Use of Cardiac Catheterization for Non–ST-Segment Elevation Acute Coronary Syndromes According to Initial Risk

Reasons Why Physicians Choose Not to Refer Their Patients

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Background: Despite the recommendation for an early invasive strategy in the treatment of patients who present with non–ST-segment elevation (NSTE) acute coronary syndromes (ACS), referral for cardiac catheterization is suboptimal; the reasons why some patients are not referred remain unclear.

Methods: Patients were recruited into the prospective, observational Canadian ACS Registry II between October 1, 2002, and December 31, 2003; 2136 patients with NSTE ACS identified through the registry were divided into tertiles according to the Thrombolysis in Myocardial Infarction risk score and the rates of catheterization compared. In addition, the most responsible physicians were asked to indicate the main reason they did not refer their patients for catheterization.

Results: The rate of referral for catheterization was 64.7%. Patients who underwent catheterization had lower in-hospital (0.8% vs 3.7%; $P<.001$) and 1-year mortality rates (4.0% vs 10.9%; $P<.001$) compared with those who did not. Higher-risk patients were referred at a similar rate as low-risk patients (62.5% vs 66.9%; $P=.25$). Among the reasons provided by the most responsible physician as to why patients were not referred for catheterization, 68.4% of patients were thought to be "not at high enough risk"; however, 59.1% of these patients were found to be at intermediate to high risk according to their baseline Thrombolysis in Myocardial Infarction risk score.

Conclusions: Cardiac catheterization is not used optimally in patients who present with NSTE ACS. Despite better in-hospital and 1-year outcomes in those patients who are referred for catheterization, many higher-risk patients are not being referred because of the perception that they are not at high enough risk. A significant opportunity remains to improve on accurate risk stratification and adherence to an early invasive strategy for higher-risk patients.

Arch Intern Med. 2008;168(3):291-296

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Group Information: A list of participating Canadian ACS Registry II Investigators and Coordinators was published in *Arch Intern Med.* 2007;167:1009-1016.

ACUTE CORONARY SYNDROMES (ACS), including myocardial infarction (MI) and unstable angina (UA), remain a major cause of mortality and morbidity despite advances in treatment. Antiplatelet and antithrombotic agents and an early invasive strategy play an important role in contemporary treatment of patients with non–ST-segment elevation (NSTE) ACS. Results of several randomized clinical trials support the use of prompt cardiac catheterization rather than an initial conservative approach for patients with NSTE ACS.[1-4] Consequently, current evidence-based guidelines recommend early cardiac catheterization for patients with NSTE ACS and high-risk features.[5-8]

Despite the recommendation for an early invasive strategy in the treatment of patients with NSTE ACS, it is apparent that use of cardiac catheterization is not optimal.[9,10] Retrospective analyses[11] have indicated that geographic variations, hospital attributes, and patient demographics, including patient risk levels and comorbidities, may contribute to the evidence-to-practice gap.

The present study aimed to explore the reasons why some patients were not referred for early invasive treatment. In addition, the study examined the appropriateness and timeliness of referral for in-hospital cardiac catheterization in patients who present with NSTE ACS in relation to both perceived risk and objective risk assessment. Finally, the study determined the relationship between early invasive treatment and 1-year outcomes.

METHODS

THE CANADIAN ACS REGISTRY II

The Canadian ACS Registry II was a prospective, multicenter observational study of the

clinical characteristics, management, and clinical outcomes in a population of patients who presented with non–ST-elevation MI (NSTEMI) and UA. Patients were recruited into the ACS Registry II between October 1, 2002, and December 31, 2003, from 36 hospitals in 7 provinces of Canada. Eligible patients were (1) at least 18 years old and (2) admitted to the hospital with a presumptive diagnosis of NSTE ACS (NSTEMI or UA) that was not secondary to a significant comorbidity, such as trauma, perioperative state, or gastrointestinal bleeding. In an attempt to minimize selection bias, there were no formal exclusion criteria and all sites were encouraged to enroll consecutive patients. Patient demographic data, clinical features, treatments, and outcomes were recorded on standardized paper case-report forms, which were then scanned directly into an electronic database (Teleform, version 7.0; Cardiff, San Diego, California) at the Canadian Heart Research Centre. An additional page of the case report form was completed for each patient by the most responsible physician. This process was facilitated by the hospital study coordinator responsible for completing the other pages. The physician identified the initial risk level of the patient (low, intermediate, or high) and indicated whether evidence- or guideline-based therapies and management[5-8] had been undertaken. In cases in which treatments were not used, the most responsible physician indicated at least 1 code identifying why a particular treatment or approach (eg, in-hospital referral for cardiac catheterization) had not been undertaken.

