

Utilisation of coronary angiography after acute myocardial infarction in Ontario over time: have referral patterns changed?

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Objective: To examine how physicians in Ontario, Canada, have altered their referral patterns for coronary angiography after acute myocardial infarction (AMI) over time.

Design: Retrospective analysis of multilinked administrative data.

Setting: Province of Ontario, Canada.

Patients: 146 365 Ontario AMI patients hospitalised between 1 April 1992 and 31 March 1999.

Main outcome measures: Utilisation trends of coronary angiography among all patients, as well as within six subgroups: elderly (versus young), women (versus men), high (versus low) risk of 30 day mortality, high (versus low) socioeconomic status, cardiology (versus non-cardiology) attending physician specialty, and hospitals with (versus without) onsite revascularisation capacity. Cox proportional hazard models were adjusted for variations in patient, physician, and hospital characteristics over time.

Results: Angiography rates in Ontario increased from 23.2% in 1992 to 35.5% in 1999 ($p < 0.0001$). Increases in utilisation of coronary angiography were most pronounced among the elderly (12.4–24.3% v 39.3–54.4% for non-elderly patients, $p < 0.0001$), the affluent (24.6–38.7% v 22.0–32.3% for less affluent patients, $p = 0.01$), and those tended to by cardiologists (32.0–47.1% v 20.3–30.1% for non-cardiology attending specialties, $p < 0.0001$) after adjusting for changes in baseline patient, physician, and hospital characteristics over time.

Conclusions: Despite universal health care availability, not all patients benefited equally from increases in service capacity for coronary angiography after AMI in Ontario. Wider implementation of data monitoring and explicit management systems may be required to ensure that appropriate utilisation of cardiac services is allocated to patients who are most in need.

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There have been many changes in the management of acute coronary syndromes over the past decade.¹ During this time, significant attention has focused on changes in referral patterns for coronary angiography after acute myocardial infarction (AMI).² For example, evidence suggests that physicians are increasingly becoming more aggressive in referring older, sicker patients for invasive cardiac procedures than previously.³⁻⁴ Despite these trends, supply factors such as the onsite availability of invasive cardiac procedures at the admitting hospital remain among the most dominant determinants of angiography worldwide.⁵⁻⁷ Nonetheless, changes in the importance of supply factors over time relative to other patient and physician characteristics is unknown.

Ontario is a unique region in which to examine temporal trends and referral patterns for coronary angiography for two reasons. Firstly, Canada's federal-provincial health care system is funded by third party payers without patient user fees, with the goal of equal access to medical services for all of its citizens.⁸⁻⁹ While studies have shown improved equity since the advent of universal health care in Canada,¹⁰ many recent studies have illustrated that the utilisation of coronary angiography following AMI is driven by factors similar to those observed elsewhere: onsite procedural capacity, geographical proximity to tertiary centres, social position, and affluence.^{5-7 11-15} Secondly, angiography utilisation rates in Ontario have historically been low among industrialised countries.¹⁶⁻¹⁸ However, funding and capacity for angiography have grown considerably throughout the 1990s.^{19 20} The extent to which physician referral patterns for coronary angiography have changed given increases in service capacity is unknown.

Accordingly, the objective of this study was to examine changes in referral patterns for coronary angiography among

patients hospitalised with AMI in Ontario. We hypothesised that since patients are selected for postmyocardial infarction (MI) coronary angiography implicitly without formal sets of rules or guidelines, changes in supply would influence the selection of some types of patients preferentially over others.²¹ As an ancillary study objective, we sought to determine whether temporal trends in mortality changed for some patients more than for others.

