

THE VALUE OF ROUTINE PREOPERATIVE MEDICAL TESTING BEFORE CATARACT SURGERY

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ABSTRACT

Background Routine preoperative medical testing is commonly performed in patients scheduled to undergo cataract surgery, although the value of such testing is uncertain. We performed a study to determine whether routine testing helps reduce the incidence of intraoperative and postoperative medical complications.

Methods We randomly assigned 19,557 elective cataract operations in 18,189 patients at nine centers to be preceded or not preceded by a standard battery of medical tests (electrocardiography, complete blood count, and measurement of serum levels of electrolytes, urea nitrogen, creatinine, and glucose), in addition to a history taking and physical examination. Adverse medical events and interventions on the day of surgery and during the seven days after surgery were recorded.

Results Medical outcomes were assessed in 9408 patients who underwent 9626 cataract operations that were not preceded by routine testing and in 9411 patients who underwent 9624 operations that were preceded by routine testing. The most frequent medical events in both groups were treatment for hypertension and arrhythmia (principally bradycardia). The overall rate of complications (intraoperative and postoperative events combined) was the same in the two groups (31.3 events per 1000 operations). There were also no significant differences between the no-testing group and the testing group in the rates of intraoperative events (19.2 and 19.7, respectively, per 1000 operations) and postoperative events (12.6 and 12.1 per 1000 operations). Analyses stratified according to age, sex, race, physical status (according to the American Society of Anesthesiologists classification), and medical history revealed no benefit of routine testing.

Conclusions Routine medical testing before cataract surgery does not measurably increase the safety of the surgery. (N Engl J Med 2000;342:168-75.)

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CATARACT surgery is the most commonly performed operation in elderly people in developed countries. In the United States, Medicare beneficiaries underwent approximately 1.5 million cataract operations in 1996. Since 1984, in the United States, this surgery has been performed almost exclusively as an outpatient procedure, with the use of local anesthesia, usually in conjunction with intravenous sedation. The rates of periop-

erative morbidity and mortality associated with cataract surgery are low.^{1,2} Nevertheless, because patients with cataracts tend to be elderly and to have serious coexisting illnesses,³⁻⁷ many physicians believe that a systematic medical examination with laboratory testing must be performed before a patient can be considered eligible for surgery.^{4,8}

In 1993, the Agency for Health Care Policy and Research published guidelines for the management of cataracts.⁹ The agency endorsed "appropriate" testing but did not provide specific recommendations based on reported data. We subsequently performed a national survey of ophthalmologists, anesthesiologists, and internists and found that the majority of the respondents routinely ordered complete blood counts, measurements of serum electrolytes, and electrocardiograms preoperatively.⁴ Other tests, such as chest radiography, blood-clotting studies, and urinalysis, were also ordered often, although less frequently. Many physicians did not think that the tests were necessary but ordered them anyway because of institutional requirements, medicolegal concerns, or a belief that another physician wanted them performed. We have estimated that the direct cost to Medicare of routine medical testing before cataract surgery is \$150 million annually.¹⁰ Because of variation in the tests ordered and uncertainty about the effectiveness of such testing, we performed a prospective, randomized clinical trial to assess whether routine medical testing before cataract surgery reduces the rate of complications during the perioperative period.

METHODS

Patients and Medical Procedures

The study was designed to be a large trial with few exclusion criteria and easily assessable principal outcomes. Nine clinical centers participated. These nine centers represented a mix of private practices operating at free-standing ambulatory-surgery centers, academic medical centers, and community hospitals. The study

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imposed no changes in the procedures for anesthesia or cataract surgery that were routine for each center and each surgeon. The study protocol was approved by the human-subjects committees of all nine centers.

Patients scheduled to undergo cataract surgery were recruited between June 1, 1995, and June 30, 1997. Patients were excluded from the study if they were less than 50 years old, were to receive general anesthesia, had had a myocardial infarction within the preceding 3 months, had undergone any preoperative medical testing during the 28 days before enrollment, or could not speak English or Spanish. Patients were not excluded for any other reason. All patients provided written informed consent before enrollment.