Data checks were performed centrally to ensure accuracy. The local hospital research ethics board approved the study, and informed consent was obtained from all participants. Patients were contacted at 1 year after enrollment by the designated study coordinator at the admitting hospital or centrally by the Canadian Heart Research Centre via telephone interview. Information collected at 1-year follow-up included interim medication use, cardiac procedures, and clinical outcomes.

RISK SCORE

The Thrombolysis in Myocardial Infarction (TIMI) risk score for UA/STEMI[12] is a composite score that uses 7 equally weighted predictor variables: age of 65 years or older, at least 3 risk factors for coronary artery disease, prior coronary stenosis of 50% or more, elevation in serum cardiac markers, ST-segment deviation on electrocardiogram, recent severe angina (≥2 episodes within 24 hours), and aspirin use in the past 7 days. Patients from the Canadian ACS Registry II were divided into low (TIMI risk score of 0-2), intermediate (TIMI risk score of 3-4), and high (TIMI risk score of 5-7) risk categories for analysis. In addition, we calculated the Global Registry of Acute Coronary Events (GRACE) risk score; the components include age, heart rate, systolic blood pressure, Killip class, cardiac arrest, serum creatinine level, ST-segment deviation, and cardiac biomarker status.[13] We have previously demonstrated significant discriminatory ability of both risk scores for in-hospital and 1-year mortality in our previous (Canadian ACS Registry I)[14] and current (Canadian ACS Registry II) registries.[15]

STATISTICAL ANALYSIS

Continuous variables are reported as median and interquartile range (IQR), whereas categorical data are reported as frequencies and percentages. Kruskal-Wallis (or Mann-Whitney) and χ^2 tests were used to compare differences in continuous and categorical variables across patient groups, respectively. A 2-sided $P<.05$ was considered statistically significant. Data processing and statistical analyses were performed by the Canadian Heart Research Centre with SAS statistical software, version 8.2 (SAS Institute Inc, Cary, North Carolina).

RESULTS

THE STUDY POPULATION

The Canadian ACS Registry II included 2359 patients from 36 hospitals in 7 provinces. Of the 36 hospitals, 15 (926 patients [39.3%]) had academic affiliations and 12 (819 patients [34.7%]) had on-site cardiac catheterization facilities (10 with cardiac surgery capability; 667 patients [28.3%]). The most responsible physicians caring for the patients were cardiologists (73.7%), internists (24.3%), general physicians or family physicians (1.3%), and emergency physicians (0.7%). Of the 2359 patients in the ACS Registry II, 223 were excluded from the current analysis because of incomplete data required to calculate the TIMI risk score. Excluded patients differed from the remaining 2136 patients only in age (median age, 71 vs 66 years) and prior history of angina (96.4% vs 51.5%); no significant differences were found in rates of in-hospital catheterization or in-hospital and 1-year outcomes.

Baseline demographic data and presenting clinical characteristics of the remaining 2136 patients are presented in **Table 1** according to the TIMI risk category. Patients of low, intermediate, and high risk differed in age and prevalence of hypertension, diabetes mellitus, hyperlipidemia, preexisting coronary artery disease, and previous revascularizations. In addition, consistent with progressively higher risk categories, there was a gradient in the likelihood of presentation with ST-segment depression, history of and presentation with congestive heart failure, and positive cardiac markers.

