Original Article

Patient Experience After Risk Stratification and Follow-up for Acute Kidney Injury After Cardiac Catheterization: Patient Survey

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ABSTRACT

Background: Acute kidney injury (AKI) after cardiac catheterization procedures is associated with poor health outcomes. We sought to characterize the experiences of patients after receiving standardized information on their risk of AKI accompanied by instructions for follow-up care after cardiac catheterization.

Methods: We implemented an initiative across 3 cardiac catheterization units in Alberta, Canada to provide standardized assessment, followed by guidance for patients at risk of AKI. This was accompanied by communication to primary care providers to improve continuity of care after hospital to community transition of care when at risk of AKI, minimizing the dose of radiocontrast media, ensuring appropriate hydration before and after procedures, and providing protocols that assess a patient’s level of risk for developing AKI, minimizing the dose of radiocontrast media, ensuring adequate hydration before and after procedures, and providing appropriate patient follow-up. These strategies were recently systematically implemented through an initiative incorporating education, computerized clinical decision support, and audit and feedback in all 3 Alberta, Canada hospitals that perform cardiac catheterization procedures. The design of the Contrast Reducing Injury Sustained by Kidneys (Contrast RISK) initiative, described in detail elsewhere, was developed with input from patients with lived experience who underwent cardiac catheterization. Improved information on the follow-up steps in their care and communication to the primary care provider were identified by patients as important elements needed to strengthen hospital to community transition of care when at risk of

Accepted October 28, 2020.

Ethics Statement: Informed consent was obtained from all participants in the survey. Ethics approval was obtained from the health research ethics boards of the University of Alberta and University of Calgary.

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See page 343 for disclosure information.

https://doi.org/10.1016/j.cjco.2020.10.019

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kidney injury. To address this need, a standardized patient information and discharge process was developed to provide relevant discharge material summarizing individual risk for contrast-induced (CI)-AKI, and appropriate steps to take during follow-up, with corresponding information sent to primary care providers. Implementation of these education and follow-up procedures for patients might improve transition of care after cardiac catheterization and lead to positive patient experiences; however, conversely, providing this additional information related to post-procedural risk could also have the unintended consequence of increasing patient anxiety and reducing patient satisfaction with care.

The objective of this study was to evaluate patient experience and satisfaction with care after cardiac catheterization, with a focus on transition from the hospital to the community after the implementation of a standardized process for risk stratification, patient education, and follow-up for patients at high risk of AKI.

Methods

Study design

We did a quantitative study using a structured survey administered via telephone to a sample of patients at increased risk of AKI (≥ 5% predicted probability using a validated multivariable model), treated at 1 of the 3 Alberta cardiac catheterization units. The survey was designed to collect participant perceptions of the information and follow-up care for AKI that they received after the Contrast RISK initiative was implemented in Alberta. Ethics approval was obtained from the health research ethics boards of the University of Alberta and University of Calgary.

Patient engagement

The design of the Contrast RISK initiative was informed by initial input from 6 patient advisors from the Alberta Health Services’ Cardiovascular Health and Stroke Strategic Clinical Network and the Kidney Health Strategic Clinical Network. On the basis of past experiences, these advisors provided recommendations for the initiative to improve patient experience through standardized communication of risk information, clarifying instructions on the follow-up steps for patients after the procedure, and enhancing communication to their primary care provider. Patient advisors reviewed and approved the final protocol for the initiative and the plan for evaluation of patient experience.

Participants and procedures

All patients were screened for study eligibility criteria before their cardiac catheterization procedure. Those who received emergency primary percutaneous coronary intervention for ST-elevation myocardial infarction, pediatric patients (younger than 18 years of age), or those already receiving dialysis were excluded from the study population. AKI risk was calculated using a validated multivariable risk model for CI-AKI (ePRISM software available from Health Outcomes Sciences, Kansas City, MO) entered into the Alberta Provincial Project for Outcomes Assessment in Coronary Heart Disease (APPROACH; www.approach.org) clinical information system. Those with a predicted probability of CI-AKI of 5% or more (comprising approximately 25% of all patients who received cardiac catheterization) were included. All participants received a standardized letter to explain that they were identified at risk of AKI and outlined steps to take in their follow-up care (Supplemental Fig. S1), and a lab requisition for follow-up serum creatinine testing to assess for communications aux fournisseurs de soins primaires en vue d’améliorer la continuité des soins prodigués aux patients quittant l’hôpital pour retourner en milieu communautaire. Un sondage structuré mené auprès de 100 participants présentant un risque accru d’IRA a permis de connaître leurs perceptions quant à l’information reçue et à leur expérience à l’égard du suivi après la mise en place de l’initiative dans chacune des unités de cathétérisme cardiaque en Alberta.

