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Original Article

Utilization and Costs of Noninvasive Cardiac Tests After Acute Coronary Syndromes: Insights From the Alberta COAPT Study

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ABSTRACT

Background: Although appropriate noninvasive cardiac tests (NICTs) after an acute coronary syndrome (ACS) provide useful prognostic information, inappropriate use leads to inefficient expenditure of existing healthcare resources. By using the Alberta **Co**ntemporary **A**cute Coronary Syndrome **P**atient Invasive **T**reatment Strategies (COAPT) Registry, we evaluated the use and costs of NICTs among patients discharged within 1 year after ACS.

Methods: All patients discharged from the hospital with a primary diagnosis of ACS in Alberta between 2004/2005 and 2015/2016 were included. Frequency of NICTs (stress tests [± imaging] and nonstress imaging tests) was determined from linked provincial databases. Costs were obtained from the Alberta Health Care Insurance Plan Medical Procedure List.

Results: Of 55,516 patients with ACS, 30,760 had at least 1 NICT (55.4%), with 13,505 (24.3%) having > 1 NICT performed within 1 year. Temporal trends of NICT increased over time (stress tests: *P* trend < 0.001; nonstress imaging tests: *P* trend < 0.001). NICT most

RÉSUMÉ

Contexte : Bien que les différents examens cardiaques non effractifs (ECNE) effectués après un syndrome coronarien aigu (SCA) fournissent des renseignements utiles au pronostic, leur emploi dans des situations inappropriées entraîne un gaspillage des ressources en santé. À l'aide du registre COAPT (***Co**ntemporary **A**cute Coronary Syndrome **P**atient Invasive **T**reatment Strategies*) de l'Alberta, nous avons évalué l'emploi des ECNE et les coûts qui y sont associés chez les patients qui ont reçu leur congé de l'hôpital dans l'année suivant un SCA.

Méthodologie : Tous les patients qui ont reçu leur congé de l'hôpital après un diagnostic primaire de SCA en Alberta entre 2004-2005 et 2015-2016 ont été inclus. La fréquence des ECNE (épreuves d'effort [avec ou sans examen d'imagerie] et examens d'imagerie au repos) a été déterminée à partir des bases de données provinciales couplées. Les coûts ont été établis à partir de la liste des actes médicaux du régime d'assurance-maladie de l'Alberta.

Résultats : Des 55 516 patients ayant présenté un SCA, 30 760 ont subi au moins un ECNE (55,4 %) dans l'année qui a suivi l'événement;

Despite improvements in early invasive management coupled with contemporary pharmacotherapy, acute coronary syndrome (ACS) studies still report recurrent event rates of approximately 10% within 1 year of the index event.[1,2] Appropriate noninvasive cardiac tests (NICTs) may provide useful prognostic information and risk stratification to reduce recurrent events; however, inappropriate use could lead to inefficient use of limited healthcare resources. In addition, different testing modalities offer varying strengths and weaknesses, which can often lead to multiple tests ordered without added value. Existing guidelines in ACS do provide guidance when NICT is indicated;[3-6] however, guideline recommendations may not have lasting effects in clinical practice. This may be due, in part, to the limited evidence supporting these recommendations after an ACS. Furthermore, inappropriate NICT may be influenced by a multitude of factors, including the lack of knowledge of previously completed investigations, patient requests for NICT to establish comfort with their current health status, and the perceived incentives of fee-for-service clinical billings.

As such, it has become important to assess use and costs of these tests in contemporary clinical practice. Using the Alberta **Co**ntemporary **A**cute Coronary Syndrome **P**atient Invasive **T**reatment Strategies (COAPT) Registry, we evaluated use and costs of diagnostic cardiac tests among patients discharged within 1 year after ACS.

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Ethics Statement: The research reported has adhered to the relevant ethical guidelines.

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commonly occurred within the first 4 months after hospital discharge (stress tests at 2 months; nonstress imaging tests at 3-4 months). In 2015/2016, the total estimated costs of NICT were $1.35M, a 22.4% increase from 2004/2005 (1.10M) ($P < 0.001$), whereas a decrease in incidence of ACS over the same time period was noted ($P = 0.008$).
Conclusions: **Rates of NICT 1 year after ACS are high and increasing over time. Estimated costs of NICT appear to be escalating out of proportion to the ACS growth. Further investigation is warranted because it is speculative whether the increase in NICT and costs results in clinical benefit after ACS.**

