Epidemiology and Ethics of Coronary Artery Bypass Surgery in an Eastern County

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Despite an extensive literature on coronary artery bypass grafting (CABG) surgery in the last decade, relatively little has been written on the demographic or socioeconomic characteristics of patients who receive this limited medical resource. In the present study data were collected on all patients (N = 539) who received this procedure over a one-year period (July 1977 to June 1978) within Erie County in western New York. Using available census tract data, age-sex adjusted surgery rates by socioeconomic status are developed for defined geographic areas. Patients residing in the city of Buffalo and those from census tracts in the lowest quartile of median family income have dramatically lower surgery rates than do others in the county ($P < .001$).

Although these discrepancies in CABG surgery rates may be partially explained by differing incidence rates of the medical indications for CABG surgery, problems of access to the service may be operative. Three different principles of distributive justice (equality, liberty, and utility) are discussed in an attempt to see how they might be applicable to the pattern documented.

Over the last decade, coronary artery bypass grafting (CABG) has been increasingly utilized as a treatment for coronary heart disease. Miller et al have estimated that 100,000 such procedures were performed in the United States by 1974,[1] and Braunwald has claimed that 70,000 CABG operations were done in this country in 1977.[2] It seems reasonable to assume that during 1981 well over 100,000 of these procedures will have been performed in the United States.

Debate on the efficacy of this procedure, particularly as it affects long-term survival, has been wide ranging. Hundreds of articles on all aspects of CABG surgery have appeared in the medical

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literature, and McIntosh and Garcia, in a review article on the subject, refer to over 200 of them in the last ten years.[3] The lay press has also picked up on the controversy, choosing to focus on the diverse reactions to the Veterans Administration cooperative study of Murphy and colleagues.[4] In a preliminary report of that study, a large, multicenter, prospective randomized trial of surgical vs medical treatment for coronary artery disease, these investigators found similar 30-month survival rates for both groups.[5] In an accompanying editorial, Braunwald pointed to the need for further studies, since the estimated cost of these procedures in 1977 approached $1 billion and could potentially affect such a large number of patients.[6] The response to both the published study and the editorial was so large that a "special correspondence" section was needed to adequately cover it.[7]

Despite the availability of such extensive literature and the continued debate that surrounds this topic, surprisingly little has been written about the demographic, socioeconomic, or occupational characteristics of patients who have received this procedure or on what basis decisions are made to use this operation for medically similar patients.

Rimm et al have reported on the occupational characteristics of patients before and after coronary artery bypass grafting surgery.[8] They found that 32 percent of patients in their study changed their occupation after the operation and suggested that further studies would be necessary to fully assess the benefits of this procedure. Others have presented data at national meetings which indicate that only 50 percent of patients have resumed their previous work. Stoney et al, in a report on the hospital and physicians' cost of CABG surgery, point out that a true cost-benefit ratio cannot be computed until long-term social costs and benefits are written into the equation.[9] This kind of computation would necessitate knowledge of the socioeconomic conditions of patients receiving CABG surgery.

How one allocates expensive and limited medical resources is a question of concern for many, both in and outside the profession. Coronary artery disease is an extremely common disorder across all segments of Western society, and a large number of patients, therefore, will have the medical indications that may make them candidates for the procedure. Decisions about who should receive the limited number of CABG operations available should be carefully considered in conjunction with the questions of cost-benefit and clinical efficacy.

In the present study, these aspects of CABG surgery are examined. By reviewing all patients receiving CABG surgery in Erie County in western New York state over a one-year period, age-sex adjusted surgery rates can be delineated for each census tract and therefore provide information on the geographic and socioeconomic distribution of CABG patients in this large and varied population area. Since Erie County (approximately 1 million population) contains inner city, urban, suburban, and rural communities, data obtained in this locale should be partially representative of national trends.

Methods

All coronary artery bypass grafting surgery was performed in four hospitals in a western New York county affiliated with the State University of New York at Buffalo School of Medicine. The Buffalo General Hospital is a 700-bed university hospital located in the heart of the inner city and draws patients from all of western New York. It accounts for more than one half of all coronary artery bypass procedures done in the county. The Millard Fillmore Hospital is a large, private urban hospital, the only one in Buffalo with a suburban branch. It does fewer CABG procedures than the Buffalo General but substantially more than do the other two hospitals in the study. The Veterans Administration Medical Center is a large facility at the edge of the city. Its CABG patients during the period under study were largely from outside Erie County (62 of 95 patients), including six from out of state. The Erie County Medical Center is a county owned hospital equipped for CABG surgery. It serves the medically indigent of the county but does provide some private care as well.

The records of all patients having CABG surgery between July 1, 1977, and June 30, 1978, from these four hospitals were obtained. All were screened to verify surgery. Data collected included age, sex, race, marital status, permanent address, and method of payment.