METHODS

Study framework

The Ontario Ministry of Health and Long-Term Care funds coronary angiography on a per capita basis, allocating slots to regional facilities on the assumption that these institutions will attempt to service their catchment area in an equitable and appropriate manner.^{7 19} Per capita rates of coronary angiography increased from 296 per 100 000 in 1992 to 412 per 100 000 adult population (age > 20) in 1999. To determine whether increases in angiography have been applied uniformly to all patients with AMI, six patient subgroups were examined. Each of these groupings has been shown to be an important factor influencing post-MI coronary angiography and outcomes in Ontario.^{3 5-7 12-15 22-24} These factors are age, sex, socioeconomic status, disease severity, attending physician

Abbreviations: AMI, acute myocardial infarction; CI, confidence interval; ICD-9, International classification of diseases, ninth revision; OMID, Ontario Myocardial Infarction Database; ROC, receiver operating characteristic

Table 1 Utilisation rates of coronary angiography in Ontario among the general population and among patients hospitalised with acute myocardial infarction (AMI) between 1992 and 1999

Angiography	Fiscal year							
	1992	1993	1994	1995	1996	1997	1998	1999
Per 100 000 population	296	301	312	315	336	341	365	412
Per 100 AMI	23.2	23.8	25.7	27.5	28.3	29.5	32.7	35.5

specialty, and onsite procedural availability at the index admitting hospital.

Sources of data

We obtained information from the Ontario Myocardial Infarction Database (OMID), which collects data from a variety of administrative sources. Hospital discharge abstracts compiled by the Canadian Institute for Health Information yielded information pertaining to the index admission, demographic characteristics of patients, coexisting illnesses, use of in-hospital procedures, and mortality. Data on claims for payment for physicians' services from the Ontario Health Insurance Plan and Canadian Institute for Health Information hospital discharge database were used to determine rates of use of cardiac procedures. The Ontario Registered Persons Database provided us with data on mortality over time, regardless of where death occurred.

The cohort consisted of all patients admitted to a hospital with a "most responsible" diagnosis of AMI (code 410 of the *International classification of diseases, ninth revision, clinical modification* (ICD-9)) between 1 April 1992 and 31 March 1999, inclusive. The accuracy of the coding of AMI in the OMID has been validated previously through multicentre chart audits.²⁵ To reduce the chances that subgroups within the cohort varied in terms of the severity of cardiovascular disease, we excluded any patient who had been hospitalised with an AMI in the

year before the index admission. We also excluded patients who were not residents of Ontario, those with invalid Ontario health card numbers, patients who were younger than 20 or older than 105 years, those discharged alive for whom the total length of the hospital stay was less than three days, those for whom AMI was coded as an in-hospital complication, and those who had been transferred from another acute care facility. Complete details of and the rationale for the inclusion and exclusion criteria have been reported previously.²⁵ This study received ethics approval at Sunnybrook and Women's College Health Sciences Centre.

Patient characteristics

Baseline patient characteristics of age, sex, socioeconomic status, and disease severity were obtained from discharge abstracts of the index AMI admission. In Ontario, administrative data do not include personal income. Hence, we used 1996 official Canadian census data to calculate the median income for each neighbourhood area corresponding to the first three characters of the postal code (forward sortation area) and imputed patients' incomes on the basis of their principal residence. Statistics Canada suppressed income data for 11 of the 504 forward sortation areas in Ontario because of small samples. Accordingly, our cohort of patients with AMI was linked to income data for a total of 493 forward sortation areas. Area level data have been widely used to impute individual

Table 2 Baseline characteristics of patients admitted to hospitals in Ontario with AMI between 1992 and 1999

