

Role of routine laboratory investigations in preoperative evaluation

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Abstract

Traditionally, routine investigations prior to surgery are considered an important element of preanesthetic evaluation to determine the fitness for anesthesia and surgery. During past few decades this practice has been a subject of close scrutiny due to low yield and high aggregate cost. Performing routine screening tests in patients who are otherwise healthy is invariably of little value in detecting diseases and in changing the anesthetic management or outcome. Thorough history and investigation of positive answers by the clinicians, combined with physical examination of patient represents the best method for screening diseases followed by few selective tests as guided by patient's health condition, invasiveness of planned surgery and potential for blood loss. A large number of investigations which are costly to pursue often detect minor abnormalities of no clinical relevance, may be risky to patients, cause unnecessary delay or cancellation of surgery, and increase medico-legal liability. An approach of selective testing reduces cost without sacrificing safety or quality of surgical care.

Key words: Routine laboratory investigations, routine preoperative tests, screening tests

Overview

The use of routine laboratory investigations before elective surgery is widespread. It is considered a part of pre-anesthetic evaluation to determine fitness for anesthesia and identify patients at high risk of postoperative complications. So pervasive is the thinking that surgeons, anesthetists, and even patients expect “battery of laboratory tests” prior to surgery.

The preoperative investigations may be divided into two categories: routine or screening and indicated or diagnostic. American Society of Anesthesiologists (ASA) Task Force on Preanesthesia Evaluation (2002)^[1] defined routine tests as those done in the absence of any specific clinical indication or purpose (i. e. tests intended to discover a disease or disorder in an asymptomatic patient and traditionally include a panel

of blood, urine tests and X-ray chest, electrocardiogram). Indicated tests are defined as tests done for a specific clinical indication or purpose, e. g. to confirm a clinical diagnosis, to assess the severity and progress of disease, and effectiveness of therapy. The latter tests are generally well accepted as they affect perioperative care and outcome^[2] However, the usefulness and cost-effectiveness of routine screening tests in the absence of any clinical indication has been questioned as the probability of finding a significant abnormality is small for laboratory tests, electrocardiogram, and chest radiography.^[3-9] Our preoperative testing practice, for the most part, falls under the category of routine or category.^[2] Many retrospective and prospective trials have demonstrated that the screening tests rarely uncover a disease in asymptomatic patients and abnormalities of laboratory test results very occasionally altered the perianesthetic management or outcome^[4,10-12] [Table 1]. However, the cost of surgical care escalates though no safety net for medico-legal problems is offered.^[3,5,10,11,13-15] This led the ASA Task Force^[1] evaluation to recommend selective testing, based on clinical evaluation and risk assessment rather than the previous shotgun approach. Such an approach reduces consultations, delays, and cancellations on the day of surgery.^[13] The impact of preoperative testing on health care is likely to extend beyond the simple reduction in number of tests performed.^[16]

This review attempts to explore various issues of routine preoperative laboratory testing such as the background for

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Table 1: Data of few studies of pre-operative routine investigations

Investigator	Type of study	ASA status	Number of patients	Age group	Type of surgery	Total tests (n)	Abnormal tests (n)	Change in anesthetic technique	Conclusion
Turnbull and Buck 1987 ^[4]	Prospective	I-II	1010	Adult	In-patient	5003	225	17	Routine tests provided little information not detected by history and physical exam.
Perez <i>et al.</i> 1995 ^[26]	Retrospective multicentre	I-III	3131	Adult	In-patient	38286	465	<1.5%	Selective and rational tests needed on basis of clinical judgment.
Dzankie <i>et al.</i> 2001 ^[11]	Prospective	I-III	544	Elderly	In-patient	2462	170	-	Routine tests not indicated on basis of age only and have low predictive value. ASA(>2), surgical risk affect outcome
Johnson <i>et al.</i> 2002 ^[10]	Retrospective	-	100	Adult	In-patient	773	70	0.2%	Outcome not predicted by routine tests, anesthesia rarely altered, high cost
Bryson <i>et al.</i> 2006 ^[12]	Retrospective	I-II	198	Adult	In and out-patient	534	205	14	Most tests normal, Management affected in few only
Shah <i>et al.</i> 2007 ^[7]	Prospective	I-II	150	Children and adult	In and out-patient	600	03	0	No routine tests needed in young healthy patients.
Sarayrah <i>et al.</i> 2009 ^[9]	Retrospective	I-II	430	Children	Class I and II	860	86	Very occasionally	Perioperative out come can not be predicted by routine tests.
Chung <i>et al.</i> 2009 ^[8]	Prospective (RCT)	I-III	527	Adults and elderly	Out-patient	1632	188	-	Perioperative adverse events not affected by abnormal tests or omitting tests.
Ranasinghe <i>et al.</i> 2010 ^[36]	Prospective	I-II	367	Adult	In and out-patient	-	-	-	Substantial cost saving by rationalizing testing practice

evolution of testing, its shortcomings and value, changing trends, current guidelines and problems in dissemination, and adoption of guidelines.