Résultats : L’âge moyen des participants était de 72,4 ans (écart type : 10,4), 37 % étaient des femmes, et le risque moyen d’IRA était de 8,8 %. La plupart des participants (63 %) étaient en mesure de se souvenir de l’information qui leur avait été transmise au sujet de leur risque d’insuffisance rénale, 68 % se rappelaient la formation reçue concernant les stratégies pour réduire leur risque, et 65 % estimaient que leur médecin de soins primaires avait recueilli suffisamment d’information pour effectuer un suivi adéquat. Quatre-vingt-six pour cent (86 %) des patients étaient satisfaits de leur transition en milieu communautaire, et 53 % étaient rassurés par l’information reçue et le suivi dont ils faisaient l’objet.

Conclusions : Ces résultats suggèrent que le fait de transmettre aux patients de l’information au sujet des risques, en plus de les éduquer et de leur permettre de collaborer avec leur fournisseur de soins primaires pour le suivi est associé à une expérience positive pour le patient et à la satisfaction à l’égard des soins reçus.
kidney injury. A corresponding letter was provided for their primary care provider (Supplemental Fig. S2).

Patients discharged from hospital on the day of or day after the procedure were selected for inclusion in this study, because of our focus on optimizing patient experience with transition from hospital to community care. Only English-speaking patients identified as being of increased risk for developing AKI were included. The study was introduced by nursing staff in each cardiac catheterization unit and informed consent for the follow-up survey was obtained by study coordinators from all patients after their catheterization procedure. One to two weeks after discharge, each participant was contacted via telephone by 1 of 3 research coordinators (J.N., D.K., P.A.J.) for survey completion. Responses were recorded and compiled in a Microsoft Excel spreadsheet (Microsoft Corp, Redmond, WA). One to two eligible patients were selected each week from each centre to participate in the survey, with a total of 100 patients sampled over 1 year of the study period (March 2018 to June 2019) from the 3 hospital sites in Alberta that participated in the Contrast RISK initiative.

Data collection and analysis

The survey was designed to measure information verification, level of uncertainty, and satisfaction of participating patients, and consisted of 12 questions, of which 8 were related to patient experience and included in this report. Three questions of the survey measured information verification, 2 questions measured the level of uncertainty of the patient, and 3 questions measured the level of satisfaction with care (Details of the Patient Experience Survey are included in the Contrast RISK Patient Follow-up Survey section of the Supplementary Material). Responses to most of the questions were categorized as yes, no, or unsure. One question to measure patient perceptions of the information they received included reassured, neutral, or anxious as possible responses, whereas 1 question to measure the level of patient satisfaction offered 5 response options ranging from very dissatisfied to very satisfied. Participant characteristics were summarized using means and SDs for continuous variables, and numbers with percentages for categorical variables. Responses to survey questions were reported descriptively using numbers with percentages. Differences in survey responses between strata were examined using Pearson $\chi^2$ test.

Results

Participant selection

A total of 17,574 patients who received cardiac catheterization or percutaneous coronary intervention in Alberta from March 2018 to June 2019 were eligible for inclusion in the Contrast RISK initiative (Fig. 1). Of these individuals, 12,935 were excluded because of a low risk of AKI, leaving a remaining 4639 potentially eligible study patients at increased risk of CI-AKI. The characteristics of the 100 participants who were selected to complete patient experience interviews were generally similar to the eligible population of patients, although

Figure 1. Flow chart of participant selection for the Patient Experience Survey. AKI, acute kidney injury; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.
The indication for the procedure was more frequently stable angina and less frequently acute coronary syndrome (ACS) for participants vs nonparticipants (Supplemental Table S1).

### Baseline characteristics

Baseline characteristics of the participants from the 3 hospital sites were relatively similar (Table 1). The average age of all participants was 72.4 years old, 62% were male, and the mean predicted risk for AKI was 8.8%. Those from site B were slightly older (76.6 years old) compared with those from site A (71.8 years old) and site C (68.7 years old). Baseline estimated glomerular filtration rate of participants ranged from a mean of 41 mL/min/1.73 m² at site A to 58 mL/min/1.73 m² at site C.

