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ORIGINAL RESEARCH

Association of Acute Kidney Injury Risk and Same-Day Discharge Practices After Percutaneous Coronary Intervention

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BACKGROUND: Same-day discharge (SDD) after percutaneous coronary intervention (PCI) may be altered when complications occur. We sought to determine whether risk of the most common complication, acute kidney injury (AKI), is associated with SDD in practice.

METHODS: Using the NCDR (National Cardiovascular Data Registry) CathPCI registry, we calculated the AKI risk for elective PCIs from 2018 to 2022 using the NCDR prediction model. Hierarchical logistic regression models were constructed to predict SDD with AKI risk and procedural variables as fixed effects, and site as a random effect. Trends in SDD rate across AKI risk categories were described and variability across sites was quantified using median odds ratios (ORs).

RESULTS: Among 1 033 096 eligible patients, 414 297 (40.1%) had SDD after PCI and rates increased throughout the study period (27.9% in 2018 to 53.4% in 2022; 1.9% per quarter). Higher AKI risks were associated with lower SDD rates (OR, 0.97 per 1% increase in AKI risk [95% CI 0.968–0.971]) although even in 2022, 41.2% of high-risk patients underwent SDD. Marked variation in SDD practices was observed across sites (overall median OR, 3.75 [95% CI 2.63–5.34]) even among the highest risk group (median OR, 3.60 [95% CI 2.34–5.56]).

CONCLUSIONS: Although patients at higher risk of AKI are less likely to undergo SDD overall, currently, 2 in 5 patients with >10% AKI risk are discharged the day of their procedure with marked variation across sites. Further work is needed to better understand the postdischarge risk of SDD in patients at higher AKI risk to improve delivery and safety of PCI.

Key Words: acute kidney injury ■ percutaneous coronary intervention ■ quality improvement ■ risk ■ same-day discharge

Over the past 4 decades, the safety of percutaneous coronary interventions (PCI) has markedly improved, particularly by reducing bleeding through improved antiplatelet/antithrombotic strategies, selective use of IIb/IIIa inhibitors, and radial artery access.[1,2] Moreover, evolving interventional technologies, coupled with intravascular physiology and imaging, have reduced target vessel revascularization and mortality.[3–5] Given these evolutions in care, deference to patients' preferences,[6] and evolving reimbursement incentives,[7] many centers have created and expanded same-day discharge (SDD) programs to avoid overnight hospitalization. Although there is loose society guidance[8] identifying which patients are safe for SDD, the decision is primarily left to institutional and physician discretion. Understanding current SDD practice patterns is needed to better guide SDD strategies.

Acute kidney injury (AKI) occurs in about 7% of patients undergoing PCI and is the most common

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CLINICAL PERSPECTIVE

What Is New?

- Overall, for patients treated with percutaneous coronary intervention, as acute kidney injury risk increases, the likelihood of same-day discharge (SDD) decreases; however, there is marked variation not explained by captured patient, procedural, or hospital factors and there are a significant proportion of patients at high risk for acute kidney injury who are undergoing SDD.

What Are the Clinical Implications?

- The significant unexplained variation in SDD discharge practice highlights an opportunity to decrease health care costs for those kept unnecessarily and improve patient safety for those needing further risk mitigating measures but are discharged without them.
- As many patients with high acute kidney injury risk are undergoing SDD, further investigation is needed to understand intermediate and long-term outcomes of SDD in this population.

Nonstandard Abbreviations and Acronyms

AKI	acute kidney injury
MOR	median odds ratio
SDD	same-day discharge

complication after PCI.[9] Whereas bleeding and mortality are often readily identifiable immediately after PCI,[10,11] AKI is not. Developing AKI after PCI increases the risk for subsequent morbidity and mortality, including permanent renal dysfunction, bleeding, death, and stroke.[9,12] Importantly, identifying AKI through serial monitoring of renal function after PCI can alter postprocedure hydration, medication dosing, and the closeness of follow-up. If, however, patients are managed with SDD, the opportunity to identify and address AKI can be missed. Alternatively, keeping patients without AKI or other adverse events in the hospital can increase health care costs and patient discomfort without perceivable benefit.[13,14]

Risk models to predict AKI after PCI can selectively offer SDD to those at lower risk of AKI, whereas those at higher risk of AKI can be considered for overnight hospitalization.[15] However, whether a pattern of preferentially deploying SDD based on AKI risk is currently being used is unknown. To address this concern, we used the NCDR (National Cardiovascular Data Registry) CathPCI data set to describe the use of SDD as a function of AKI risk and to examine variability in its use across US centers.

