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Association of ethnicity and acute kidney injury after cardiac surgery in a South East Asian population

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Editors' key points

- This study tested the hypothesis that ethnicity is an independent predictor of postoperative acute kidney injury (AKI) in patients undergoing cardiac surgery in a South East Asian population.
- Ethnicity was shown to be an independent predictor of AKI after cardiac surgery.
- Other clinical risk factors that predicted AKI in this study include hypertension, diabetes mellitus, and poor EuroSCORE.

Background. Postoperative acute kidney injury (AKI) is a frequent and serious complication after cardiac surgery. Clinical factors alone have failed to accurately predict the incidence of AKI after cardiac surgery. Ethnicity has been shown to be a predictor of AKI in the Western population. We tested the hypothesis that ethnicity is an independent predictor of AKI in patients undergoing cardiac surgery in a South East Asian population.

Methods. A total of 1756 consecutive patients undergoing cardiac surgery were prospectively recruited. Among them, data of 1639 patients met the criteria for analysis. There were 1182 Chinese, 195 Indian, and 262 Malay patients. The main outcome was postoperative AKI, defined as a 25% or greater increase in preoperative to a maximum postoperative serum creatinine level within 3 days after surgery.

Results. Five hundred and seventy-nine patients (35.3%) developed AKI after cardiac surgery. Ethnicity was shown to be an independent predictor of AKI after cardiac surgery with Indians and Malays having a higher risk of developing AKI when compared with Chinese patients (odds ratio: Indian *vs* Chinese 1.44, Malay *vs* Chinese 1.51).

Conclusions. Indians and Malays have a higher risk of developing AKI after cardiac surgery than Chinese in a South East Asian population. Ethnicity was shown to be an independent predictor of AKI after cardiac surgery.

Keywords: acute kidney injury; cardiac surgery; ethnicity

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Introduction

A significant number of patients undergoing cardiac surgery worldwide experiences complications including acute kidney injury (AKI).[1] Post cardiac surgery AKI occurs in 5–30% of patients, and up to 1% of patients that develop AKI will require dialysis.[1 2] The effect on patients and healthcare services is amplified as even relatively modest degrees of postoperative AKI were associated with increases in hospital morbidity, mortality, and cost of care.[3] Mortality exceeds 60% for patients requiring dialysis.[2 4] Discharge to an extended-care facility for survivors of a postoperative AKI is increased two- to three-fold compared with those without AKI.

Patient ethnicity in Western populations (Caucasians *vs* African Americans) independently predicts post-cardiac surgery AKI.[5] The impact of ethnicity (Chinese *vs* Indians *vs* Malays) on AKI in the South East Asian population is however unknown. We tested the hypothesis that ethnicity in this population has an independent association with AKI in patients undergoing cardiac surgery, over and above known risks of AKI such as increased age, diabetes, poor cardiac reserves, hypertension, and prior cardiac failure.

Methods

With institutional review board approval, we prospectively recruited 1756 patients who underwent cardiac surgery at the two main heart centres in Singapore in 2009 and 2010. Perioperative genetic, safety, and outcomes data were prospectively collected and entered into a cardiac anaesthesia database. Patients who were on either haemodialysis or peritoneal dialysis were excluded. Other exclusion criteria included history of emergency surgery and severe hepatic, cerebrovascular (past history of stroke, transient ischaemic attack, or carotid artery stenosis of $>70\%$), or renal (preoperative serum creatinine >177 μmol litre^{-1}) disease. Data extracted from the patients include patient characteristics, risk factors, surgical data, and postoperative outcomes up to 30 days post surgery.

Perioperative renal data

Serum creatinine values were obtained daily from the preoperative day till discharge from the intensive care unit. Preoperative serum creatinine (CrPre) was the value obtained closest to surgery. Peak serum creatinine (CrMax) was the highest creatinine value obtained within the first 3 postoperative days. The peak fractional change in postoperative serum creatinine level (% ΔCr) was the primary outcome variable used in the study, defined as the percentage of difference between preoperative serum creatinine and highest postoperative value. This is a continuous variable generally unaffected by baseline renal function. The serum creatinine level is determined by using a dry-slide enzymatic reflectance technique. Creatinine levels typically peak on the second postoperative day and return to baseline by Day 5.