### Patient Experience Survey responses

When questioned related to information verification, 63% of participants recalled receiving information on their risk of kidney injury (Fig. 2), and 68% recalled receiving education on steps to prevent kidney injury. Additionally, 75% of patients recalled receiving instructions to perform follow-up lab work. When questioned related to uncertainty, 73% of participants reported they believed the information was helpful to them, 2% said the information was not helpful to them, and 25% said they were unsure. Among the 25 patients who

### Table 1. Participant characteristics

| Variable                                           | All (N = 100) | Site A (n = 31) | Site B (n = 34) | Site C (n = 35) |
|----------------------------------------------------|---------------|----------------|----------------|----------------|
| Mean age (SD)                                      | 72.4 (10.4)   | 71.8 (8.3)     | 76.6 (10.5)    | 68.7 (10.7)    |
| Sex, n (%)                                         |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| Female                                             | 37 (37)       | 8 (25.8)       | 13 (38.2)      | 16 (45.7)      |
| Male                                               | 62 (62)       | 23 (74.2)      | 20 (58.8)      | 19 (54.3)      |
| Mean eGFR (SD), mL/min/1.73 m²                      | 51.1 (22)     | 40.9 (18.3)    | 53.2 (20.4)    | 58.2 (23.9)    |
| Mean serum creatinine (SD), mmol/L                 | 142.2 (109.1) | 190.2 (155.7)  | 115.2 (38.2)   | 125 (91.8)     |
| Mean risk of AKI (SD), %                            | 8.8 (5.3)     | 9.3 (5.9)      | 8.3 (3.9)      | 8.9 (5.9)      |
| Mean risk of dialysis (SD), %                       | 0.4 (0.7)     | 0.4 (0.5)      | 0.2 (0.1)      | 0.5 (1)        |
| Mean Hgb (SD), g/L                                 | 131.6 (21.3)  | 128.8 (21.2)   | 127 (22.4)     | 138.4 (18.9)   |
| Mean LVEDP (SD)                                    | 13.5 (7.7)    | 16.1 (8.4)     | 15.2 (8)       | 9.2 (4)        |
| Anemia, n (%)                                       |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| No                                                 | 57 (57)       | 15 (48.4)      | 18 (52.9)      | 24 (68.6)      |
| Yes                                                | 42 (42)       | 16 (51.6)      | 15 (44.1)      | 11 (31.4)      |
| CAD presentation, n (%)                             |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| Asymptomatic                                       | 38 (38)       | 16 (51.6)      | 10 (29.4)      | 12 (34.3)      |
| NSTEMI                                             | 22 (22)       | 3 (9.7)        | 6 (17.6)       | 13 (37.1)      |
| Nonischemic                                        | 1 (1)         | 1 (3.2)        | 0              | 0              |
| STEMI                                              | 4 (4)         | 0              | 3 (8.8)        | 1 (2.9)        |
| Stable angina                                      | 24 (24)       | 5 (16.1)       | 13 (38.2)      | 6 (17.1)       |
| Unstable angina                                    | 10 (10)       | 6 (19.4)       | 1 (2.9)        | 3 (8.6)        |
| Cerebrovascular disease history, n (%)              |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| No                                                 | 79 (79)       | 23 (74.2)      | 27 (79.4)      | 29 (82.9)      |
| Yes                                                | 20 (20)       | 8 (25.8)       | 6 (17.6)       | 6 (17.1)       |
| Diabetes, n (%)                                     |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| No                                                 | 35 (35)       | 8 (25.8)       | 15 (44.1)      | 12 (34.3)      |
| Yes                                                | 64 (64)       | 23 (74.2)      | 18 (52.9)      | 23 (65.7)      |
| HF history, n (%)                                   |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| No                                                 | 72 (72)       | 23 (74.2)      | 26 (76.5)      | 23 (65.7)      |
| Yes                                                | 27 (27)       | 8 (25.8)       | 7 (20.6)       | 12 (34.3)      |
| HF within 2 weeks, n (%)                            |               |                |                |                |
| Missing                                            | 1 (1)         | 0              | 1 (2.9)        | 0              |
| No                                                 | 89 (89)       | 30 (96.8)      | 32 (94.1)      | 27 (77.1)      |
| Yes                                                | 10 (10)       | 1 (3.2)        | 1 (2.9)        | 8 (22.9)       |
| Indication, n (%)                                   |               |                |                |                |
| Acute coronary syndrome                             | 36 (36)       | 9 (29.0)       | 10 (29.4)      | 17 (48.6)      |
| Cardiomyopathy                                     | 2 (2)         | 2 (6.4)        | 0              | 0              |
| Congestive heart failure                            | 11 (11)       | 4 (12.9)       | 2 (5.9)        | 5 (14.3)       |
| Other                                              | 8 (8)         | 5 (16.1)       | 1 (2.9)        | 2 (5.7)        |
| Post heart transplantation workup                  | 1 (1)         | 1 (3.2)        | 0              | 0              |
| Preoperative assessment                             | 1 (1)         | 1 (3.2)        | 0              | 0              |
| Pulmonary hypertension                             | 1 (1)         | 1 (3.2)        | 0              | 0              |
| Serious arrhythmia                                 | 2 (2)         | 0              | 2 (5.9)        | 0              |
| Stable angina                                      | 25 (25)       | 5 (16.1)       | 14 (41.2)      | 6 (17.1)       |
| Valvular heart disease                             | 13 (13)       | 3 (9.7)        | 5 (14.7)       | 5 (14.23)      |