METHODS

Data Source

The American College of Cardiology Foundation's CathPCI registry is the largest US registry of interventional and diagnostic catheterizations with nearly 2000 participating sites.[16,17] Participants prospectively capture detailed data on patient demographics, clinical presentation, procedural characteristics, coronary anatomy and in-hospital outcomes using standardized definitions.[18] Data quality monitoring and annual audits are performed to ensure accuracy. The study was approved by Saint Luke's Hospital's institutional review board, which waived the requirement for informed consent given that the study only used deidentified data. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Study Population

We considered all 3 064 042 PCI procedures from October 1, 2018 to July 1 2022 in the CathPCI Version 5 data set. We excluded 1 685 867 nonelective PCIs, and 15 756 PCI events in which the patient had a myocardial infarction, stroke, cardiac arrest or bleed the day of the procedure, making them ineligible for SDD. We also excluded hospitals that did not have 3 consecutive quarters of data reporting, gaps in reporting, or low volumes (<99 PCIs over the entire time period), leading to the exclusion of 206 876 procedures. Subsequent hospital procedures (n=89 534) and those for whom preprocedural AKI risk could not be calculated (n=28 684 PCI) and those without a discharge date (n=109) were also excluded, resulting in a final analytic sample of 1 033 096 patients.

Same-Day Discharge

SDD was defined as discharge on same date as the PCI procedure, and all others were considered subsequent discharges.

Estimating AKI Risk

Congruent with the Kidney Disease Improving Global Outcomes guidelines, AKI is defined as an absolute increase in serum creatinine by 0.3 mg/dL or a relative increase of >50% of the preprocedural value.[19] Each patient's AKI risk was calculated using the NCDR CathPCI 2014 AKI risk model, which has been previously adopted to the CathPCI v5 data set (c-statistic=0.71)[20] and was available to CathPCI sites during the study period. It serves as a key metric of

NCDR's quality benchmarking. To simplify data interpretability, AKI risk was categorized as low (below the median, <7%), moderate (7%–10%), high (10%–15%), and very high (>15%) risk.

Safe Contrast Ratio

Given the potential to reduce AKI risk by limiting contrast exposure,[21] we also assessed the extent to which adherence to safe-contrast limits may have accounted for SDD in patients who were predicted to be at high risk for AKI. For each patient, we calculated a patient-centered safe-contrast threshold that would reduce the risk of AKI by 15% after PCI based on models using a patient's specific AKI risk developed by Malik et al.[22] Although the model can be used to calculate a safe-contrast threshold to reduce risk by any amount, a risk reduction of 15% was selected as this was presented in the original paper and has been selected by most sites. This model uses all the factors that influence postprocedural AKI risk to determine contrast thresholds and when adhered to is associated with less AKI than common 3 × glomerular filtration rate (GFR) models.[22] We then calculated a safe-contrast ratio in which the numerator was the actual amount of contrast received and the denominator was the patient-centered contrast volume threshold described previously. A contrast ratio >1 indicates the patient received higher than their calculated safe contrast volume and a ratio <1 indicates the patient received less than their calculated safe contrast volume.

Statistical Analysis

Among eligible procedures, we described and compared the patient characteristics of those who did or did not undergo SDD. Categorical variables were summarized using percentages and compared by chi-square tests. Continuous variables are reported as means±SD or medians (with interquartile ranges) depending on their distribution. Because traditional significance testing is sensitive to large sample sizes, standardized differences in proportions and means were calculated, with a difference of ≥10% considered clinically meaningful.

To understand patient-level predictors of SDD, a hierarchical logistic regression model was developed with SDD as the dependent variable and site as a random effect to account for clustering within hospitals. Independent variables included patient's AKI risk, access site, age, procedural time of day, frailty, and procedural complexity (ie, presence of heavy calcification; treatment of left main or bifurcation lesions, chronic total occlusion, vein graft intervention, or use of mechanical support). Odds ratios (ORs) are reported for a 1% change in SDD rates. As the influence of each individual variable on SDD decisions could change based on the AKI risk, we conducted this analysis in the overall cohort and repeated the analysis for each AKI risk category. As a secondary analysis, the use of contrast was added to the model, categorized by safe contrast ratios of <1, 1.0 to 2.0, 2.0 to 3.0, and >3.0, and we tested for an interaction with preprocedure AKI risk.