For the patients who agreed to participate in the study, each scheduled cataract operation in a single eye was randomly assigned either not to be preceded by routine medical testing (the no-testing group) or to be preceded by routine testing (the routine-testing group). Patients were informed of the group assignment of their operation and were given a letter and study brochure to take to the health care provider who was to perform the preoperative medical assessment. If the patient's operation was randomly assigned to the no-testing group, the letter requested that no preoperative testing be performed, unless the patient presented with a new or worsening medical problem that would warrant medical evaluation with testing even if surgery were not planned. For patients whose operations were randomly assigned to the routine-testing group, the letter requested that a 12-lead electrocardiogram, complete blood count, and measurements of serum electrolytes, urea nitrogen, creatinine, and glucose be obtained. The study imposed no other requirements on the preoperative medical evaluation. For patients with diabetes, blood glucose was measured on the day of surgery, regardless of the group assignment, at the centers that routinely performed this measurement during perioperative monitoring.

Randomization

Each planned cataract operation in a single eye was randomly assigned to the routine-testing or no-testing group. If a patient was enrolled for surgery in one eye and was subsequently enrolled for surgery in the other eye, the second operation was randomly assigned to a study group independently of the first. Patients undergoing surgery in the second eye were not eligible for the study if the operation was scheduled to be performed within 28 days after the operation in the first eye. Randomization was stratified according to clinical center, age (in decades), and health status as reported by the patients (fair, good, very good, or excellent vs. poor) and was performed in blocks of four. The scheduled operations for patients within a given age and health-status category were randomly assigned to one of the two study groups until two operations had been assigned to each of the two groups, completing the block of four. Randomization was performed by computer at the time of enrollment at each center.

Representativeness and Crossovers

The representativeness of the enrolled patients was assessed by comparison of their risk of perioperative complications (according to the American Society of Anesthesiologists [ASA]¹¹ classification) with the risk among patients who were potentially eligible but not invited to participate in the study (because of the large number of cataract operations, which prohibited enrollment of all eligible patients) during a one-month period in each of the two years of enrollment. The ASA classification of risk is based on a rating of the patient's physical status, from I (healthy) to V (moribund). Crossover status was determined according to the information about preoperative tests that was recorded in the surgical chart on the day of surgery. Crossover was considered complete if a patient whose operation had been randomly assigned to the routine-testing group did not undergo any tests or, conversely, if a patient whose operation had been assigned to the no-testing group underwent all three standard preoperative tests. Crossover was considered partial if a patient whose operation had been assigned to either group underwent one or two of the three standard tests.

Data Collection and Outcomes

Base-line and preoperative data were collected with use of a standardized medical-history questionnaire, completed by the patient at the time of enrollment, and a brief medical-history form (for documentation of coexisting illnesses and medications), completed by the health care provider at the time of the preoperative medical examination. Intraoperative medical events and treatments were recorded on a standardized form by the anesthesiologist or nurse anesthetist. Additional data from the day of surgery included the time of discharge (and the reason for a delay, if any), recorded by a member of the nursing staff. Postoperative information (including subsequent hospitalizations, unscheduled visits to a physician, or death) was collected by standardized telephone interview of the patient (or a family member, in the case of death) conducted by the study coordinator one week after the operation.

Table 1 lists the definitions of adverse events used in the study. Whenever a response on a data-collection form indicated that an event had occurred, the relevant medical records were reviewed by two investigators (an internist and an anesthesiologist) to determine whether it met one of the study's definitions of an adverse event. The reviewers of events were not informed of the study-group assignment of the patients, but it was not feasible to remove all references to preoperative test results from the medical records. However, the event reviewers dictated a summary of each medical event without mentioning the presence or absence of preoperative medical and laboratory test results. This summary was subsequently reviewed in a masked fashion by one of two investigators (both of whom were internists and neither of whom was an event reviewer), who made a clinical judgment about whether a preoperative test was likely to have affected (and by what mechanism) the probability of the event's occurrence or its severity and whether, for postoperative events, there was a plausible relation between the event and the cataract surgery. Medical events that occurred on the day of surgery before discharge were considered to be related to the performance of the surgery.

