

# Early and Long-Term Survival in Patients with Acute Kidney Injury

## after Acute Type A Aortic Dissection



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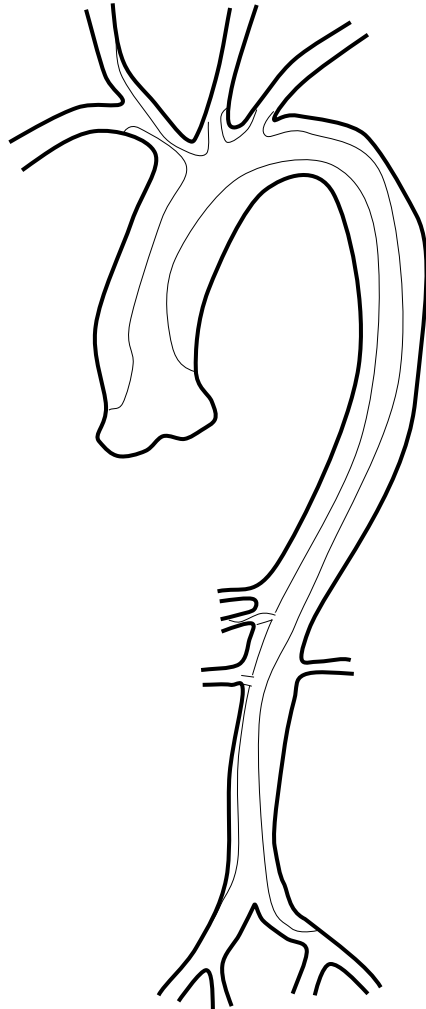
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# Background, Materials and Methods

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- The overall incidence of acute kidney injury (AKI) after aortic surgery is well documented, but its impact on the outcome of acute type A aortic dissection (ATAAD) has not been thoroughly investigated.
- The aim of this study was to determine the significance of AKI in predicting postoperative morbidity and mortality in ATAAD patients.
- We performed a retrospective analysis using a prospectively maintained database of 520 patients who underwent aortic surgery from September 2004 to February 2023.
- AKI was classified according to the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines.
- We used a risk-adjusted Cox proportional hazards regression model to assess long-term survival.

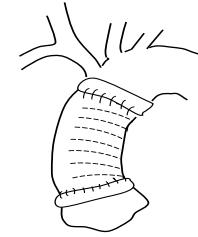
# Surgical procedure



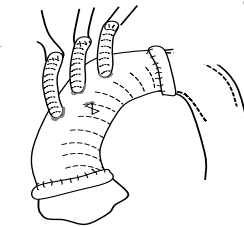
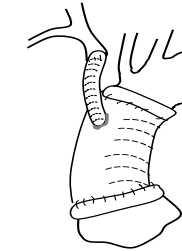
“Tear-oriented surgery”  
we performed an acute aortic dissection repair using a HAR or PAR with an intimal tear exclusion to reduce in-hospital mortality and morbidity in patients older than 70 years.



Hemiarch



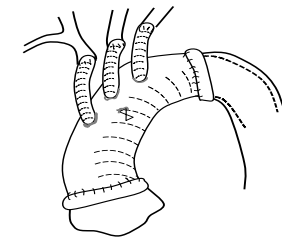
Partial arch



Total arch replacement

TAR was applied in condition described below if patients' condition was permitted

- Younger patients
- Connective tissue disorder
- Severe dissection involving supra-aortic orifices
- Enlarged aortic arch