After creating the patient-level model, to understand contemporary trends in SDD nationally, we assessed the proportion of SDD at the hospital level for each quarter within our data set. We created a multilevel logistic regression model to predict hospital-level SDD proportion per quarter with the specific quarter being the independent variable of interest. To better quantify variability in SDD use across sites, the proportion of elective PCI procedures undergoing SDD was calculated by dividing the number of SDD by the total number of potentially eligible patients at each site, overall and across categories of AKI risk. We then calculated the median OR (MOR) from the final preprocedural hierarchical model predicting SDD, highlighting variability across centers. The MOR is the likelihood that a statistically identical patient would undergo SDD at one randomly selected hospital as compared with another randomly selected hospital. By definition, the MOR is always ≥1, where an MOR of 1 reflects no site-level variation in use of SDD and an MOR of 2 would mean that the relative odds for a patient from one randomly selected hospital to undergo SDD was 2-fold higher compared with an identical patient at another randomly selected hospital. We further recalculated the MOR after including hospital level variables in the hierarchical model to assess whether these may explain variation seen. Hospital-level variables considered relevant to SDD practice included PCI volume as higher volume centers were likely more comfortable with increased throughput via SDD, and median procedure start time as earlier start times would allow more time for observation before SDD.

All analyses were conducted using SAS 9.4 and figures were created in R (ggplot2).

RESULTS

Among 1 033 096 eligible patients from 1325 hospitals included in our final sample, 414 297 (40.1%) received SDD. Over time, the rate of SDD steadily increased by 2% each quarter, with a slight increase during the onset of the COVID-19 pandemic (Q1 and Q2 of 2020). The median age of study participants was 69.0, 71.3% were men, 86% were identified as White, 43.4% had diabetes, 90.3% had hypertension, 41.2% never smoked, 89.7% had hyperlipidemia, 17.7% had GFR >90 mL/min/1.73 m^2, 4.3% were at least moderately frail, and 25% had heart failure. Nearly two thirds were at low risk of AKI (655 975; 63.5%), 15.3% at moderate

risk, 11.7% at high risk, and 9.6% at very high risk of AKI. Radial access was used in 53.0% of procedures; the median reported contrast volume was 150 mL (105.0–200.0); 1.0% required mechanical support; interventional lesions were in a graft 4.6% of the time, the left main 4.0% of the time, involved a bifurcation 12.3% of the time and had severe calcification 12.9% of the time. The median number of beds for hospitals in the cohort was 396.0 (251.0–587.0); and 52.9% were teaching hospitals (Table 1).

In unadjusted analysis, patients receiving SDD were younger and more likely to be male, undergo radial access, receive lower contrast volumes, and have higher GFRs. They were less likely to be frail, to undergo PCI for severely calcified or left main coronary, or to have received mechanical circulatory support for their PCI. SDD rates were lower in those at higher AKI risk. In the low-risk AKI group, the SDD rate was 42.7%, 38.6% in the moderate AKI risk group, 36.3% in the high-risk group, and 29.7% in the highest risk group, throughout the study period (P<0.0001) (Table 2). Overall, for each 1% risk increase in AKI risk, the odds of SDD decreased (OR, 0.963 [95% CI, 0.962–0.964]), with slight variations by AKI risk within categories (Table 2). Over time, there was an increase in SDD rate for all AKI risk categories with 1.9% (95% CI, 1.86–1.93) increase per quarter overall; 1.93 (95% CI, 1.88–1.97) in those at the lowest risk of AKI and 1.62%/quarter in those with the highest AKI risk (95% CI, 1.54–1.7; Figure 1). By 2022, 41.2% of the patients in the high- and very high-risk AKI categories underwent SDD.

There was a significant interaction between AKI risk and safe-contrast ratio with regard to SDD. Overall, excess contrast was associated with decreased the likelihood of SDD, but this association was more pronounced in lower AKI risk categories. Very high-risk patients with contrast ratio >3 had 0.485 odds of SDD (95% CI, 0.451–0.521) compared with very high-risk patients with a contrast ratio <1 whereas patients with moderate AKI risk and contrast ratio >3 had a 0.211 odds of SDD (95% CI, 0.198–0.224) compared with those receiving a contrast ratio <1 (Figure 2). However, 28.8% of moderate to very high-risk patients who received >2 to 3 times their safe contrast limit were sent home without further observation.

Finally, there was a marked variation in SDD practice that was not explained by captured patient-, procedure-, or hospital-level factors. In the model accounting for patient factors and procedural complexity with hospital as a random effect the MOR was 3.75, indicating that the likelihood of SDD for statistically identical patients treated by 2 random hospitals varied by 3 to 4 times. Even after adding hospital-level factors such as PCI volume, the MOR for SDD was 3.61, indicating significant variation not attributable to captured variables (Table 3, Figure 3).

DISCUSSION

With increasing efforts to improve the efficiency and lower the costs of PCI, SDD has been increasingly adopted in elective cases.[23] To better understand the adoption of SDD through the lens of patient safety, we analyzed the largest US PCI database and found that SDD rates are increasing over time, regardless of AKI risk. Although patients with higher AKI risk are less likely to undergo SDD, more than 2 in 5 patients at the high risk of AKI are sent home the day of their procedure. Importantly, the use of SDD varies widely across individual centers, independent of patient and procedural characteristics, underscoring the need for better guidance to improve the consistency and efficiency of SDD after PCI.