Patient addresses were replaced by the appropriate census tract code. Cases were then coded

Table 1. Coronary Artery Bypass Grafting Surgery Performed in Erie County, July 1, 1977 to June 30, 1978

Hospital	Number Surgeries Reported	Patient Data Available	Erie County Residents	Data Not Available
Buffalo General Hospital	427	388	274	39
Millard Fillmore Hospital	236	233	209	3
Veterans Administration Medical Center	97	95	33	2
Erie County Medical Center	39	37	23	2
Total	799	753	539	46

for each of the other parameters, and the results tabulated. The Community Services Research and Development Program of the Department of Social and Preventive Medicine at State University of New York at Buffalo has data stored in a computer program for all 215 census tracts in Erie County. The data for this program were obtained from the 1970 census. They were subsequently found to be accurate based on household surveys conducted by the department. For each census tract, the following information was obtained: total population, median family income, percentage of population that was white, number of males and females, and a breakdown of the population by age brackets.

Since data and cases were available in 215 census tracts in 40 towns or neighborhoods, it was necessary to group the data for ease of presentation. This was done first by combining neighborhood and town data into three defined geographic divisions: the City of Buffalo, suburban Erie County, and rural Erie County. In addition to geographic groupings, the data were also ordered by median family income in each census tract and divided into quartiles. This was done to more accurately assess socioeconomic status, since some geographic areas had many census tracts that showed wide variations in median family income.

The age-sex adjusted rate of CABG surgeries per 1,000 population was then computed for both geographic areas and strata of median family income in the census tract of residence.

The null hypothesis was that surgery rates were equivalent in the three geographic areas and in the four quartiles of median family income of census tract of residence. Conventional chi-square tests of the significant difference of the rates were computed for the data.

In addition, chi-square analysis for linearity, as well as nonlinearity of surgery rate vs quartile of median family income, was performed.

Results

Again, only those CABG surgery patients known to be from Erie County were included in the study. The maximum number of "nonrespondents" in the study was therefore 46 (whose residences were unknown) plus however many Erie County residents had CABG surgery done elsewhere. As can be seen from Table 1, the total number of cases of coronary artery bypass grafting reported by all hospitals was 799. Of these, 539 were definitely performed on patients from Erie County. Forty-six cases were placed in the category labeled "data not available," either because the patient file was not available or because no record of surgery was found in the file. Whether those cases were from inside or outside the county cannot be determined.

As can be seen from Table 2, the majority of CABG surgery patients from Erie County are white, male, and between the ages of 45 to 64

Table 2. Age, Sex, and Race of Coronary Artery Bypass Grafting Surgery Patients in Erie County, July 1, 1977 to June 30, 1978

	Number	Percent
Sex		
Male	448	83.1
Female	91	16.9
Age		
Less than 45 years	64	11.9
45-64 years	434	80.5
65 years and older	41	7.6
Race		
White	312	57.9
Other	9	1.7
Unknown*	218	40.4
Males		
Less than 45 years	52	9.7
45-64 years	361	67.0
65 years and older	28	5.0

*One of the hospitals reviewed failed to report these data

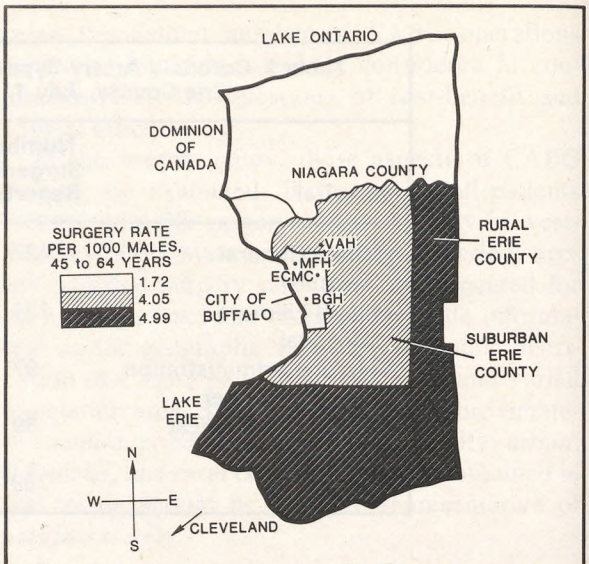

Figure 1. Age-sex adjusted CABG surgery rate in Erie County, white male patients, aged 45 to 64 years. VAH—Veterans Administration Hospital Medical Center; MFH—Millard Fillmore Hospital; ECMC—Erie County Medical Center; BGH—Buffalo General Hospital

years. The patients were divided into the age groupings shown in Table 2. First, incidence data for coronary heart disease are often presented in these age categories[10]; and second, Medicare eligibility would require a division of the age group 65 years and over. Although data on racial background of the CABG patients are incomplete (due entirely to the failure of Millard Fillmore Hospital to report it), analysis of the place of residence of CABG patients from Millard Fillmore Hospital shows that only five cases resided in census tracts with less than a 90 percent white population. The remaining cases were from census tracts with an average white population of 97 percent.