Perioperative anaesthesia, surgical, and perfusion management

Perioperative surgical management and clinical practices at the two heart centres were similar and followed international standards. Typically, anaesthesia was induced with i.v. induction agents (etomidate or propofol) and maintained with balanced anaesthesia regime of low-dose fentanyl (10–20 $\mu g\ kg^{-1}$) and volatile agents (primarily sevoflurane). Conventional cardiopulmonary bypass circuits with roller pumps, membrane oxygenators, heat exchangers, venous reservoirs, cardiotomy suction, and arterial blood filters were used. Perfusion targets were mild-to-moderate hypothermia (32–35°C), haematocrit levels of >22%, activated clotting times of >400 s, glucose levels of <10 mmol $litre^{-1}$, nonpulsatile flow rate of 2.2 to 2.4 litre m^{-2}, and mean arterial pressure of 50–70 mm Hg. Myocardial protection was achieved with cold blood cardioplegia. Aprotinin was not used in any of the patients.

Patient characteristic variables included several previously reported risk factors for perioperative kidney injury after cardiac surgery, including age, gender, cardiopulmonary bypass time, weight, hypertension, history of diabetes, and preoperative ejection fraction. Other variables included preoperative use of reno-active drugs such as angiotensin-converting enzyme inhibitors and loop diuretics, and also total cholesterol levels.

Statistical analysis

An initial, unadjusted analysis compared CrPre, CrMax, and %ΔCr among the three major ethnic groups. Known patient characteristic and surgical risk factors were also compared with Student's *t*-test for parametric data and χ^2 test for nonparametric data. The association of the three major ethnic groups with %ΔCr was then evaluated with the use of logistic regression analysis. Significant patient characteristic and surgical risk factors were added to the model, and nonsignificant covariates were removed from the multi-variate analysis in a stepwise manner. *Post hoc* pair-wise comparison between the ethnic groups was performed manually. Analyses were performed with the use of SPSS 18.0 (SPSS, Inc., Chicago, IL, USA); significance was judged at $\alpha=0.05$.

Results

Out of 1756 patients, 1639 patients met the criteria for analysis. One hundred and seventeen patients were not included in the analysis because of incomplete data (11 patients) or belonging to other ethnic groups (106 patients). Of 1639 patients, 1182 were Chinese, 262 were Malays, and 195 were Indians. Baseline clinical details are shown in Table 1. Overall, 32.7% of Chinese, 42.7% of Malay, and 41% of Indians developed AKI after cardiac surgery (Fig. 1). Those who developed AKI were more likely to be older, female, hypertensive, diabetic, and with poor ventricular function. These patients also had longer cardiopulmonary bypass times and aortic cross-clamping times (Table 2). A total of 21 patients (1.3%) developed a new need for dialysis. The creatinine level at discharge in patients with AKI was 111.9 ± 86.4 μmol $litre^{-1}$ (range: 30–903 μmol $litre^{-1}$).

Table 1 Clinical characteristics and acute kidney injury after cardiac surgery. Figures are *n* (%) or mean ± SD. AKI, acute kidney injury; LVEF, left ventricular ejection fraction

	AKI	No AKI	*P*-value
n	579	1060	
Age (yr)	61.6 ± 9.9	57.2 ± 10.8	<0.001
Female gender	147 (25.4%)	207 (19.5%)	0.006
History of hypertension	473 (81.7%)	744 (70.2%)	<0.001
Ethnicity			
Chinese	387 (32.7%)	785 (67.3%)	
Malay	112 (42.7%)	150 (57.3%)	0.002
Indian	80 (41%)	115 (59%)	
History of diabetes mellitus	310 (53.5%)	445 (42%)	<0.001
LVEF 30–50%	198 (34.2%)	356 (33.6%)	0.812
LVEF <30%	71 (12.3%)	69 (6.5%)	<0.001
EuroSCORE (logistic)	5.3 ± 7.0	3.5 ± 4.7	<0.001

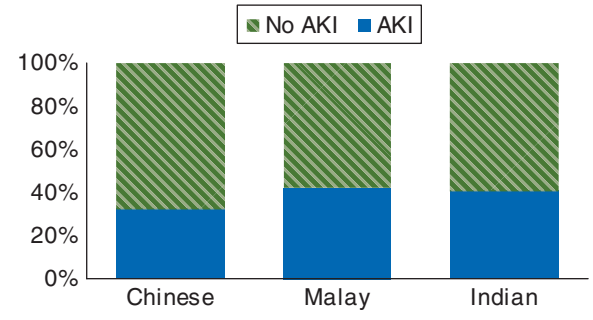

Fig 1 The percentage of patients in each ethnic group that developed acute kidney injury after cardiac surgery.