Over the past 2 decades, various randomized controlled trials demonstrated the general safety of SDD after PCI.[24–26] Subsequently, hospitals across the nation started widely implementing SDD protocols. Previous work using the CathPCI evaluated SDD practice from 2009 to 2017 and found that SDD increased throughout this period from 4.5% to 28.6%.[27] 30-day mortality and rehospitalization rates were low, and there was no difference in rates among patients undergoing SDD compared with those with an overnight stay. However, the authors recognized that many other important outcomes were not assessed and SDD discharge is not safe for all. They also found significant variation in SDD practice that was not accounted for by the access site (MOR, 4.15). Our study extends this prior work by showing continued increases in the use of SDD, regardless of AKI risk, and highlighting persistent and marked variability across centers. This was observed even after the American College of Cardiology provided a guidance document to support the rational use of SDD.

AKI Risk

AKI, the most common adverse event after percutaneous coronary intervention, can be mitigated by periprocedural interventions, and is accurately predicted using preprocedural variables.[9,15,21,28] Thus, there is an opportunity to stratify patients by AKI risk and provide appropriately aligned individualized care. Patients at elevated risk could be observed longer, receive further periprocedural hydration, and an extended hold of nephrotoxic agents. In our study, we found that AKI risk was inversely associated with odds of SDD. This suggests physicians preferentially reserve SDD for patients with lower risk, although it is unclear whether decisions were informed by AKI risk, procedural complexity, comorbidities, or other periprocedural risks that are often associated with AKI. However, 29.7% of patients with very high risk of AKI undergo SDD with marked variation by the center.

Table 1. Baseline Characteristics of the Study Cohort

	Total N=1 033 096	Same-day discharge 40.1% N=414 297	Extended observation/ inpatient admission? 59.9% N=618 799	Standardized difference (%)
Age, y (IQR)	69 (61–76)	68 (61–75)	69 (62–77)	11.87
Male sex	736 406 (71.3)	307 254 (74.2)	429 152 (69.4%)	10.7
Body mass index, kg/m^2 (IQR)	29.5 (26.1–33.7)	29.6 (26.3–33.8)	29.4 (25.9–33.7)	3.66
Hypertension	933 157 (90.3)	371 111 (89.6)	562 046 (90.8)	4.21
Dyslipidemia	926 208 (89.7)	373 813 (90.2)	552 395 (89.3)	3.16
Prior myocardial infarction	313 328 (30.3)	125 582 (30.3)	187 746 (30.4)	0.06
Prior PCI	515 991 (50.0)	213 738 (51.6)	302 253 (48.9)	5.5
Prior coronary artery bypass graft	190 266 (18.4)	66 645 (16.1)	123 621 (20.0)	10.14
Peripheral arterial disease	145 093 (14.1)	53 571 (12.9)	91 522 (14.8)	5.38
Chronic lung disease	162 248 (15.7)	58 819 (14.2)	103 429 (16.7)	6.97
Hemoglobin, g/dL (IQR)	13.7 (12.4–14.8)	13.9 (12.7–14.9)	13.6 (12.2–14.7)	17.82
Cerebrovascular disease	165 558 (16.0)	59 670 (14.4)	105 888 (17.1)	7.44
Diabetes	447 813 (43.4)	172 679 (41.7)	275 134 (44.5)	5.62
Canadian Study of Health and Aging Frailty Scale				14.39
1: Very fit	8409 (0.8)	3682 (0.9)	4727 (0.8)	
2: Well	75 429 (7.3)	32 339 (7.8)	43 090 (7.0)	
3: Managing well	398 730 (38.7)	169 354 (41.0)	229 376 (37.2)	
4: Vulnerable	414 075 (40.2)	164 642 (39.8)	249 433 (40.4)	
5: Mildly frail	89 494 (8.7)	30 479 (7.4)	59 015 (9.6)	
6: Moderately frail	37 071 (3.6)	10 977 (2.7)	26 094 (4.2)	
7: Severely frail	6690 (0.6)	1771 (0.4)	4919 (0.8)	
8: Very severely frail	801 (0.1)	165 (0.0)	636 (0.1)	
9: Terminally ill	102 (0.0)	24 (0.0)	78 (0.0)	
History of heart failure	258 362 (25.0)	91 822 (22.2)	166 540 (26.9)	11.06
New York Heart Association class				14.44
I	85 388 (33.2)	32 037 (35.0)	53 351 (32.2)	
II	91 170 (35.4)	34 168 (37.3)	57 002 (34.4)	
III	72 422 (28.1)	23 391 (25.5)	49 031 (29.5)	
IV	8567 (3.3)	2007 (2.2)	6560 (4.0)	
Preprocedural systolic blood pressure, mm Hg (IQR)	150.0 (135168)	149 (135–167)	150 (135–169)	3.63
Radial access	547 802 (53%)	274 605 (66.3)	273 197 (44.2)	45.82
Procedural complexity				
Chronic total occlusion	59 666 (5.9)			
Left main PCI	41 806 (4.0)	10 666 (2.6)	31 140 (5.0)	
Severe calcification	132 796 (12.9)	43 320 (10.5)	89 476 (14.5)	12.16
Graft	47 283 (4.6)	15 454 (3.7)	31 829 (5.1)	6.87
Bifurcation	124 591 (12.3)	42 532 (10.3)	82 059 (13.3)	
Mechanical circulatory support	9781 (0.95)	340 (0.08)	9441 (1.5)	
GFR				11.29
GFR >90	183 167 (17.7)	76 802 (18.5)	106 365 (17.2)	
GFR >60–90	511 916 (49.6)	215 233 (52.0)	296 683 (47.9)	
GFR 60–45	200 184 (19.4)	77 290 (18.7)	122 894 (19.9)	
GFR 45–30	89 027 (8.6)	30 364 (7.3)	58 663 (9.5)	
GFR <30	21 978 (2.1)	6353 (1.5)	15 625 (2.5)	
GFR <15	26 824 (2.6)	8255 (2.0)	18 569 (3.0)	
Contrast volume	150 (105–200)	130 (100–180)	155 (115–210)	34.91