AKI, acute kidney injury; CAD, coronary artery disease; eGFR, estimated glomerular filtration rate; HF, heart failure; Hgb, hemoglobin; LVEDP, left ventricular end-diastolic pressure; NSTEMI, non-ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction.
responded as unsure, 23 of them could not recall receiving information about the risk of kidney injury. When asked how the information they received made them feel, 53% felt reassured, 35% felt neutral, 9% felt anxious, and 1% responded unsure. These results were consistent between strata of men and women, those with an ACS vs non-ACS indication, and those with vs without chronic kidney disease (CKD). Compared with patients younger than 70 years of age, those older than 70 years of age were more likely to feel reassured (Table 2).

When questioned about satisfaction with their follow-up care experience, 68% believed that the general practitioner was aware of the follow-up care, and 65% believed their general practitioner was prepared with enough information to provide follow-up. Most patients expressed satisfaction with their transition from the hospital to home; 64% responded with very satisfied, 22% responded with somewhat satisfied, 8% responded with neither satisfied or dissatisfied, 2% responded with very dissatisfied, and 4% were unsure. These results were consistent between strata of participants younger than vs older than 70 years of age, men and women, those with an ACS vs non-ACS indication, and those with vs without CKD.

**Discussion**

Using a structured survey, we characterized the perceptions of patients at increased risk of AKI regarding the information and follow-up care they received after implementation of a new initiative designed to improve patient experiences in these areas after cardiac catheterization in Alberta. Approximately two-thirds of participants in our study indicated that they believe they were informed of the risks of developing AKI, recommendations to reduce this risk, and follow-up steps for blood work and care after the procedure. Most patients expressed that receiving this information was helpful, and that they were reassured more often than anxious. Further, most participants perceived that their community physician received enough information to conduct appropriate follow-up, and patients were satisfied with their transition from the hospital to community.

Providing patients with information about their individual risk of AKI and prevention strategies is a pivotal step to empowering patients with knowledge about their health status and risk. Approximately one-third of the patients did not recall receiving this information before discharge in our study. This might be attributed to either a lack of patient recall, or an insufficient amount or mechanism of discharge education. It is possible patients might struggle to retain this information immediately after a medical procedure, or they might not review the relevant educational material provided to them at discharge. Care providers might not explain information in a way that is understood by all, might explain when a family member or friend is not present, or might not have provided the information at all despite the attempts made to implement these steps into workflow during the Contrast RISK initiative. Providing education to patients can be an effective way to facilitate relay of knowledge to care providers, which might have supported effective follow-up care of patients at risk of AKI in this study.

**Limitations**

Although most of our participants responded positively to the survey questions, there are some limitations to the inferences we can draw from this study. Because of the design of the study we were not able to compare these results with a control group before the implementation of our initiative. This
limits our ability to determine the degree to which these findings were attributable to previous practices vs the additional elements introduced by our initiative. However, other research has reported systemic failures to meet patients’ in-hospital and postdischarge information needs in coronary disease care.\(^1\)\(^9\),\(^1\)\(^0\)

