



Original contribution

Usefulness of routine preoperative testing: a prospective single-observer study^{☆,☆☆}

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Abstract

Study Objective: The purpose of this study is to determine whether routine preoperative testing has a usefulness not previously recognized in a small preliminary study to decide if such a hypothesis might be worthy of testing in a larger study.

Design: Single-observer, prospective, observational study.

Setting: Tertiary-care referral center in South India that performs 11 preoperative tests on each patient.

Patients: One hundred twenty-seven adult patients scheduled for elective neurosurgery.

Interventions: Patients were studied to determine whether outcome was influenced by laboratory tests, which were either indicated by health history elicited by a computerized rule-based questionnaire or unindicated by patient history.

Measurement and Main Results: Of the 1395 tests performed preoperatively, 513 (36.8%) were indicated and 882 (63.3%) were unindicated. Of 513 indicated tests, 17 (3.3%) prompted changes in patient care; 8 (0.91%) of 882 unindicated tests ($P < .001$) prompted changes in care. All patients with anemia, significant electrocardiographic abnormalities, or HIV infection were detected by the computerized questionnaire. Among the changes in care prompted by unindicated tests, 4 patients received diabetic therapy or counseling, and 4 patients with abnormal silhouettes on chest radiograph had nonbeneficial echocardiography. Only screening for diabetes seemed to have usefulness as a routine preoperative test in this patient population.

Conclusion: Although the incidence of unindicated preoperative screening tests is still more than 50%, no previously unidentified benefit was found to support this persistence of unwarranted testing. The limited number of patients in this study necessitates a larger study to ensure greater certainty before such

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a recommendation is made to the public. If similar results in another but larger study involving similar design, simple changes in the system of preoperative care may save the health care system the considerable expense of unwarranted testing.

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1. Introduction

Despite studies showing a low rate of abnormal results from preoperative laboratory tests not indicated by patient history [1], a majority of patients scheduled for elective surgery are still subjected to a battery of preoperative tests. We sought to determine if this persistence of screening by tests was due to some as yet unquantified benefit. Selection of laboratory tests on the basis of patient history and physical examination has been suggested to eliminate unnecessary preoperative laboratory testing [1-4]. But dependence of history to limit unnecessary laboratory tests has been criticized for lack of consistency and uniformity in application of criteria for test ordering. Physicians may disagree about which tests to order when several physicians interview the same patient [5]. To improve the consistency and uniformity of preoperative history taking, we relied on an automated questionnaire that is completed by the patient. Answers to questions posed by a computerized questionnaire, HealthQuiz, and health status scores were indistinguishable from those obtained when questions were asked in a personal interview. HealthQuiz also generates a list of suggested tests by rule-based algorithms that depend on a patient's responses [6].

At a tertiary care center in South India, The Nizam's Institute of Medical Sciences, all adult patients presenting for elective surgery undergo the following 11 tests preoperatively: hematocrit, total, and differential white blood cell (WBC) count; blood sugar; blood urea nitrogen, serum creatinine, sodium, and potassium; chest radiograph; electrocardiogram (ECG); and the enzyme-linked immunosorbent assay for antibodies to HIV. The preoperative testing protocol at the Institute afforded an opportunity to evaluate the occurrence of abnormal test results from preoperative evaluation. We also studied the perioperative outcomes and the influence of abnormal test results on patient management, such as further investigation or treatment of an underlying condition before surgery. Thus, we hoped to determine if the persistence of preoperative testing was due to some previously overlooked benefit.

2. Materials and methods

The study protocol was approved by the Nizam's Institute of Medical Science's review board, and informed consent was obtained for each patient. To facilitate a single-observer study, we chose a convenient sample of consecutive adult patients scheduled for elective neurosurgery (intracranial, spinal, and peripheral neural procedures)