Characteristic	Year of presentation								p Value
	1992	1993	1994	1995	1996	1997	1998	1999	
Number of patients	17404	17643	17617	17967	18848	18829	18888	19169	0.002
Sociodemographics									
Median age (years)	67.0	66.9	67.1	67.3	67.6	67.7	67.9	68.2	<0.0001
> 65 years old (%)	59.8	60.4	60.5	61.2	62.4	62.6	62.6	62.8	<0.0001
Women (%)	36.3	35.8	36.7	36.8	36.8	36.4	35.9	37.1	0.25
Median neighbourhood income (\$C)	20009	20018	20009	20037	20041	20054	20043	20043	0.038
Poor† (%)	52.3	51.4	51.5	50.7	50.3	49.7	49.9	50	<0.0001
Clinical									
Shock (%)	2.5	2.5	2.4	2.3	2.5	2.4	2.3	2.2	0.03
CHF (%)	19.3	19.4	20	19.7	21.5	21.5	22.1	22.8	<0.0001
Pulmonary oedema (%)	1.4	1.4	1.4	1.3	1.2	1.2	1	1.3	0.0003
Arrhythmias (%)	13.6	13.7	14.5	13.9	15.1	14.4	14.6	15.5	<0.0001
Diabetes with complications (%)	1.6	1.6	1.8	2	2.3	2.6	3.3	3.8	<0.0001
Malignancies (%)	4.1	2.4	2	1.7	1.8	1.8	2.1	2.2	<0.0001
Cerebrovascular disease (%)	4.2	3.7	3.9	4.2	4	4.4	4	4	0.39
Acute renal failure (%)	1.5	1.3	1.4	1.5	1.7	1.7	1.8	2.3	<0.0001
Chronic renal failure (%)	2.1	1.9	2	2.1	2.8	2.8	3.5	4	<0.0001
Predicted 30 day mortality (%)	10.2	10.0	10.2	10.2	10.2	10.2	10.2	10.2	0.14
Sick‡ (%)	50.6	49.9	50.6	50.8	52.6	52.5	53.2	54.3	<0.0001
Attending physician									
Non-cardiology attending (%)	75.1	73.2	72.4	71.3	70.1	68.8	69	68	<0.0001
Hospital									
No revascularisation centre (%)	88.5	88.9	89	89.4	88.7	90.2	92	95.9	<0.0001

*Derived from the *International classification of diseases, ninth revision*, codes in the 15 secondary diagnostic fields of the Canadian Institute for Health Information database.

†Poor refers to patients with below median socioeconomic status.

‡Sick refers to patients with above median illness severity (predicted 30 day mortality).

CHF, congestive heart failure.

Table 3 Coronary angiography rates per 100 AMI patients according to subgroups for patients admitted with AMI in Ontario between 1992 and 1999

Variable	Year of presentation								OR*	95% CI	p Value
	1992	1993	1994	1995	1996	1997	1998	1999			
Age											
≥65	12.4	13.5	15.5	16.9	18.3	19.1	21.9	24.3	2.27	2.11 to 2.43	<0.0001
<65	39.3	39.5	41.4	44.2	45.0	46.9	50.7	54.4	1.84	1.73 to 1.97	<0.0001
Sex											
Women	15.1	17.0	18.0	19.7	21.4	22.2	24.6	26.5	2.03	1.86 to 2.22	<0.0001
Men	27.9	27.6	30.2	32.0	32.4	33.7	37.2	40.8	1.79	1.69 to 1.89	<0.0001
Socioeconomic status											
Poorer† than average	22.0	22.4	23.5	25.1	26.3	27.7	30.3	32.3	1.69	1.59 to 1.81	<0.0001
Wealthier than average	24.6	25.3	28.1	29.9	30.3	31.2	35.1	38.7	1.94	1.82 to 2.07	<0.0001
Clinical											
Sicker‡ than average	9.5	10.7	12.3	13.4	15.3	15.6	18.3	20.7	2.49	2.28 to 2.71	<0.0001
Healthier than average	37.3	36.9	39.5	42.0	42.8	44.8	49.0	53.1	1.91	1.79 to 2.03	<0.0001
Attending physician											
Non-cardiologist	20.3	20.9	21.8	23.1	24.1	24.8	27.7	30.1	1.69	1.59 to 1.79	<0.0001
Cardiologist	32.0	31.7	35.9	38.5	38.2	39.9	43.8	47.1	1.89	1.74 to 2.05	<0.0001
Hospital											
No revascularisation facility	21.7	22.4	24.2	26.1	26.6	28.0	31.2	35.1	1.95	1.86 to 2.05	<0.0001
Revascularisation facility	34.7	34.8	37.8	39.1	42.0	43.2	49.8	44.8	1.53	1.29 to 1.81	<0.0001

*Odds ratio for angiography between 1992 and 1999.