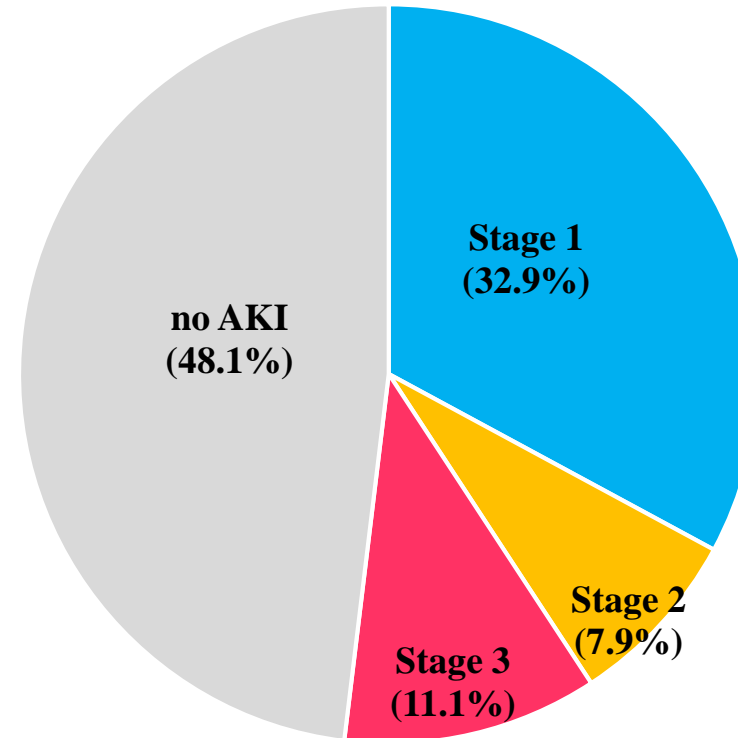


Total arch replacement

# Post-operative acute kidney injury

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- AKI (+): 270 pts. (51.9%)
- AKI (-): 250 pts. (48.1%)



# Patient Characteristics

	AKI (+) (n = 270)	AKI (-) (n = 250)	P Value
Age (y)	66.3±13.2	71.3±10.6	<0.0001
Gender: Male	173 (64.1%)	84 (33.6%)	<0.0001
Hypertension	178 (65.9%)	154 (61.6%)	0.32
Diabetes mellitus	14 (5.2%)	18 (7.2%)	0.37
Coronary artery disease	12 (4.4%)	11 (4.4%)	1.00
Cerebrovascular disease	22 (8.2%)	14 (5.6%)	0.30
Connective tissue disease	5 (1.9%)	7 (2.8%)	0.56
Prior cardiac surgery	8 (3.0%)	8 (3.2%)	1.00
Acute chest pain	161 (59.6%)	142 (56.8%)	0.53
Acute back pain	129 (47.8%)	87 (34.8%)	0.003
Shock	52 (19.3%)	49 (19.6%)	1.00
Cardiopulmonary resuscitation	9 (3.3%)	14 (5.6%)	0.29
Cardiac tamponade	41 (15.2%)	49 (19.6%)	0.20
Coma	7 (2.6%)	4 (1.6%)	0.55

	AKI (+) (n = 270)	AKI (-) (n = 250)	P Value
Organ malperfusion	107 (39.6%)	73 (29.2%)	0.01
Cerebral	49 (18.1%)	52 (20.9%)	0.44
Coronary	19 (7.0%)	5 (2.0%)	0.006
Visceral	17 (6.3%)	1 (0.4%)	0.0001
Extremities	37 (13.7%)	14 (5.6%)	0.002
Renal	29 (10.7%)	9 (3.6%)	0.002
Hemoglobin, g/dL	13.6±8.1	12.2±1.8	0.008
Albumin, g/dL	3.7±0.5	3.5±0.5	0.0001
Creatinine, mg/dL	1.08±0.57	0.89±0.39	<0.0001
eGFR, mL/min/1.73m <sup>2</sup>	57.3±21.6	61.9±20.6	0.02
DeBakey classification			
Type I	219 (81.1%)	147 (58.8%)	
Type II	41 (15.2%)	97 (38.8%)	<0.0001
Type III retrograde	10 (3.7%)	6 (2.4%)	

# Surgical details

	AKI (+) (n = 270)	AKI (-) (n = 250)	P Value
Surgical procedure			
Total-arch replacement	147 (54.4%)	91 (36.4%)	
Partial-arch replacement	12 (4.4%)	18 (7.2%)	0.0002
Hemi-arch replacement	111 (41.1%)	141 (56.4%)	
Concomitant procedure	44 (16.3%)	22 (8.8%)	0.01
Aortic root replacement	27 (10.0%)	15 (6.0%)	0.11
CABG	29 (10.7%)	5 (2.0%)	<0.0001
AVR	14 (5.2%)	5 (2.0%)	0.06
Resection of the intimal tear	249 (92.2%)	239 (96.0%)	0.09
Procedure time			
Cardiopulmonary bypass time (min)	278.8 ± 99.4	231.7 ± 69.0	<0.0001
Myocardial ischemia time (min)	161.8 ± 63.0	139.3 ± 49.1	<0.0001
Selective cerebral perfusion time (min)	153.9 ± 87.3	119.2 ± 73.7	<0.0001
Circulatory arrest time (min)	73.5 ± 35.0	65.6 ± 25.7	0.004
Lowest body temperature (°C)	25.8 ± 2.7	25.4 ± 2.3	0.04