Since men between the ages of 45 to 64 years received the majority of the operations in Erie County (67 percent), the analysis on that subgroup will be reported. The results for all other subgroups are almost identical. Table 3 displays the place of residence of male CABG patients aged 45 to 64 years from Erie County and includes a surgery rate computed from the population at risk in each geographic area. The vast majority of patients receiving this surgery in Erie County were from both suburban and rural areas, both of which had a rate of surgery per population at risk almost 2.5 times greater than in the city. These data are also illustrated in Figure 1.

Similar differences in the rates are found when CABG patients were grouped by quartiles of median family income of the census tract in which they resided (Table 4). The surgery rate per quartile of median family income increases through the first three quartiles. An additional analysis for nonlinearity throughout the entire curve is also significant (chi square = 9.6, $P < .01$) and demonstrates a significant curvilinear relationship (chi-square = 18.6, $P < .001$). Finally, Table 5 displays the method of payment for these patients. Over 85 percent had private insurance and only 4 percent were on Medicaid.

Discussion

Although there are probably a few patients from Erie County who received CABG surgery elsewhere (Rochester or Cleveland, for instance), the performance of over 500 such surgeries in an area of over 1,000,000 people is consistent with the

Table 3. Geographic Distribution of Men Aged 45 to 64 Years Having Coronary Artery Bypass Grafting Surgery in Erie County, July 1, 1977 to July 30, 1978

Area	Population	CABG Recipients	Surgery Rate per 1000 Men Aged 45 to 64 Years
City	52,394	90	1.72
Suburb	58,295	236	4.05
Rural	7,012	35	4.99
Total	117,701	361	3.07

X^2=58.05, 2 *df*, P<.0001

prediction of over 100,000 such operations nationwide. The majority of these procedures were done on men between the ages of 45 to 64 years (67 percent). Since one hospital did not have information on race available in its records, it is impossible to definitely delineate the incidence of surgery along racial lines. Nevertheless, since census tract data are available for patients where race was not delineated in the record (approximately 40 percent) and since these patients (with the exception of five cases) were from census tracts with an average white population of 97 percent, it is reasonable to conclude that it is highly likely that only a small number of blacks in Erie County received CABG surgery during the study period.

The age-sex adjusted surgery rates for men aged 45 to 64 years indicates that this procedure was not performed equally across geographic or socioeconomic groups within the county. Geographically, the highest surgery rate is found in the rural areas of Erie County. Two important facts ought to be noted, however, in evaluating these data. First, census tract data reveal that the median income in the rural areas is relatively high, and second, no rural township is more than a 60-minute drive from the major medical centers providing tertiary care. In a sense then, although these areas are considered rural geographically and politically, they cannot be understood to represent typical rural America.

What does seem clear is that male patients residing in the city or in census tracts with low median family income receive much less CABG surgery than would be expected based solely on the population at risk. Although census tract data may not be fully accurate in 1978 and do not fully account for either all of the risk factors which influence prevalence or associated diseases that may contraindicate the procedure, the lower rate of CABG surgery for certain groups is striking. Although specific data on the incidence of coronary heart disease in each census tract are not available, it would be unlikely that such information would serve to totally equalize the rate of CABG surgery across the county. It is possible, however, that precise information on the number of patients in each group with indications for CABG surgery might explain some of the discrepancy. It may be, for instance, that patients from poorer neighborhoods do not have intractable angina and are simply not CABG candidates. Although there are some data which suggest that blacks have less symptomatic coronary heart disease than whites,[11] there is also a report of increased coronary atherosclerosis in young black men when compared with whites.[12] Although family income data are not specific for each CABG recipient, data on method of payment for all patients in the study corroborate the low rate of surgery among poor, as measured by Medicaid eligibility.

There are, however, other reasons for these discrepancies, which seem reasonable to postulate and do not rely on the unclear data about symptomatic coronary heart disease across different groups. It seems fair to hypothesize, for example, that the higher rate of CABG surgery among those residing in the suburbs or rural areas and those from census tracts with higher median family income reflects better access to private primary and secondary medical services with subsequent refer-

Table 4. Distribution of Coronary Artery Bypass Grafting Surgery Patients in Erie County by Quartile of Median Family Income for Men Aged 45 to 64 Years, July 1, 1977 to July 30, 1978

	Quartile of Median Family Income				
	0-25	25-50	50-75	75-100	Total
Population	29,327	29,227	29,497	29,650	117,701
CABG Recipients	50	87	113	111	361
(Expected CABG)	(90)	(90)	(90)	(91)	(361)
Surgery Rate (per 1,000)	1.70	2.98	3.83	3.74	3.07

X^2=28.2, 3 *df*, P<.001

ral for tertiary care. Along these lines, could the higher surgery rate in rural communities be accounted for on the basis of well-worked-out referral plans coupled with the relative proximity to the centers?