Values are n (%). Due to our large sample size standardized differences are presented, where values >10.0% generally indicate a clinically meaningful difference. GFR indicates glomerular filtration rate; IQR, interquartile range; and PCI, percutaneous coronary intervention.

Table 2. Same-Day Discharge Rate by AKI Risk

AKI risk category	Total	Same-day discharge	Odds ratio per 1% increase in AKI risk (95% CI)*	*P* value
Overall	1 033 096 (100%)	414 297 (40.1%)	0.963 (0.962– 0.964)	<0.0001
Low (<7%)	655 975 (63.5%)	280 303 (42.7)	0.9 (0.896– 0.904)	<0.0001
Moderate (7%–10%)	157 932 (15.29%)	60 952 (38.6)	0.931 (0.919– 0.944)	<0.0001
High (10%–15%)	120 356 (11.65%)	43 734 (36.3)	0.928 (0.919– 0.937)	<0.0001
Very high (>15%)	98 833 (9.57%)	29 308 (29.7)	0.977 (0.975– 0.979)	<0.0001

Total number and percentage of patients within each AKI category for those undergoing same-day discharge. The fourth column includes the odds of same-day discharge for each 1% increase in AKI risk overall and within the various AKI risk categories. As expected, odds of same-day discharge decreased with each increase in AKI risk overall and the association was more pronounced in the lower AKI risk categories. AKI indicates acute kidney injury.

*Variables for the model in which the odds ratios were calculated include access site, age, procedural time of day, frailty, and procedural complexity (ie, presence of heavy calcification; treatment of left main or bifurcation lesions, chronic total occlusion, vein graft intervention, or use of mechanical support).

Contrast Volume

An argument can be made that patients with elevated AKI risk could be safely discharged if measures are taken to decrease postprocedural risk, such as limiting contrast below a safe threshold.[29] Although multiple methods to calculate maximum recommended contrast volumes are available in the literature, many centers neglect to follow these contrast volume thresholds.[30] In our model, we used the patient-centered contrast threshold, which uses the entirety of factors known to influence the risk of AKI to calculate a contrast volume thought to reduce risk by 15%. This