Historical perspective for evolution of routine laboratory testing and challenges to practice

During 1940-1960, clinicians elicited thorough history and physical examination for preoperative assessment and only selective laboratory tests were ordered to confirm or refute clinical diagnosis.^[17,18] In late 1960s, the introduction of a biochemical auto-analyzer made it easier for clinicians to obtain a large number of tests with a small addition of cost. The ease of ordering and low cost of obtaining many laboratory tests made this new method of evaluation attractive.^[14] This practice evolved from the assumption that early and frequent testing could detect disease in their pre-clinical stage to allow early and less costly treatment.^[17,19] This thinking was accepted as dogma and rapidly made its way into medical mindset of all health care workers such that excessive testing was equated with efficient care.^[19] Many hospitals made rather arbitrary rules to perform a series of laboratory tests prior to any

operative procedure^[14,20] with the assumption that voluminous information would enhance the safety of surgical patients and reduce the liability for adverse events.^[19] The practice continued for years without any scientific basis of the usefulness and with little consideration of cost.^[5,13,17,18,20,21]

During the past three decades, this practice of routine investigations prior to surgery has been challenged by several academic publications^[2,3,10,16,18,22] as it involves a sizable cost without significant benefit to millions of patients undergoing surgery. The early studies to debunk the routine preoperative screening tests were published in mid and late 1980s. In a retrospective review of charts of over 2000 elective surgical patients who underwent battery of tests including complete blood cell count, differential blood count, prothrombin time, glucose level, serum electrolytes, creatinine, platelet count, etc, Kaplan *et al.* (1985) demonstrated that only 96 (22%) tests revealed abnormalities. Of 96 abnormal test results, only 10 could not be determined by history and examination, of which only 4 were of actual clinical significance. Similar findings were reported in healthy adults^[4,23] and in children.^[9,24]

Numerous subsequent studies involving ambulatory^[5,25] or inpatient surgery^[10,26,27] demonstrated that the frequency of abnormal laboratory test results in asymptomatic patients was very low and 60-75% of patients would not have required any test if guided by clinical evaluation.^[3,6,26,28] Even in very elderly patients, at higher risk of perioperative morbidity and mortality, ultimate benefit of routine tests prior to non-cardiac surgery seemed doubtful.^[11]

Schein *et al.* (2002)^[21] in a multicenter trial involving more than 10,000 patients of cataract surgery reported that incidence of postoperative adverse events and death was same whether preoperative routine tests were done or omitted. Similarly, studies of other ambulatory surgical patients where no preoperative investigations were done showed no adverse effects on postoperative outcome as a result of omission of tests.^[8,29]

A Health Technology Assessment systematic review^[30] concluded that routine screening laboratory tests produce wide range of abnormalities even in healthy patients. The clinical significance of abnormalities was uncertain and usefulness was doubtful as they rarely influenced management. There was no evidence that routine tests either improved or worsen postoperative outcome.^[3]

Evidence is similarly lacking for an association for testing without indication and improvement in outcome. Routine electrocardiogram (ECG) and chest X-ray (CXR) have also shown low utility in healthy patients. The abnormal findings of CXR in asymptomatic patients ranged between 10% and 50%^[30,31,32] but those which could alter anesthetic management were rare.^[21,26,33] Similarly the incidence of abnormal ECG findings was very high^[20,26,34] but the anesthetic management was affected in less than 5% of patients^[21,26,34] The ASA Task Force^[1] suggested preoperative ECG only for patients with known or suspected cardiovascular risk factors and not on the basis of age alone. Regarding chest X-ray, the Task Force did not recommend extremes of age, smoking, stable COPD, or cardiac disease as unequivocal indications of chest radiography. Tests of clotting functions in normal patients with no risk factors were incapable of predicting perioperative bleeding.^[21,35]

The studies evaluating utility and cost-effectiveness of preoperative tests documented low yield and escalation of cost.^[6,8,36,37] The results of cited studies and innumerable other published large trials^[6,23,27] have clearly shown that performing battery of tests on a routine basis without indication produce very low abnormal findings and contributed significantly to overall health cost.^[5,10]

