- 71% cross-validation accuracy, 73% test accuracy
- AUC-ROC of 0.71, AUC-PR of 0.50
- Increased stroke risk:
 - Age ≥ 65
 - Female
 - High social vulnerability index (SVI \ge 75%)
 - Dissection with malperfusion (cerebral excluded)
 - Severe CKD
 - Total Arch procedure
 - Adjunctive Root

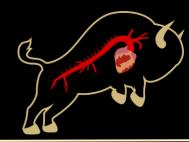


Results: Circulatory Arrest Protection

Circulatory Arrest Protection		Circulatory Arrest Protection						
Shaggy Protocol	27 (13.4%)	Shaggy Protocol HCA only	•	٠				0.56 (0.53, 0.59) 0.84 (0.83, 0.86)
HCA Only	4 (2.0%)	Non-Shaggy RCP Non-Shaggy ACP			⊷ ⊷			1.27 (1.23, 1.32) 1.47 (1.38, 1.58)
Non-Shaggy RCP	10 (5.0%)	Non-Shaggy ACP + RCP			H e t			1.17 (1.13, 1.21)
Non-Shaggy ACP	151 (75.1%)	_						
Non-Shaggy ACP + RCP	7 (3.5%)	0.0	0.5	1.		2.0 (with 95% CI)	2.5	3.0

Shaggy Aorta protocol

- Patient cannulated centrally for CPB
- Innominate artery is cannulated for SACP during cooling
- Distal anastomosis completed under HCA with RCP only (if < 10 minutes) vs RCP for 3-10 minutes + SACP (if > 10 minutes)
- RCP is used to allow flushing out of potentially embolic debris



<u>Conclusions</u>

- A machine-learning logistic regression model achieved excellent accuracy, quantified impact of specific patient characteristics in predicting stroke after operative management of acute type A aortic dissection
- Risk factors for stroke include advanced age, CKD, female gender, high social vulnerability, malperfusion, more extensive arch replacement, adjunctive root replacement
- Shaggy protocol demonstrated decreased stroke risk
- Limitations
 - Circulatory arrest protection strategy may be reflection of risk of stroke at time of procedure (e.g. RCP only may be selected in group at risk for embolization)
 - Historical bias; Shaggy protocol adopted in December 2018
 - Single center study, limited sample size

Questions???