Original Article

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

Jennifer Natha, PharmD,[a] Pantea Amin Javaheri, MSc,[a] Denise Kruger, RT,[a]

Eleanor Benterud, MN,[a] Winnie Pearson,[a] Zhi Tan, MSc,[a] Bryan Ma,[a] Ben D. Tyrrell, MD,[b,c]

Bryan J. Har, MD, MPH,[d,e] Michelle M. Graham, MD,[f,g] and Matthew T. James, MD, PhD[a,e,h,i]

[a] Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

[b] Department of Medicine, University of Alberta, Edmonton, Alberta, Canada

[c] CK Hui Heart Centre, University of Alberta, Edmonton, Alberta, Canada

[d] Department of Cardiac Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

[e] Libin Cardiovascular Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

[f] Department of Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, Canada

[g] Mazankowski Heart Centre, University of Alberta, Edmonton, Alberta, Canada

[h] Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

[i] O'Brien Institute of Public Health, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

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

RÉSUMÉ

Contexte : L'insuffisance rénale aiguë (IRA) après un cathétérisme cardiaque est associée à de mauvais résultats en matière de santé. Nous avons voulu décrire l'expérience des patients après qu'on leur ait transmis de l'information standardisée concernant le risque d'IRA et des directives pour les soins de suivi après un cathétérisme cardiaque.

Méthodologie : Nous avons mis en place une initiative dans trois unités de cathétérisme cardiaque en Alberta, au Canada, afin de permettre une évaluation standardisée, puis d'offrir des directives concernant les patients à risque d'IRA. Notre initiative comprenait également des

Acute kidney injury (AKI) occurs in up to 1 in 10 patients who undergo cardiac catheterization and is associated with significant risks for longer hospital stays, poorer health outcomes, and greater costs to the health care system.[1-6] However, AKI and its complications may be mitigated via

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.[7-9] 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.[10]

The design of the **C**ontrast **R**educing **I**njury **S**ustained by **K**idneys (Contrast RISK) initiative, described in detail elsewhere,[10] 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

care when patients transition from the hospital to the community. A structured survey from a sample of 100 participants at increased risk of AKI determined their perceptions of information provided and experiences with follow-up steps after the initiative was implemented in each cardiac catheterization unit in Alberta.

Results: The mean age of participants was 72.4 (SD 10.4) years, 37% were female, and the mean risk of AKI was 8.8%. Most (63%) participants were able to recall the information provided to them about their risk of kidney injury, 68% recalled the education provided on strategies to reduce risk, and 65% believed their primary care practitioner had received enough information to conduct appropriate follow-up care. Eighty-six percent of patients were satisfied with their transition to the community, and 53% were reassured by the information and follow-up care they received.

Conclusions: These findings suggest that communicating risk information to patients, in combination with education and collaboration for follow-up with primary care providers, is associated with positive patient experiences and satisfaction with care.

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. 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 postprocedural 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 ($\geq$ 5% predicted probability using a validated multivariable model),[11,12] 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.[13,14] 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 **A**lberta **Pr**ovincial **P**roject for **O**utcomes **A**ssessment in **C**oronary **H**eart Disease (APPROACH; www.approach.org) clinical information system.[15] 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
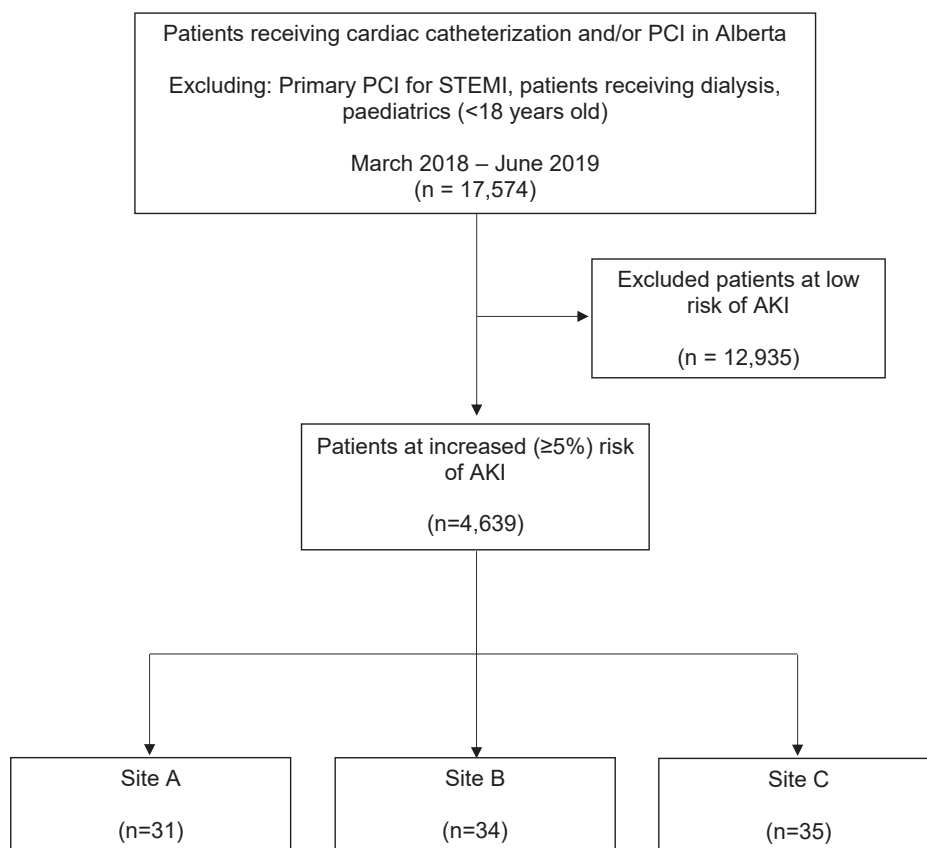
Natha et al.
AKI Risk Stratification and Follow-up