†Poorer refers to patients with below median socioeconomic status.

‡Sicker refers to patients with higher than median illness severity or predicted 30 day mortality.

CI, confidence interval; OR, odds ratio.

socioeconomic status and inferences based on this method appear to be valid.^{26–29}

To control for variations in severity of illness on admission, we used the Ontario AMI mortality prediction rule for 30 day and one year mortality.²⁹ The variables in this model were age, sex, cardiac complications (for example, congestive heart failure, cardiogenic shock, arrhythmias), and comorbid status (for example, diabetes mellitus, stroke, acute and chronic renal disease, and malignancy), as derived from the ICD-9-CM codes present in the 15 secondary diagnostic fields of the hospitalisation database. This prediction rule was derived in a different subset of the OMID (that is, all AMI patients admitted between 1 April 1994 and 31 March 1997) with areas under the receiver operating characteristic (ROC) curve of 0.775 for 30 day mortality and 0.793 for one year mortality. The predictive accuracy of the model was confirmed in the cohort of AMI patients used in this study (that is, areas under the ROC curve were 0.76 for 30 day mortality and 0.78 for one year mortality) and independently validated with data from 4836 AMI patients from Manitoba and 112 234 AMI patients from California (ROC curve areas of 0.77 in both samples).³⁰

Physician and hospital characteristics

According to previous work by our group and others, the likelihood of undergoing a major coronary procedure during the 6–12 months after AMI is most strongly influenced by the attending physician's specialty and whether the patient was admitted to a hospital with the onsite capacity to perform such procedures (for example, a catheterisation laboratory, with or without revascularisation facilities).^{5–7 22 23 31 32} The attending physician's specialty was identified from hospital discharge abstracts and Ontario Health Insurance Plan data. Patients were categorised according to the type of facilities available at the admitting institution (no onsite facilities or onsite facilities for angiography and revascularisation), regardless of whether they were subsequently transferred to another hospital. Patients at six hospitals that had onsite catheterisation only facilities were excluded from the analysis because of the small sample size (3.5% of the study cohort).

Outcomes

The two outcomes examined in this study were the use of coronary angiography and mortality at six months and one year. Coronary angiography was examined from the day of admission for up to six months after the AMI to allow for appropriate risk stratification.

Statistical analysis

Crude rates of angiography six months after AMI were analysed for all patients and for selected subgroups defined by age, sex, illness severity, neighbourhood income, availability of onsite revascularisation facilities, and attending physician specialty. Age was categorised into two groups: < 65 and ≥65 years. Illness severity and neighbourhood income were dichotomised about the median, while attending physician specialty was dichotomised into “cardiologists” and “non-cardiologists”. As discussed above, onsite service availability was categorised into hospitals with and those without onsite angiography and revascularisation facilities.

Cox proportional hazards models were developed to determine the relation of the above factors to the likelihood of having an angiogram at six months and to mortality one year after AMI. Death was the main censoring variable in the examination of factors that predicted coronary angiography. For each subgroup, analysis was adjusted for changes in patient (that is, age, sex, severity of illness, neighbourhood median income), physician, and hospital factors over time. This was accomplished by forcing each of these factors into the model and testing for their interactions against the year of hospitalisation as a continuous variable for each of the analyses. Data for patients admitted with AMI in each of the eight fiscal years from 1992 to 1999 were analysed. The interaction between each of the six factors and the year of admission was forced into the overall model to determine temporal trends. While some of these factors were correlated, formal diagnostic testing for collinearity did not show any variance inflation factor to be > 5.0. Accordingly, collinearity was not a significant issue for this analysis (that is, the maximum variance inflation factor was 2.9 across patient, physician, and hospital characteristics).