Further, we collaborated with patient advisors who identified

| Table 2. Select Patient Experience Survey results stratified according to age, sex, indication, and CKD status |
| --- |
| **Question** | **Strata** | **Response** | **n (%)** | **P** |
| How did all the information you received make you feel? | Age | Younger than 70 years | Reassured | 17 (45.9) | 0.02 |
| | | | Neutral | 19 (51.4) |
| | | | Anxious | 1 (2.7) |
| | Older than 70 years | Reassured | 36 (60.0) |
| | | Neutral | 16 (26.7) |
| | | Anxious | 8 (13.3) |
| Sex | Female | Reassured | 22 (61.1) | 0.67 |
| | | Neutral | 11 (30.6) |
| | | Anxious | 3 (8.3) |
| | Male | Reassured | 30 (50.0) |
| | | Neutral | 24 (40.0) |
| | | Anxious | 6 (10.0) |
| Indication | ACS | Reassured | 16 (47.0) | 0.53 |
| | | Neutral | 14 (41.2) |
| | | Anxious | 4 (11.8) |
| | Non-ACS | Reassured | 37 (58.7) |
| | | Neutral | 21 (33.3) |
| | | Anxious | 5 (7.9) |
| CKD Status | No CKD | Reassured | 35 (54.7) | 0.76 |
| | | Neutral | 24 (37.5) |
| | | Anxious | 5 (7.8) |
| | CKD | Reassured | 18 (54.5) |
| | | Neutral | 11 (33.3) |
| | | Anxious | 4 (12.1) |
| Overall how satisfied or dissatisfied were you with your transition of care? | Age | Younger than 70 years | Very satisfied | 24 (66.7) | 0.51 |
| | | | Somewhat satisfied | 10 (27.8) |
| | | | Neither | 2 (5.6) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 0 (0) |
| | Older than 70 years | Very satisfied | 40 (66.7) |
| | | | Somewhat satisfied | 12 (20.0) |
| | | | Neither | 6 (10.0) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 0 (0) |
| Sex | Female | Very satisfied | 22 (62.9) | 0.90 |
| | | | Somewhat satisfied | 9 (25.7) |
| | | | Neither | 3 (8.6) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 1 (2.9) |
| | Male | Very satisfied | 42 (70.0) |
| | | | Somewhat satisfied | 13 (21.7) |
| | | | Neither | 4 (6.7) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 1 (1.7) |
| Indication | ACS | Very satisfied | 23 (65.7) | 0.98 |
| | | | Somewhat satisfied | 8 (22.8) |
| | | | Neither | 3 (8.6) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 1 (2.8) |
| | Non-ACS | Very satisfied | 41 (67.2) |
| | | | Somewhat satisfied | 14 (23.0) |
| | | | Neither | 5 (8.2) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 1 (1.6) |
| CKD Status | No CKD | Very satisfied | 40 (61.5) | 0.28 |
| | | | Somewhat satisfied | 18 (27.7) |
| | | | Neither | 5 (7.7) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 2 (3.1) |
| | CKD | Very satisfied | 24 (77.4) |
| | | | Somewhat satisfied | 4 (12.9) |
| | | | Neither | 3 (9.7) |
| | | | Somewhat dissatisfied | 0 (0) |
| | | | Very dissatisfied | 0 (0) |

ACS, acute coronary syndrome; CKD, chronic kidney disease.
these areas of patient experience as opportunities for improvement in care, which suggests there might have been positive changes accompanying our initiative. There are also limitations to the survey itself. Because of the design and inability to link responses to the actual processes of care that each patient received, we were unable to identify what barriers were encountered that prevented some patients from recalling information or having optimal experiences. Further qualitative studies in this area might help answer why these patients had such experiences and areas for improvement. Finally, although most patients reported positive experiences after the implementation of the initiative, further research is required to determine if these experiences in fact correlated with fewer adverse downstream health events of CI-AKI including prolonged hospital stays, readmission, and kidney failure requiring dialysis after implementation of this initiative.10

Our study has important implications for improving care practices to reduce the risk of AKI and improve patient experiences after cardiac catheterization. Individualizing care and involving the patient in care has been shown to promote adherence and improve health outcomes in other settings.21,22 Our results suggest that patient-centred initiatives such as those implemented in our study can achieve high levels of patient knowledge and understanding, and this is associated with awareness of subsequent care recommendations, as well as high levels of satisfaction when transitioning from care within the hospital to care in the community. Our findings are also reassuring that providing this information about risk from a procedure, when accompanied by education about the steps being taken to mitigate this risk, was associated with perceptions of reassurance more often than anxiety by patients. Further research to identify remaining barriers to receiving consistent education and retention of this information might provide an opportunity for further improvements in existing processes and lead to more patients reporting optimal experiences.

Conclusion
Most patients were able to recall information provided to them about their risk of AKI, the appropriate steps to take in their follow-up care, and were satisfied with transitions of care after implementation of a patient-targeted initiative for AKI risk stratification and follow-up after cardiac catheterization. These findings might help inform the design of other patient-centred health care interventions related to risk stratification and transitions of care.

Funding Sources
This study was supported by a Partnership for Research and Innovation in the Health System grant from Alberta Innovates and Alberta Health Services and a Strategic Patient Oriented Research Chronic Disease Network Grant: CAN-SOLVE Chronic Kidney Disease Network, from the Canadian Institutes of Health Research.

Disclosures
M.T.J. has received investigator-initiated research grant funding for unrelated work from Amgen Canada. The remaining authors have no conflicts of interest to disclose.

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Supplementary Material
To access the supplementary material accompanying this article, visit CJC Open at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2020.10.019.