EARLY REFERRAL FOR CARDIAC CATHETERIZATION

During the index admission, 1382 of 2136 patients (64.7%) were referred for cardiac catheterization. The mean (SD) TIMI risk score of patients who underwent cardiac catheterization during the index hospitalization was 2.99 (1.38) compared with 3.11 (1.41) ($P=.07$) for those who did not undergo cardiac catheterization. No statistically significant difference was found between the rate of referrals made for cardiac catheterization (66.9% vs 63.7% vs 62.5%; $P=.25$) or actual in-hospital cardiac catheterizations (62.0% vs 59.1% vs 56.3%; $P=.19$) among low-, intermediate-, and high-risk patients. Of those patients who received cardiac catheterization during the index hospitalization, no difference was seen ($P=.18$) in the median waiting times for low-risk (3 days; IQR, 2-6 days), intermediate-risk (3 days; IQR, 2-6 days), and high-risk (4 days; IQR, 2-6 days) patients.

Analysis with patients (n=2066) stratified into tertiles of low-, intermediate-, and high-risk categories using the GRACE risk score for in-hospital mortality[13] similarly demonstrated that higher-risk patients were referred less often for cardiac catheterization. Indeed, lower-risk patients were referred for catheterization more frequently than higher-risk patients (73.7% vs

Table 1. Baseline Demographic and Clinical Characteristics of Patients According to TIMI Risk Category[a]

Characteristic	TIMI Risk Score		
	Low (0-2) (n = 791 [37.0%])	Intermediate (3-4) (n = 1020 [47.8%])	High (5-7) (n = 325 [15.2%])
Age, median (IQR), y	58 (52-68)	69 (59-77)	72 (66-78)
Male	527 (66.6)	677 (66.4)	202 (62.2)
White	729 (92.2)	950 (93.1)	296 (91.1)
Risk factors			
Hypertension	334 (42.2)	651 (63.8)	271 (83.4)
Diabetes mellitus	108 (13.7)	286 (28.0)	158 (48.6)
Hyperlipidemia	288 (36.4)	633 (62.1)	265 (81.5)
Current smoker	193 (24.4)	207 (20.3)	73 (22.5)
Family history of CAD	334 (42.2)	434 (42.6)	159 (48.9)
Medical history			
Prior angina	193 (24.4)	613 (60.1)	293 (90.2)
Prior MI	116 (14.7)	390 (38.2)	202 (62.2)
Prior PCI	61 (7.7)	251 (24.6)	147 (45.2)
Prior CABG	28 (3.5)	177 (17.4)	105 (32.3)
Prior stroke or TIA	45 (5.7)	125 (12.3)	43 (13.2)
Prior CHF	37 (4.7)	105 (10.3)	60 (18.5)
Systolic BP, median (IQR), mm Hg	145 (127-168)	148 (130-168)	149 (130-169)
Heart rate, median (IQR), /min	78 (66-90)	76 (65-90)	75 (65-89)
Killip class II-IV	68 (9.7)	155 (16.4)	84 (26.7)
ST-segment depression	44 (5.6)	217 (21.3)	158 (48.6)
Creatinine, median (IQR), mg/dL	0.97 (0.84-1.14)	1.04 (0.88-1.26)	1.12 (0.93-1.45)
Initial positive cardiac markers[b]	372 (47.1)	504 (49.5)	211 (65.1)

Abbreviations: BP, blood pressure; CABG, coronary artery bypass graft; CAD, coronary artery disease; CHF, congestive heart failure; IQR, interquartile range; MI, myocardial infarction; PCI, percutaneous coronary intervention; TIA, transient ischemic attack; TIMI, Thrombolysis in Myocardial Infarction.

SI conversion factor: To convert to micromoles per liter, multiply by 88.4.

[a] Data are presented as number (percentage) of patients unless otherwise indicated.

[b] Initial value of creatine kinase, creatine kinase–MB fraction, or troponin was greater than the local laboratory's upper limit of normal.

70.1% vs 54.9%; $P<.001$ for low, intermediate and high risk, respectively). Significant differences were also found in referral rates for cardiac catheterization by cardiologists compared with noncardiologists (77.0% vs 67.6%; $P<.001$) and for hospitals with on-site catheterization facilities vs those without (75.6% vs 58.6%; $P<.001$).

