



## Original Research Article

## A prospective observational study to evaluate the impact of pre-operative investigations on resource utilisation and peri-operative management in elective surgeries

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## ABSTRACT

**Introduction:** During the past decades, practice of routine investigations prior to surgery has been challenged as it has little impact on perioperative management but increases cost, causes delay and increases laboratory load. We aimed to prospectively assess the influence of pre-operative investigations on resource utilisation and peri-operative management in elective surgeries.

**Materials and Methods:** Prospective observational study was done in 500 Patients, who attended pre-anaesthetic check-up (PAC) for elective surgeries. Number of investigation already performed before arriving in PAC and their results in terms of normal and abnormal tests were noted. Based on National Institute for Health and Care Excellence (NICE) guideline, the test was considered as indicated or unindicated. These patients were then followed up till the post-operative period and any referral, further investigation or delay done during pre-operative was noted. An abnormal test result was said to be impactful if it resulted in referral, delay or further investigations. Cost analysis was done for every test that was considered not necessary based on NICE guidelines.

**Results:** Majority (60.6%) of the patients had at least one abnormal test results on routine pre-operative tests, but only 6.93% of all tests performed had any impact in terms of referral, further testing or delay. Only 5 (0.14%) of all 3462 abnormal test had significant impact which it lead to change in perioperative management.

**Conclusion:** The practice of prescribing large number of routine pre-operative investigations is prevalent in the institution. Most of the investigations are done without following any guidelines, which leads to wastage of resources.

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### 1. Introduction

Preoperative evaluation which is a basic element of anaesthesia care, aims to evaluate the patients in order to optimise patient's health, improve the quality of Anaesthesia and return the patient to normal functioning at the earliest. Pre-operative evaluation initially included taking history and examination only. Sometimes selective laboratory tests were advised which could give additional diagnostic

or prognostic information in peri-operative management. The main purpose of preoperative investigations is to provide additional diagnostic and prognostic information to supplement the clinical history of a patient with the aim to provide better peri-operative management.

The task forces of the American Society of Anaesthesiologists (ASA)<sup>1</sup> and National Institute of Health and Care Excellence (NICE)<sup>2</sup> have provided guidance on the use of pre-operative laboratory tests before elective surgeries for the last one and half decades. These guidelines

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are against the practice of routine pre-operative laboratory tests but, the tradition of routine preoperative testing is still prevalent. Till date several studies have been done to evaluate the impact of pre-operative investigations but most of the literatures are from developed countries with a paucity of literature in the Indian population. Moreover most studies are retrospective in nature. Recently in 2016 new guidelines were published by National Institute of Clinical and Health Excellence (NICE),<sup>2</sup> and as no literature was found using this new guidelines, we aimed to prospectively evaluate the impact of pre-operative investigations on resource utilisation and peri-operative management in elective surgeries.

## 2. Materials and Methods

A Prospective Observational Study was conducted in a tertiary care teaching hospital from May 2019 to November 2019 after approval from Institutional ethical committee. Five hundred patients attending pre-anaesthetic check-up (PAC) clinic for evaluation and risk stratification before planned elective surgeries were included in the study. Their demographic parameters, date of arrival in PAC, American Society of Anaesthesiologist (ASA) status, Grade of surgery according to NICE guidelines 2016 were recorded. Grades of surgery taken from NICE guidelines are present in Table 1, which is graded as major, intermediate or minor. The number of investigations already performed before arriving in PAC and their results in terms of normal and abnormal tests was noted. A test was considered as abnormal if it was not within normal limits as assigned by institutional laboratory. Based on the guidelines, the test was considered as indicated or unindicated. Numbers of abnormal tests and their impact was expressed in absolute number as well as a percentage.

All these patients were then followed up on subsequent PAC visits till one day prior to surgery and the total no. of PAC visits, any referral, further investigation and consequent delay were confirmed pre-operatively. In post-operative period, changes in the on-going management, alteration in the anaesthetic procedure or monitoring plan were noted. An abnormal test result was said to be impactful if it resulted in referral, delay or further investigations. Impact was considered to be significant only if it led to a change in the perioperative anaesthetic management-postponing the elective case for further optimisation, changes in the on-going management, altering the anaesthetic procedure or monitoring plan.

