Effects of diabetes mellitus and chronic kidney disease on major outcomes in patients undergoing cardiac surgery

Mark W Berguson[1], Jordan Goldhammer[1], Hong Liu[2], Rohinton Morris[3], Jianzhong Sun[1]

[1] Department of Anesthesiology, Thomas Jefferson University Hospital [2] Department of Anesthesiology, University of California Davis Medical Center

[3] Division of Cardiothoracic Surgery, Thomas Jefferson University Hospital

Introduction

- Diabetes mellitus (DM) is the leading cause of chronic kidney disease (CKD). CKD typically manifests in late stages of DM.
- DM and CKD are prevalent in patients with cardiovascular disease.
- The impact of concurrent DM and CKD on major adverse cardiocerebral events (MACE) in patients undergoing cardiac surgery remains unclear.[1,2]

Objective

- To determine the effect of DM and CKD on major outcomes in patients undergoing cardiac surgery.

Methods

- Retrospective cohort study.
- 4,255 consecutive patients from two tertiary hospitals receiving cardiac surgery, including:
  - Coronary artery bypass graft (CABG), valve surgery, CABG plus valve surgery, or other cardiac surgery.
- 4,028 met inclusion criteria and were divided into four groups:
  - No CKD or DM (control), only CKD, only DM, or concurrent CKD and DM.
- Major outcomes include:
  - MACE, 30-day mortality, renal failure, readmission, and cardiac and neurological complications.

❖ CKD was defined as a baseline estimated glomerular filtration rate (eGFR) <60 ml/min/ 1.73m² based on preoperative serum creatinine levels.[1]

❖ MACEs include perioperative myocardial infarction, cardiac arrest, permanent stroke, and coma.

Table 2. Postoperative complications in patients with diabetes mellitus plus chronic kidney disease undergoing cardiac surgery.

OUTCOMES	Control (N = 1813)	DM (N = 707)			CKD (N = 898)			DM+CKD (N = 610)		
Complication	%	%	Odds Ratio	p	%	Odds Ratio	p	%	Odds Ratio	p
30-day mortality	2.15	1.56	0.71 (0.36-1.41)	0.34	8.46	4.2 (2.83-6.24)	<0.001	6.56	3.19 (2.03-5.01)	<0.001
Readmission	12.24	17.26	1.49 (1.17-1.9)	<0.001	13.70	1.13 (0.89-1.44)	0.285	17.87	1.55 (1.21-2)	<0.001
Renal Failure	2.65	2.97	1.12 (0.66-1.89)	0.66	8.46	3.39 (2.34-4.92)	<0.001	10.98	4.53 (3.09-6.65)	<0.001
Cardiac Complications	5.74	3.25	0.55 (0.34-0.87)	0.01	10.13	1.85 (1.38-2.48)	<0.001	7.54	1.34 (0.93-1.92)	0.109
Neurological Complications	2.10	3.25	1.57 (0.92-2.65)	0.09	5.01	2.46 (1.58-3.82)	<0.001	4.75	2.33 (1.42-3.81)	<0.001
MACE	4.96	5.09	1.02 (0.69-1.52)	0.89	12.92	2.83 (2.12-3.78)	<0.001	10.00	2.12 (1.51-2.98)	<0.001
Any Complications	21.84	25.46	1.22 (0.99-1.49)	0.05	33.52	1.8 (1.51-2.15)	<0.001	37.21	2.12 (1.73-2.58)	<0.001

Notes : Cardiac complications include perioperative myocardial infarction, heart block, and cardiac arrest. Neurological complications include transient ischemic attack, permanent stroke, and coma. MACE (major adverse cardiocerebral events) includes mortality, myocardial infarction, cardiac arrest, permanent stroke, and coma. Any complications include readmission, mortality, renal failure, cardiac, and neurological

TABLE 1. Demographic and Clinical Characteristics

Characteristics	Diabetes and Chronic Kidney Disease						
	Control (1813)	DM (707)	p	CKD (898)	p	DM+CKD (610)	p
Age, yrs	59.7 ± 13.9	61.9 ± 10.4	<0.001	67 ± 13.1	<0.001	65.3 ± 10.8	<0.001
Male gender	72.8	72.6	0.900	61.5	<0.001	58.4	<0.001
BMI, kg/m^2	28.2 ± 6.4	30.9 ± 9.2	<0.001	27.9 ± 6	0.223	30.6 ± 7.2	<0.001
Past medical history							
Hypertension	67.0	84.9	<0.001	75.6	<0.001	90.7	<0.001
Smoker	23.0	22.5	0.784	19.5	0.037	15.9	<0.001
Cerebrovascular disease	11.5	14.7	0.030	19.2	<0.001	23.3	<0.001
Peripheral vascular disease	8.5	13.4	<0.001	13.3	<0.001	21.6	<0.001
Chronic lung disease	19.9	20.2	0.835	24.2	0.01	20.5	0.734
Family history CAD	42.5	49.5	0.001	40.3	0.283	42	0.828
Clinical pattern							
Angina	11.4	13	0.266	12.5	0.423	12.1	0.634
Congestive heart failure	20.5	21.6	0.533	35.6	<0.001	42	<0.001
Previous MI	27.2	39.5	<0.001	30.4	0.086	41.1	<0.001
Medical Therapy							
Beta blockers	51.5	58.3	0.002	57.1	0.006	62.5	<0.001
ACE inhibitors or ARB	41.0	58.4	<0.001	42.1	0.599	54.3	<0.001
Aspirin	65.1	80.2	<0.001	68.2	0.119	79.3	<0.001
Lipid lowering	13.2	16	0.068	15.0	0.188	18.2	0.002
Perfusion time, min	153.8 ± 79.7	149.1 ± 71.7	0.149	167 ± 86.3	<0.001	162 ± 86.8	0.041
Cross-clamp time, min	114.1 ± 60.7	112.4 ± 56.5	0.500	121.8 ± 61.4	0.002	123.8 ± 66.1	0.001
CABG	20.7	28.7	<0.001	19.5	0.466	23.6	0.128
Valve	7.8	4	<0.001	10.6	0.017	4.4	0.004
CABG + Valve	4.0	4	0.939	4.1	0.907	3.4	0.518
Others	7.9	3.5	<0.001	10.0	0.07	6.1	0.127