REASONS FOR NOT REFERRING PATIENTS FOR CARDIAC CATHETERIZATION

Overall, 754 patients were not referred for in-hospital cardiac catheterization during index hospitalization. If a patient was not referred for cardiac catheterization, the most responsible physician was asked to provide the primary reason (**Table 2**). Overall, the most frequently reported reason given in 68.4% of cases was that the patient was not considered high risk enough and/or current clinical trial evidence did not support an early invasive strategy for the individual patient. Previously defined coronary anatomy (unsuitable for revascularization or pending revascularization) (16.4%); renal insufficiency (1.6%); active bleeding, recent surgery or trauma, other comorbid conditions or safety concerns (9.3%); and/or patient (or family) refusal (4.2%) were provided as other reasons for not referring for catheterization.

Table 2. Primary Reason for Not Referring a Patient for Cardiac Catheterization

Reason	No. (%) of Patients (n = 754)
Patient not high risk enough or clinical trial evidence does not support use	516 (68.4)
Patient or family refusal	32 (4.2)
Renal insufficiency	12 (1.6)
Active bleeding or recent surgery or trauma	1 (0.1)
Other comorbid conditions	43 (5.7)
Other safety concerns	26 (3.4)
Anatomy already defined	
Unsuitable for intervention	93 (12.3)
Planned intervention	31 (4.1)

Among the 516 patients (68.4%) who were not referred for cardiac catheterization because the most responsible physician believed that they were not high enough risk and/or clinical trial evidence did not support an early invasive strategy, 305 (59.1%) were actually at intermediate or high risk according to their calculated baseline TIMI risk score. Similarly, analysis with the GRACE risk score found that 330 of the 470 patients (70.2%) not referred for cardiac catheterization were in fact at intermediate to high risk. Not surprisingly, differences were found in the baseline characteristics of those patients who were not referred to cardiac catheterization because of perceived lower risk when compared with those referred for cardiac catheterization. These differences included older age, more female patients, more congestive heart failure, more coronary artery bypass grafts, more stroke or transient ischemic attacks, and worse Killip class status at presentation, but lower incidence of ST-segment depression and positive cardiac marker status (**Table 3**). The mean (SD) GRACE risk score of patients who underwent cardiac catheterization during the index hospitalization was 117 (35) compared with 131 (42) ($P<.001$) for those who did not undergo cardiac catheterization.

Among the 754 patients not referred for cardiac catheterization, cardiologists (n = 510) and noncardiologists (n = 244) were equally likely to not refer patients because of perceived lower risk (41.6% vs 38.5%; $P=.43$).

OUTCOMES

In-hospital vital status was available for all patients. Of 2136 patients, 42 (2.0%) died during their index hospitalization. Of 2094 patients discharged alive, 47 (2.2%) did not consent to follow-up, 1834 (87.6%) were alive at 1 year, 92 (4.4%) died by the 1-year follow-up, and 121 (5.8%) were lost to follow-up. In-hospital revascularization was undertaken in 764 patients (35.8%) overall, with 565 pa-

Table 3. Baseline Characteristics of Patients at Intermediate to High Risk According to Referral for Cardiac Catheterization[a]

Characteristic	No Cardiac Catheterization Because Not High Enough Risk (n = 305)	Referred for Cardiac Catheterization (n = 853)	*P* Value
Age, median (IQR), y	74 (67-81)	68 (58-74)	<.001
Male	172 (56.4)	588 (68.9)	<.001
Risk factors			
Hypertension	213 (69.8)	586 (68.7)	.71
Diabetes mellitus	98 (32.1)	262 (30.7)	.65
Hyperlipidemia	189 (62.0)	593 (69.5)	.02
Current smoker	49 (16.1)	204 (23.9)	.004
Family history of CAD	122 (40.0)	406 (47.6)	.02
Medical history			
Prior angina	207 (67.9)	551 (64.6)	.30
Prior MI	142 (46.6)	341 (40.0)	.05
Prior PCI	82 (26.9)	261 (30.6)	.22
Prior CABG	75 (24.6)	146 (17.1)	.004
Prior stroke or TIA	56 (18.4)	75 (8.8)	<.001
Prior CHF	51 (16.7)	69 (8.1)	<.001
Prior PAD	44 (14.4)	107 (12.5)	.40
Systolic BP, median (IQR), mm Hg	150 (129-170)	148 (130-167)	.38
Heart rate, median (IQR), /min	79 (68-94)	74 (64-88)	<.001
Killip class II-IV	65 (23.9)	116 (14.3)	<.001
ST-segment depression	60 (19.7)	261 (30.6)	<.001
Creatinine, median (IQR), mg/dL	1.09 (0.87-1.38)	1.03 (0.89-1.22)	.03
Initial positive cardiac markers[b]	127 (41.6)	491 (57.8)	<.001

