DIABETES MELLITUS DOES NOT INCREASE THE INCIDENCE OF ACUTE KIDNEY INJURY AFTER CARDIAC SURGERY IN PATIENTS WITH CHRONIC KIDNEY DISEASE; A NESTED CASE-CONTROL STUDY

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INTRODUCTION AND OBJECTIVES

Cardiac surgery, is commonly associated with the onset of acute kidney injury (AKI) [1]. Renal function deterioration after such operations is associated with significant increase in all-cause hospital mortality [2]. The heterogeneity of the definitions used for AKI in relevant literature resulted in high variance of incidence rates. Diabetes mellitus (DM) is present in about 20-25% of individuals undergoing cardiac surgery [1,2] and has been associated with increase in post-surgery cardiovascular events in some [1], but not all studies [3]. As data on the effect of DM on AKI incidence in this setting are scarce and contradictory, we aimed to evaluate in comparison the incidence of AKI, (defined by the AKIN, RIFLE and KDIGO criteria) in matched patients with and without DM undergoing cardiac surgery and to directly examine the effect of DM on AKI development.

METHODS

This is a nested case-control study from a cohort of patients undergoing cardiac surgery (coronary artery bypass grafting, aortic or mitral valve replacement, thoracic aortic aneurysm repair, aortic dissection repair, atrial septal defect closure or combination of these procedures) during a 18-month period in a single center. The exclusion criteria were: Type-1 diabetes, end-stage-renal-disease, death during surgery and ongoing AKI prior to surgery. A total 199 type-2 diabetics were identified to represent the cases and were matched to 199 non-diabetic individuals for gender, age and estimated glomerular filtration rate (eGFR). Diagnosis of AKI was made separately with the use of RIFLE, AKIN and KDIGO criteria. The incidence of AKI was compared between the two groups in the total population and in subgroups according to preoperative eGFR. Univariate and multivariate logistic regression analysis were conducted to identify factors associated with AKI.

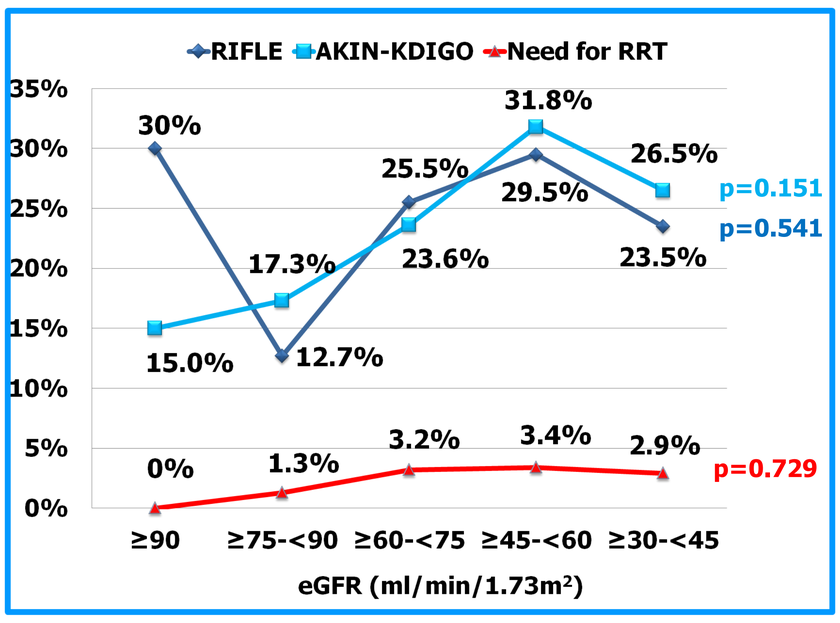
RESULTS

Baseline demographic and clinical characteristics of the patients are presented in Table 1. The incidence of AKI after cardiac surgery in the population studied was 23.6% based on the AKIN and the KDIGO criteria and 25.4% based on the RIFLE criteria (Figure 1). The incidence of AKI was moderately high, but similar between the two study groups (Table 2). A trend towards increased incidence of AKI from eGFR subgroup 1 to subgroup 3a was noted in diabetic patients (Figure 2). No significant differences were detected between the two study groups within any eGFR subgroup studied with regards to AKI occurrence. In multivariate analysis, age and duration of cardiopulmonary bypass were associated with AKI occurrence. Diabetes was not related with AKI development in the regression analysis (Table 3).

