Original Article

Pre-operative laboratory testing: A prospective study on comparison and cost analysis

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ABSTRACT

Background and Aims: Pre-operative investigations are performed before any surgical intervention under anaesthesia. Many are considered as routine. However, there are no clear guidelines regarding these in India. We aim to look at the relevance of the laboratory investigations ordered routinely and their cost implications compared with the National Institute of Clinical Excellence (NICE) guidelines. **Methods:** This prospective study was carried out at a tertiary care hospital. A total of 163 patients scheduled for elective surgical procedures were included in this study. Neither the surgeons nor anaesthesiologists involved in the case were aware of the study. The laboratory investigations of the patients who underwent surgery were noted. All values were categorised as normal or abnormal and they were assessed as indicated or unindicated based on NICE guidelines. **Results:** One hundred and sixty-three patients were subjected to a total of 984 tests. Forty three patients (26%) were subjected to tests as per NICE guidelines. Of the 984 tests, 515 tests were unindicated (52%). Out of the 515 unindicated tests, 7 (1.3%) were abnormal. None of these seven tests required any intervention or change of anaesthetic plan. The most common unindicated tests done were cardiac echocardiography and chest X-ray (92.5% and 93% respectively). The additional cost incurred towards unindicated tests was 63% of the total cost for the tests. **Conclusion:** Pre-operative laboratory investigations add to cost significantly. Patient premorbid conditions and surgical grade should guide the clinician to request for the relevant laboratory tests.

Key words: Cost, laboratory tests, pre-operative

INTRODUCTION

All patients are subjected to pre-operative evaluation before surgery. The importance of pre-operative assessment and laboratory tests based on clinical examination has been well reviewed.[1] Patients are classified into one of the 5 grades according to the American Society of Anesthesiologists' (ASA) physical status.[2] All these patients are evaluated with battery of laboratory investigations. However, it has been realised that many of the investigations are of minimal benefit. Many studies have questioned the need for these investigations.[3,4] All the available literature which has addressed the issue of pre-operative tests and its cost implications have come from the developed countries[5,6] and there are few such studies in our population.[7,8] With raising costs, the health-care industry is looking to minimise additional expenses incurred through these investigations, and thus, it becomes prudent to be judicious in requesting for laboratory investigations. We studied to evaluate the additional cost implications of pre-operative investigations in patients scheduled for elective surgery compared to the currently available guidelines.

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METHODS

A prospective study was undertaken between June and August 2011 at a tertiary care hospital. Ethics committee approval was obtained. One hundred and sixty-three patients of either gender scheduled for elective procedures in the study period were included. Patients scheduled for cardiac and emergency procedures were excluded from this study. The demographic data, diagnosis and nature of procedure were noted.

All laboratory investigations ordered and the instrumental tests (electrocardiogram [ECG], echocardiogram [ECHO], chest X-ray [CXR]) performed were also noted. All values were categorised as normal or abnormal based on the reference values of the laboratory. Based on the National Institute of Clinical Excellence (NICE) guidelines,[9] surgical grades were recorded and also ASA physical status defined as per guidelines. Based on the guidelines, the tests were considered as required or not required. Any specific tests done on instructions by the anaesthesiologist or patients' comorbid conditions were categorised as indicative tests. All other tests were considered as routine.

Any abnormal ECG with clinical correlation of signs and symptoms were further subjected to ECHO to determine the severity of the cardiac disease. Test performed outside of these indications were considered as routine and unnecessary. Cost analysis was done for every test which was considered not necessary based on NICE guidelines. No surgeons or the anaesthesiologists were informed about the study to remove bias. The financial implications on the patient and the institute were analysed.

RESULTS

A total of 163 patients of either gender scheduled for elective surgical procedures were prospectively evaluated. There was no data loss or inappropriate data. The missing data were of ECG, complete blood count (CBC) in one patient each, cardiac ECHO in two patients and international normalised ratio and blood grouping tests in five patients. The demographic data and nature of procedure are outlined in Table 1.

The majority of the patients were adults and in ASA physical status 1 and 2. The nature of surgical procedures performed were equally distributed between Grades 1 and 2 (40%) and Grades 3 and 4 (47%). The remaining 13% were neurosurgical procedures. This has been separately considered as per the NICE guidelines.