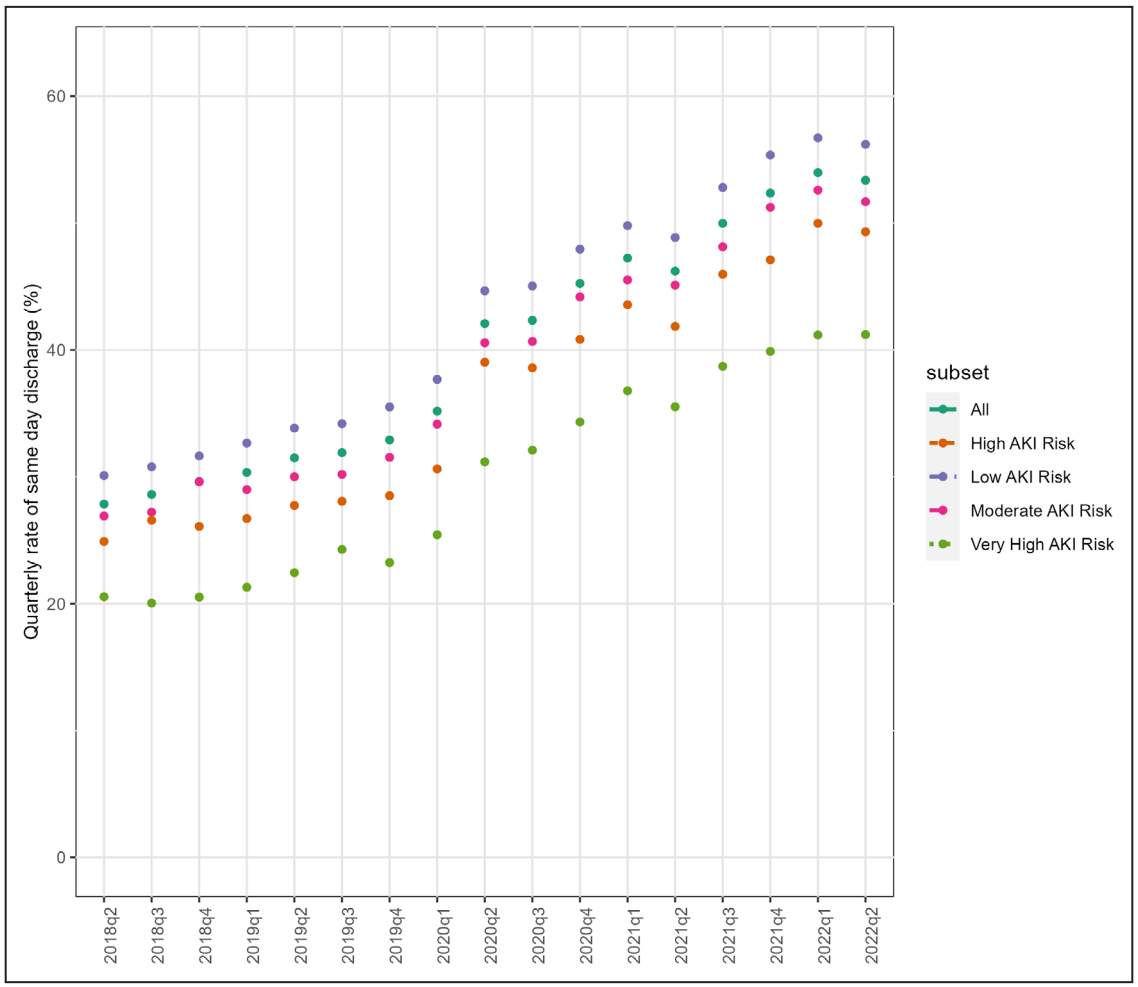

Figure 1. Same-day discharge trend by AKI risk group.
This line graph demonstrates the trend of same-day discharge over time for all patients and those within each AKI risk category. AKI indicates acute kidney injury.

