Causes and outcome of dialysis-dependent acute kidney injury treated outside the intensive care unit

LANDESKRANKENHAUS FELDKIRCH
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Background and Aim

Acute kidney injury (AKI) is increasing globally. It is associated with adverse outcomes such as chronic kidney disease (CKD), end-stage renal disease (ESRD) or death and with a high economic burden. In particular, patients suffering the most severe form of AKI requiring dialysis treatment (AKI-D) are at highest risk for death and ESRD.
National and international nephrology societies emphazise the urgent need for prevention of AKI.
Whereas causes and outcome of AKI-D patients treated in the ICU setting are described extensively, few data exist about AKI-D treated outside the ICU, mainly at nephrology departments.
The aim of this study was to define the causes, predisposing comorbidities, medication and the outcome in an AKI-D patient cohort, treated with intermittent hemodialysis outside the ICU.

Methods

All adult patients with AKI-D treated in one single Nephrology and Dialysis unit at the Academic Teaching Hospital Feldkirch, a tertiary health care reference center serving a population of 400.000 inhabitants in the most western province of Austria,
between January 2010 and June 2015 were evaluated retrospectively.
AKI-D was defined as AKI treated with acute intermittent hemodialysis. Dialysis was indicated at the discretion of the treating physicians. The team of nephrologists remained unchanged during the observation period. All patients with known end-stage renal disease and patients treated with renal replacement therapy in the ICU were excluded from this analysis.
To identify possibly risk factors for preventable AKI-D, patients were grouped into hemodynamically mediated AKI-D, caused by a decreased renal perfusion with exclusion of other intrinsic renal diseases, and non-hemodynamic AKI-D.

Results

During 66 months 128 patients (57% males, mean age 69.3 years) were treated. AKI-D was community-acquired in 70.3%. The most frequent comorbidities were hypertension (62.5%), chronic kidney disease (CKD) (58.9%), coronary artery disease (CAD) (46.1%), diabetes (35.9%) and heart failure (34.1%). Most patients were prescribed diuretics (61.7%) and inhibitors of the renin-angiotensin-aldosterone system (RASI) (57.8%) and 46.1% had a combination of both. In the 40 patients with non-hemodynamic AKI-D interstitial nephritis (n=15) was the prominent diagnosis. Patients with hemodynamic AKI-D (n=88) were older (72.6 vs 62.1 years, p=0.001), suffered more often from CKD (68.2% vs 33.3%, p=0.003), CAD (54.5% vs 27.5%, p=0.004) and diabetes (42.0% vs 22.5%, p=0.033), and were more frequently on diuretics (75.0% vs 32.5%, p<0.001), RASI (67.0% vs 37.5%, p=0.002) or their combination (58.0% vs 20.0%, p<0.001). Twenty-two patients (17.2%) died and 27 patients (21.1%) died or developed end-stage renal disease. In a multivariate-adjusted logistic regression model the risk for dialysis-requiring AKI due to hemodynamic causes increased by 5% for each year of higher age (β 1.05, 95% CI 1.01-1.08, p=0.015), by nearly 200% with pre-existing use of ACEI or ARB (β 2.93, CI 1.23-6.98, p=0.015), and by nearly 250% with pre-existing loop diuretic therapy (β 3.48, 1.30-9.32, p=0.013).

Conclusions

AKI-D treated outside the ICU most often afflicts elderly patients with one or more comorbid conditions, who are treated with diuretics and RASI. In most instances, an acute intercurrent illness such as diarrhea, acute heart failure or infections, all of which cause volume depletion and a reduction of renal perfusion, precipitates AKI-D.
These findings suggest that in this group of vulnerable patients drugs that may impair renal perfusion such as diuretics, RASI and NSAID should be withheld during any acute illness. Whether such an approach is successful in preventing hemodynamic AKI-D needs further studies.