Statistical Analysis

The primary analysis of events was performed on an intention-to-treat basis. For the overall event rate, events were counted on a per-operation basis (i.e., patients who had events both intraoperatively and postoperatively contributed one event to the overall rate). A secondary analysis was performed according to the treatment actually received (routine testing vs. no testing). Stratified analyses were performed to determine whether preoperative testing might have had effects that differed among various subgroups of patients.

Before enrollment began, the data safety and monitoring committee discussed criteria for stopping the study early and decided not to apply a specific statistical rule for stopping it. Interim data supplied to the committee did not support early termination of the study.

RESULTS

Characteristics of the Patients

We invited 19,354 patients scheduled to undergo 20,775 cataract operations at the nine participating centers between June 1, 1995, and June 30, 1997, to participate in the study (Fig. 1). We enrolled 18,189 patients scheduled to undergo 19,557 operations (participation rate, 94 percent). The two study groups had similar proportions of operations that were canceled and not rescheduled before the conclusion of the study (1.5 percent in the routine-testing group and 1.6 percent in the no-testing group). Among the enrolled patients who did have surgery, data were available from the day of surgery for 100 percent and from one week after surgery for 99.8 percent.

TABLE 1. DEFINITIONS OF ADVERSE EVENTS.

EVENT	DEFINITION
Myocardial infarction	Evolving changes in the ST-T segment, new Q waves, or both on an electrocardiogram; symptoms of ischemia plus abnormal serum levels of cardiac enzymes; or symptoms of ischemia plus new left bundle-branch block
Myocardial ischemia	New or more severe chest pain diagnosed as ischemia and requiring treatment
Congestive heart failure	New pulmonary edema on a chest radiograph or a diagnosis of congestive heart failure
Arrhythmia	New or worsening disturbance of heart rhythm requiring new treatment or a change in treatment
Hypertension	Increase in systolic pressure to ≥ 140 mm Hg or in diastolic pressure to ≥ 90 mm Hg with new antihypertensive treatment or a change in treatment required
Hypotension	Decrease in systolic pressure to ≤ 100 mm Hg, with treatment required
Stroke	Abrupt onset of a focal neurologic deficit lasting ≥ 24 hr
Transient ischemic attack	Abrupt onset of a focal neurologic deficit lasting < 24 hr and resulting from cerebrovascular ischemia
Respiratory failure	Need for mechanical ventilation
Bronchospasm	Wheezing or excessive coughing requiring a bronchodilator or theophylline
Oxygen desaturation	Decrease in oxygen saturation to $\leq 90\%$, with supplemental oxygen required
Hypoglycemia	Blood glucose level low enough to require intravenous dextrose
Diabetic ketoacidosis	Hyperglycemia with an increase in the anion gap, metabolic acidosis, and serum or urinary ketones
Nonketotic hyperosmolar syndrome	Hyperglycemia with plasma osmolarity > 320 mOsm/liter, without ketonemia
Other	New or worsening medical problem requiring treatment with a specific medication or procedure

The two groups were well balanced in terms of the center at which the surgery was performed, age, sex, race, coexisting illnesses, ASA risk class, and self-reported health status (Table 2). The 6 percent of patients who were invited to participate in the study but declined were slightly older than those who were enrolled (mean age, 75 years vs. 73 years), more likely to be women (68 percent vs. 61 percent), and more likely to report a poor health status (2.9 percent vs. 1.6 percent). A comparison of the sex, age, and ASA risk class in the group of enrolled patients and a sample of those who were eligible but not invited to participate revealed no differences in sex or age and indicated that the enrolled patients were less likely to have an ASA risk class of III, indicating the presence of severe systemic disease that was not incapacitating (35 percent vs. 41 percent).

Principal Outcomes

According to the intention-to-treat analysis, the cumulative rate of medical events was the same in the two groups (31.3 events per 1000 operations) (Table 3). The rate of medical events on the day of surgery

was similar in the two groups, as was the rate of events during the postoperative period. Only one patient had a medical event during each of two operations (both of which had been assigned to the routine-testing group).