Cost analysis was done for every test that was considered not necessary based on NICE guidelines. Total cost of investigations was calculated based on the rates fixed by Central Government Health Services empaneled laboratory and the financial implications on the patient and the institute was analysed.

The investigations done for diagnostic purposes were excluded from this study. Any disease specific investigation done as a consequence to significant patient's history or clinical examination was not considered impactful as these were not routine investigation.

The data was collected by a fixed designated anaesthesiologist for the entire duration of the study. However, designated anaesthesiologist was not supposed to either filter out any investigations or intervene to modify the PAC process conducted by other colleague of the same rank. None of the surgeon or anaesthesiologist was informed about the study in order to remove any bias. The patients directly evaluated by the designated anaesthesiologist were excluded from the study.

### 2.1. Statistical analysis

Categorical variables were presented in number and as a percentage (%) and continuous variables were presented as mean  $\pm$  SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test were used. Quantitative variables were compared using Independent t test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups. Qualitative variables were correlated using Chi-Square test. Spearman rank correlation coefficient was used to assess the association of various parameters with AMH and comparison of correlation coefficient was performed between the three groups. Receiver operating characteristic curve was used to find out cut off point of parameters for predicting PCOD and PCOM. The p value of  $<0.05$  was considered to be statistically significant. The data was entered in MS EXCEL spread sheet and analysis was done using SPSS (IBM Corp. Released 2013. IBM SPSS Statistical Package for Windows, Version 21.0. Armonk, NY:IBM Corp)

## 3. Results

From a total of 500 patients, only 197 were having all investigations as normal. 303 patients had at least one abnormal investigation, which forms 60.6%. Out of total 3462 test done, 398 tests were abnormal, in a sample of 500 patients. The prevalence of abnormal test results was 11.49%. 60.3% abnormal test (240 of 398) results had an impact in terms of referrals, delay or further investigation. However only 5 out of 240 (2.08%) have significant impact i.e. those, which actually led change in the on-going management, alteration in the anaesthetic procedure or monitoring plan. Test with significant impact formed only 0.14% (5 of total 3462 tests) of total test done [Table 3].

Complete blood count (CBC) was the commonest abnormal test found. It was abnormal in 252 of the 500 tests done (50.4%). Among CBC, low haemoglobin (Hb) was the commonest abnormality found. Out of 500 test done 168

**Table 1:** Surgical grades and examples adapted from National Institute for Health and Care Excellence

Grades	Examples (not limited to)
Minor	Excising skin lesion Draining breast abscess Primary repair of inguinal hernia
Intermediate	Excising varicose veins in the leg Tonsillectomy or adenotonsillectomy Knee arthroscopy. Total abdominal hysterectomy Endoscopic resection of prostate Lumbar discectomy
Major	Thyroidectomy Total joint replacement Lung operations Colonic resection Radical neck dissection

**Table 2:** Demographic, physical status and surgical grade wise distributions

Parameters	<i>n</i> or mean $\pm$ standard deviation or median [IQR (Q3-Q1)]
Age in years	37.33 $\pm$ 13.47 (27 – 48)
Body weight	59.23 $\pm$ 12.91 (25-115)
<b>Gender distribution</b>	
Male	236
Female	264
<b>ASA Physical Status</b>	
I	352
II	148
<b>Nice Grade of Surgery</b>	
Major/Complex	212
Intermediate	226
Minor	62

ASA-American Society of Anaesthesiologist

**Table 3:** Prevalence of abnormal test and distribution of routine tests done with respective results and impacts

Pre-operative laboratory tests	Tests done (N=500)	Abnormal tests	Abnormal test with Impact (N=tests done)	
			All tests with an Impact, (referral, delay, further investigations)	Tests with Significant Impact, (Postponing elective case for further optimisation, changes in the on-going management, altering the anaesthetic procedure and monitoring plan)
Complete Blood Count	500	252	131	3
Liver Function Test	484	33	21	0
Renal Function Test	499	17	11	0
Random Blood Sugar	495	3	3	0
Urine Routine & Microscopy	492	27	15	0
Chest X-ray	500	25	21	1
Electrocardiogram	492	41	38	1
Total	3462	398	240	5

(33.6%) patients had abnormal haemoglobin, and among these 168 patients, only 81 (48.2%) had an impact in terms of referrals, delay or further investigation.