13 505 (24,3 %) d'entre eux ont subi plus d'un ECNE. Les tendances temporelles en matière d'ECNE affichent une hausse (épreuves d'effort : p tendance < 0,001; examens d'imagerie au repos : p tendance < 0,001). Les ECNE ont généralement été effectués au cours des 4 premiers mois après la sortie de l'hôpital (épreuves d'effort, dans les 2 mois; examens d'imagerie au repos, dans les 3 à 4 mois). Le coût total des ECNE effectués en 2015-2016 a été évalué à 1,35 M$, soit une hausse de 22,4 % par rapport à 2004-2005 (1,10 M$) ($p < 0,001$), tandis que l'incidence des SCA a diminué au cours de la même période ($p = 0,008$).
Conclusions : **Les taux d'ECNE effectués dans l'année suivant un SCA sont élevés et augmentent au fil du temps. Le coût estimatif de ces ECNE semble s'accroître de façon disproportionnée par rapport à la croissance des SCA. Une enquête plus approfondie s'impose; à l'heure actuelle, on ne peut que spéculer quant aux bienfaits cliniques qui découlent de l'augmentation des ECNE effectués après un SCA et des coûts qu'ils engendrent.**

Methods

Study design and population

This was a retrospective, population-based cohort of all patients 18 years and older who were hospitalized and discharged alive with a primary diagnosis of ACS in Alberta, Canada, between April 1, 2004, and March 31, 2016. ACS hospitalizations were identified using the following International Classification of Diseases 10th Edition (ICD-10) codes: unstable angina: I20.0; non−ST-elevation myocardial infarction (NSTEMI): I21.4; and ST-elevation myocardial infarction (STEMI): I21.0, I21.1, I21.2 or I21.3. Concurrent ACS hospitalizations of the same patient occurring within 24 hours were considered as belonging to the same episode. The first ACS episode during the study period was considered as the index ACS episode (if multiple ACS episodes occurred per patient). We excluded individuals who died before discharge from the hospital and patients residing outside of Alberta. This study met the local requirements for ethics approval.

Data source and linkage

Data from the Alberta Ministry of Health used for this study, linked using a unique patient identifier, have been described.[7] In brief, these include (1) the Discharge Abstract Database, which contains diagnostic and treatment information, length of stay, and discharge status for patients admitted to a hospital in Alberta; (2) the National Ambulatory Care Reporting System database, which includes information on emergency department or outpatient clinic visits and mode of arrival; and (3) the Alberta Health Care Insurance Registry, which tracks the vital status of all residents of Alberta. The Discharge Abstract Database and National Ambulatory Care Reporting System databases record up to 25 and 10 diagnosis fields, respectively, that are classified according to the ICD-10 codes. Because Alberta has a government-funded single-payer healthcare system with universal access, these datasets capture all patient interactions with the healthcare system.

Exposures and other covariates

NICTs were identified using the following ICD 9th Revision/ICD 10 code: exercise stress test (EST): 2HZ08EJ, 03.41A, 03.41B, 03.41C; pharmacologic stress test (PST): 2HZ08EK, 03.41D, 03.44A; echocardiography (ECHO): 3IP30, 3HZ30, X213, X215, X216, X217, X306, X307, 02.82A; cardiac myocardial perfusion imaging (MPI): 3IP70CC, 3IP70CE, 3IP70KG, 3IP70KGS, X170, X171; cardiac magnetic resonance imaging (MRI): 3IP40; and cardiac computed tomography (CT): 3IP20. Prices of cardiac tests were based on the Schedule of Medical Benefits in Alberta as of January 1, 2017.

Statistical analysis

Baseline patient characteristics were divided according to no tests, stress test (± imaging [ECHO, MPI, or MRI)] and nonstress imaging tests (ECHO, MPI, CT, or MRI without stress component), and presented as median and interquartile range or mean and standard deviation for continuous variables and number (percentage) for categorical variables. Differences among groups were tested using the Kruskal−Wallis test for continuous variables and chi-square test for categorical variables. Temporal trends over years were tested using the Cochran−Armitage test.

To examine factors associated with first NICT (stress test and nonstress imaging test as 1 group), a stepwise ($P \leq 0.20$ as "in" criteria and $P \leq 0.05$ as "out" criteria) multivariable logistic regression model was developed using available patient characteristics plus year of index ACS. Odds ratios with corresponding 95% confidence intervals and Wald statistic of the final model were reported.

The level of statistical significance was set at $\alpha < 0.05$. Statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc, Cary, NC).