Significance was considered to be indicated by $p < 0.05$ in all analyses. The SAS (version 8) statistical software package was used for all analyses (SAS Institute, Cary, North Carolina, USA).

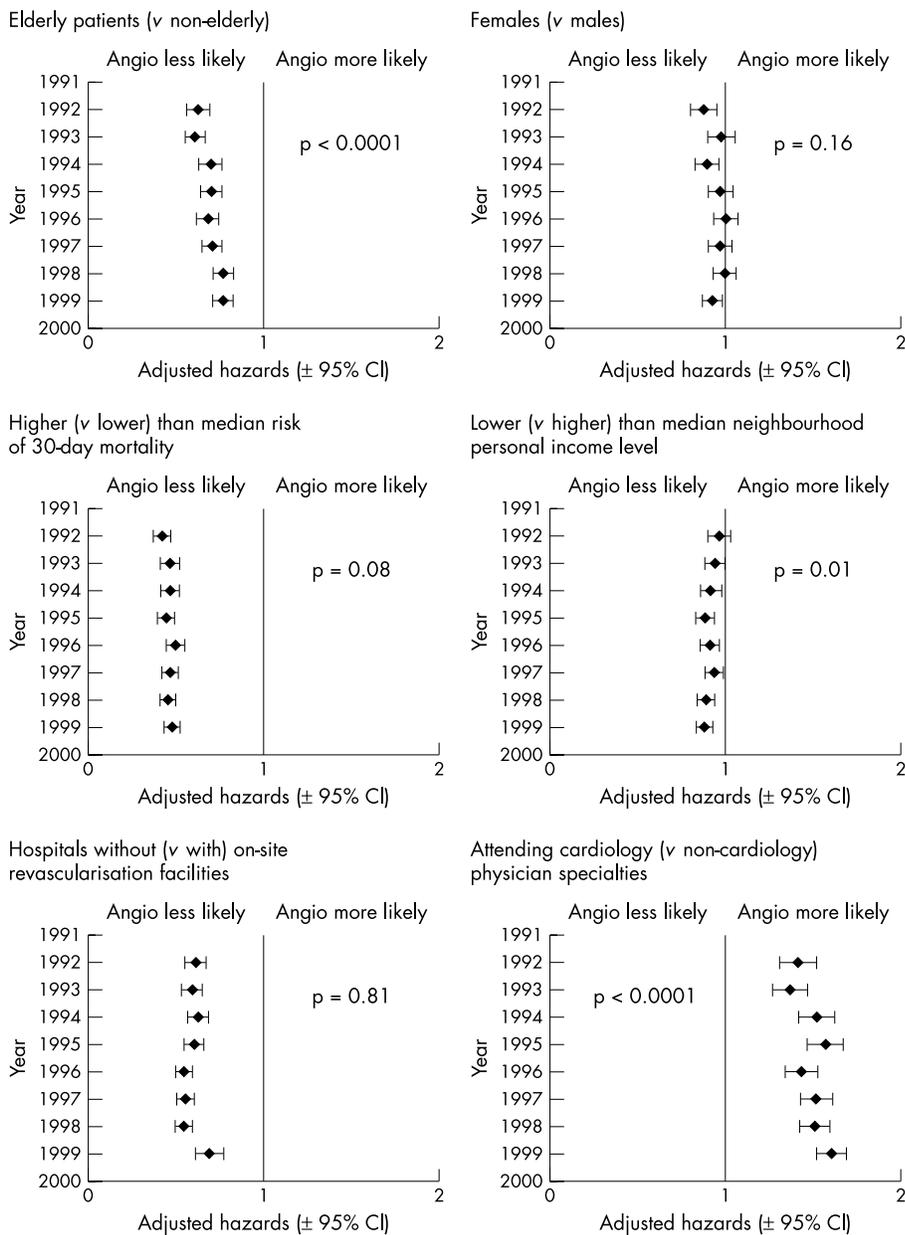


Figure 1 Trends in the six month utilisation rate of coronary angiography by subgroup, after adjustment for baseline patient, physician, and hospital characteristics among patients hospitalised with acute myocardial infarction between 1992 and 1999 in Ontario. Each of the six figures illustrates the adjusted risk ratios for angiography among the elderly (versus non-elderly), women (versus men), those with higher (versus lower) than median risk of 30 day mortality, those with higher (versus lower) than median neighbourhood personal income, hospitals without (versus with) onsite revascularisation facilities, and attending cardiology (versus non-cardiology) physicians. The p value reflects the interaction between the particular factor examined and the year of admission after adjustment for all remaining patient, physician, and hospital characteristics. Elderly refers to patients ≥ 65 years of age; angio, coronary angiography.

RESULTS

Baseline data

Table 1 shows the increase in angiography rates in the overall population and among the patients hospitalised with AMI in Ontario between 1992 and 1999. The correlation between the six month rate of coronary angiography per 100 AMI patients per year and the annual rates of coronary angiography per 100 000 entire adult population was 0.98 (p < 0.0001).

Table 2 shows significant changes in baseline characteristics of patients with AMI over time. Namely, AMI patients have become progressively older. While predicted 30 day mortality rates did not change significantly throughout the decade, the proportion of patients undergoing angiography when categorised as having higher than median illness severity increased progressively over time. In contrast, there was a steady decline in the proportion of patients admitted to hospitals with onsite revascularisation facilities as compared with hospitals without and in the proportion of patients managed by non-cardiologists as compared with cardiology attending physicians over time.