during general anesthesia maintained by a single anesthesiologist. Patients were excluded from the study if they required emergency intervention before surgery, had altered sensorium, or if they were bedridden before admission to the hospital. Preoperative history taking was facilitated by HealthQuiz Prescreen II (Nellcor, San Diego, Calif). The HealthQuiz is a hand-held computer that presents 60 to 120 health-related questions for preoperative evaluation [6]. Patients respond to each question by pressing 1 of the 3 buttons: "yes," "no," or "not sure." After answering a question, they press the button labeled "Go to the next question" to continue. A preprogrammed algorithm based on criteria established by an expert panel [1,2,6] guides the HealthQuiz in the identification of potential health problems and suggests appropriate tests for detecting these problems. If a patient could not read English, a single observer (SM) translated the questions and recorded patient responses. For analysis of blood tests, normal was defined within the usual ranges adopted at the hospital. Interpretation of pulmonary images on the posteroanterior view of the chest radiograph was based on the protocol suggested by Feigin [7]. Abnormalities on cardiovascular images, skeletal abnormalities (ie, cervical rib, vertebral column) on chest radiographs, and ECG abnormalities were evaluated by a medical consultant (JM). Pursuing the results of preoperative tests by medical consultations, further investigation, or treatment of an underlying condition was at the discretion of the surgeon or medical consultant. The ASA Task Force on Preanesthesia Evaluation defined an unindicated (routine) test as that ordered in the absence of a specific clinical indication or purpose, whereas an indicated test is that ordered for a specific clinical indication or purpose [8]. For the purpose of this study, morbidity was defined as surgical or medical requiring special attention for management.

Confidence intervals (CIs) were computed for proportions, and the difference in proportions was calculated by χ^2 test.

3. Results

The frequency of abnormal results for tests indicated or unindicated by patient history from the HealthQuiz and changes in patient care are listed in Table 1. For the 127 patients selected (57% men; median age, 38 years; interquartile range, 32-47 years), some 1395 tests were performed. Chest radiographs could not be obtained for two patients for technical reasons. In 7 cases, surgery was deferred after preoperative evaluation because further

Table 1 Frequency of abnormal preoperative laboratory test results and changes in patient care prompted by them

Laboratory test	Method	Normal values	Percentage of abnormal test results (and 95% CIs)				
			Total test abnormalities	Indicated by patient history	Not indicated by patient history	Change in care from tests	
						Indicated by patient history	Not indicated by patient history
Hematocrit	Electric impedance (Coulter T-450)	40%-54% for men, 38%-47% for women	44.9 (36.1, 54.0)	30.0 (22.1, 38.7)	14.9 (9.2, 22.4)	1.4 (0.03, 7.4)	0 (0, 6.6)
WBC count, total	Electric impedance (Coulter T-450)	4.5-11 000/mm ³	22.4 (15.2, 30.3)	10.2 (5.6, 11.6)	11.8 (6.8, 18.7)	0 (0, 5.7)	0 (0, 5.6)
Differential count	Manual microscopic method	Neutrophils, 40%-80%; lymphocytes, 20%-40%; monocytes, 2%-10%; basophils, <1%; eosinophils, 1%-6%	43.3 (34.5, 52.4)	7.1 (3.3, 13.1)	36.2 (27.9, 45.2)	0 (0, 13.7)	0 (0, 3.5)
Fasting blood sugar	Glucose oxidase peroxidase method (enzymatic assay of plasma)	60-140 mg/dL	11.0 (6.2, 17.8)	6.3 (2.8, 12.0)	4.7 (1.7, 10.0)	10.3 (4.2, 20.1)	6.8 (1.9, 16.5)
Blood urea	Glucose dehydrogenase method	15-40 mg%	5.5 (2.2, 11.0)	2.4 (0.5, 6.8)	3.1 (0.8, 7.9)	0 (0, 6.8)	0 (0, 4.8)
Serum creatinine	Jaffe's method (picric acid sodium hydroxide method)	0.6-1.5 mg/dL	0.78 (0.02, 4.3)	0.8 (0.02, 4.3)	0 (0, 2.9)	0 (0, 6.8)	0 (0, 4.8)
Serum sodium	Ion selective electrode method	135-145 mEq/L	30.7 (22.8, 39.5)	0.8 (0.02, 4.3)	29.9 (22.1, 38.7)	0 (0, 23.2)	0 (0, 3.2)
Serum potassium	Ion selective electrode method	3.5-5 mEq/L	21.2 (14.5, 29.4)	2.4 (0.5, 6.8)	14.1 (8.6, 21.5)	0 (0, 23.2)	0 (0, 3.2)
Chest radiograph	Posteroanterior view		12.8 (7.5, 20.0)	5.6 (2.3, 11.2)	7.2 (3.3, 13.2)	3.0 (0.08, 15.8)	4.3 (1.2, 10.8)
ECG	12 lead		11.0 (6.2, 17.8)	9.4 (5, 15.9)	1.6 (0.2, 5.6)	7.5 (2.8, 15.6)	0 (0, 7.5)
HIV	Enzyme-linked immunosorbent assay for initial screening; confirmation of positive result with Western blot test		1.6 (0.2, 5.6)	0 (0, 2.9)	5.1 (0.6, 17.3)	0 (0, 4.1)	