Table 1: Demographic data

Data	Number of patients (*n*=163)
Age (years)	
<16	11
>16	152
Sex	
Male	96
Female	56
ASA grade	
1 and 2	142
3	21
4	0
Surgical grade	
1	22
2	42
3	53
4	24
Neurosurgical procedures	22

ASA – American Society of Anesthesiologists

The number of laboratory tests and instrumental tests done is shown in Table 2. A total of 720 laboratory tests and 264 instrumental tests were done. Out of the 163 patients only 43 patients were subjected to laboratory tests as per the guidelines which translate to 26%. Out of the 984 tests done 515 tests were not indicated. This was significant as more than 52% were unindicated tests. The total number of tests which were found to be abnormal when performed in unindicated cases were seven, amounting to only 1.1%. Out of these seven tests, CXR was found to be abnormal in two patients. Both these patients underwent major surgical procedure (surgical Grades 3 and 4) without perioperative events. ECG and ECHO were found to be abnormal in one patient each. Both these patients were young, clinically fit in ASA physical status 1 and were incidental findings. No further evaluation was carried out on these patients. Two other patients had abnormal platelet count in CBC and hyponatraemia. This was neither correlating with the underlying disease nor the clinical condition of the patient. The repeat tests were found to be normal. One patient had altered coagulation values with no clinical indicators. This again was done as routine test. The repeat test was normal. The most common investigation considered as routine was CXR irrespective of the age and the nature of the procedure. Out of 88 (55%) patients who had CXR, 82 (93%) were not indicated. In 75 (45%) patients where CXR was not done were as per guidelines. Grouping and cross matching was done in 46% (39/84) of patients where

expected intraoperative blood loss was minimal. Cost analysis was performed for unindicated tests and the savings for the patient and resource for the hospital calculated. For the 515 (52%) unindicated tests, the total cost amounted to Rs. 171,358. The major cost was towards performing ECHO and CXR accounting to more than 56% of the total cost [Table 3].

We observed that many patients were referred to the cardiologists for cardiac evaluation in patients scheduled for surgical procedure based on the age and nature of the procedure. ECHO was not indicated in 74 out of the 81 patients (92.5%) as per guidelines. This accounted for 42% of the total additional cost incurred towards unindicated investigations.

DISCUSSION

The present study results indicate that unnecessary investigations could be reduced significantly by good pre-operative evaluation of patients, with no loss of clinically relevant information and patient care. It is necessary to identify the risk factors and request for investigations based on the patient comorbid conditions and nature of surgery. Guidelines help to have a structured, patient directed, evidence-based approach for workup of these patients scheduled for surgery. Thus, patients in good health require minimum investigations.

Only 26% of patients were subjected to laboratory tests as per the guidelines, and 52% of the tests were not indicated. This again adds to the resource utilisation with no benefits. The total number of tests which were found to be abnormal when performed in unindicated cases were only seven. The repeat tests in three instances were normal. This would have influenced the anaesthetic plan and thus increased the cost.

The reduction in costs following patient directed investigations have been reported by earlier studies.[6,10,11] A cost analysis study showed a reduction of 63% of cost per patient by applying their institute guidelines.[6] Similarly, in another study, selective

Table 2: Laboratory tests and instrumental tests

Investigation	Number of patients where investigations done	Investigations not done	Investigations done as per guidelines	Investigations done-unindicated
CXR (*n*=163)	88	75	6	82
ECG (*n*=162)	96	66	58	38
ECHO (*n*=161)	80	81	6	74
CBC (*n*=162)	144	18	113	31
Electrloytes (*n*=163)	129	34	73	56
Urea/creatinine (*n*=163)	134	29	80	54
RBS (*n*=163)	128	35	66	62
INR (*n*=158)	101	57	22	79
Blood grouping (*n*=158)	84	74	45	39
Total	984	467	469	515

ECHO – Echocardiogram; ECG – Electrocardiogram; CXR – Chest X-ray; CBC – Complete blood count; RBS – Random blood sugar; INR – International normalised ratio (coagulation profile)

Table 3: The cost analysis considered as indicated and unindicated tests

Laboratory tests	Unindicated tests	Number of indicated tests done	Cost/unit (₹)	Actual cost (₹)	Cost incurred on unindicated tests (₹)
CXR	82	6	300	26,400	24,600
ECG	38	58	150	14,400	5700
ECHO	74	6	980	78,400	72,520
CBC	31	113	210	30,240	6510
Electrolytes	56	73	286	36,894	16,016
Urea/creatinine	54	80	190	25,460	10,260
RBS	62	63	60	7680	3720
INR	79	22	286	28,886	22,594
Blood grouping	39	45	242	20,328	9438
Total	515			268,688=00	171,358=00
Cost towards appropriate tests					97,330=00
Additional cost (%) spent on unindicated tests					63

ECHO – Echocardiogram; ECG – Electrocardiogram; CXR – Chest X-ray; CBC – Complete blood count; RBS – Random blood sugar; INR – International normalised ratio

ordering of investigations by the anaesthesiologists significantly reduced the number of tests and the cost by almost 25% and reduced by 41% if consultant assessed and ordered for the tests.[12] The present study had a similar estimation of 63% cost reduction by applying the NICE guidelines.

