

EDITORIAL COMMENT

Comparing the U.S. and Canadian Approaches to Coronary Angiography: What Have We Learned?*

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Coronary angiography after myocardial infarction is one of the most well-studied procedures in contemporary medical care (1), yet substantial geographic variability persists in the use of this procedure both within the U.S. (2,3) and between the U.S. and Canada (4–6). In this issue of the *Journal*, Batchelor et al. (7) described the effect of this variability on the detection of severe coronary artery disease (CAD), and they attempted to assess its implications for patients' outcomes (7).

Using data from the Global Use of Strategies to Open Occluded Arteries in Acute Coronary Syndromes (GUSTO-1) trial, Batchelor et al. (7) compared the frequency with which patients with severe (left-main or three-vessel) CAD were detected in the U.S. and Canada. On the basis of earlier randomized clinical trials, these patients were

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likely to experience reduced mortality over five years if they underwent coronary artery bypass graft (CABG) surgery rather than continuing with medical therapy alone (8). As previously reported from the GUSTO-1 trial (5), U.S. patients underwent coronary angiography much more often than clinically comparable Canadian patients (71% vs. 27%).

Batchelor et al. (7) extended this finding by evaluating the results of coronary angiography. In the U.S., approximately two-thirds of patients with severe CAD were detected by angiography, whereas in Canada only about one-fifth of such patients were identified. Although no actual outcomes were presented for these patients, the investigators estimated that five more patients would be expected to survive five years for every 1,000 patients treated with the more

frequent use of angiography and CABG surgery in the U.S. relative to the more conservative Canadian approach.

This gain, however, came at the cost of performing many more angiograms in the U.S. in patients without severe CAD (59% of all patients in the U.S. vs. 22% of all patients in Canada). Some of these patients experienced recurrent ischemia or reinfarction and probably benefited from percutaneous transluminal coronary angioplasty (PTCA) for one- or two-vessel disease, but most of them seemed to have had uncomplicated myocardial infarctions (9). Presumably, U.S. physicians were tempted to "take a look" at such patients' coronary anatomy with the hope of detecting unrecognized severe disease or performing elective PTCA.

When interpreting analyses of clinical practices from GUSTO-1 or other randomized clinical trials, readers should carefully consider whether the study's patients are representative of the broader population of interest. In the case of GUSTO-1, all patients met strict eligibility criteria for the administration of thrombolytic therapy (presentation within 6 h of the onset of symptoms, ST elevation on the initial electrocardiogram and no major contraindications), and almost all patients actually received this treatment (9). Participating hospitals were much more likely to offer coronary angiography and revascularization procedures on-site than were U.S. and Canadian hospitals in general (5,6). Moreover, patients who enrolled in GUSTO-1 were younger and had fewer coexisting illnesses than patients who were not enrolled (10). GUSTO-1 patients in both the U.S. and Canada were more likely to undergo coronary procedures than patients with myocardial infarction (MI) in either country usually do.

Nonetheless, the findings of Batchelor et al. (7) are probably generalizable to more typical patients with MI in these two countries. The substantially greater use of coronary angiography and revascularization procedures in post-MI patients in the U.S. compared with Canada has also been described in the Survival and Ventricular Enlargement trial with different enrollment criteria (4) as well as in a population-based study based on administrative data (6). Therefore, the greater diagnostic yield for detecting severe CAD in the U.S. relative to Canada would also probably be present in less narrowly defined cohorts from these two countries.

What lessons can physicians and policymakers draw from this study? Before angiography, neither U.S. nor Canadian physicians identified patients with an increased risk of severe CAD at a frequency greater than chance. This finding highlights the need for better statistical tools to predict severe CAD. Such tools must incorporate readily available clinical information, have reasonable accuracy and be well disseminated if they are to be useful to practicing physicians. Although such tools were not a primary focus of their

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analysis, Batchelor et al. (7) generated one such tool from GUSTO-1 data, using six simple variables to achieve moderate accuracy in predicting severe CAD. Further refinement of such tools could help physicians become more selective in their use of coronary angiography after MI, thereby recommending it more often to patients with a high probability of severe disease and less often to patients with a low likelihood.