Table 1: Baseline demographic and clinical characteristics of the patients

Parameters		Diabetics	Non-diabetics	P
N		199	199	-
Age (years)		66.42± 9.1	67.36± 8.3	0.289
Gender	Female	35 (8.8 %)	35(8.8 %)	1.000
	Male	164 (41.2 %)	164 (41.2 %)	1.000
BMI (kg/m²)		29.120±6.5	28.209±4.1	0.097
Hypertension (n,%)		157 (54 %)	134 (46 %)	**0.013**
Dyslipidemia (n,%)		149 (58.7 %)	105 (41.3%)	**0.010**
Coronary Heart Disease (n,%)		197 (99%)	193 (97%)	0.284
Stroke (n,%)		25 (12.6%)	17 (8.5%)	0.253
Peripheral Vascular Disease (n,%)		28 (14.1%)	23 (11.6 %)	0.549
Chronic Obstructive Pulmonary Disease (n,%)		42 (21.1%)	48 (24.1%)	0.472
NYHA Classification	No Heart Failure	6 (3%)	2 (1%)	0.483
	Class 1	81 (40.7%)	87 (43.7%)	
	Class 2	103 (51.8%)	102 (51.3%)	
	Class 3	9 (4.5%)	7 (3.5%)	
	Class 4	0 (0%)	1 (0.5%)	
EuroSCORE I		4.9±4.6	5.8±5.9	0.084
EuroSCORE II		1.9±1.7	2.1±2.1	0.353
Renal Function Groups	Group 1	21 (10.6%)	19 (9.5%)	1.000
	Group 2a	36 (18.1%)	39 (19.6%)	
	Group 2b	74 (37.2%)	83 (41.7%)	
	Group 3a	48 (24.1%)	40 (20.1%)	
	Group 3b	18 (9%)	16 (8%)	
pre-surgery use	Diuretics	92 (46.2%)	76 (38.2%)	0.104
	ACEIs/ARBs	48 (24.1%)	38 (19.1%)	0.223

Figure 1: AKI incidence in eGFR sub-groups in total population



Parameters		Diabetics	Non-diabetics	P
N		199	199	
Pre-Surgery	Creatinine (mg/dl)	1.1±0.2	1.09±0.2	0.817
	eGFR (ml/min/1.73m²)	68.3±28.5	67.5±16.1	0.724
Post-Surgery	Creatinine (mg/dl)	1.08±0.3	1.06±0.2	0.438
	eGFR (ml/min/1.73m²)	69.1±17.4	69.6±16.7	0.800
After 24 h	Creatinine (mg/dl)	1.2±0.3	1.2±0.3	0.925
	eGFR (ml/min/1.73m²)	62.4±18.2	62.5±19.7	0.960
	Urine output (ml)	3,553±887.1	3,766±822.6	**0.053**
After 48 h	Creatinine (mg/dl)	1.1±0.4	1.1±0.3	0.207
	eGFR (ml/min/1.73m²)	64.3±20.2	67.5±22.1	0.138
	Urine output (ml)	2,998±1083	3,296±1111	**0.013**
AKI with AKIN(n,%)		48 (24.1%)	46 (23.1%)	0.906
AKI with RIFLE (n,%)		50(25.1 %)	50(25.1 %)	1.000
AKI with KDIGO (n,%)		48(24.1%)	46(23.1%)	0.906
Renal Replacement Therapy in ICU		7(3.5%)	3(1.5%)	0.169

Table 2: Serum creatinine, eGFR, 24-hour urine excretion at different time points of the study and incidence of AKI during the first 48 hours from surgery in diabetic and non-diabetic patients.