Results

Of the 55,516 patients discharged alive from the hospital with ACS, 34.0% had unstable angina, 47.1% had NSTEMI, and 18.9% had STEMI. Of these, 30,760 patients had at least 1 NICT (55.4%), with 13,505 (24.3%) having > 1 NICT performed within 1 year. Of the stress tests [± imaging] performed, 3368 (6.1%) were pharmacologically induced. Of the nonstress imaging tests, 96.5% were ECHO, 7.5% were cardiac MPI, 5.1% were cardiac MRI, and 1.0% were cardiac CT.

Table 1. Baseline patient characteristics and treatment during index ACS hospitalization according to NICT received within 1 year

	All patients	No test	Stress test	Nonstress imaging test	*P* value*
	55,516	24,756	23,946	6814	
Age, y (mean, SD)	66.3 (13.9)	71.1 (14.3)	61.0 (11.5)	67.2 (13.3)	< 0.001
Age, y (median, IQR)	66 (56, 77)	73 (60, 83)	60 (53, 69)	68 (58, 78)	< 0.001
Female gender, n (%)	17,747 (32.0)	9714 (39.2)	5689 (23.8)	2344 (34.4)	< 0.001
Index ACS classification, n (%)					< 0.001
Unstable angina	18,876 (34.0)	6637 (26.8)	9693 (40.5)	2546 (37.4)	
NSTEMI	26,145 (47.1)	12,920 (52.2)	10,149 (42.4)	3076 (45.1)	
STEMI	10,495 (18.9)	5199 (21.0)	4104 (17.1)	1192 (17.5)	
Index treatment strategy, n (%)					< 0.001
CABG	3844 (6.9)	1370 (5.5)	1657 (6.9)	817 (12.0)	
PCI	29,044 (52.3)	9400 (38.0)	16,489 (68.9)	3155 (46.3)	
Medically managed	22,628 (40.8)	13,986 (56.5)	5800 (24.2)	2842 (41.7)	
Comorbidities, n (%)					
Prior MI	6281 (11.3)	3497 (14.1)	1910 (8.0)	874 (12.8)	< 0.001
Heart failure	7374 (13.3)	4425 (17.9)	1494 (6.2)	1455 (21.4)	< 0.001
Peripheral vascular disease	2168 (3.9)	1280 (5.2)	552 (2.3)	336 (4.9)	< 0.001
Cerebrovascular disease	1496 (2.7)	911 (3.7)	356 (1.5)	229 (3.4)	< 0.001
Dementia	1479 (2.7)	1339 (5.4)	50 (0.2)	90 (1.3)	< 0.001
COPD	5871 (10.6)	3343 (13.5)	1657 (6.9)	871 (12.8)	< 0.001
Rheumatic disease	638 (1.1)	321 (1.3)	206 (0.9)	111 (1.6)	< 0.001
Peptic ulcer disease	463 (0.8)	242 (1.0)	134 (0.6)	87 (1.3)	< 0.001
Liver disease	345 (0.6)	198 (0.8)	91 (0.4)	56 (0.8)	< 0.001
Diabetes	14,373 (25.9)	7149 (28.9)	5184 (21.6)	2040 (29.9)	< 0.001
Paralysis	270 (0.5)	188 (0.8)	37 (0.2)	45 (0.7)	< 0.001
Renal disease	3352 (6.0)	2238 (9.0)	628 (2.6)	486 (7.1)	< 0.001
Cancer	1402 (2.5)	930 (3.8)	293 (1.2)	179 (2.6)	< 0.001
Charlson score (mean, SD)	1.2 (1.6)	1.5 (1.8)	0.8 (1.2)	1.4 (1.6)	< 0.001
Charlson score (median, IQR)	1 (0, 2)	1 (0, 2)	0 (0, 1)	1 (0, 2)	< 0.001
Rural residence, n (%)	11,149 (20.1)	5363 (21.7)	4271 (17.8)	1515 (22.2)	< 0.001

ACS, acute coronary syndrome; CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; MI, myocardial infarction; NICT, noninvasive cardiac test; NSTEMI, non−ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; SD, standard deviation; STEMI, ST-elevation myocardial infarction.

* *P* values are for comparison among no test, stress test, and nonstress imaging test groups.

In follow-up, 10.4% of patients died after the index ACS event at 1 year (death from index hospital discharge to 1 year). Of patients who survived their ACS and were discharged from the hospital, those with no subsequent NICT had the highest mortality (20.5%) but were noted to have the greatest baseline risk. Lower rates of 1-year mortality were observed in those with at least 1 NICT (2.3%).