A different approach to the selection of patients for early coronary angiography was tested in the Thrombolysis in Myocardial Infarction (TIMI) II trial (11), in which 3,262 patients with acute MI were randomized to either an invasive or a conservative strategy. In the former, routine coronary angiography was carried out 18 to 48 h after admission, and in the latter, predischarge stress testing was performed and angiography carried out if spontaneous or stress-provoked ischemia was detected. In both groups, revascularization was carried out if the coronary anatomy was appropriate. In the invasive strategy, 63% of the patients underwent early revascularization, and in the conservative arm, 33% had angiography (a percentage similar to the Canadian patients in GUSTO-I) and only 20%, less than one-third of those in the invasive arm, underwent revascularization. Both early (six week) and late (three year) follow-up showed essentially identical outcomes (12). Thus, by limiting early postinfarction angiography to patients with ischemia, the need for coronary angiography could be greatly reduced without adversely affecting important outcome end points (death, recurrent infarction as well as ejection fraction at rest or during exercise). The value of this approach was confirmed in the Should We Intervene Following Thrombolysis? trial (13).

For Canadians, Batchelor et al. (7) have added to previous research that suggested that the restricted availability of coronary angiography and revascularization procedures may result in suboptimal relief of cardiac symptoms (4,5) and possibly some increased risk of avoidable mortality, particularly for elderly patients (5,14). In the Canadian system of global budgets for medical care, decisions to restrict coronary procedures are fairly explicit. As long as citizens and legislators are well aware of these restrictions and their consequences, lower procedure rates and longer waits may be acceptable to most Canadians. In the Canadian political system, competing budgetary priorities within and beyond health care have thus far been judged more compelling than the need to increase the availability of coronary procedures to U.S. levels. Nonetheless, Batchelor et al. (7) presented evidence that low rates of coronary angiography for Canadian patients over age 75 may fail to identify many patients with severe CAD who would benefit from CABG surgery. The ethical and clinical foundation for such rationing must continue to be reevaluated as new data on the outcomes of older patients become available.

In the U.S., a very different health-care system has evolved. The Medicare program provides nearly universal access to primary and specialty care for persons aged 65 and

older, but lack of insurance and low income can be major barriers to coronary procedures for younger persons (15,16). Moreover, a tradition of unrestricted fee-for-service care and minimal regulation of cardiac services has resulted in the wide dissemination of facilities for performing coronary angiography and revascularization procedures. As a result, well-insured patients with CAD can expect to receive coronary angiography and revascularization procedures with little or no delay, as demonstrated by the high U.S. rate of angiography in GUSTO-1. Few U.S. patients or physicians would seek to emulate the more restrictive approach to coronary procedures found in Canada, but many would welcome the more equitable access that the Canadian system provides to low-income residents.

Rather than responding to U.S.–Canadian comparisons, U.S. physicians and policymakers are more likely to react to strong evidence of geographic variations within the U.S. Substantial differences in rates of coronary procedures among U.S. regions—without clear effects on outcomes—generate ample uncertainty about the appropriate use of these resources (2,3). Past studies have demonstrated that the on-site availability of coronary procedures is a major factor determining whether patients receive them in the U.S. (17–19). Paradoxically, this factor favors the selection of younger and lower-risk patients for angiography—a group that may derive limited benefit from this procedure (20). Although economic incentives contribute to this pattern of care, physicians who perform coronary procedures or practice in hospitals that offer them actually perceive coronary angiography as more beneficial than do other physicians, particularly for patients with uncomplicated conditions (21). Thus, altering physicians' decision making about this procedure will not be a simple task.

Future research can build on the work of Batchelor et al. (7) by assessing how often severe CAD is detected and appropriately managed in U.S. regions with widely varying rates of coronary angiography. As the understanding of CAD and its treatment evolves, studies of clinical practice can illuminate how physicians balance the many clinical and economic influences on their decision making—and the subsequent effect of their decisions on patients' outcomes.

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