The types of medical events were similar in the groups, with the exception of bronchospasm, which occurred very rarely but was more frequent both intraoperatively and postoperatively in the no-testing group (Table 4). Overall, treatment for hypertension and arrhythmia (principally, bradycardia) accounted for 61 percent of the events in the no-testing group and 68 percent of the events in the routine-testing group.

On the basis of the masked review of the summaries of medical events, 33 percent of postoperative events in each of the study groups were judged to have had a plausible causal relation to the performance of cataract surgery. The reviewers concluded that preoperative testing might have decreased the likelihood or the severity of the event for 5.9 and 4.2 percent of intraoperative events in the no-testing and routine-testing groups, respectively ($P=0.45$) and for 6.6

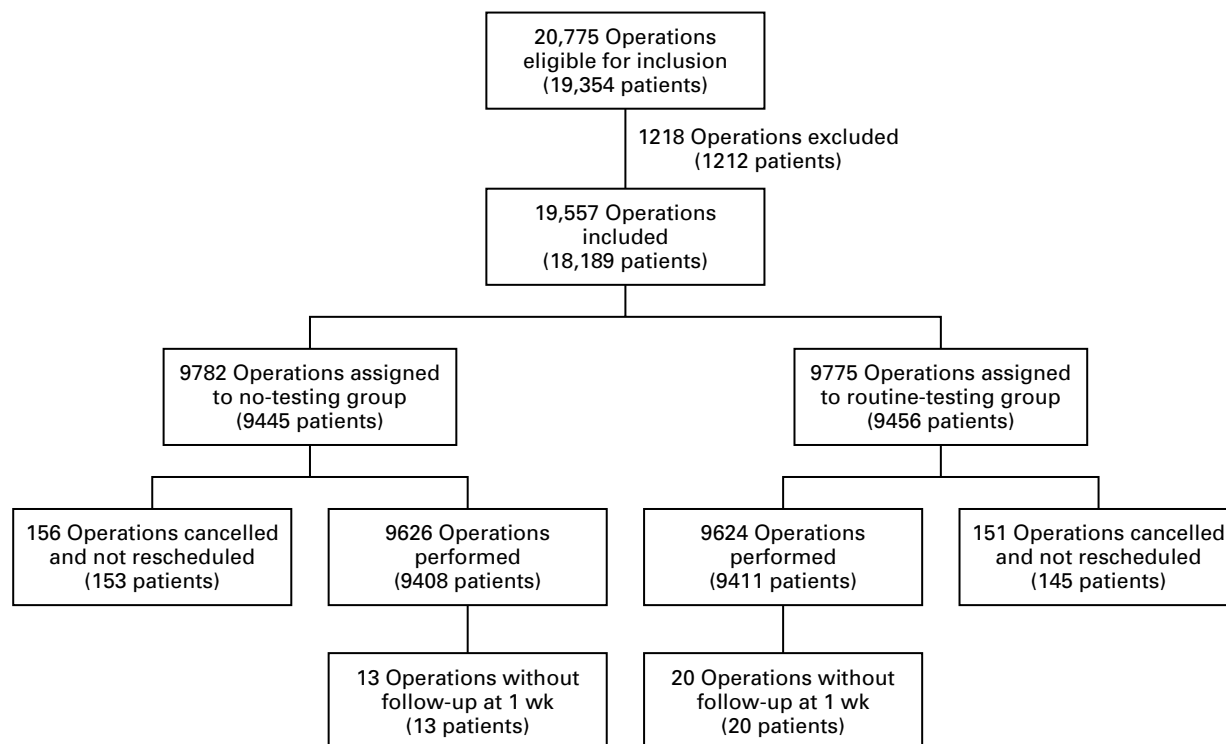


Figure 1. Enrollment of Patients and Random Assignment of Cataract Operations to Routine Preoperative Testing or No Preoperative Testing.