Shortcomings of routine laboratory testing

Although the laboratory tests can help in ensuring optimal preoperative condition, routine screening tests have several shortcomings. The tests ordered in the absence of clinical indication, while frequently abnormal, fail to predict perioperative complication and seldom influence anesthetic management.^[3, 6, 10, 30, 38] Nonselective testing produces many false positive, false negative, or borderline results.^[14, 35, 39] Further evaluation or repeat test may cause unnecessary psychological and economical burden^[15, 20, 40] and postponement of surgery.^[14, 18, 35, 41] False negative tests lead to sense of security and may result in unfavorable outcome.^[40] Frequently, the abnormalities detected are not pursued and the clinicians proceed with anesthesia and surgery ignoring them.^[12,14] Abnormalities detected if not pursued leaves the clinicians open to more medico-legal liability than if the test was not ordered in the first place.^[3,42,43]

Changing practice of preoperative testing

There are still substantial areas of uncertainty in the literature due to the lack of randomized prospective trials and relatively low incidence of post-operative adverse events.^[16] But the medical,^[3, 4, 6, 21] surgical,^[6, 18, 35, 44] and anesthesia^[10,11,12,26,38,45] literature is replete with reports from studies that have established that screening tests without specific indication is wasteful. Based on the available data there is general consensus that only the selective tests should be advised consistent with the clinical evaluation^[17, 22, 45] considering patients health status, presence of medical diseases, current medication, invasiveness or risk of proposed operative procedure (minimally, moderately or highly invasive),^[14] and potential for blood loss.^[1, 14, 15, 18, 20, 41, 43] The tests should be obtained for specific clinical indication (e. g. obtain blood glucose in a known or suspected patient of diabetes or require complete blood count in surgeries where moderate or severe blood loss is expected) that may increase perioperative risk or influence management of anesthesia or surgery^[10, 14, 15, 41, 43, 46] and not simply because the patient is to undergo surgery. Healthy patients of ASA physical status I and II without co-existing medical condition undergoing minimally invasive outpatient surgery may require no routine investigations,^[8, 14, 15, 25, 27, 44] whereas those scheduled for moderately or severely invasive surgery which cause major physiological stress, few baseline tests may be done.^[46] Further testing is needed only as per specific medical condition. In older patients with medical diseases, likelihood of abnormal tests is higher; therefore more liberal testing may be done. However using age as a criteria for routine tests is debated^[11, 34, 46] and ASA physical status and risk of surgery are considered better predictors of surgical outcome in elderly patients.^[11, 34] There is growing evidence

that physiological age with overall health condition and invasiveness of surgery rather than chronological age should determine the need of tests especially ECG.^[34,47]

Value of routine tests

To determine the usefulness and interpretation of the laboratory test results, following issues need consideration.

1. Relevance—although some test abnormalities are clearly of concern (e. g. raised blood sugar), others may have little or no effect on perioperative anesthetic management or outcome e. g. WBC count.^[19]
2. Normal value—usually the normal or reference range of a laboratory investigation is set arbitrarily based on 95% confidence interval. Therefore, the *bete noire* of the definition is that up to 5% of normal individuals may have abnormal values and vice versa.^[39,41] It has been estimated that by ordering 10 independent tests in a healthy person, there are 40% chances that one of the test result will be abnormal by random chance alone.^[35,39,41] Therefore, to determine its clinical relevance, the test results should be interpreted within context of clinical situation.^[46]
3. Sensitivity, specificity of tests and prevalence of disease—the usefulness of screening a disease depends on the sensitivity and specificity of the test and the prevalence of the disease in the population. Screening tests in the asymptomatic population should only be done in patients where the potential condition is significant and of reasonable prevalence.^[19,41]
4. Consideration of cost—a sizable amount of money can be saved by selective testing and use of a less costly test if quality of information is not compromised.^[20,38]
5. Risk and cost versus benefit—the risks of an intervention based on results is associated with significant cost both in terms of money and potential harm^[31] and also the risk may outweigh the benefit.^[10,14,41] For example following a positive non-invasive test, coronary angiography and bypass surgery may be advised before a non-cardiac surgery. Although outcome may improve, morbidity

associated with the procedures may be greater than any benefit.^[41]