339

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.

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 χ^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

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 m^2	51.1 (22)	40.9 (18.3)	53.2 (20.4)	58.2 (23.5)
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.

wthe 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 m^2 at site A to 58 mL/min/1.73 m^2 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
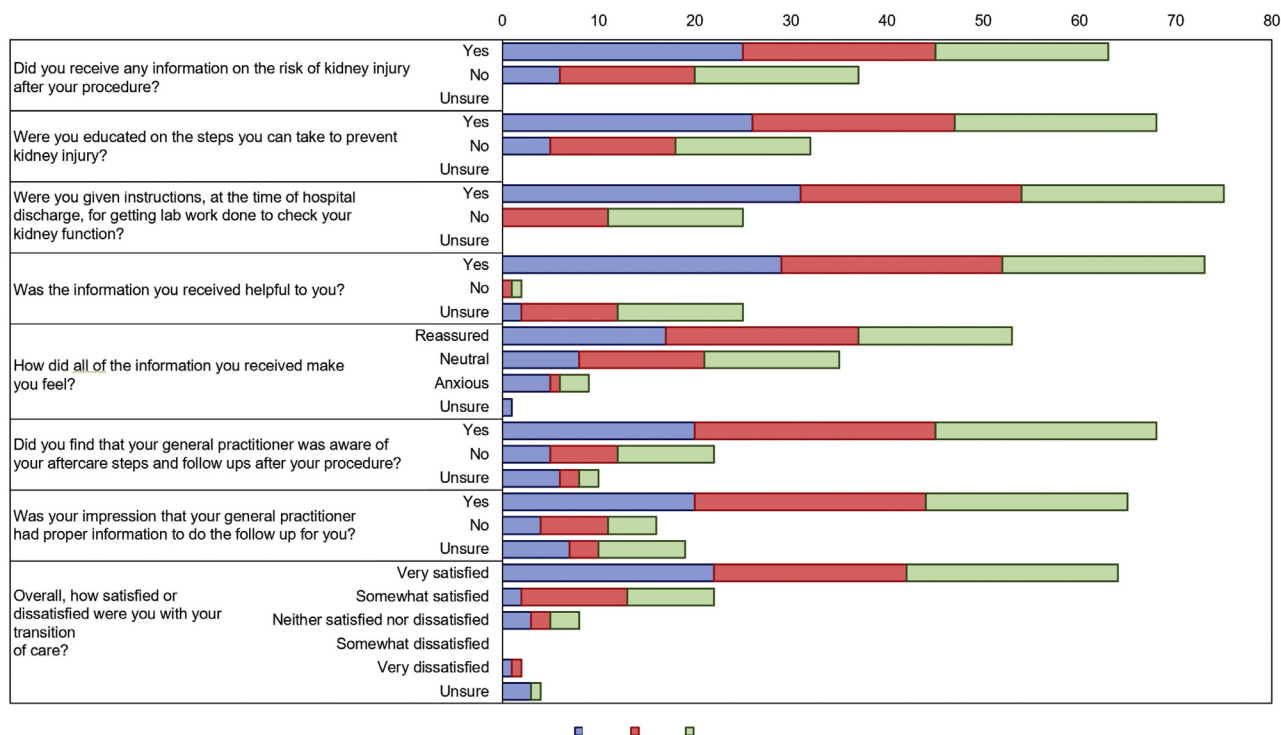
Figure 2. Patient Experience Survey results.

