Renal Artery Malperfusion after Aortic Dissection: Clinical Diagnosis and Correlation with Acute Kidney Injury

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Introduction

Acute kidney injury (AKI) is a common complication after aortic dissection and is associated with adverse clinical outcomes. Potential mechanisms contributing to AKI after aortic dissection include renal malperfusion or underlying renal dysfunction from comorbidities. While renal malperfusion is the one acutely treatable cause of AKI, the association of AKI with ongoing renal artery malperfusion and the clinical ability of physicians to identify renal malperfusion is unknown.

Objectives

- Assess predictors of ongoing renal artery malperfusion, including acute kidney injury
- Assess the diagnostic utility of clinical suspicion and acute kidney injury to predict ongoing renal artery malperfusion

Methods

- Retrospectively reviewed medical records of patients admitted to the University of Michigan between 1995 and 2018 with aortic dissection requiring aortic catheterization for the diagnosis and possible treatment of arterial malperfusion
- Arterial malperfusion was suspected by the clinical team based on history, physical exam, radiographic studies, or laboratory values
- Renal artery malperfusion was defined as a systolic pressure gradient of ≥15 mmHg between the aortic root and each renal artery
- AKI was identified using serum creatinine levels according to the Kidney Disease: Improving Global Outcomes (KDIGO) criteria
- Statistical analysis included chi-squared test or Fisher's exact test for dichotomous variables, and Student's t-test for continuous variables. Results with p-values ≤ 0.05 were considered statistically significant.

Results

Table 1. *Indications for Aortic Catheterization and Evaluation of Arterial Obstruction*

Variable	n = 526 (%)
Suspected Renal Malperfusion	273 (51.9)
Refractory Hypertension	199 (37.8)
Elevated serum creatinine	82 (15.6)
CT malperfusion	85 (15.2)
Suspected Mesenteric Malperfusion	178 (33.8)
Abdominal pain	22 (17.5)
Nausea/Vomiting	9 (1.7)
Gastrointestinal blood	22 (4.2)
Elevated lactate, AST, ALT, amylase, or lipas	39 (7.4)
CT malperfusion	21 (4.0)
Suspected Lower Extremity Malperfusion	185 (35.2)
Right-sided absent or deminished pulses	73 (13.9)
Left-sided absent or deminished pulses	48 (9.1)
Bilateral absent or deminished pulses	64 (12.1)

473 patients without prior dialysis requirement (mean age 58.0 years, 75.7% male) presented with aortic dissection and suspected arterial malperfusion of the intestines, kidneys, or lower extremities. These patients underwent a total of 526 cases of aortic catheterization with manometric measurements to identify ongoing arterial malperfusion. The most common indications for manometric catheterization are listed in Table 1.

Table 2. *Univariate Analysis of Ongoing Renal Artery Malperfusion in Patients Presenting with Suspected Arterial Malperfusion*

Variable	Renal Malperfusion (n = 267)	No Renal Malperfusion (n = 259)	p-Value
Demographics			
Age, years	57.3 ± 13.4	58.7 ± 13.9	0.293
Male	188 (74.3%)	170 (76.9)	0.453
Comorbidities			
Diabetes mellitus	22 (8.2)	12 (4.6)	0.186
Hypertension	217 (81.3)	206 (79.5)	0.737
Coronary artery disease	46 (17.2)	43 (16.6)	0.891
Congestive heart failure	12 (4.5)	14 (5.4)	0.729
Peripheral vascular disease	14 (5.2)	6 (2.3)	0.151
Chronic kidney disease	16 (6.0)	19 (7.3)	0.613
COPD	29 (11.0)	35 (13.5)	0.505
Stroke	15 (5.6)	10 (3.9)	0.469
Extent of Dissection			
Stanford acute type A	107 (40.1)	97 (37.5)	0.537
Stanford chronic type A	21 (7.9)	33 (12.7)	0.065
Stanford acute type B	118 (44.2)	99 (38.2)	0.164
Stanford chronic type B	21 (7.9)	30 (11.6)	0.150
Hospitalization			
Baseline sCr (mg/dL)	1.19 ± 0.56	1.20 ± 0.78	0.979
Acute Kidney Injury, KDIGO criteria	201 (75.3)	127 (49.0)	<0.001
Duration	20.4 ± 25.7	13.7 ± 29.5	0.006

Data are presented as mean ± SD or number (%)

Results (Cont.)

Ongoing renal artery malperfusion was identified in 267 (50.8%) cases. For these cases, 87 had right renal artery obstruction, 77 had left renal artery obstruction, and 103 had bilateral renal artery obstruction. AKI was found in 328 (62.4%) cases at time of aortic catheterization and was associated with ongoing renal artery malperfusion in 201 (75%) cases compared to 127 (49.0%) cases without renal artery malperfusion (Table 2). Other univariate variables, which were not significantly associated with renal artery malperfusion, are listed in Table 2.

Renal artery malperfusion was suspected by the clinical care team in 273 cases (51.9%). The diagnostic utility of clinical suspicion or AKI to predict ongoing renal malperfusion as determined by sensitivity, specificity, positive predictive value, and negative predictive value are listed in table 3.

Table 3. *The Diagnostic Utility of Clinical Suspicion and Acute Kidney Injury to Predict Ongoing Renal Artery Obstruction*

	Clinical Suspicion	AKI, KDIGO criteria
Senstivity	65.2%	75.3%
Specificity	61.8%	51.0%
PPV	63.7%	61.3%
NPV	63.2%	66.7%

Conclusions

AKI is common among patients with aortic dissection and is associated with ongoing renal artery obstruction. However, clinical suspicion and AKI are poor predictors of ongoing renal artery obstruction. Future studies are needed to improve identification of renal artery malperfusion in patients with aortic dissection.