Abbreviations: BP, blood pressure; CAD, coronary artery disease; CABG, coronary artery bypass graft; CHF, congestive heart failure; IQR, interquartile range; MI, myocardial infarction; PAD, peripheral arterial disease; PCI, percutaneous coronary intervention; TIA, transient ischemic attack.

SI conversion factor: To convert to micromoles per liter, multiply by 88.4.

[a] Data are presented as number (percentage) of patients unless otherwise indicated.

[b] Initial value of creatine kinase, creatine kinase–MB fraction, or troponin was greater than the local laboratory upper limit of normal.

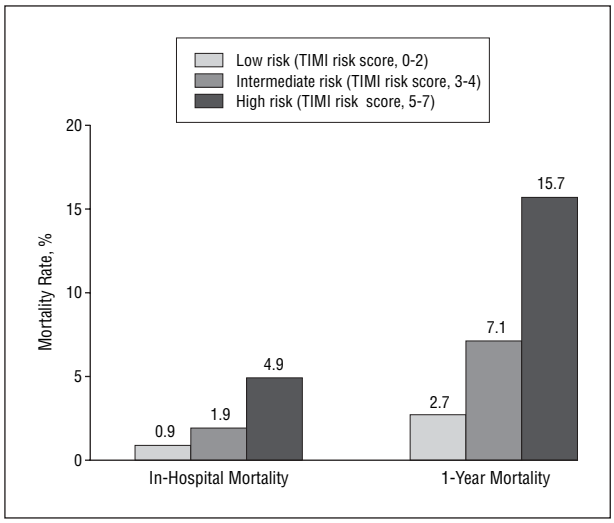

Figure 1. In-hospital and 1-year mortality according to the Thrombolysis in Myocardial Infarction (TIMI) risk score.

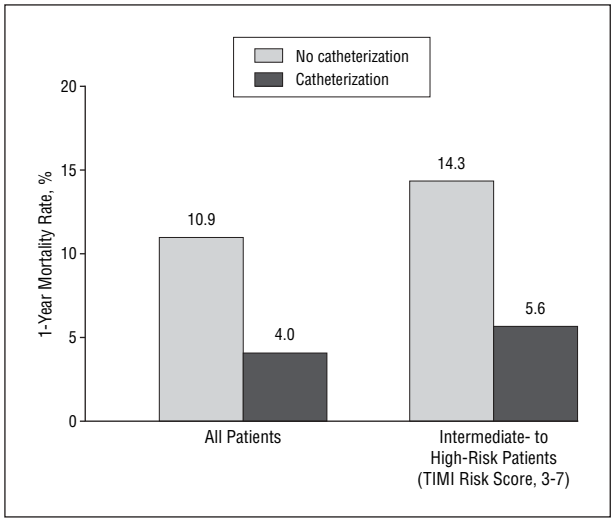

Figure 2. One-year mortality rate for all patients and higher-risk patients according to whether in-hospital cardiac catheterization was performed. TIMI indicates Thrombolysis in Myocardial Infarction.

tients (26.5%) undergoing percutaneous coronary intervention, and 199 patients (9.3%) undergoing coronary artery bypass graft. The all-cause mortality rates during the index hospitalization and at 1-year follow-up according to TIMI risk scores are shown in **Figure 1**. The differences in mortality rates across all 3 risk categories were statistically significant both during the index hospitalization ($P<.001$) and at 1-year follow-up ($P<.001$).