Crude trends in coronary angiography over time

Table 3 shows the unadjusted rates of coronary angiography according to each of the six patient subgroups between 1992 and 1999. On average, patients who were younger, male, healthier, more affluent, attended to by cardiologists, and admitted to hospitals with onsite revascularisation facilities were more likely to undergo coronary angiography in each of the presenting years. While progressive increases in the use of coronary angiography over time were noted for all AMI patients, crude increases in relative rates were most pronounced among the elderly (96% relative increase in angiography between 1992 and 1999, p < 0.001) and among those in the highest risk categories (118% relative increase in angiography between 1992 and 1999, p < 0.001).

Adjusted trends in coronary angiography over time

Figure 1 illustrates trends in coronary angiography for each of the six patient subgroups after adjustment for baseline differences in case mix, physician factors, and hospital characteristics. Utilisation rates of coronary angiography increased more significantly among older patients, among those in higher

Table 4 Adjusted relative change in the hazard ratios for angiography within six months after AMI over seven years in Ontario by subgroup, 1992–1999

Subgroup	Six month angiography		One year mortality	
	Adjusted change in RR (%)	p Value	Adjusted change in RR (%)	p Value
Patients ≥65 (v <65)	23.8	<0.0001	2.8	0.71
Women (v men)	5	0.16	0.7	0.83
Sicker* patients (v healthier)	10.2	0.08	26.4	<0.01
Poorer† patients (v wealthier)	-8.7	0.01	-11.0	<0.01
Attending non-cardiology (v cardiology) physician specialties	-18.1	<0.0001	15.7	<0.001
Admitting hospitals without (v with) onsite revascularisation facilities	-1.4	0.81	-7.2	0.25

*Sicker refers to patients with above median illness severity of predicted 30 day mortality.