Table 2 Outcomes: morbidity and mortality

	Operation	Age-sex	Abnormal test results and patient management			
			Tests not indicated by health quiz		Tests indicated by health quiz	
<i>Mortality cause</i>						
Cerebellar contusion	Decompression of cerebellopontine angle mass	47-M	None	Not applicable	Serum sodium, 132 mEq/L	None
Frontal lobe hemorrhagic infarct	Frontal craniotomy and decompression of pituitary adenoma	35-M	Total leukocyte count, 20000; neutrophil count, 83%; fasting blood sugar, 444 mg/dL	Insulin dose adjusted	None	
Aspiration pneumonitis	Decompression of cerebellopontine angle mass	39-M	None	Not applicable	Hematocrit, 37%, fasting blood sugar, 214 mg/dL	Perioperative insulin therapy
Aspiration pneumonitis	Decompression of olfactory groove meningioma	62-M	Hematocrit, 36%; fasting blood sugar, 151 mg/dL	None	Differential leukocyte count for basophils, 2%; serum sodium, 130 mEq/L; serum potassium, 5.1 mEq/L; cardiomegaly on chest radiograph	Echocardiography and coronary angiography, normal
Intraventricular hemorrhage	Decompression of parietooccipital meningioma	51-F	Hematocrit, 36.8%; inverted T waves on ECG in leads III, V ₁ -V ₃	None	Eosinophil count 0; cervical rib on chest radiograph	None
<i>Morbidity cause</i>						
Oral herpes	Decompression of craniopharyngioma	35-F	Hematocrit, 50.2%	None	None	Not applicable
Wound dehiscence	Cervical laminectomy	66-M	Hematocrit, 32%	None	None	Not applicable
Leak of cerebrospinal fluid and meningitis	Decompression of parietooccipital meningioma	52-M	Hematocrit, 37.5%; fasting blood sugar, 212 mg/dL	Counseling for diabetes mellitus	Serum sodium, 134 mEq/L	None
Leak of cerebrospinal fluid and meningitis	Decompression of frontal lobe meningioma	65-F	Hematocrit, 37%; lymphocytes, 15%; serum potassium, 3.2 mEq/L	None	Cardiomegaly on chest radiograph	Concentric left ventricular hypertrophy on echocardiograph
Chest discomfort on postoperative day 1; no evidence of myocardial ischemia from cardiac enzymes or serial ECG	Decompression of cerebellopontine angle mass	45-M	None	Not applicable	Hematocrit, 32%	None
Electrolyte changes: hyponatremia and hypokalemia on postoperative days 4-7, despite insulin therapy in this diabetic patient; patient responded to intravenous replacement therapy	Lumbar laminectomy and decompression of spinal cord tumor	65-F	Left ventricular hypertrophy with strain on ECG	Normal echocardiogram	Cardiomegaly on chest radiograph	Normal echocardiograph
Hiccups that started on postoperative day 5 and persisted for 1 week	Decompression of craniopharyngioma	58-M	Hematocrit, 39%; blood urea, 42 mg/dL	None	Eosinophils, 0%	None
Diabetes insipidus that resolved spontaneously	Decompression of craniopharyngioma	20-M	Hematocrit, 36.5%	None	Eosinophils, 0%; serum sodium, 148 mEq/L	None
Diabetes mellitus that required insulin therapy postoperatively	Decompression of frontoparietal glioma	47-M	None	Not applicable	Eosinophils, 0%; fasting blood sugar, 202 mg/dL	Insulin therapy
Diabetes mellitus that required insulin therapy postoperatively	Excision of frontal osteomyelitic bone	43-M	Cardiomegaly on chest radiograph; inverted T waves in leads I, II, V ₄ -V ₆	None	Fasting blood sugar, 227 mg/dL	Insulin therapy

investigation revealed no need for surgery. There was no intraoperative mortality or morbidity. Five (4.2%) patients died and 10 (8.3%) had postoperative morbidity. Neither the deaths nor the morbidity was caused by omission of preoperative tests (Table 2).