Patient characteristics

Patient characteristics and treatment received during the index ACS hospitalization according to NICTs received are depicted in Table 1. Patients who did not receive any NICTs within 1 year of ACS were older, more commonly female, and more likely to have comorbidities. More commonly, these patients were treated conservatively without revascularization. The patients who received a stress test were younger and less likely to be female, and had a lower comorbid burden. These patients were more likely to have a percutaneous coronary intervention (PCI) as their treatment during the index ACS episode. Patients receiving a nonstress cardiac imaging test were older and had a higher likelihood of comorbidities. More commonly, these patients were treated with coronary artery bypass grafting for their index event.

Temporal trends

As depicted in Figure 1A, NICTs were commonly used after an ACS, with stress test use being highest. Both stress test (43.2% in 2004/2005 to 47.8% in 2015/2016, *P* trend < 0.001) and nonstress imaging test (8.5% in 2004/2005 to 14.6% in 2015/2016, *P* trend < 0.001) use appears to be increasing over time in the follow-up of patients with ACS within 1 year (Fig. 1A).

With regard to the frequency of specific NICT (Fig. 1B), ESTs have steadily increased from 38.9% in 2004/2005 to 46.3% in 2015/2016 (*P* trend < 0.001), whereas PSTs have decreased over time from a peak of 9.7% in 2007/2008 to 5.3% in 2015/2016 (*P* trend < 0.001). As for nonstress imaging tests, ECHO rates have increased substantially from 8.5% in 2004/2005 to 14.1% in 2015/2016 (*P* trend < 0.001) 1 year after discharge for ACS and currently occupy the majority of nonstress imaging tests. Conversely, MPI (nonstress) declined from 18.4% in 2004/2005 to 11.6% in 2015/2016. As shown in Figure 1C, approximately one-half of patients with ACS who receive a NICT will undergo additional tests, a pattern that appears consistent over time.

Time to first NICT

The first NICT was most often performed within 4 months of discharge from index ACS (Fig. 2). Stress tests were more common and peaked at 2 months, whereas nonstress imaging tests (lower proportion) were mostly performed between 2 and 4 months after discharge.

Estimated costs

From 2004/2005 to 2015/2016, the total estimated costs of NICTs have increased 22%, with estimated costs exceeding