As per NICE guidelines of total the 3462 test done only 491 (14.1%) were as per NICE guidelines, i.e. 2971 (85.8%) were unindicated. The total cost of processing the requested investigations as per the list provided by Central Government Health Services empaneled laboratories would equate to Indian National Rupees (INR) 429173 with INR 370808 spent on unindicated test and only INR 58365 spent for indicated test. This means that 85.43% of estimated cost incurred, is on unindicated tests. 14,454 patients (90.8%) were satisfied related to their pre-operative evaluation.

#### 4. Discussion

The goal of PAC is to gather information about the patient and formulate an anaesthetic plan for conducting smooth anaesthesia without or with minimal perioperative morbidity and mortality.<sup>3</sup> History, Physical examination and Laboratory Investigations are three important components of pre-operative evaluation. The preoperative investigations can be divided into two categories: routine (or screening) and indicated (or diagnostic).

Routine tests are those tests done in the absence of any specific clinical indication and these are tests intended to discover a disease or disorder in an asymptomatic patient and traditionally include a panel of blood, urine tests and chest X-ray, electrocardiogram (ECG). Indicated tests are defined as tests performed to confirm a clinical diagnosis, assess the severity and progress of disease, or effectiveness of therapy.<sup>1</sup> The latter tests are generally well accepted as they affect perioperative care and outcome.<sup>(4)</sup> Most often practice of preoperative testing, falls under the category of routine tests. For many years it has been usual practice to test apparently healthy patients for some hidden problems that might affect management. Identification of clinically undiagnosed conditions which require preoperative treatment before surgery or a change in anaesthetic management may be a possible benefit of routine preoperative investigations, however a false positive finding may lead to unnecessary, costly investigations or treatment leading to delay in surgery.<sup>4</sup> There has been very few prospective study from Indian population evaluating practice of prescribing pre-op investigation. Most studies do not mention the clear basis or guidelines of labelling a test result as indicated. Local guidelines have been employed in some studies.<sup>5</sup> Karim et al.<sup>6</sup> have used a combination of guidelines to define an indicated test. In 2016 new guidelines were published by National Institute for Health and Care Excellence (NICE),<sup>2</sup> which stress to further reduce unnecessary testing. As no literature was found using these recent guidelines, which stress to further reduce unnecessary testing. We aimed to prospectively

evaluate the impact of pre-operative investigations on resource utilisation and peri-operative management in elective surgeries

In the present study, 303 (60.6%) of the patients had at least one abnormal tests result, which is similar to the study done by Karim et al. in which 57.2% had abnormal result.<sup>7</sup> Out of 3462 test done in 500 patients only 398 were abnormal amounting to 11.49%, this is similar to 11.6% of abnormal test results found in a study done by Karim et al.<sup>7</sup>

The largest no. of abnormal test result was found in complete blood count (CBC) reports, among which were low haemoglobin was the commonest abnormality found. Out of 500 test of CBC done 168 (33.6%) were abnormal (Hb <13 gm. % in males and Hb <11.5% in females taken as abnormal). This is similar to the results in the study by Karim et al.<sup>7</sup> where they found 33.9% incidence of abnormal CBC reports.