Current recommendations/guidelines

Substantial variations are found in the practice of preoperative testing and it varies markedly from one hospital to other and among clinicians of the same hospital.^[47,48] In an attempt to rationalize this issue, guidelines have been systematically developed after analysis of studies, best evidence available, and consensus of expert professionals.^[14,15,18,19,20,30,49] Preoperative diagnosis-based guidelines provide basic recommendations for laboratory and other tests [Table 2, based on the guidelines available in text books of anesthesia and scientific journals].^[14,15,18,19,48,49] The recommendations can be accepted as such or can be modified based on local need and individual practice, to ensure highest quality of surgical care. Bryson *et al.* (2006)^[12] noted that abnormal laboratory results were equally common in patients having ambulatory or inpatient surgery suggesting that the guidelines were over inclusive and could be further refined. Similarly, in women requiring gynecologic surgery, adherence to guidelines^[49] resulted in a large number of inappropriate tests.^[32] Therefore, guidelines should be periodically reviewed and re-evaluation should not be restricted to outpatients only.^[12] They should be audited as warranted by evolution of medical knowledge, technology, and pattern of practice.^[12,32,47]

Problems in adoption of guidelines

Over the past one decade some change has occurred and the number of routine tests have decreased^[23,24,29] along with cost of care both at individual^[50,51] and institutional level^[8,36,37] while safety of patients was not affected.^[8,13,19,37,38,50] Still 30-60% tests continue to be greatly in excess of that recommended.^[12,47] It is a matter of great concern that despite clear results of innumerable studies and recommendations from professional societies, after nearly 30 years, the dissemination and adoption of guidelines to routine practice is problematical.^[2,16,18] The

Table 2: Preoperative diagnosis based investigations before elective surgery

Complete blood count	Serum creatinine and electrolytes	Blood glucose	ECG	X-ray chest	Coagulation studies
Major surgery	Kidney disease,	Diabetes	Cardiac disease	Chronic lung	Liver disease
Neonates	Hypertension	Family H/o diabetes	Hypertension	disease	Renal dysfunction
Males > 70 years	Diabetes	Obese	Chronic lung	Heavy smoker	Family H/o Bleeding disorder
Females >45 years	Poor nutritional states	Stroke	disease	Radiation therapy	On anticoagulant drugs
Chronic renal, liver, lung disease	Stroke	Poor nutritional states	Diabetes	Aortic aneurysm	
Anemia	Medication	Steroids use	Thyroid disease	Cardiomegaly	
Malignancy	- Digoxin	Cushing's, Addison's	Morbid obesity		
Poor nutritional states	- Diuretics		Digoxin therapy		
Vascular aneurysms	- Steroids		Males > 45 years		
	- Chemo-therapy		Females >55 years		

reasons why clinicians continue to order the routine tests before surgery are not clear^[26] but a number of reasons have been suggested.^[51] Difficulty in changing previous work pattern or behavior,^[2,13,18] fear of cancellation of surgery,^[51] missing some important information during evaluation,^[14] and institutional requirement^[18] are few. Fear of litigation is a real concern among clinicians who worry that not carrying out the tests will have to be answered in the case of an adverse event during anesthesia.^[6,18,52,53] An important reason of over testing in teaching institutes is belief among junior staff that the consultants wanted them or simply by force of habit that is passed down through successive generations of junior staff.^[10,50] In many hospitals and institutions the laboratory tests are ordered by the surgeons and the anesthetist are reluctant to cancel the tests ordered by surgical colleagues.^[12] Any scheme that proposes to rationalize routine testing must address these issues that will otherwise act as barriers.^[18]

The professionals involved in surgical care of patients include primary care physicians, internists, anaesthetists, and surgeons who should jointly try to curb on this practice. The efforts to change the old practice should include making the clinicians aware of limited value and unnecessary cost of the screening tests by providing credible data. They should also be assured that reducing or omitting the routine tests would not affect quality of care or safety of patients and would not increase the medico-legal liability. There is a strong need of continuing education of junior medical staff and consensus among consultants about change in practice both at national and local level.^[37,42] At the same time, it is also necessary to advocate for establishment of a more structured approach to manage surgical patients during the initial phase of the perioperative process to permit implementation of guidelines whose use can significantly reduce unnecessary tests.^[16] This calls for establishment of preoperative assessment clinics to provide cost-effective quality patient care,^[11] where the anesthesiologists who understand the risk factors of both the patients as well as surgery, can clinically evaluate and order appropriate and necessary investigations for a particular patient.^[20]

Key Points

1. Performing routine tests in all surgical patients as a screening tool is inefficient, unnecessary, and expensive.
2. The value of preoperative screening lies in the clinician's assessment; the selective tests are then ordered considering specific information obtained from patient's interview, examination, review of medical records and the type, and invasiveness of proposed surgery and anesthesia.
3. The tests should be done only if results are likely to affect patient management and postoperative outcome.

4. They should not be guided by tradition, vested interest, or cost alone.
5. It is a misconception that obtaining battery of routine tests provides medico-legal protection against liability.
6. Adoption of guidelines for testing can maximize the yield and prevent waste of resource and time.

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