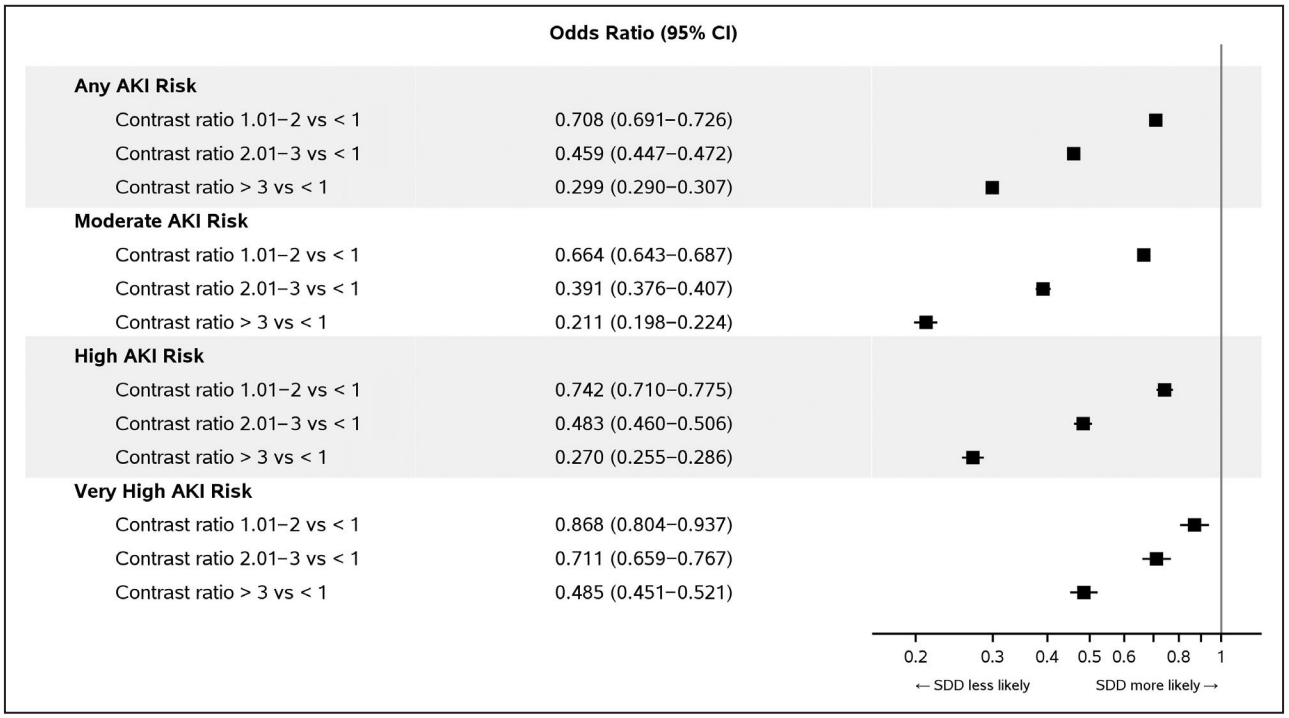

Figure 2. Forest plot showing relationship between contrast ratio and odds of SDD in each AKI risk category.
This demonstrates the likelihood of same-day discharge within the AKI groups as the contrast administered exceeds the safe contrast threshold to varying degrees. AKI indicates acute kidney injury; and SDD, same-day discharge.

contrast volume calculation was also shown to be associated with a lower risk of AKI than commonly used 2 mL×GFR or 3 mL×GFR limits commonly quoted in literature[22] and has demonstrated prospectively to reduce AKI rates.[21,31] In our study, we found that as the contrast volume administered exceeded the safe contrast limit, the odds of SDD decreased. Still, 28.8% of moderate to very high-risk patients who received >2 to 3 times their safe contrast limit were sent home without further observation.

Table 3. Association of Patient-, Procedural-, and Hospital-Level Factors With SDD Discharge

Variable	Model 1: patient characteristics+random effect for hospital Adjusted OR (95% CI)	Model 2: model 1+hospital characteristics Adjusted OR (95% CI)
Patient level: probability of AKI (10% increase)	0.76 (0.76– 0.77)	0.76 (0.76– 0.77)
Patient level: femoral vs radial access	0.36 (0.35– 0.36)	0.36 (0.35– 0.36)
Patient level: age (1-decade increase)	0.92 (0.92– 0.93)	0.92 (0.92– 0.93)
Patient level: Canadian Study of Health and Aging Frailty Scale (1-point increase)	0.89 (0.89– 0.9)	0.89 (0.89– 0.9)
Patient level: complex case	0.67 (0.68– 0.66)	0.67 (0.68– 0.66)
Hospital level: PCI volume, per quarter reporting (10-PCI increase)	…	1.07 (1.05– 1.09)
Hospital level: median PCI start time (1-hr increase)	…	0.75 (0.69– 0.82)
Median OR	3.75	3.61
Intercluster correlation coefficient	0.37	0.35
Cluster variance	1.939	1.828

Model 1: includes only patient-level factors and a random effect for hospital to account for clustering within hospitals. Model 2: patient-level variables and hospital-level variables to assess whether these explain the variation in SDD practices. Ultimately even after adjusting for all patient- and hospital-level variables there was still significant variation in SDD that was unexplained with a median OR of 3.61.

AKI indicates acute kidney injury; OR, odds ratio; PCI, percutaneous coronary intervention; and SDD, same-day discharge.