The data on method of payment of CABG surgery patients are consistent with both the geographic and socioeconomic distribution of surgeries. For men aged 45 to 64 years, only 15 (4 percent) had Medicaid as their method of payment. The obvious underrepresentation of this group of patients receiving CABG surgery could be understood either in terms of that group's relatively poor access to the private health care system, which generated the vast majority of referrals to the centers, or in terms of a vastly reduced prevalence of the symptoms of coronary heart disease, which would make them surgical candidates. In addition, the few Medicaid CABG recipients might reflect an inappropriate "payment policy" by this particular insurance plan, especially when compared with Blue Shield. In New York State for example, Medicaid reimburses up to (but often less than) 85 percent of the "usual and customary rate," whereas in Washington, DC, for example, the reimbursement for CABG surgery by Blue Shield was increased by 75 percent from 1975 to 1978.[13]

In conclusion, the data presented here clearly point to significant discrepancies in the distribution of CABG surgery across a large heterogeneous geographic area. Whether the pattern observed represents "inequities" in the system cannot be fully ascertained from this study. Even if this pattern truly represents an unequal distribution among equally needy candidates, it will be necessary to first consider and apply principles of distributive justice to the problem before judging its "fairness." Questions about scarce health care resource allocation have a "moral" component but are, in the final analysis, questions of public policy which have little to do with the ethical positions of individual providers.

Table 5. Method of Payment of CABG Surgery Patients in Erie County for Men Aged 45 to 64 Years, July 1, 1977 to June 30, 1978

Method of Payment	Number of Patients	Percent
Blue Cross/Blue Shield	248	69
Commercial	68	19
Medicaid	15	4
Veterans	27	7
Private	3	1
Total	361	100

Ethical Considerations

The distribution of limited medical resources may require justification in the often conflicting moral principles of equality, liberty, and utility. An egalitarian theory, as proposed by Veatch,[14] or the notion of "justice as fairness" as developed by

Rawls[15] would demand the dispensing of scarce medical goods based purely on need, by lottery, or even as it may benefit the "least well-off" in society. The data on the distribution of CABG surgery in Erie County suggest that its moral foundations could be found in these kinds of distributive theories only if one could clearly document that few patients from the city or from poor neighborhoods or of black ancestry had the indications for coronary artery bypass grafting surgery.

On the other hand, a principle of utility that enjoins one to maximize the greatest good for the greatest number[16] may also help us to explain these data. Cost-benefit analysis presupposes this moral principle[17] and is often the approach used in justifying the allocation of expensive and scarce medical resources. If, for example, CABG surgery is performed on those patients who will, as a result of their surgery, be able to further contribute to society (by virtue of the work they do), then the distribution pattern seen in this study may be justifiable. Since a large-scale analysis on the "contributions" of patients after receiving CABG surgery has yet to be completed, it is presently difficult to invoke the principle of utility as the moral basis for the distributive pattern documented.

Finally, the notion of liberty as expanded philosophically by Nozick[18] and extrapolated to health care by Sade[19] may be applicable to the distributive pattern observed. If health care resources (ie, CABG surgery) were in some sense rightfully "owned" by those who possess them, then they are at liberty to parcel them in the manner they choose as long as the personal freedoms of others are not violated. In this view, the preferential performance of CABG surgery on predominantly white, financially viable patients would be morally "right" and imminently "fair." However, even presupposing a libertarian principle, problems of "ownership" of health care goods remain unclear. Since medical education and hospital facilities are subsidized in no small part by public monies, this view of justice may be difficult to apply in the health care field.

In conclusion, this study examines the distribution of a scarce but important health care resource across a large and heterogeneous geographic area, and demonstrates clear discrepancies among various geographic and socioeconomic groups. Whether the pattern of CABG surgery indicates unequal allocation or represents simply the unequal distribution of real surgical candidates across these groups (or, in the spirit of compromise, some of both) is uncertain. What does seem clear is that if a rational and just health policy for this nation is to be developed, it will be necessary to examine prevailing patterns of distribution for many health care resources, to thoroughly discern the factors which may explain them, and to unpack and scrutinize, in multidisciplinary forums, the principles of justice that may or should underlie them.

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