†Poorer refers to patients with below median socioeconomic status.

socioeconomic classes, and among those managed by admitting cardiologists over time. Table 4 shows that on average, each progressive year between 1992 and 1997 was associated with a 3.4% (95% confidence interval (CI) 1.7% to 4.4%, $p < 0.0001$), 1.2% (95% CI 0.7% to 1.6%, $p = 0.01$), and 2.6% (95% CI 1.9% to 2.8%, $p < 0.0001$) increase in the relative risk of angiography among elderly (versus non-elderly) patients, those residing in more affluent (versus less affluent) neighbourhoods, and those managed by a cardiologist (versus non-cardiology physician) respectively, after adjustment for changes in baseline characteristics over time. These relative increases translated into absolute angiography increases of 23.8%, 8.7%, and 18.1% after adjustment for baseline characteristics for each of the three above subgroups, respectively. In contrast, trends in the adjusted rates of angiography were similar in men and women ($p = 0.16$), in those who had higher and lower levels of illness severity ($p = 0.08$), and in those admitted to hospitals with and without onsite revascularisation facilities ($p = 0.81$).

Mortality

The overall crude one year AMI mortality rate in Ontario decreased from 24% to 22% between 1992 and 1999 ($p < 0.0001$). Table 4 shows that after adjustment for baseline characteristics, reductions in mortality over time were most pronounced among those with lesser illness severity ($p = 0.002$), those residing in less affluent neighbourhoods ($p = 0.002$), and those managed by cardiology physicians during the index admission ($p < 0.001$). Adjusted mortality rates decreased in a similar fashion among elderly patients compared with the young, among men compared with females, and among those admitted to hospitals with as compared with hospitals lacking onsite revascularisation facilities.

DISCUSSION

Our study found that while increases in overall capacity for coronary angiography did result in significant increases for most patients hospitalised with AMI in Ontario, physicians referred some patient subgroups disproportionately. Specifically, referral rates for post-MI angiography have risen most predominantly among the elderly, the more affluent, and those being managed by cardiologists as compared with non-cardiology attending physicians. In contrast, increases in utilisation rates of coronary angiography were similar among men and women and among patients admitted to centres with or without onsite revascularisation facilities. Intergroup differences in one year mortality have progressively narrowed between indices of risk and levels of socioeconomic status, have widened between attending cardiology and non-cardiology specialties, and have remained unchanged between age categories, sex, and hospital subgroups.

Our findings are consistent with previously published data showing more aggressive invasive cardiac procedural utilisation rates among elderly patients over time.^{3,4} Despite the significant temporal relation between angiography use and age, sex specific differences were inconsistent and did not vary significantly over time. While women were less likely to undergo angiography after an AMI in the early 1990s, sex gaps narrowed during the mid 1990s, only to widen again towards the end of the decade. Given that women are generally older than men at AMI presentation,³³ such inconsistent findings may not be surprising, since any potential sex related temporal differences may have been overshadowed by the temporal increases in angiography use among the elderly.

Our results are also consistent with studies showing persistent inequities in socioeconomic related access to medical care despite increasing funding and supply.^{34,35} The finding that socioeconomic related disparities in the utilisation of post-MI coronary angiography widened with time may suggest that physicians preferentially select more affluent patients for discretionary procedures when faced with increasing supply or capacity. Indeed, one recent study found that socioeconomic disparities decreased with increasing angiography supply when funding was allocated based on models that accounted for markers of medical need.³⁶ While it is possible that the phenomenon of supply induced preferential access observed in our study was confined to those with lower levels of clinical urgency or necessity,²¹ our findings may suggest that increases in supply alone may perpetuate rather than eliminate access inequities to specialised cardiac services when resources are implicitly rather than explicitly managed. Thus, we believe that our findings support the need for reform initiatives that refine the methods by which patients are selected and referred for coronary angiography in Ontario. Indeed, such initiatives may include the earmarking of funds to specific sociodemographic or clinical subgroups.