Impact of abnormal results Notably, 60.3% (240 out of 398) abnormal test results had an impact in terms of further testing, referrals and delay for optimisation indicating that anaesthesiologists considered about 40% of abnormal test as clinically insignificant and did not subject patients to re-investigation or further investigation, however 2.08% i.e only 5 out of 240, had significant impact actually leading to changes in perioperative anaesthetic management. Significant impact among abnormal test result was found in 1% of total patients. Percentage of impact due to abnormal investigations was 100% with Random Blood Sugar, 92% with ECG, 64% with Renal Function Test, 63% with Liver Function Test, 55.5% with Urine Routine & Microscopy and least (51.9%) with CBC in the present study. A total of 48.2% (81 of 168) of the total abnormal haemoglobin results led to an impact in terms of further testing, referrals and consequent delay for optimisation. However, only 3 of these impacts led to change in perioperative management. This low number of impacts in CBC with respect to other investigations may be because borderline results are considered clinically insignificant for low risk ASA I and ASA II surgeries and are not followed up with further investigations, referrals or delay, therefore if such borderline results are corroborated with detailed history and clinical examination, it will not be labelled as abnormal so, the no. of abnormal result with impact will further decrease.

In the present study only 5 (0.14%) of all 3462 abnormal test had significant impact as it lead to change in perioperative management. Three out of five significant impacts was due to abnormal haemoglobin where elective case was postponed for further optimisation in pre-operative visit or on the operation table. In one patient with abnormal chest X-ray regional anaesthesia was administered instead of initially planned General Anaesthesia (GA). A case cleared from cardiology for ECG abnormality, developed fresh changes on the table, due to which it was postponed,

**Table 4:** Comparison pre-operative investigations with the standard guidelines

Investigations	Number of investigations done	As per guidelines	Unindicated	Not done in patients
Complete Blood Count	500	212	288	0
Liver Function Test	484	0	484	16
Renal Function Test	499	67	432	1
Random Blood Sugar	495	0	495	5
Urine Routine & Microscopy	492	0	492	8
Chest X-ray	500	0	500	0
Electrocardiogram	492	212	280	8
Total	3462	491	2971	38

**Table 5:** The cost analysis considered as indicated and unindicated tests

Investigations	Number of investigations done	As per guidelines	Unindicated	Cost per unit (in Rupees)	Actual cost (in Rupees)	Cost on unindicated test (in Rupees)
Complete Blood Count	500	212	288	155	77500	44640
Liver Function Test	484	0	484	259	125356	125356
Renal Function Test	499	67	432	259	129241	111888
Random Blood Sugar	495	0	495	28	13860	13860
Urine Routine & Microscopy	492	0	492	40	19680	19680
Chest X-ray	500	0	500	70	35000	35000
Electrocardiogram	492	212	280	58	28536	16240
Total	3462	491	2971		429173	366664
Per patient cost					858.34	733.328
Cost towards appropriate test						62509
Additional cost (%) spent on unindicated tests						85.43%

but did not reported for re-evaluation in the period of study.

A study done by Dzankic et al.<sup>8</sup> reviewing data of 46,977 patients from a national database who underwent routine preoperative testing found that neither laboratory testing nor abnormal results were associated with post-operative complications. Even abnormal test values found in routine testing among elderly patients failed to predict post-operative complications. This is similar to the results in present study in which there was no incidence of serious complication however the percentage of significant impact, measured in terms of change in perioperative management was 0.14%.

The percentage of impact/ abnormal results in the studies done in the developed countries, show results ranging as 0.3%;<sup>9</sup> 0.3%;<sup>10</sup> 0.38%;<sup>11</sup> 1.8%;<sup>7</sup> 2.6%.<sup>12</sup> The traditional practice of routine pre-operative tests, before elective surgery is still very much prevalent, this lead to unnecessary delay and loss of resources. Our study also found similar results. Unlike the present study there has been no clear-cut definition of impact, significant impact or complication as

has been done in the present study.

NICE gives a well-defined and easy to understand guidelines by classifying patients on the basis of ASA and type of surgery in a tabulated form while ASA task force practice advisory have no such classification, therefore NICE was opted as standard guideline for our study. Also recently in 2016 a new updated NICE guideline was published which replaces NICE guideline CG3 (published June 2003).