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.[16,17] 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.[18]

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

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	2 (3.3)	
	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.

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.[19,20] Further, we collaborated with patient advisors who identified

Natha et al.
AKI Risk Stratification and Follow-up

343

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 us 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

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.

References

1. James MT, Ghali WA, Knudtson ML, et al. Associations between acute kidney injury and cardiovascular and renal outcomes after coronary angiography. Circulation 2011;123:409-16.

2. Uzunhasan I, Yildiz A, Arslan S, et al. Contrast-induced acute kidney injury is associated with long-term adverse events in patients with acute coronary syndrome. Angiology 2017;68:621-6.

3. James MT, Ghali WA, Tonelli M, et al. Acute kidney injury following coronary angiography is associated with a long-term decline in kidney function. Kidney Int 2010;78:803-9.

4. Collister D, Pannu N, Ye F, et al. Alberta kidney disease network. Health care costs associated with AKI. Clin J Am Soc Nephrol 2017;12:1733-43.

5. Subramanian S, Tumlin J, Bapat B, Zyczynski T. Economic burden of contrast-induced nephropathy: implications for prevention strategies. J Med Econ 2007;10:119-34.

6. Klarenbach S, Manns B, Pannu N, et al. Economic evaluation of continuous renal replacement therapy in acute renal failure. Int J Technol Assess Health Care 2009;25:331-8.

7. Brown JR, McCullough PA, Splaine ME, et al. How do centres begin the process to prevent contrast-induced acute kidney injury: a report from a new regional collaborative. BMJ Qual Saf 2012;21:54-62.

8. Brown JR, Solomon RJ, Sarnak MJ, et al. Reducing contrast-induced acute kidney injury using a regional multicenter quality improvement intervention. Circ Cardiovasc Qual Outcomes 2014;7:693-700.

9. Amin AP, Crimmins-Reda P, Miller S, et al. Reducing acute kidney injury and costs of percutaneous coronary intervention by patient-centered, evidence-based contrast use: the Barnes-Jewish Hospital experience. Circ Cardiovasc Qual Outcomes 2019;12:e004961.

10. James MT, Har BJ, Tyrrell BD, et al. Clinical decision support to reduce contrast-induced kidney injury during cardiac catheterization: design of a randomized stepped-wedge trial. Can J Cardiol 2019;35:1124-33.

11. Tsai TT, Patel UD, Chang TI, et al. Validated contemporary risk model of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the National Cardiovascular Data Registry Cath-PCI Registry. J Am Heart Assoc 2014;3:e001380.

12. Ma B, Allen DW, Graham MM, et al. Comparative performance of prediction models for contrast-associated acute kidney injury after percutaneous coronary intervention. Circ Cardiovasc Qual Outcomes 2019;12:e005854.

13. Wasylak T, Strilchuk A, Manns B. Strategic clinical networks: from pilot to practice change to planning for the future. CMAJ 2019;191(suppl): S54-6.

14. Santana MJ, Zelinsky S, Ahmed S, et al. Patients, clinicians and researchers working together to improve cardiovascular health: a qualitative study of barriers and priorities for patient-oriented research. BMJ Open 2020;10:e031187.

15. Ghali WA, Knudtson ML. Overview of the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease. On behalf of the APPROACH investigators. Can J Cardiol 2000;16:1225-30.

16. Edwards AG, Naik G, Ahmed H, et al. Personalised risk communication for informed decision making about taking screening tests. Cochrane Database Syst Rev 2013;2:CD001865.

17. Gillies K, Cotton SC, Brehaut JC, Politi MC, Skea Z. Decision aids for people considering taking part in clinical trials. Cochrane Database Syst Rev 2015;11:CD009736.

18. Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. Implement Sci 2015;10:21.

19. Oterhals K, Hanestad BR, Eide GE, Hanssen TA. The relationship between in-hospital information and patient satisfaction after acute myocardial infarction. Eur J Cardiovasc Nurs 2006;5:303-10.

20. Decker C, Garavalia L, Chen C, et al. Acute myocardial infarction patients' information needs over the course of treatment and recovery. J Cardiovasc Nurs 2007;22:459-65.

21. Graham MM, Norris CM. A new way to listen to patients: heeding patient reported experiences to improve quality of care. Can J Cardiol 2019;35:1265-6.

22. Robinson JH, Callister LC, Berry JA, Dearing KA. Patient-centered care and adherence: definitions and applications to improve outcomes. J Am Acad Nurse Pract 2008;20:600-7.

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.