A statistically significant difference was also found in in-hospital (0.8% vs 3.7%; $P<.001$) and 1-year (4.0% vs 10.9%; $P<.001$) mortality rates among those patients who underwent cardiac catheterization during the index hospitalization vs those who did not. This result remained statistically significant after excluding early deaths (those within the first 48 hours). There was a significantly higher rate of in-hospital (re)infarction (6.8% vs 2.4%; $P<.001$) and a composite of death or MI during the index hospitalization (7.1% vs 5.0%; $P=.047$) in patients who underwent cardiac catheterization; however, by 1 year, the composite of death or MI rate was significantly lower (12.5% vs 16.4%; $P=.02$). When the analysis was restricted to those patients who had intermediate- or high-risk TIMI risk scores, the difference in in-hospital (1.0% vs 4.8%; $P<.001$) and 1-year (5.6% vs 14.3%; $P<.001$) mortality rates between those patients who received cardiac catheterization during the index hospitalization vs those who did not remained statistically significant. **Figure 2** illustrates the 1-year mortality rate for all patients and for higher-risk patients (TIMI risk score of 3-7), according to whether in-hospital cardiac catheterization was performed. A statistically significant higher 1-year mortality rate was found among the higher-risk patients (TIMI risk score of 3-7) who were not referred for cardiac catheterization because they were not considered high risk when compared with the higher-risk patients (TIMI risk score of 3-7) who received in-hospital cardiac catheterization (9.1% vs 5.6%, respectively; $P=.04$). Similarly, analysis using the GRACE score demonstrated a higher 1-year mortality rate among those with higher GRACE scores who did not receive in-

hospital catheterization when compared with those who did (14.0% vs 6.0%; $P<.001$).

COMMENT

In this study of patients who presented with NSTE ACS, approximately two-thirds were referred for cardiac catheterization during index hospitalization. Consistent with previous studies, we observed that higher-risk patients underwent cardiac catheterization at a similar rate and with the same timing as low-risk patients. Furthermore, patients who underwent in-hospital cardiac catheterization had lower in-hospital and 1-year mortality rates. The unique insight our study provides relates to the reasons why patients were not referred for cardiac catheterization, and these reasons were obtained directly from the treating physician. Although patients were not referred for cardiac catheterization for a variety of apparently legitimate reasons, it is concerning that in more than two-thirds of these cases, the most responsible physician believed that the patient was "not at high enough risk" to warrant this intervention, when, in fact, a large proportion (59.1%) of these patients were at intermediate to high risk according to their baseline TIMI risk score.

Key goals of this study were to evaluate the use of early cardiac catheterization in patients who present with NSTE ACS and to explore the reasons why some patients are not being appropriately referred for this evidence-based treatment strategy. An early invasive treatment strategy in patients with UA and NSTEMI and high-risk indicators has been endorsed as a class 1A recommendation by the most recent American College of Cardiology/American Heart Association practice guidelines.[6] The FRISC (Fragmin and Fast Revascularisation During Instability in Coronary Artery Disease) II trial showed an important reduction of the combined end points of death or MI after 1 year in patients randomized to an early interventional approach,[1,16] particularly among patients at intermediate to higher risk.[17] These findings were confirmed by the TACTICS-TIMI 18 (Treat Angina With Aggrastat and Determine Cost of Therapy With an Invasive or Conservative Strategy—Thrombolysis in Myocardial Infarction 18) study, which also showed benefit from an early invasive strategy in intermediate-risk (TIMI risk score of 3-4) and high-risk patients (TIMI risk score of 5-7).[2,12] The RITA-3 (Randomised Intervention Trial of Unstable Angina 3) trial demonstrated the benefit of an invasive strategy, with the greatest long-term benefit among higher risk categories.[18] As noted in other nonclinical trial, real-world populations[10,19] and consistent with clinical trial data, we observed lower in-hospital and 1-year mortality rates among higher-risk patients undergoing cardiac catheterization during the index hospitalization. Nevertheless, we found that the rate and timing of in-hospital cardiac catheterization were not different for these high-risk patients who were more likely to benefit from an early invasive strategy compared with their lower-risk counterparts.