Values are % for categorical variables and Mean ± SD for continuous variables.

Results

- There were significant demographic differences between the control group and the remaining three groups, with the control group tending to be younger, have fewer comorbidities, and take fewer medications (Table 1).
- Among 4,028 patients:
  - 45% (1,813) had no DM or CKD.
  - 17.6% (707) had DM.
  - 22.3% (898) had CKD.
  - 15.1% (610) had DM plus CKD.
- Outcomes for the control, DM, CKD, and DM plus CKD groups were (Figure 1, Table 2):
  - MACE rates: 5.0%, 5.1%, 12.9%, and 10.0%, respectively (DM group did not meet significance).
  - 30-day mortality rates: 2.2%, 1.6%, 8.5%, and 6.6%, respectively (DM group did not meet significance).
  - Cardiac complication rates: 5.7%, 3.3%, 10.1%, and 7.54%, respectively (DM plus CKD group did not meet significance, DM group was significantly lower).
  - Neurological complication rates: 2.1%, 3.3%, 5.0%, and 4.8%, respectively (DM group did not meet significance).
  - Renal failure rates: 2.7%, 3.0%, 8.5%, and 11.0%, respectively (DM group did not meet significance).

Discussion

- Patients with CKD or concurrent DM and CKD are more likely to experience worse outcomes following cardiac surgery than those patients without CKD or DM.
- This may indicate that end-organ damage, in particular CKD, is a major risk factor for patients undergoing cardiac surgery.

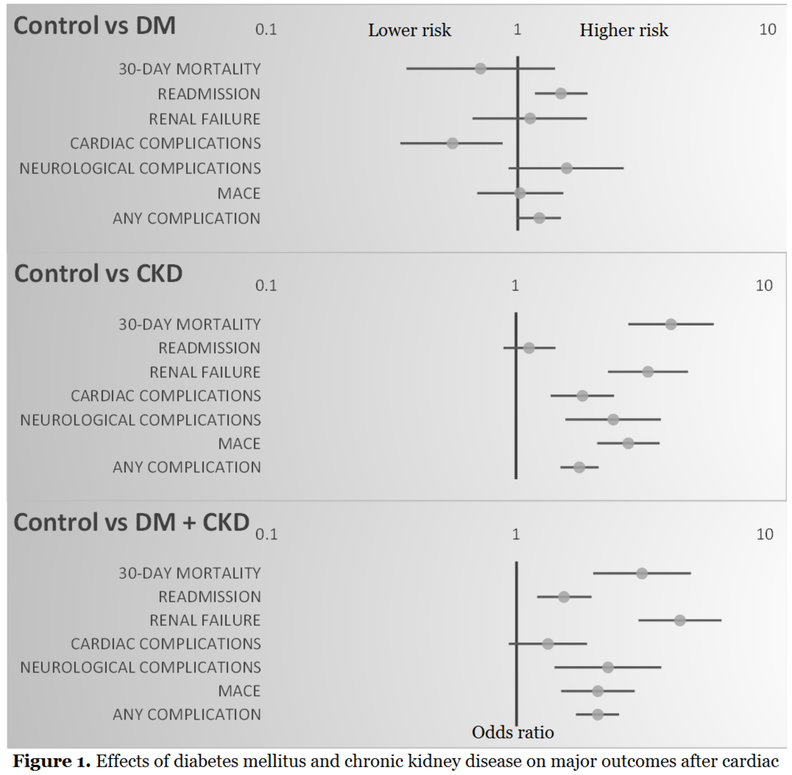

Figure 1. Effects of diabetes mellitus and chronic kidney disease on major outcomes after cardiac surgery.

References

1. Yao L, Young N, Liu H, Li Z, Sun W, Goldhammer J, Tao L, He J, Diehl J, Sun JZ. Evidence for preoperative aspirin improving major outcomes in patients undergoing cardiac surgery: a cohort study. *Ann Surg* 2015; 261:207-12.
2. Debella YT, Giduma HD, Light RP, Agarwal R. Chronic kidney disease as a coronary disease equivalent – a comparison with diabetes over a decade. *Clin J Am Soc Nephrol* 2011; 6:1385-1392.