A total of 1368 patients were enrolled for two operations (one in each eye). Six patients refused enrollment for both of two operations (one in each eye), and 47 patients were enrolled for an operation in one eye but refused enrollment for an operation in the other eye. For 337 patients in the no-testing group and 319 patients in the routine-testing group, each of two operations was randomly assigned to a different group. For three patients in the no-testing group and six patients in the routine-testing group, each of two operations was cancelled and not rescheduled. For 218 patients in the no-testing group and 213 patients in the routine-testing group, each of two operations that were performed was assigned to the same group. For 690 patients, each of two operations that were performed was randomly assigned to a different group.

and 16.4 percent of postoperative events in the two groups ($P=0.02$).

The overall rate of complete crossovers was 5.9 percent, with significant variation according to the participating center. The majority (71 percent) of complete crossovers were from the routine-testing to the no-testing group. For older patients, those with worse health according to their own report, and those with a higher ASA risk class, the rate of crossover from routine testing to no testing exceeded the rate of crossover from no testing to routine testing. Among patients whose operations were randomly assigned to the no-testing group, those who did not undergo any tests had a lower rate of medical events (29.1 events per 1000 operations) than those who underwent some of the tests (52.6 events per 1000) or all the tests (36.7 events per 1000). The group that crossed over from no testing to some testing had significantly more coexisting illnesses and worse self-reported health status than those who did not undergo any preoperative testing.

Subgroup Analyses

We found no benefit of routine preoperative medical testing when the analysis was stratified according to the participating center or the age, sex, or race of the patient. Similarly, there were no significant differences in event rates when the data were stratified according to coexisting illness, ASA risk class, or self-reported health status (Table 5). Finally, we explored the hypothesis that routine preoperative testing might have resulted in the cancellation or postponement of surgery for patients found to be at risk for adverse medical events. No support for this hypothesis was found, since the frequency of cancellation or postponement for medical reasons was similar in the two groups (2.5 percent in the no-testing group and 2.3 percent in the routine-testing group).

DISCUSSION

Preoperative medical testing for all types of surgery accounts for about \$30 billion in health care costs annually.¹² Over the past 15 years, a substantial

TABLE 2. BASE-LINE CHARACTERISTICS OF THE PATIENTS, ACCORDING TO THE GROUP ASSIGNMENT.*

CHARACTERISTIC	OPERATIONS SCHEDULED		OPERATIONS PERFORMED	
	NO TESTING (N=9782)	ROUTINE TESTING (N=9775)	NO TESTING (N=9626)	ROUTINE TESTING (N=9624)
Age (yr)	74±8	73±8	74±8	73±8
	no. of operations (%)			
Age range				
50–59 yr	690 (7.1)	679 (6.9)	677 (7.0)	670 (7.0)
60–69 yr	2156 (22.0)	2163 (22.1)	2111 (21.9)	2129 (22.1)
70–79 yr	4567 (46.7)	4549 (46.5)	4507 (46.8)	4477 (46.5)
80–89 yr	2220 (22.7)	2256 (23.1)	2182 (22.7)	2220 (23.1)
≥90 yr	149 (1.5)	128 (1.3)	149 (1.5)	128 (1.3)
Female sex	5920 (60.5)	6006 (61.4)	5831 (60.6)	5907 (61.4)
Race or ethnic group				
White	7867 (80.4)	7872 (80.5)	7778 (80.8)	7791 (81.0)
Black	628 (6.4)	621 (6.4)	600 (6.2)	593 (6.2)
Hispanic	834 (8.5)	868 (8.9)	805 (8.4)	834 (8.7)
Other or unknown	453 (4.6)	414 (4.2)	443 (4.6)	406 (4.2)
ASA risk class†				
I			875 (9.1)	920 (9.6)
II			5310 (55.2)	5288 (54.9)
III			3354 (34.8)	3338 (34.7)
IV			70 (0.7)	63 (0.7)
Not known			17 (0.2)	15 (0.2)
Coexisting illness‡				
Hypertension			4519 (46.9)	4502 (46.8)
Angina			1807 (18.8)	1797 (18.7)
Myocardial infarction or condition treated by coronary-artery bypass grafting			1378 (14.3)	1305 (13.6)
Arrhythmia			1613 (16.8)	1544 (16.0)
Congestive heart failure			396 (4.1)	385 (4.0)
Aortic stenosis			45 (0.5)	56 (0.6)
Other heart disease			275 (2.9)	271 (2.8)
Thromboembolic disease			188 (2.0)	215 (2.2)
Transient ischemic attack			860 (8.9)	809 (8.4)
Chronic obstructive pulmonary disease or asthma			1373 (14.3)	1386 (14.4)
Diabetes mellitus			1446 (15.0)	1429 (14.8)
Anemia			554 (5.8)	571 (5.9)
Bleeding disorder			495 (5.1)	508 (5.3)
Renal disease			274 (2.8)	281 (2.9)
Thyroid disease			930 (9.7)	932 (9.7)
Liver disease			162 (1.7)	203 (2.1)
None of the above			2297 (23.9)	2409 (25.0)
Self-reported health status§				
Excellent			1431 (14.9)	1465 (15.2)
Very good			2844 (29.5)	2889 (30.0)
Good			4047 (42.0)	3936 (40.9)
Fair			1153 (12.0)	1191 (12.4)
Poor			150 (1.6)	143 (1.5)