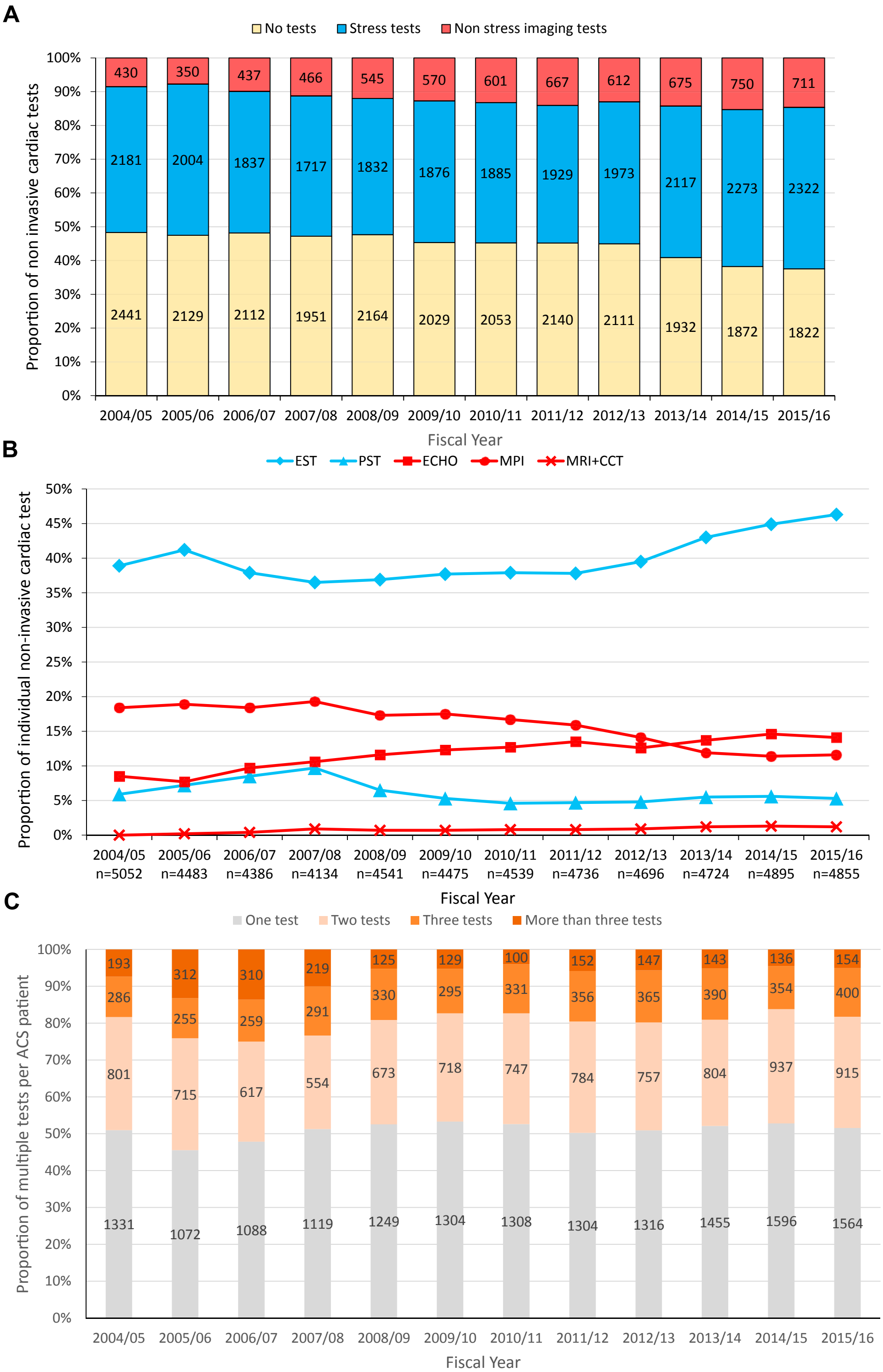

Figure 1. Patients and percentages of no tests, stress tests, and nonstress imaging tests over years among patients with index acute coronary syndrome (ACS) **(A)**. Frequency of type of noninvasive cardiac test (NICT) per ACS population **(B)**. Multiple NICTs within 1 year after index hospital discharge **(C)**. CCT, cardiac computed tomography; ECHO, echocardiography; EST, exercise stress test; MRI, magnetic resonance imaging; PST, pharmacologic stress test.

$1.35 million (CAD) yearly in 2015/2016 ($P < 0.001$) (Fig. 3A, purple), which have increased to a larger degree than the occurrence of incident ACS events (overall decrease in incidence of ACS, $P = 0.008$). The cost trends for both stress tests and nonstress imaging tests appear to increase over time (Fig. 3A), with the majority of these costs attributed to EST and ECHO (Fig. 3B).

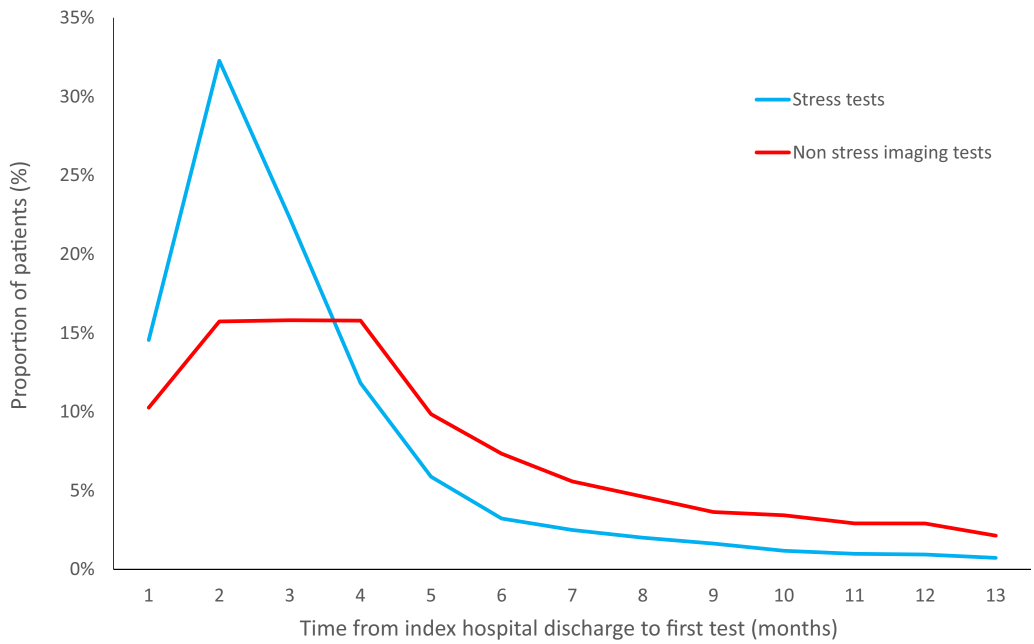

Figure 2. Proportion of patients according to time to first NICT (stress test or nonstress imaging test) after index hospital discharge. ACS, acute coronary syndrome.