Of the 1395 tests performed preoperatively, 513 (36.8%) were indicated and 882 (63.2%) were unindicated by the rules programmed into the HealthQuiz. Of the 513 indicated tests, 17 (3.3%) prompted changes in patient care compared to the 8 (0.91%) of 882 unindicated tests (odds ratio, 3.74; 95% CIs, 2.60-8.74; $P < .001$; Table 1). The changes in management prompted by the 17 indicated tests were as follows: blood transfusion in one, insulin therapy or counseling in 7, cardiac consultation and/or altered monitoring for myocardial ischemia in perioperative period in 7, and adoption of extra precautions by health workers during the care of two patients who were HIV positive (confirmed by Western blot test). As a result of the unindicated tests, 4 patients received diabetic therapy or counseling and 4 patients with abnormal silhouettes on chest radiograph had echocardiographic examination that was judged to be nonbeneficial by the observer.

HealthQuiz recommended HIV tests for both patients who were confirmed HIV positive by Western blot test. Fasting blood sugar was abnormal in 6 patients for whom HealthQuiz did not recommend the test. Perioperative insulin therapy was instituted in 4 patients to manage diabetes mellitus, and one patient was counseled for management of diabetes at the time of discharge. In one patient, diabetes was secondary to acromegaly, which was evident on physical examination. In another, patient, an abnormal blood sugar value was a false-positive result, which became apparent from repeat tests. Nine patients (4 with cardiovascular changes) for whom HealthQuiz did not recommend a chest radiograph had abnormalities on their radiographs. Although patients with cardiovascular changes had further testing with 2-dimensional echocardiography, the confirmation ($n = 2$) or lack of confirmation ($n = 2$) by echocardiography of radiographic findings did not influence the hospital course or outcome. HealthQuiz did not suggest chest radiographs for the two patients for whom technical reasons precluded this evaluation; both had an uneventful perioperative course. For other tests not recommended by the HealthQuiz, abnormal results neither influenced preoperative management nor perioperative outcome.

4. Discussion

Routine preoperative screening tests consume considerable patient and physician time and financial resources. It has been suggested that unnecessary preoperative testing could be eliminated without adversely affecting outcome by selective screening on the basis of patient history. This opinion is largely founded on retrospective reviews [1-3,9].

In our study, the HealthQuiz eliminated inconsistencies in judgment about the importance of an item in patient history, which has been judged by other reviewers as a problem of previous studies [5]. In this prospective, preliminary, single-observer study, we evaluated not only the influence of abnormal results on perioperative management, but also on adverse medical and surgical outcomes. We believe such results indicate that this hypothesis now is worthy of proving or disproving in a study involving a multiple of the patients we studied.

We found a relatively high proportion of abnormal results of both indicated and unindicated tests because we used routine hospital reference laboratory reference ranges rather broader "action limits." Although the questionnaire failed to distinguish among the groups (overlap of confidence intervals) with high and low likelihood of having abnormal results on most preoperative tests, it did select patients with nearly 4-fold higher likelihood of a change in care resulting from detection of abnormalities.

We found one possible exception to the second (corollary) hypothesis that much unwarranted testing could be eliminated by rule-based screening questionnaire without adversely affecting patient care. This exception was to continue to screen for diabetes mellitus. Preoperative evaluation may present an opportunity to screen for diseases such as diabetes mellitus to initiate early treatment. Such treatment might prevent long-term complications, especially in a country where routine care is rare. Recent anecdotal reports from India indicate that the prevalence of diabetes mellitus is increasing, especially in the urban population. In this sample of 127 patients, incidence of diabetes mellitus was 13.4% (95% CI, 8%-20%) as revealed by history or newly diagnosed from routine screening using a threshold value of 140 mg/dL (7.78 mmol/L). Recent guidelines suggest a threshold value for plasma glucose of 126 mg/dL (7.0 mmol/L) to make the diagnostic criterion more sensitive [10]. Considering this recommendation and the occurrence of asymptomatic diabetes mellitus requiring perioperative insulin therapy in our sample, routine screening for the disease in adults seems advisable in this setting.