Physicians may utilise increasing supply differently across specialties. In our study, cardiologists became increasingly more aggressive in referring patients for coronary angiography compared with non-cardiologists. Moreover, this physician specialty effect may explain why angiography rates rose similarly at hospitals with and without onsite revascularisation facilities, given exponential increases in the number of cardiologists practising at community based hospitals with no onsite revascularisation facilities throughout the decade. Many studies have illustrated that cardiologists have become increasingly more aggressive in referring patients for catheter based interventions over time.^{3,4} Non-cardiologists may be less aware of recent studies favouring aggressive interventional approaches in patients after an AMI or they may be less capable of influencing angiography rates. This in part may relate to perceived differences in the efficacy of newer adjunctive technologies used in combination with catheter based

interventions,³⁷ given that recent evidence suggests that variations in the use of established evidence based treatments may be diminishing with time.²

Intergroup differences in coronary angiography did not correlate ecologically with variations in mortality over time, supporting the observations of other population based studies illustrating that the two outcomes are independent of one another.^{4,38} Indeed, for socioeconomic status the relation between angiography trends and mortality trends were discordant. For example, despite relative increases in angiography use among the most affluent, mortality rates declined more dramatically among the poor. Nonetheless, coronary angiography may be serving as a proxy for other evidence based treatments whose trends are also changing disproportionately in some subgroups relative to others.⁴ For example, age differences seen in the use of thrombolytic agents and angiography were also seen in the use of β blockers and calcium channel blockers in a cohort of elderly AMI patients in a Medicare database.⁴ Moreover, it is unknown whether variations in access to angiography account for differences in softer outcomes such as quality of life within subgroups.³⁹

Study limitations

There are two important limitations in our study. Firstly is the use of linked administrative data, which limited our ability to characterise the patients in our cohort, either in regard to their own baseline health status or in regard to the specific nature of the care they received during the index hospitalisation or in follow up. In particular, we were unable to assess whether trends and variation in the use of cardiac procedures over time were appropriate or inappropriate. Nonetheless, we did control for many important prognostic variables, such as age, sex, presence or absence of coexisting conditions, and the presence or absence of complications, such as cardiogenic shock, at the time of the index admission. Secondly, we incorporated ecological rather than individual level markers of socioeconomic status. It is unknown whether such access disparities would have persisted had we used individual socioeconomic indicators. Nonetheless, these limitations must be traded off against the comprehensiveness of our sample, which itself is highly representative of the Canadian population.

Conclusion

Our findings suggest that, despite universal health care, not all types of patients have benefitted equally from increases in overall service capacity for coronary angiography. Further study is required to discern whether increased supply will decrease previously noted biases in the absence of formal policies directed towards certain disadvantaged groups. It will also be important to determine who would be most likely to benefit from increases in supply. Wider implementation of data monitoring and explicit management systems may be required to ensure that appropriate utilisation of specialised cardiac services is allocated to patients who are most in medical need.

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IMAGES IN CARDIOLOGY.....

Use of intravascular ultrasound in evaluating coronary artery aneurysm

A 61 year old woman without any significant past medical history was admitted to our hospital with acute coronary syndrome. Coronary angiography revealed diffuse coronary ectasia without true evidence of stenosis. The right anterior oblique view showed two coronary aneurysms in the circumflex coronary artery and an ectatic left anterior descending coronary artery (upper panel). In order to evaluate the morphology of this vessel abnormality and to definitely exclude coronary artery stenosis, intravascular ultrasound (IVUS) was performed. IVUS visualised the complete absence of any atherosclerotic changes in the normal part of the circumflex artery (panel A) and in the aneurysmic vessel segments (panels B and C).

Coronary artery aneurysm is a rare clinical entity for which a variety of aetiologies have been reported. Coronary artery aneurysm can be atherosclerotic in origin, secondary to coronary interventions, or inflammatory in origin, including autoimmune vasculitis (Takayasu disease, systemic lupus erythematosus, polyarthritis nodosa), connective tissue disorders (Marfan's syndrome, Ehlers-Danlos syndrome) and congenital lesions.

In contrast to the presented case, coronary artery aneurysm is most commonly found in primarily atherosclerotic coronary artery disease. Despite intense diagnostic approaches the exact aetiology of the coronary abnormality in this case could not be clarified. The disease has therefore been described as non-atherosclerotic and non-inflammatory coronary ectasia, with vasculitis-like vessel alterations of unknown origin.

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