The estimated saving in costs that was calculated refers to the application of the NICE guidelines in our patient population. However, this may not be an ideal way of interpreting our data and draw conclusions. Compared to the developed countries, developing countries have limitations with respect to the access to health care. Awareness about the health issues is limited to education and affordability with the urban gaining advantage over rural population. Thus, in most instances what has been termed as the inappropriate test may be an appropriate test in the given situation. It has been defined as not indicated for few tests based on the population studied and abnormal results reported. It becomes necessary to define similar guidelines based on the study population. The incidence of diabetes is on the rise, and the clinical scenario is changing. Based on this, blood glucose estimation, what is termed as unnecessary in the guidelines in select patients may be appropriate in our group of patients wherein they are evaluated for the 1st time for any pre-existing disease. Hence, this becomes an appropriate test in our population.

Thus, a 52% reduction in the number of tests would lead to optimal utilisation of the hospital resources. The indirect additional cost to the patient in the present analysis was accounted towards CXR, coagulation profile and cardiac ECHO. We looked into the cardiac risk and pre-existing comorbidities and the need for cardiac ECHO testing. Based on these, we found more than 90% of the time ECHO requested by the physicians or surgeons was inappropriate leading to unnecessary testing and additional cost. Studies have looked into the need for the routine ECGs and chest radiographs.[13-15] In a large study involving 6111 patients undergoing elective surgery, the usefulness of routine chest radiographs and its influence on anaesthetic management was evaluated.[16] They found 18.3% were abnormal out of which only 5.1% (313 patients) were considered as useful which altered anaesthetic management. The presence of respiratory disease and age >60 years with ASA class 3 or more contributed to the probability of usefulness of the test. Similarly, routine ECG screening for patients with no cardiovascular risk added very little to predict perioperative cardiac complications.[17] Inappropriate pre-operative tests can lead to a false-positive results, causing unnecessary delay in surgery and also add to patient anxiety.[18] In two of our patients where ECG and ECHO were found to be abnormal neither required intervention nor influenced on the anaesthetic management in the perioperative period.

In a report on the need for pre-operative ECG and its usefulness, it was concluded that test should be ordered only in high-risk individuals.[19] The author suggested that clinical indicators like age more than 45 years, cardiovascular and respiratory diseases and surgical severity, should guide for pre-operative screening.

We observed that many patients were referred to the cardiologists for cardiac evaluation in patients scheduled for surgical procedure based on the age and nature of the procedure. The need for this instrumental investigation was determined by the nature of the clinical status of the patient and also the severity of the existing comorbidities. Of the 81 patients who had ECHO, 74 patients (92.5%) ECHO were neither clinically indicated nor had pre-existing comorbidities. This accounted for 42% of the total additional cost incurred towards unindicated investigations. ECHO has not been included in the NICE guidelines.

With increasing consumer protection issues, anaesthesiologists fear of the legal implications of leaving out tests, and this has been addressed in few studies.[1] However, anaesthetists still consider 48% of the routinely prescribed tests to be unnecessary.[6] There are very few studies which looked at the issues in adopting the guidelines with respect to the Indian scenario. The issues were fear of cancellation, the force of habit passed down from senior colleagues, and most importantly legal implications.[7]

In another data analysis, it was observed that nearly 63.3% of the tests were unindicated. This was evaluated using patient questionnaire, and tests need was determined by the rule-based algorithm that depended on the patient's response. Their data included only neurosurgical patients which form a different group with respect to surgical risks and nature of the disease.[20]

In a retrospective cost analysis study, total cost towards the laboratory tests was calculated.[8] However, cost

incurred towards indicated and unindicated tests was not done.

It is necessary that the guidelines should be pertinent to the population at large addressed. The laboratory tests should be patient centered and need-based which should add to the pre-operative preparation, intraoperative modification of anaesthesia care and post-operative management. All the current guidelines reported are based on the meta-analysis studied in the developed nations. In India, where more than 70% is rural population with awareness and literacy rate in health care is low, presentation to the hospital will always be at the advanced stage of the disease. This precludes the use of these standard guidelines in our patient population.

Thus, there is a need for developing guidelines to suit our population considering the socio-economic status, time of presentation and the nature of the disease being treated. Certain tests though not indicated need to be done till we have sufficient evidence to omit from routine tests in our population. To our knowledge, this is first prospective study looking at the cost implications of pre-operative laboratory testing both indicated and unindicated and costs savings in the Indian population.

CONCLUSION

Pre-operative guidelines of laboratory testing fully introduced in clinical practice could notably increase efficiency without affecting the quality of care. The cost savings from optimal pre-operative tests can be significant. We need to move away from ordering routine tests, to patient and disease specific and need-based laboratory testing. Considering the poor compliance of our population towards regular health check-ups, it may be necessary to develop guidelines pertinent to our country and further review the process.

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Conflicts of interest

There are no conflicts of interest.

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