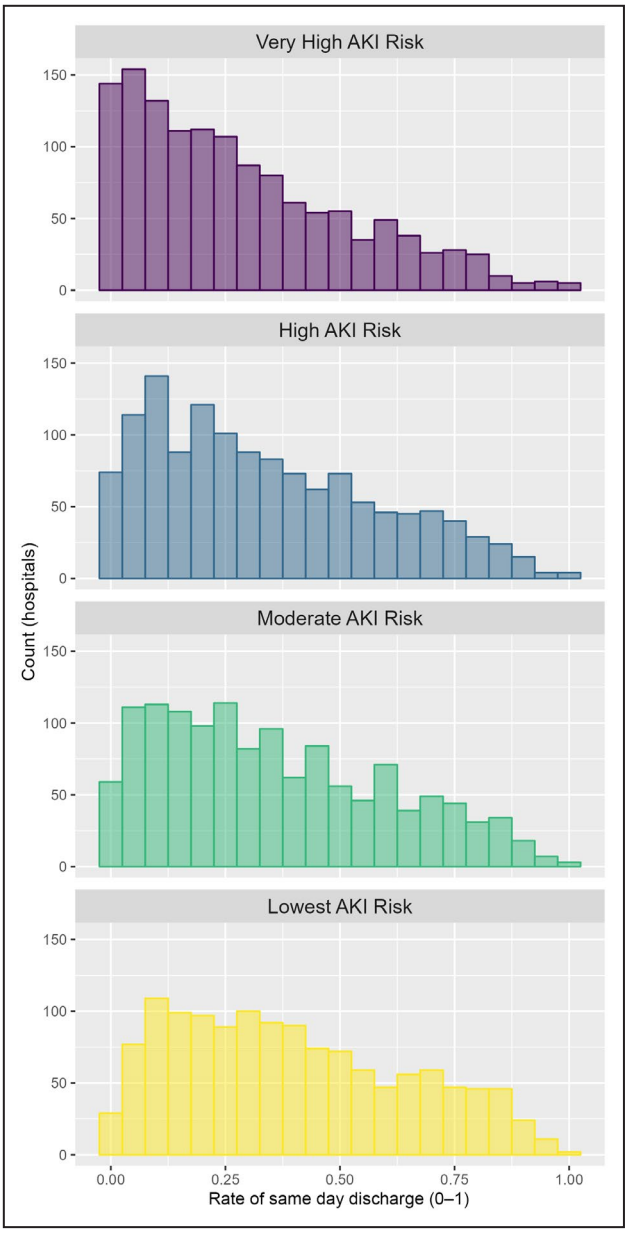

Figure 3. The hospital-level distribution of same-day discharge categorized by AKI risk.
There is significant variation in same-day discharge practices among the 1325 hospitals studied. Although there is an association of same-day discharge practice and AKI risk, a significant proportion of hospitals discharge high-risk patients the same day of their PCI. AKI indicates acute kidney injury; and PCI, percutaneous coronary intervention.

Variation

Ultimately it appears that there is significant variation in SDD practice at the institution level that is not explained by patient, procedural, or hospital factors. Bradley et al. first noted this in their paper with an MOR of 4.15.[27] Our study is from a more contemporary cohort that has benefited from additional data on how to implement SDD and adjusted for more variables such as AKI risk (which correlates with other risk factors), frailty, time of PCI, and institution PCI volume, in addition to access site that the Bradley et al adjusted for. Even with our robust investigation the MOR was 3.6 showing we are still a long way from understanding what is driving this variation in practice and developing protocols to reduce it. Streamlined SDD decision making could enhance patient safety by monitoring patients who need it yet reduce cost and improve patient satisfaction by discharging patients less likely to benefit from extended observation.

Limitations

Our paper should be interpreted in light of the following limitations. First, without linkage to a long-term data set we are unable truly understand the implications of SDD after PCI in patients with elevated preprocedural AKI risk. Although logic implies that these patients, particularly those who received very high volumes of contrast, would benefit from monitoring, further postprocedural hydration, and potential medication adjustments, we do not have empiric data to support this claim. However, the variation in practice does suggest that some centers may take these data into consideration whereas others do not. Second, as this is a retrospective study, we are unsure whether centers that observe patients with elevated risk for extended periods of time do so because of AKI risk specifically or due to other factors. Indeed bleeding and mortality risk correlate and could be influencing practice more than AKI. Third, serum creatinine may not rise the initial day after PCI. Thus, high-risk patients may need to receive risk mitigating therapies inpatient but then be surveilled for AKI occurrence as an outpatient. Fourth, due to the retrospective nature of our study and availability of variables from the data set, there could be residual confounding we are unable to account for. Finally, centers could be implementing AKI mitigating factors that are not captured by the data set such as extended preprocedure hydration or outpatient renal function surveillance. However, the literature shows that many PCI practices seem to be agnostic to risk, and it is likely that patients are notreceiving intentional surveillance.[30] As such, it remains critical to highlight this variation, particularly among the vulnerable population with elevated AKI risk, and suggest further intentional research and patient-centered management for this group.

CONCLUSIONS

Preprocedural AKI risk is inversely associated with odds of SDD after outpatient PCI. However, there is large hospital-level variation in SDD practice not explained by patient risk, procedural factors, or hospital characteristics, highlighting an opportunity to

potentially reduce health care costs and increase patient safety. Further studies are warranted to quantify the implications of this variability and the intermediate to long-term effects of SDD in patients with elevated AKI risk.

ARTICLE INFORMATION

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