*Plus–minus values are means ±SD. Because of rounding, not all percentages total 100.

†The American Society of Anesthesiologists (ASA) classification of risk is based on physical status. Class I denotes good health, class II mild systemic disease, class III severe systemic disease that is not incapacitating, class IV incapacitating systemic disease that is a constant threat to life, and class V death expected within 24 hours, with or without surgery.

‡The categories are not mutually exclusive.

§Self-reported health status was the response to the question, “In general, how would you rate your health?” For one patient in the no-testing group, information on the self-reported health status was missing.

TABLE 3. RATES OF INTRAOPERATIVE AND POSTOPERATIVE ADVERSE EVENTS.*

EVENT	NO TESTING (N=9626)		ROUTINE TESTING (N=9624)		RELATIVE RISK (95% CI)†
	no. of events	no./1000 operations	no. of events	no./1000 operations	
Overall					
Death	2	0.2	1	0.1	2.00 (0.2–22.0)
Hospitalization	33	3.4	28	2.9	1.17 (0.7–2.0)
Other events	266	27.6	272	28.3	0.97 (0.8–1.2)
Total	301	31.3	301	31.3	1.00 (0.9–1.2)
Intraoperative					
Death	0		0		
Hospitalization‡	5	0.5	3	0.3	1.67 (0.4–7.0)
Other events	180	18.7	187	19.4	0.96 (0.8–1.2)
Total	185	19.2	190	19.7	0.97 (0.8–1.2)
Postoperative					
Death	2	0.2	1	0.1	2.00 (0.2–22.0)
Hospitalization	30	3.1	25	2.6	1.20 (0.7–2.0)
Other events	89	9.2	90	9.4	0.99 (0.7–1.3)
Total	121	12.6	116	12.1	1.04 (0.8–1.3)

*Two events occurred (one intraoperative and one postoperative) in five operations in each group. Events that occurred before discharge were considered intraoperative.

†The relative risk is for operations that were not preceded by routine testing as compared with operations that were preceded by testing. CI denotes confidence interval.

‡For the intraoperative period, hospitalization was defined as an unplanned hospital admission.

body of research has raised questions about the value of routine medical testing before elective surgery.^{12–18} Most abnormalities in laboratory values can be predicted from the patient's history and findings on physical examination; moreover, laboratory abnormalities, when discovered, rarely lead to changes in perioperative treatment. In an attempt to limit preoperative medical testing to patients with specific indications, a variety of guidelines have been developed.^{13,16,18} In general, however, these guidelines favor the routine preoperative ordering of a complete blood count, serum electrolyte measurements, and an electrocardiogram for patients 65 years old or older, regardless of their health. For patients with specific medical conditions, routine preoperative ordering of these and, in many cases, additional tests has been recommended.