# Early outcomes

	<b>AKI (+) (n = 270)</b>	<b>AKI (-) (n = 250)</b>	<b>P Value</b>
30-day mortality	21 (7.8%)	4 (1.6%)	<b>0.0008</b>
Hospital mortality	31 (11.5%)	5 (2.0%)	<b>&lt;0.0001</b>
New-onset neurologic dysfunction	45 (16.7%)	25 (10.0%)	<b>0.03</b>
Temporary neurologic deficit	8 (3.0%)	6 (2.4%)	0.79
Permanent neurologic deficit	37 (13.8%)	19 (7.6%)	<b>0.03</b>
Reexploration for bleeding	22 (8.2%)	9 (3.6%)	<b>0.04</b>
Tracheostomy	32 (11.9%)	10 (4.0%)	<b>0.001</b>
Mechanical ventilation time > 48 hours	153 (56.7%)	52 (20.8%)	<b>&lt;0.0001</b>
Intensive care unit stay, days	10.9 ± 15.1	5.4 ± 6.6	<b>&lt;0.0001</b>
Hospital stay, days	40.2 ± 36.9	29.0 ± 22.0	<b>&lt;0.0001</b>
Renal function			
Renal failure needed CHDF	42 (15.6%)	0	<b>&lt;0.0001</b>
Max Creatinine in 2POD, mg/dL	1.95±0.98	0.99±0.38	<b>&lt;0.0001</b>
Max Creatinine in 7POD, mg/dL	2.15±1.39	1.00±0.39	<b>&lt;0.0001</b>
Creatinine at discharge, mg/dL	1.15±0.91	0.76±0.26	<b>&lt;0.0001</b>

# Univariable and multivariable analyses of hospital mortality

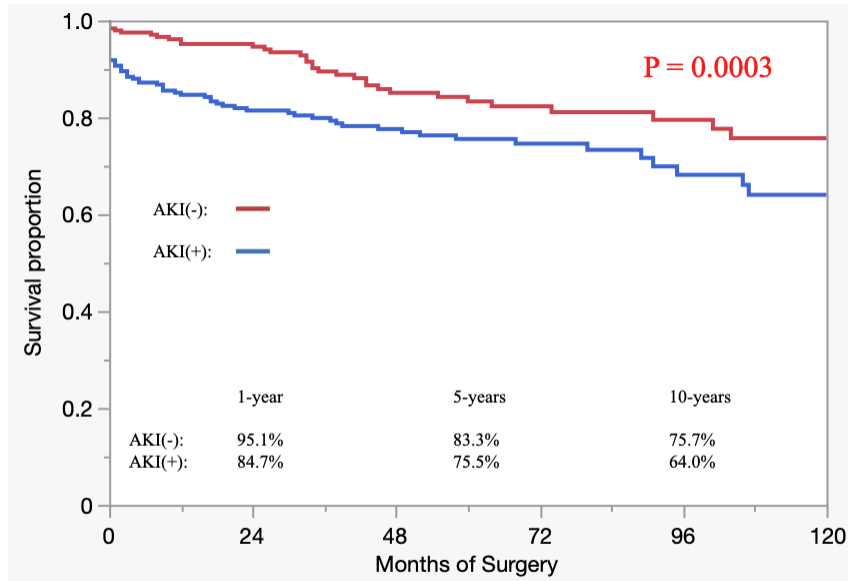
	Univariable			Multivariable		
	OR	95%CI	p value	OR	95%CI	P value
Acute kidney injury	6.36	2.43-16.62	0.0002	5.02	1.72-14.62	0.003
Extremities malperfusion	3.50	1.54-7.93	0.003	2.63	1.01-6.87	0.05
Coronary malperfusion	8.36	3.30-21.19	<.0001	4.72	1.47-15.24	0.01
Visceral malperfusion	13.51	4.95-36.91	<.0001	5.29	1.64-17.07	0.005
Shock	2.54	1.24-5.20	0.01	1.39	0.52-3.69	0.51
Cardiopulmonary resuscitation	7.06	2.69-18.52	<.0001	6.59	1.60-27.07	0.009
Concomitant procedure	5.29	2.55-10.96	<.0001	1.95	0.76-5.00	0.16