Factors associated with the use of NICT

As shown in Table 2, male gender and urban residence were significantly associated with a higher likelihood of receiving a NICT. In contrast, older patients with comorbidities such as diabetes, prior MI, peripheral vascular disease, chronic obstructive pulmonary disease, liver disease, paralysis, renal disease, and cancer were less likely to receive a NICT. Of note, patients with an index invasive procedure (vs a conservative approach) more commonly received a follow-up NICT. Finally, the year of the index ACS event (latter year) (2004/2005-2015/2016) was associated with a higher likelihood of receiving a NICT within the year after discharge.

Discussion

In a large comprehensive provincial registry with a single-payer, government-funded healthcare system, approximately one-half of patients with ACS receive at least 1 NICT within the first year of their index event. Moreover, one-quarter underwent multiple NICTs within the first year. Over time, a greater number of NICTs are being performed for patients with ACS after discharge, with the majority of these performed within the first 4 months. Finally, over time, estimated costs of NICTs appear to be escalating out of proportion to the ACS patient population. As such, further investigation is warranted to address the optimal use of limited healthcare financial resources, specifically related to NICT use in patients with ACS.

It is interesting to note that older patients and those with comorbidities were less likely to receive NICT. Although for many patients this may be considered justified, there may be a cohort of patients who would be at higher risk for recurrent events and may benefit from further testing after an ACS. As such, there may be a risk-treatment paradox in patients with ACS, an observation that has been demonstrated previously.[8] Conversely, we found lower-risk patients were more likely to receive NICTs, of which the utility may be of limited benefit.

Our finding of 55.4% of patients with ACS receiving at least 1 NICT (the majority being stress tests) within 1 year after ACS deserves attention. Although stress tests have potential attributes, the clinical benefit still remains largely unknown. This is particularly relevant in an era of rapid reperfusion for STEMI and an early invasive approach in non−ST-elevation ACS coinciding with advancements in evidence-based pharmacotherapy. In a large registry of U.S. patients receiving PCI (National Cardiovascular Data Registry CathPCI Registry, 2005-2007), in which 62% of enrolled patients presented with an ACS, diagnostic testing was common after revascularization but was not associated with a lower risk of death or MI.[9] Among the 10,293 Veterans Affair patients with PCI (more than one-half had ACS), 21.8% had a stress test within 1 year (most being performed with PST [79.8%]), yet stress testing rates did not correlate with improved survival.[10] In 112,691 patients with PCI (39.1% with MI) performed in Ontario, Canada, 59.8% had at least 1 stress test performed within 2 years; however, only 5.9% underwent subsequent coronary angiography and only 3.1% received repeat revascularization within 60 days of the stress test.[11] Thus, these data suggest a low yield of routine stress testing to alter clinical practice or improve patient outcomes.

Similar arguments can be made for risk stratification of patients with ACS with nonstress imaging tests to assess left ventricular function. Largely based on historic studies, left ventricular systolic dysfunction was associated with increased mortality at 6 months and 1 year, but limited to the small number of patients with a left ventricular ejection fraction of $\leq$ 30%.[12-14] In the current era, a minority of patients with ACS present with severe left ventricular dysfunction or