Most patients who undergo cataract surgery are Medicare beneficiaries, who are 65 years old or older. As would be anticipated, the prevalence of coexisting illnesses and associated laboratory abnormalities in this age group is high.^{3,5–7} Presumably, this characteristic might justify the routine preoperative laboratory testing that has historically been performed. Data on preoperative medical testing for cataract surgery are limited to two small studies,^{3,19} each involving approximately 100 operations. These studies indicated that the results of laboratory tests were frequently not reviewed and that even when they were, patients with abnormal results still received routine intraoperative treatment.

Our study demonstrates that perioperative morbidity and mortality are not reduced by routine use of commonly ordered preoperative medical tests. The rate of perioperative medical events, including hospitalization and death, was the same in patients who underwent a standard battery of laboratory tests as it was in patients who did not undergo the tests, and there were no significant differences when the data were stratified according to specific coexisting conditions or the severity of a condition. Perioperative death or hospitalization was very rare; in fact, most of the medical events occurred during surgery and were not serious, and it was rarely judged that medical tests would have helped to reduce the risk or severity of an event. Investigators who were unaware of the group assignment of each operation determined that some of the intraoperative events (4.2 percent) and postoperative events (16.4 percent) in the group assigned to routine preoperative testing might have been prevented or the severity of the events ameliorated by such testing. Possible interpretations of this finding are that the treating physicians did not review the test results, that the test results might have prompted a change in patient care without actually improving the outcome, or that there was variation in the criterion for intervention according to specific test results. Although crossover to preoperative testing occurred more frequently among sicker patients whose operations were randomly assigned to the no-testing group than among healthier patients, it is not apparent that testing

TABLE 4. DIAGNOSES ASSOCIATED WITH ADVERSE EVENTS.*

EVENT	INTRAOPERATIVE EVENTS				POSTOPERATIVE EVENTS			
	NO TESTING (N=9626)		ROUTINE TESTING (N=9624)		NO TESTING (N=9626)		ROUTINE TESTING (N=9624)	
	no. of events	no./1000 operations	no. of events	no./1000 operations	no. of events	no./1000 operations	no. of events	no./1000 operations
Cardiovascular								
Myocardial infarction	0		0		3	0.3	5	0.5
Myocardial ischemia	7	0.7	4	0.4	3	0.3	3	0.3
Congestive heart failure	0		0		5	0.5	5	0.5
Arrhythmia†	60	6.2	65	6.8	13	1.4	10	1.0
Bradycardia	44	4.6	45	4.7	8	0.8	2	0.2
Atrial fibrillation	6	0.6	8	0.8	3	0.3	6	0.6
Ventricular tachycardia	1	0.1	0		0		1	0.1
Other arrhythmia	11	1.1	13	1.4	2	0.2	1	0.1
Hypertension	102	10.6	118	12.3	13	1.4	16	1.7
Hypotension	12	1.2	10	1.0	8	0.8	4	0.4
Cerebrovascular								
Stroke	0		0		2	0.2	4	0.4
Transient ischemic attack	0		0		0		1	0.1
Pulmonary								
Respiratory failure	0		0		1	0.1	1	0.1
Bronchospasm	7	0.7	1	0.1	2	0.2	0	
Oxygen desaturation	3	0.3	4	0.4	4	0.4	1	0.1
Upper respiratory tract infection	1	0.1	0		14	1.5	19	2.0
Pneumonia	0		0		5	0.5	6	0.6
Metabolic‡								
Hypoglycemia	2	0.2	0		0		0	
Treatment for hyperglycemia in patients with diabetes	0		0		3	0.3	3	0.3
Anemia	0		0		1	0.1	1	0.1
Hypokalemia	0		0		0		2	0.2
Other								
Musculoskeletal problem	0		0		24	2.5	15	1.6
Urinary tract infection	0		0		11	1.1	9	0.9
Dermatitis	0		0		7	0.7	7	0.7
Gastrointestinal disturbance	0		0		11	1.1	12	1.2
Atypical chest pain	1	0.1	1	0.1	2	0.2	2	0.2
Other§	0		0		4	0.4	8	0.8

*The rate of bronchospasm differed significantly between the two groups. There were no other significant differences between the groups.

†Some patients had more than one type of arrhythmia.