Table 1. Baseline characteristics

	N(%) or mean±SD	Hemodynamic AKI, n=88	Non-hemodynamic AKI, n=40	P*
Gender, n(%)				
Male Female	73 (57%) 55 (43%)	45 (51.1%) 43 (48.9%)	28 (70%) 12 (30%)	0.046
Age (years)	69.3	72.6	62.1	0.001
Co-morbidities, n (%)				
Diabetes mellitus	46 (35.9%)	37 (42%)	9 (22.5%)	0.033
Hypertension	80 (62.5%)	58 (65.9%)	22 (55%)	0.237
Heart failure	24 (18.7%)	19 (21.6%)	5 (12.5%)	0.222
CAD	59 (46.1%)	48 (54.5%)	11 (27.5%)	0.004
PAD	30 (23.4%)	23 (26.1%)	7 (17.5%)	0.285
Liver cirrhosis	8 (6.3%)	6 (6.8%)	2 (5%)	0.999
Comorbidities per patient	1.9	2.2	1.4	
Current smoker, n (%)	23 (18%)	13 (14.8%)	10 (25%)	0.162
Medication, n (%)				
ACE-I	47 (36.7%)	39 (44.3%)	8 (20%)	0.008
ARB	27 (21.1%)	20 (22.7%)	7 (17.5%)	0.502
ACE-I or ARB	74 (57.8%)	59 (67.0%)	15 (37.5%)	0.002
Loop diuretic	51 (39.8%)	44 (50%)	7 (17.5%)	< 0.001
Thiazide diuretic	47 (36.7%)	41 (46.6%)	6 (15.0%)	0.001
Loop or thiazide diuretic	79 (61.7%)	66 (75%)	13 (32.5%)	<0.001
Spironolactone	13 (10.2%)	11 (12.5%)	2 (5.0%)	0.343
NSAID	30 (23.4%)	19 (21.6%)	11 (27.5%)	0.503
PPI	65 (50.8%)	44 (50.0%)	21 (52.5%)	0.793
Metformin	25 (19.5%)	21 (23.9%)	4 (10.0%)	0.092
Antibiotic	24 (18.8%)	17 (19.3%)	7 (17.5%)	0.807
Statin	60 (46.9%)	46 (52.3%)	14 (35.0%)	0.070
Aspirin	41 (32%)	33 (37.5%)	8 (20%)	0.049
Community-acquired AKI	70.3%	63 (71.6%)	27 (67.5%)	0.639

Abbrevations: CAD, coronary artery disease; PAD, peripheral artery disease; ACE-I, ACE-inhibitor; ARB, angiotensin II receptor blocker; NSAID, non-steroidal anti-inflammatory drugs; PPI, proton pump inhibitors; AKI, acute kidney injury. *group difference hemodynamic *vs* non-hemodynamic

Table 2. Causes of AKI

Hemodynamic (n=88)	N (%)	Non-hemodynamic (n=40)	N (%)
Diarrhea	35 (39.8%)	Interstitial nephritis	15 (37.5%)
Heart failure	12 (13.6%)	Rapid progressive glomerulonephritis	4 (10%)
Septic diseases	11 (12.5%)	Rhabdomyolysis	4 (10%)
Dehydration	14 (15.9%)	Obstructive nephropathy	1 (2.5%)
Blood loss	6 (6.8%)	Contrast-induced AKI	3 (7.5%)
Acute coronary syndrome	4 (4.6%)	Light-chain nephropathy/myeloma	2 (5%)
Hypercalcemia	2 (2.3%)	Cholesterol emboli	2 (5%)
Decompensated liver cirrhosis	2 (2.3%)	Ethylene glycol poisoning	2 (5.0%)
Lactatacidosis	2 (2.3%)	Tumor lysis syndrom	2 (5%)
		Catastrophic antiphospholipid syndrome	1 (2.5%)

Table 3. Exposure to variant drug combinations and acute intercurrent events causing AKI-D

	All N (%)	Hemodynamic N (%)	Non-hemodynamic N (%)	P*
Diuretics and RASI -and diarrhea -and heart failure -and septic disease -and contrast agent	59 (46.1)	51 (58%) 22 (25%) 7 (8.8%) 6 (6.8%) 4 (4.5%)	8 (20%)	<0.001
Diuretics and RASI and NSAID	12 (9.4%)	10 (11.4%)	2 (5%)	0.34
Diuretics and NSAID	16 (12.5%)	12 (13.6%)	4 (10%)	0.78
RASI and NSAID	17 (13.3%)	13 (14.8%)	4 (10%)	0.58

Abbrevations: RASI, renin-angiotensin-aldosterone system inhibitor; NSAID, non-steroidal anti-inflammatory drugs.
*group difference hemodynamic *vs* non-hemodynamic

Table 4. Patient and renal outcome

	Hemodynamic	Non-hemodynamic	P
Recovery of kidney function	69 (78.4%)	34 (85%)	0.383
Death	17 (19.3%)	5 (12.5%)	0.343
Dialysis or death	20 (22.7%)	7 (17.5%)	0.502

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