## Univariable and multivariable analyses of AKI

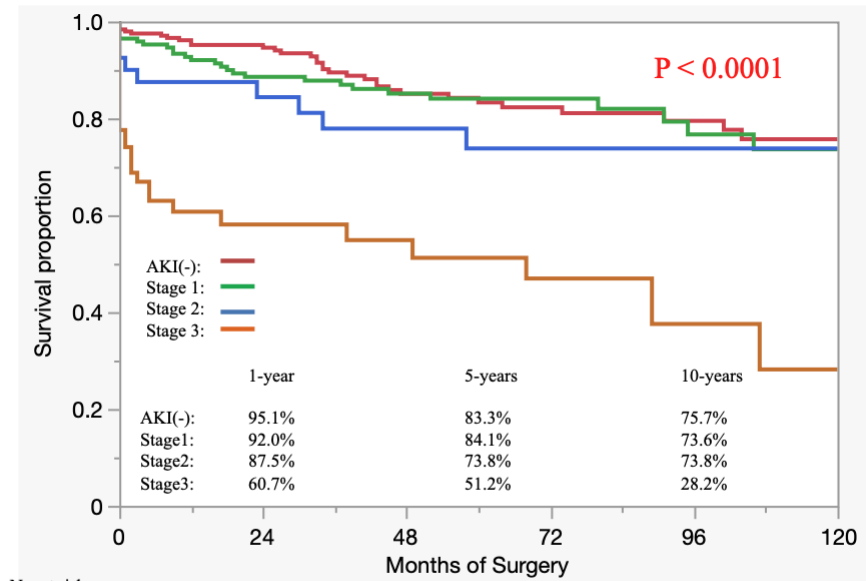
	Univariable			Multivariable		
	OR	95%CI	p value	OR	95%CI	P value
Age (y)	0.97	0.95-0.98	<.0001	0.99	0.97-1.01	0.44
Gender: Male	3.52	2.46-5.06	<.0001	2.80	1.86-4.22	<.0001
Coronary malperfusion	3.71	1.36-10.09	0.01	2.34	0.73-7.45	0.15
Visceral malperfusion	16.66	2.20-126.17	0.007	12.17	1.51-98.08	0.02
Extremities malperfusion	2.67	1.40-5.06	0.003	2.33	0.68-2.94	0.35
Renal malperfusion	3.22	1.49-6.95	0.003	2.33	0.98-5.53	0.06
Surgical procedure (TAR vs HAR)	2.05	1.43-2.94	<.0001	0.81	0.35-1.90	0.63
Concomitant procedure	2.02	1.17-3.48	0.01	0.84	0.39-1.78	0.65
Cardiopulmonary bypass time (min)	1.01	1.00-1.01	<.0001	1.00	1.00-1.01	0.02
Myocardial ischemia time (min)	1.01	1.00-1.01	<.0001	1.00	0.99-1.01	0.15
Selective cerebral perfusion time (min)	1.01	1.00-1.01	<.0001	1.00	0.99-1.01	0.80
Circulatory arrest time (min)	1.01	1.00-1.02	0.003	1.00	0.99-1.01	0.46
Lowest body temperature (°C)	1.07	1.00-1.15	0.04	1.15	1.06-1.25	0.001

# Survival curves



No. at risk						
AKI (-):	243	170	110	70	47	24
AKI (+):	268	165	124	69	40	24

AKI(+) and AKI(-)



No. at risk						
AKI (-):	243	170	110	70	47	24
Stage1 :	170	119	87	46	30	19
Stage2 :	40	28	22	14	7	3
Stage3 :	58	21	16	11	5	2

stratified KDIGO

## Univariable and multivariable analyses of overall survival

	Univariable			Multivariable		
	HR	95%CI	p value	HR	95%CI	P value
Acute kidney injury	1.64	1.10-2.44	0.01	1.61	1.00-2.55	0.04
Renal malperfusion	2.00	1.15-3.49	0.01	1.36	0.75-2.46	0.31
Coronary malperfusion	3.52	1.93-6.44	<.0001	2.79	1.30-5.96	0.008
Visceral malperfusion	3.86	1.94-7.68	0.0001	3.83	1.75-8.40	0.0008
Prior cardiac surgery	2.60	1.14-5.95	0.02	3.91	1.66-9.25	0.002
Shock	2.44	1.63-3.66	<.0001	1.25	0.76-2.05	0.38
Cardiopulmonary resuscitation	5.44	3.07-9.63	<.0001	3.26	1.65-6.47	0.0007
Concomitant procedure	1.70	1.06-2.73	0.03	0.86	0.48-1.56	0.62
Age	1.04	1.02-1.06	<.0001	1.04	1.02-1.07	0.0002
Albumin	0.40	0.30-0.56	<.0001	0.44	0.30-0.65	<.0001
Creatinine at discharge	1.75	1.75-1.96	<.0001	1.88	1.56-2.23	<.0001

# Conclusions

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- The onset of acute Kidney Injury (AKI) following surgery for acute aortic dissection is associated with increased mortality and morbidity and is a significant predictor of in-hospital death.
- Major risk factors for the development of AKI include male gender, visceral malperfusion, extended duration of cardiopulmonary bypass, and lower body temperature.
- AKI is a poor indicator of long-term outcome.
- According to the KDIGO criteria, patients with stage 3 AKI have worse outcomes.