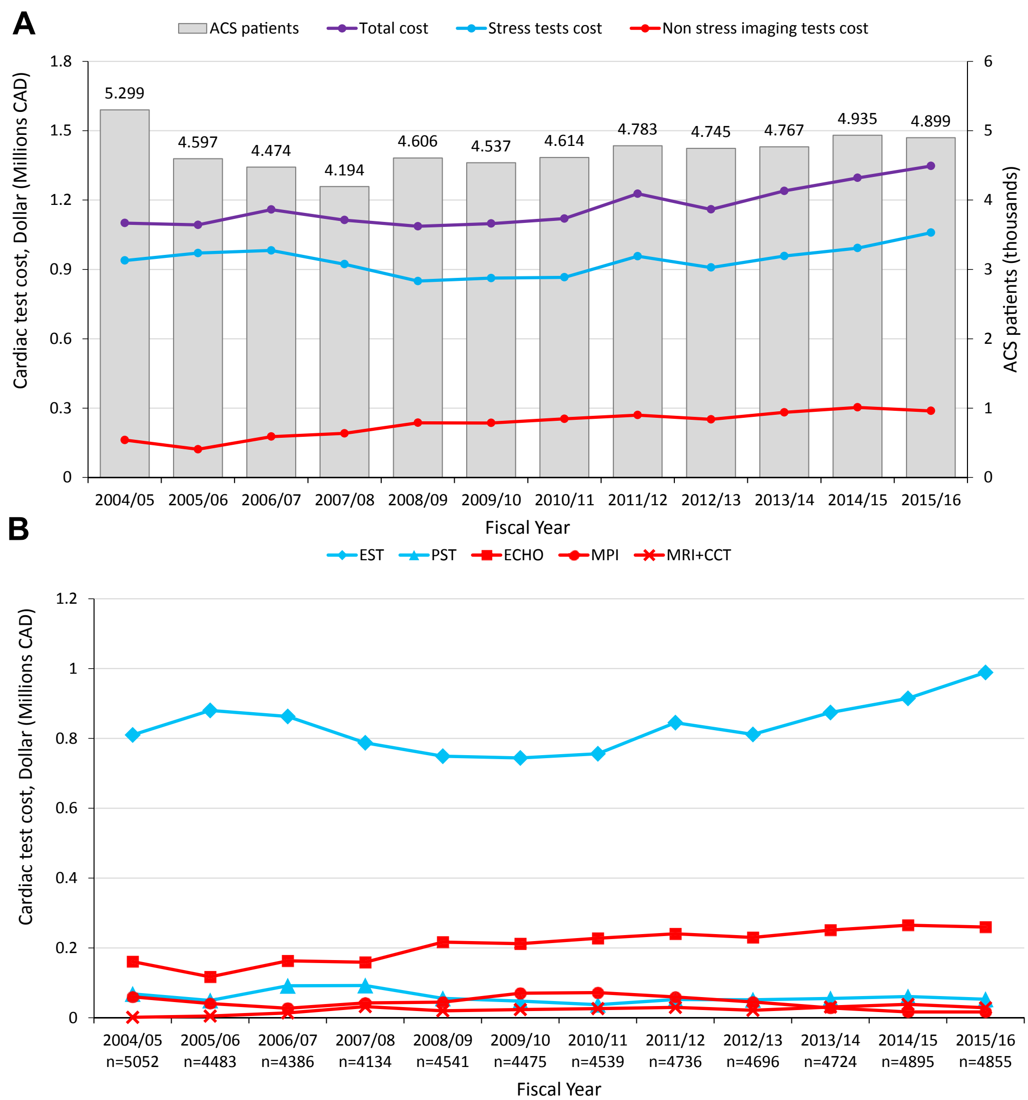

Figure 3. Cost of NICTs over years **(A)**. Cost of NICTs over years according to type of test **(B)**.

develop it during their index event, yet the majority of patients with ACS routinely receive outpatient nonstress imaging tests. These higher-risk patients arguably could be identified on the basis of clinical presentation and standard inpatient investigation (in-hospital left ventricular assessment) and selected for outpatient nonstress imaging tests, which would still align with current ACS guidelines and would preclude subsequent nonstress imaging tests for those with normal (or near normal) left ventricular function. This could support a cost-effective strategy of tailored use of clinically appropriate NICTs, while avoiding the broad application of these tests for all patients with ACS.

Particularly alarming are the increasing trends toward a greater number of NICTs being performed in patients with ACS. Of particular concern are the frequent and increasing use of ESTs (most common stress test) and increasing rates of ECHOs performed (the most common stress imaging test), which has nearly doubled over the study period. Although functional testing is used in cardiac rehabilitation assessment and for the development of exercise prescriptions (and not for functional ischemia in many cases), in our opinion these should not be used as a diagnostic EST for defining myocardial ischemia and should not be clinically billed. Moreover, if an EST is performed in cardiac rehabilitation, it should be made widely available for clinicians to review in the outpatient setting, which currently is a challenge in Alberta. However, more than one-half of patients with ACS do not participate in cardiac rehabilitation. Data from the Edmonton zone found only 43% of European Canadians with coronary disease attended cardiac rehabilitation (despite efforts);[15] thus, a considerable number of these tests are performed in clinical follow-up, which needs to be curtailed. With the emergence of more sophisticated forms of NICTs (ie, positron emission tomography, cardiac MRI, stress ECHO), it has become more attractive to routinely risk stratify patients noninvasively with the aim of reducing subsequent cardiac events. However, these advancements in cardiac testing may not be justified given the equivocal benefits of NICTs 1 year after ACS. As such, further efforts are required to promote appropriate NICTs, while curtailing inappropriate investigations in