From a public health point of view, the screen for HIV in presurgical patients may also be beneficial. Few individuals will be screened in India at any other time, and the prevalence of HIV is increasing steadily in India [11]. For example, the prevalence of HIV-positive tests in surgical patients as revealed by routine screening at the institute was 0.63% in 1996, 0.8% in 1997, and 1.1% in 1998. Although our sample has shown the usefulness of selective HIV screening on the basis of patient history, such dependence may not always be wise. In India, the social stigmata attached to an admission of sex with multiple partners make it difficult to elicit a history of sexual promiscuity from female patients. Sometimes spouses may not be available to confirm sexual history. However, evaluation of the cost-effectiveness of screening

Table 3 Comparison of the results of current study with that reported in systematic literature search [8].

Test	% Total test abnormalities in routine testing (range)	Comparability with current study	% Abnormalities when test is indicated (range)	Comparability with current study	% Changes in clinical care when test is indicated (range)	Comparability with current study
Hematocrit	0.2-38.9	No	0.4-5	No	NR	NA
Total WBC count	2.9-17.6	No	6.3-60.8	Yes	0-14.9	Yes
Blood sugar	5.4-13.8	Yes	NR	NA	NR	NA
Serum potassium	1.5-12.8	No	1-29.5	Yes	NR	NA
Chest radiograph	2.5-60.1	Yes	7.7-65.4	No	0.5-75.3	Yes
ECG	7-42.7	Yes	4.8-78.8	Yes	2-20	Yes

strategies for prevention of HIV was beyond the scope of this study.

Recently, the ASA Task Force on Preanesthesia Evaluation made a recent systematic review to evolve evidence-based practice advisory for preanaesthesia evaluation [8]. The advisory concluded that tests intended to discover a disease or disorder in an asymptomatic patient do not make an important contribution to the process of perioperative assessment and management of the patient by the anesthesiologist. The advisory emphasized that the need for selective preoperative tests (ie, tests ordered after consideration of specific information obtained from sources such as medical records, patient interview, physical examination, and type or invasiveness of the planned procedure and anesthesia) may assist the anesthesiologist in making decisions about the process of perioperative assessment and management.

Table 3 compares the results of current study with the data found in the practice advisory literature review for 6 tests (hematocrit, total WBC count, blood sugar, serum potassium, chest radiograph, and ECG) with regard to total percentage of abnormalities, abnormalities for indicated tests, and changes in clinical care in indicated tests. For a particular item, we concluded comparison to be true (ie, agreeable) if the point estimate of occurrence in our study was in the range described in the advisory. In 4 of the 18 items, comparison was not possible, as the advisory could not find data for those items in the literature. For the remaining 14 items, comparison was agreeable for 9 items (64.3%) and not agreeable for 5 items. For comparisons related to changes in clinical care for indicated tests,

comparisons were possible for 3 tests (ie, total WBC count, chest radiograph, and ECG). For all these tests, the results observed in our study were comparable with those in the literature.

History is an important component in preoperative evaluation for identifying potential problems that can affect preoperative management or outcome. In this preliminary test of the hypothesis in a prospective study, there appeared to be no unidentified outcome or process benefit that accounts for the persistence of over more than 60% of preoperative testing that is unwarranted by medical history. Our small patient sample and restriction to the neurosurgical population somewhat limits the generalizability of our results.¹ Until more epidemiological data are available in India, routine preoperative screening for diabetes mellitus may be beneficial.

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¹ The following data list the occurrence of coexisting problems in 2049 consecutive operated neurosurgical patients in 20 months. The data were retrieved from the neuroanesthesiology computer database with hard copy source being anesthesia charts and patient clinical records. History and/or laboratory testing identified the coexisting problems. This data collection were independent of the HealthQuiz study. The occurrence (%) of the problems was as follows: hypertension (13.08%), coronary artery disease (1.56%), valvular heart disease (0.59%), bronchial asthma (1.22%), diabetes mellitus (7.03%), nephropathy (0.59%), hepatitis B (1.81%), HIV (0.2%). Because the data on HIV were obtained from operated cases, the exact prevalence may be underestimated because of possible cancellation of positive cases.

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