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Differential Effects of SGLT2 Inhibitors on Contrast-Associated Acute Kidney Injury According to Hemoglobin and Age: A Propensity-Score Matched Analysis

Byungkwan Jung, Chae Eun Kim, Ae Jin Kim, Jae Hyun Chang, Wookyung Chung, Ji Yong Jung
Department of Internal Medicine, Gachon University Gil Medical Center, Korea, Republic of

Objectives : Sodium-glucose cotransporter-2 inhibitors (SGLT2i) are widely used in type 2 diabetes, heart failure, and chronic kidney disease. Given their expanding indications, SGLT2i are increasingly prescribed to patients undergoing contrast-enhanced procedures. However, their impact on contrast-associated acute kidney injury (CA-AKI) remains uncertain. We evaluated the overall risk of CA-AKI in SGLT2i users and identified clinical effect modifiers.
Methods : In this single-center propensity-score matched study (2007–2025), 346 SGLT2i users and 1,979 matched non-users were selected from 7,853 angiography patients using variable-ratio matching (caliper 0.2). Weighted logistic regression with multiple imputation (m=5) was performed. Interaction models were used to identify effect modification.
Results : The overall incidence of CA-AKI was similar in SGLT2i users (9.25%) and non-users (9.20%; adjusted OR 0.89, 95% CI 0.54–1.49, P=0.661). Hemoglobin (Hb) significantly modified the association (interaction OR 0.754 per 1 g/dL increase, P-interaction=0.023); the adjusted odds ratio crossed 1.0 at an estimated Hb level of 11.2 g/dL. SGLT2i use was associated with higher risk below this threshold and lower risk above it. Age also significantly modified the association (interaction OR 1.036 per year, P-interaction=0.037), with the interaction curve crossing the null at 72.4 years. A significant interaction by sex was observed (P-interaction=0.022), with a trend toward higher risk among females.
Conclusions : While the overall association between SGLT2 inhibitor use and CA-AKI was neutral, baseline hemoglobin and age significantly modified this association. Periprocedural SGLT2i management may require individualized consideration, particularly in elderly patients with low hemoglobin levels.

Figure1_Integrated.png

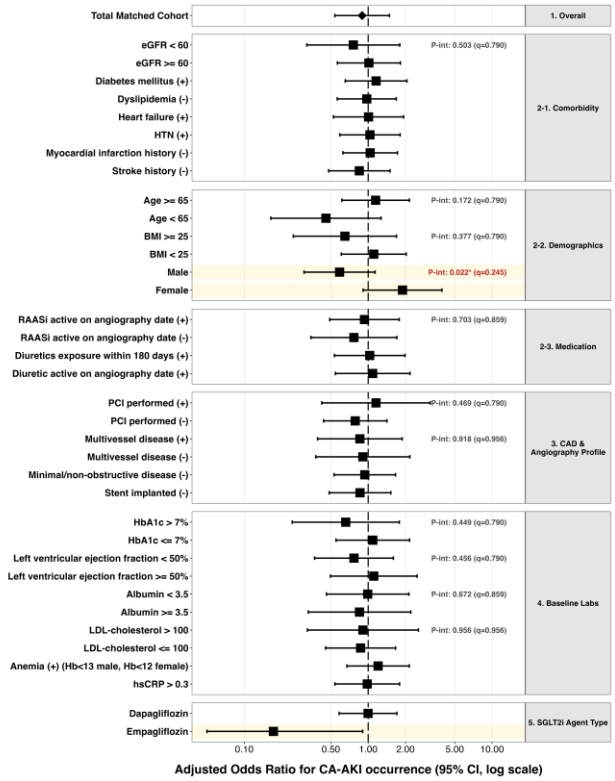

Figure 1. Overall and subgroup analyses of SGLT2i effect on CA-AKI.

Estimates were pooled across multiple imputation datasets (m=5).

The forest plot shows adjusted odds ratios (aORs) for CA-AKI across clinical subgroups. While categorical age groups did not reach statistical interaction significance, continuous interaction models (Figure 2) confirmed age as a significant effect modifier (P-interaction=0.037). Sex showed significant interaction (P-interaction=0.022), likely reflecting baseline hemoglobin distribution differences between groups.

In agent-type rows, Empagliflozin showed a nominally significant association with lower CA-AKI odds (aOR 0.17, 95% CI 0.03-0.90; P=0.038).

In angiography-related rows, PCI (+) indicates therapeutic percutaneous coronary intervention performed during angiography test, whereas PCI (-) indicates diagnostic angiography without PCI.

Some subgroup pairs show only one level because the opposite level did not meet the information criterion (minimum 2x2 cell count < 10) and was omitted from forest display, thereby omitting P-int in those rows due to lack of valid pairs.

P-int values indicate subgroup interaction; highlighted rows indicate either nominally significant interaction (raw P-int < 0.05) or nominally significant row-level treatment effect (P < 0.05 with 95% CI excluding 1). Asterisks (*) denote nominal interaction significance, with FDR q-values shown in parentheses.

Abbreviations: SGLT2i, sodium-glucose cotransporter-2 inhibitor; CA-AKI, contrast-associated acute kidney injury; CAD, coronary artery disease; RAASi, renin-angiotensin-aldosterone system inhibitor; PCI, percutaneous coronary intervention; eGFR, estimated glomerular filtration rate; hsCRP, high-sensitivity C-reactive protein; CI, confidence interval; P-int, P for interaction.

Figure1_Integrated.png

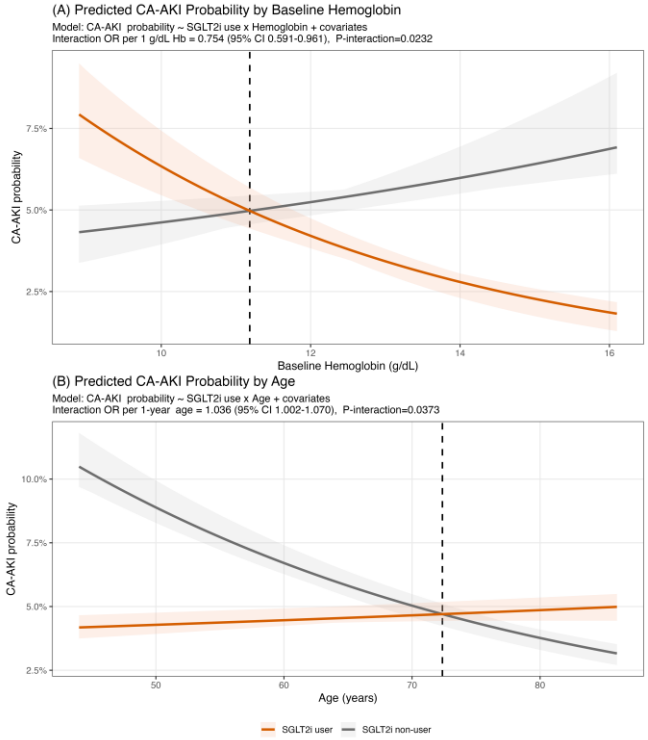

Figure 2. Predicted probability of CA-AKI according to baseline hemoglobin and age.

(A) Interaction between SGLT2i use and continuous hemoglobin levels (P-interaction=0.023). (B) Interaction between SGLT2i use and age (P-interaction=0.037). Shaded areas indicate 95% confidence intervals. Dashed vertical lines indicate risk-to-benefit crossover points at Hb 11.2 g/dL and age 72.4 years, respectively.

Abbreviations: SGLT2i, sodium-glucose cotransporter-2 inhibitor; CA-AKI, contrast-associated acute kidney injury; CI, confidence interval.