Table 2. Factors significantly associated with use of NICT (includes stress test and nonstress imaging test)

	Wald chi-square	Odds ratio (95% CI)	*P* value
Age, per 10-y increase	2437.58	0.69 (0.69-0.70)	< 0.001
Male	117.57	1.25 (1.20-1.30)	< 0.001
Diabetes	71.89	0.84 (0.80-0.87)	< 0.001
Prior MI	40.22	0.83 (0.78-0.88)	< 0.001
Peripheral vascular disease	22.18	0.80 (0.73-0.88)	< 0.001
COPD	31.80	0.84 (0.79-0.90)	< 0.001
Liver disease	16.83	0.62 (0.49-0.78)	< 0.001
Paralysis	20.12	0.53 (0.40-0.70)	< 0.001
Renal disease	75.08	0.70 (0.65-0.76)	< 0.001
Cancer	58.46	0.63 (0.56-0.71)	< 0.001
Urban vs rural	71.93	1.21 (1.16-1.27)	< 0.001
Index invasive (PCI/CABG) vs medical management	1885.20	2.33 (2.24-2.42)	< 0.001
Year of index ACS from 2004 to 2015, per year	53.92	1.02 (1.01-1.03)	< 0.001

ACS, acute coronary syndrome; CABG, coronary artery bypass grafting; CI, confidence interval; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; NICT, noninvasive cardiac test; PCI, percutaneous coronary intervention.

clinical practice given the lack of sustainability of increasing healthcare expenditure, particularly in a government-funded single payer health system.

The development of guidelines for appropriateness of NICTs after an ACS is of paramount importance because they do not currently exist. However, the American College of Cardiology Foundation Appropriate Use Criteria for cardiac tests in stable ischemic heart disease have been developed and report testing in asymptomatic patients to be rarely appropriate.[16] Of note, a recent Canadian study of > 3 million MPIs from 2000 to 2015 found a significant decline in MPI rates associated with the publication of the 2009 Appropriate Use Criteria statement in stable ischemic heart disease. This translated to a cost savings of CAD$72 million for the province of Ontario.[17] Although limited to a single imaging modality, this study emphasizes the economic impact that lies in development of Appropriate Use Criteria guidelines. In our study, the escalating costs of NICTs appears out of proportion to the growth in the ACS patient population, and ascertainment of these findings should prompt funding authorities to reexamine quality metrics in a cost-efficient manner after ACS.

It is of interest to note the 10% mortality in our population-based observational cohort of patients with ACS at 1 year. Although ACS mortality has declined over time,[18] long-term mortality remains a concern. In the Worchester Heart Attack Study of patients with acute MI between 1997 and 2005, the 1-year postdischarge mortality did decrease over time; however, in 2005 the case fatality rate was still 8.4% for STEMI and 18.7% for NSTEMI.[19] Thus, further efforts are required to improve survival in these patients; however, the role of NICT in mitigating these outcomes is still unclear.

Study strengths and limitations

Our study has some strengths and limitations. We acknowledge this is mainly a descriptive analysis of NICTs in Alberta. Still, the trends of increasing use after ACS and the estimated costs (using Alberta Health Care Insurance Plan Medical Procedure List data) are unique and provide useful data for governmental bodies faced with higher costs of provincial healthcare budgets. In our opinion, our data support further investigation into the use of NICTs to identify those patients who would truly benefit. Moreover, further exploratory analyses are required to determine whether the increased trend of NICTs is justified but speculative. This is an observational analysis using administrative datasets, which may be susceptible to residual unmeasured confounders (ie, comorbidities precluding NICTs). There may have been some NICTs performed outside of the province and would not have been captured. The detailed clinical interpretations of NICTs were not available, making it difficult to assess the patients who may derive benefit. Conversely, it is difficult to comment on the use of these tests for identifying patients who are low risk. Thus, the absence of interpretive results makes it difficult in determining the diagnostic yield of these tests after ACS. However, our intent for the current analysis was to provide a descriptive analysis on the use, trends, and costs of NICTs, which we believe provides support for further exploratory analyses. Last, patient outcomes were not explored in depth because this was beyond the scope of the current study.

Conclusion

In patients who are discharged from the hospital with an ACS, rates and costs of NICTs within the year are high and appear to be increasing at a pace much faster than Alberta's ACS growth. Given the financial costs and burden on provincial health budgets, further investigation is warranted because it is speculative whether the increase in cardiac tests and costs results in clinical benefit after ACS.

Disclosures

The authors have no relevant conflicts of interest to disclose.

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