Previous studies[10,19-23] have examined the disparity between guideline recommendations and the actual use of early invasive treatment strategies. In the CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the American College of Cardiology/American Heart Association Guidelines?) quality improvement initiative, it was found that an early invasive management strategy was used in only 45% of the high-risk patients who presented to hospitals with full revascularization capabilities and was more likely to be used in patients who were younger, had fewer comorbidities, and were cared for by cardiologists.[10] Furthermore, the presence of on-site catheterization facilities favors the use of revascularization procedures.[22,23] Findings published by the GRACE investigators revealed that cardiac catheterization was undertaken in 53% and 42% ($P<.001$) of their patients who presented with NSTEMI and UA, respectively.[22] In the present study of patients with NSTE ACS, the overall referral rate for in-hospital cardiac catheterization was 64.7%, with most undergoing cardiac catheterization during the index hospitalization. Among higher-risk patients, 62.5% were referred for in-hospital cardiac catheterization, whereas 56.3% underwent the procedure. Higher rates of cardiac catheterization were seen in those patients cared for by cardiologists and in centers with on-site catheterization facilities, consistent with results of previous studies.

To the best of our knowledge, no contemporary study has prospectively examined this evidence-to-practice gap with cardiac catheterization in patients with NSTE ACS based on specific feedback from the treating physician. The gap may in part be explained by a conscious decision on the part of the physician and/or the patient to avoid cardiac catheterization, especially when there is an increased risk of treatment complications in patients with greater comorbidity (eg, renal dysfunction) that is often associated with higher cardiac risk. However, in the present study, two-thirds of the patients were not referred because the perception was that the patient was not high risk enough to justify the intervention. However, the TIMI risk assessment indicates that patient risk was often underestimated by the treating physicians, and as a result many higher-risk patients were deprived of the potential benefit of an early invasive treatment strategy. Almost 60% of those patients not undergoing cardiac catheterization were found to have intermediate- or high-risk TIMI scores, and they represented the group of patients who benefited the most from an early invasive treatment strategy in the 3 clinical trials that supported this approach.[1-3] Similar analyses with the GRACE risk score yielded the same information. This disparity between the perceived risk and the objective and validated risk assessment (as measured by the TIMI risk score and GRACE risk score) may explain why some higher-risk patients were not treated with the early invasive strategy supported by clinical trials and evidence-based guidelines. Although the present study suggests that treating physicians may be underestimating risk, it is unclear which patient characteristics contribute to this underestimation. We speculate that physicians may be simply focusing on only 1 or 2 risk factors (such as ST-segment depression or troponin status) when risk-stratifying patients while potentially underestimating and/or deemphasizing other important factors (such as increasing age).

Although the Canadian ACS Registry II attempted to capture and accurately reflect the real-world treatment of patients, the study has several limitations. First, sites re-

cruited to participate in the Canadian ACS Registry II were not randomly selected or population based, and patients may have been enrolled on a nonconsecutive basis. The methods for data collection might have limited the inclusion of patients who died before or shortly after admission, thereby limiting the generalizability of our findings. Second, because physicians were asked to choose from a checklist of potential reasons, additional reasons for not referring patients for cardiac catheterization may be missed. Nevertheless, this could not account for the failure of treating physicians to recognize the high-risk features in most patients.

In conclusion, patients who present with NSTE ACS are not being referred for cardiac catheterization according to their risk of an adverse outcome. Furthermore, a significant proportion of higher-risk patients are not referred for cardiac catheterization because of a misperception that they are not at high enough risk. The association of early cardiac catheterization with better in-hospital and 1-year outcomes suggests that there remains a significant opportunity to improve on accurate risk stratification and adherence to the proven early invasive treatment strategy for higher-risk patients.

Accepted for Publication: September 17, 2007.
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Financial Disclosure: Drs Fitchett, Langer, and Goodman have received support as speakers and consulting honoraria and research grant support from Bristol-Myers Squibb, Sanofi Aventis, and Pfizer.
Funding/Support: The Canadian ACS Registry II was sponsored by the Canadian Heart Research Centre, Pfizer Canada Inc, Sanofi-Synthelabo Canada, and Bristol-Myers Squibb Canada Inc.
Role of the Sponsor: The industrial sponsors had no involvement in the study conception or design; collection, analysis, and interpretation of data; writing, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

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