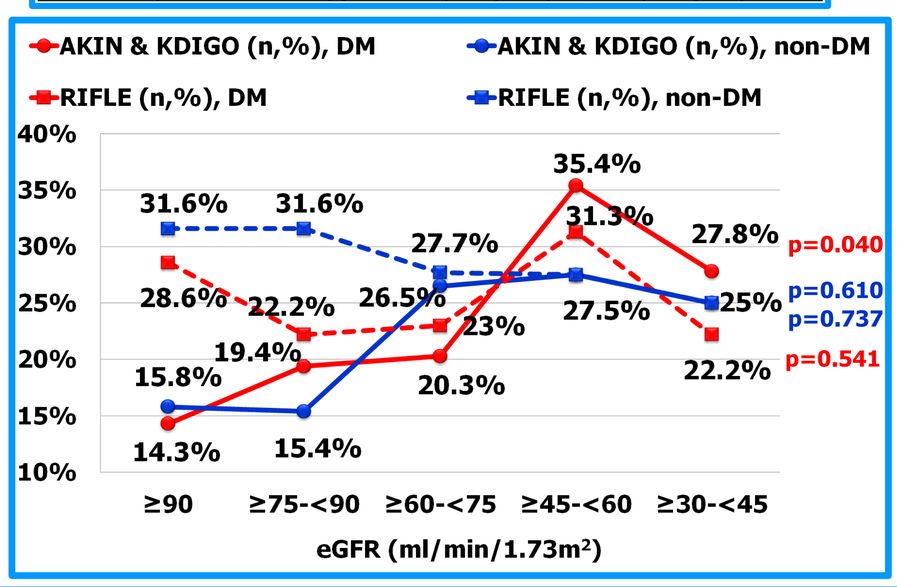


Figure 2: Incidence of AKI in eGFR sub-groups in patients with and without DM

Parameter		Univariate analysis: Unadjusted Odds Ratio (95% CI)	P	Multivariate analysis: Adjusted Odds Ratio (95% CI)	P
Gender	Male	Reference Group			
	Female	1.148 (0.634-2.079)	0.649		
Age (per year)		1.047 (1.017-1.078)	0.002	1.034 (1.001-1.068)	0.043
BMI (per kg/m²)		1.035 (0.993-1.078)	0.108	1.027 (0.986-1.070)	0.211
eGFR Groups	Group 1	Reference Group		Reference Group	
	Group 2a	1.188 (0.414-3.409)	0.748	1.107 (0.370-3.314)	0.856
	Group 2b	1.747 (0.681-4.486)	0.246	1.296 (0.480-3.499)	0.608
	Group 3a	2.644 (1.001-7.025)	0.050	1.676 (0.579-4.855)	0.341
	Group 3b	2.040 (0.643-6.474)	0.226	1.211 (0.341-4.304)	0.767
Diabetes		1.057 (0.666-1.679)	0.813		
Chronic Obstructive Pulmonary Disease		1.242 (0.895-1.942)	0.107	1.550 (0.881-2.728)	0.125
Hypertension		1.095 (0.646-1.857)	0.735		
Dyslipidemia		1.202 (0.737-1.960)	0.460		
Coronary Heart Disease		0.932 (0.279-3.985)	0.897		
NYHA Classification	No Heart Failure	Reference Group			
	Class 1	0.877 (0.170-4.523)	0.875		
	Class 2	0.917 (0.179-4.694)	0.917		
	Class 3	1.800 (0.271-11.957)	0.543		
	Class 4	n/a	n/a		
Ejection Fraction (per %)		0.996 (0.977-1.016)	0.710		
Pre-surgery use	Diuretics	1.019 (0.638-1.626)	0.939		
	ACEIs/ ARBs	1.058 (0.606-1.847)	0.844		
EUROSCORE II (per unit)		1.173 (1.048-1.314)	0.006	1.001 (0.863-1.161)	0.990
Cardiac Surgery	Elective	Reference Group			
	Urgent	0.853 (0.430-1.692)	0.650		
	Emergency	2.133 (0.350-12.993)	0.411		
Cardiopulmonary bypass (per min)		1.010 (1.005-1.016)	<0.001	1.009 (1.003-1.015)	0.004
Intra-aortic Balloon pump use		1.321 (0.562-3.105)	0.523		
Intubation time (per hour)		1.019 (1.003-1.034	0.017	1.008 (0.996-1.020)	0.192
Post-Surgery Complications		2.093 (1.310-3.343)	0.002	1.503 (0.897-2.520)	0.122

Table 3: Univariate and multivariate regression analysis for occurrence of AKI defined by KDIGO criteria in the total studied population.

CONCLUSIONS

- Incidence of AKI after cardiac surgery remains relatively high
- DM does not constitute a separate risk factor for AKI development in cardiac surgery
- This is in contrast to other settings (e.g. percutaneous coronary angioplasty) where DM increases the incidence of AKI significantly.
- Among patients with DM, baseline renal function is a parameter related inversely with the incidence of AKI.
- Age and cardiopulmonary bypass time are factors associated with AKI development in all patients.

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