‡There were no cases of diabetic ketoacidosis or nonketotic hyperosmolarity.

§In the no-testing group, chills, depression, syncope, and a vasovagal episode were each associated with one operation. In the routine-testing group, anxiety was associated with two operations, and dizziness, hyponatremia, amnesia, syncope, hyperventilation, and dyspnea were each associated with one.

reduced the risk of adverse perioperative events among those who crossed over. Finally, we did not find evidence that preoperative medical testing resulted in the postponement or cancellation of surgery for patients found to be at risk for medical events.

The principal strengths of this study include its large size, its randomized design, the minimal exclusion of patients, and the virtually complete ascertainment of medical events during the study period. In the light of these strengths, we believe that the results of the study support a change from the common practice of ordering medical tests routinely for patients scheduled for cataract surgery. Of course, this does not mean that medical testing is unhelpful or not indicated for all patients. In our study, the

guideline for patients whose operations were randomly assigned to the no-testing group was that tests should be ordered only when the history or a finding on physical examination would have indicated the need for a test even if surgery had not been planned (e.g., electrocardiography for new or worsening angina). We recommend that this approach be adopted as a guideline for the preoperative assessment of patients for cataract surgery.

We have previously estimated that the cost of routine medical testing before cataract surgery exceeds \$150 million annually.¹⁰ Given the results of this study, it is likely that most of these costs could be saved without any negative effect on patients' health or clinical outcomes. Furthermore, it is reasonable to consider applying our findings to similar popu-

TABLE 5. RATES OF INTRAOPERATIVE AND POSTOPERATIVE EVENTS STRATIFIED ACCORDING TO BASE-LINE MEDICAL STATUS.*

MEDICAL STATUS	INTRAOPERATIVE EVENTS				POSTOPERATIVE EVENTS			
	NO TESTING		ROUTINE TESTING		NO TESTING		ROUTINE TESTING	
	no. of events	no./1000 operations	no. of events	no./1000 operations	no. of events	no./1000 operations	no. of events	no./1000 operations
Coexisting illness								
Hypertension	122/4519	27.0	120/4502	26.7	63/4519	13.9	58/4502	12.9
Angina	42/1807	23.2	43/1797	23.9	37/1807	20.5	27/1797	15.0
Myocardial infarction or condition treated by coronary-artery by-pass grafting	35/1378	25.4	35/1305	26.8	28/1378	20.3	21/1305	16.1
Arrhythmia	40/1613	24.8	35/1544	22.7	27/1613	16.7	19/1544	12.3
Congestive heart failure	14/396	35.4	14/385	36.4	10/396	25.3	7/385	18.2
Diabetes mellitus	49/1446	33.9	46/1429	32.2	21/1446	14.5	17/1429	11.9
Any other illness†	157/7329	21.4	160/7215	22.2	104/7329	14.2	95/7215	13.2
ASA risk class‡								
I	8/875	9.1	7/920	7.6	13/875	14.9	15/920	16.3
II	69/5310	13.0	74/5288	14.0	65/5310	12.2	60/5288	11.3
III	105/3354	31.3	106/3338	31.8	41/3354	12.2	41/3338	12.3
IV	3/70	42.9	3/63	47.6	3/70	42.9	0	
Self-reported health status								
Excellent	28/1431	19.6	24/1465	16.4	17/1431	11.9	11/1465	7.5
Very good	52/2844	18.3	44/2889	15.2	23/2844	8.1	42/2889	14.5
Good	68/4047	16.8	82/3936	20.8	59/4047	14.6	37/3936	9.4
Fair	32/1153	27.8	38/1191	31.9	18/1153	15.6	21/1191	17.6
Poor	5/150	33.3	2/143	14.0	4/150	26.7	5/143	35.0

*Denominators are the numbers of operations in each subgroup, as provided in Table 2.

†This category refers to any of the other coexisting illnesses listed in Table 2.

‡The American Society of Anesthesiologists (ASA) classification of physical status is provided in Table 2.

lations of patients scheduled to undergo other procedures that are associated with similar surgical risk and in which local anesthesia and intravenous sedation are used.

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APPENDIX

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