Keshavan, Swamy.<sup>13</sup> was the only study we found which utilize NICE guidelines in the Indian population. In the present study 85.81% i.e. 2971 out of 3462 tests were unindicated as per NICE guidelines.<sup>2</sup> This was much higher than the previous study conducted by Keshavan, Swamy.<sup>14</sup> were they found 52% of the tests as unindicated. This could be because the present study was conducted in a public sector setup, having patients belonging to poor socio-economic group where all investigations are done free of cost as compared to corporate setup. Moreover their study was based on older guidelines of NICE, whereas the present

study was based on newer NICE guidelines published in 2016 which aims to further reduce unnecessary testing.

Minimum 4 investigations were done by all patients, were as maximum investigation advised by guidelines is 3, so none of the patient was investigated following NICE guidelines. Large numbers of tests are done with the assumption that routine pre-op testing will detect hidden abnormalities which are not detected by history and clinical examination. NICE and similar other guidelines reported are based on studied in the developed nations. India is a developing country where majority of people belongs in rural community where health care facilities are poor due to which patient presents to hospitals at advanced stage.

The present study being in a public sector hospital, investigation was not charged but if we calculate cost based on the rates fixed by Central Government Health Services empaneled laboratories. The total, estimated of cost of processing the requested investigations equates to INR 429173 with INR 370808 spent on unindicated test and only INR 58365 spent for indicated test. This means that 85.43% of estimated cost incurred is on unindicated tests. This is higher than the estimation of 63%. In a study done by Keshavan et al.<sup>14</sup> and Ferrando et al.<sup>15</sup> Per patients cost works out to be INR 858.34 out of which INR 741.61 was towards unindicated test. In a study by Ranasinghe et al.<sup>16</sup> in 2011 in Srilanka comparable results were found in terms of cost towards tests.

Cost-effective healthcare delivery has great relevance in developing countries. One of the major drivers of healthcare costs is the inappropriate utilisation of medical technology and services. Routine pre-operative investigational services appear to be one such area. The reduction in costs following patient directed investigations have been reported by earlier studies.<sup>15,17,18</sup> A cost analysis study showed a reduction of 85% of cost per patient by applying guidelines. Not just monetary cost but manpower which is involved in the processing tests and referrals will also be saved. Moreover the concomitant man-hours loss of patients due to repeated hospital visit will add on the total cost towards the unindicated tests. Thus, a reduction in the number of tests would not only lead to a corresponding reduction in cost, but in the long run, the reductions in the number of tests would create an excess of resources (e.g. equipment, staff, premises).

The most common reason for practicing routine pre-operative investigation is identification of unsuspected conditions requiring treatment before surgery or a change in anaesthetic management.<sup>19</sup> A study also reveals that even abnormal test values found in routine testing among elderly patients failed to predict post-operative complications.<sup>8</sup> The present study found that all of the patients were prescribed unindicated tests, despite the existence of recommendations to the contrary for nearly 15 years.<sup>2</sup> This indicates that the practitioners prescribing test in the institution were either not aware about guidelines or, were not convinced about

them.<sup>18</sup> One of the reasons provided by perioperative team for doing routine investigations is the fear of litigation for missing subclinical medical problems which may manifest during the perioperative period.<sup>20</sup> This reason can be discarded as the court of law depends on evidence; and current evidences indicate that incidental findings or abnormal results of routine pre-operative tests have minimal or negligible impact on anaesthetic management.

## 5. Conclusion

Results in the present study demonstrated that majority (60.6%) of the patients had at least one abnormal test results on routine pre-operative investigations, but only 6.93% of these had any impact in terms of referral, further testing or delay. Only 5 (0.14%) of all 3462 abnormal test had significant impact which it lead to change in perioperative management. The practice of prescribing large no. of routine pre-operative investigations is prevalent in our institution. Most of the investigations are done without following any guidelines, which leads to wastage of resources. Such practice also affects patient's satisfaction.

A multicentre study with larger sample size including ASA I to IV would highlight the practices followed in different setups and different ASA grades. Adoption of a standard guideline in the institutional practices will save resources. An interventional study can be done by first educating the Anaesthetist and Surgeons about the latest guidelines and then studying its effectiveness in modifying prevalent practices. Study the Awareness of guidelines and other factors effecting current practice of prescribing investigations, among the Anaesthetists and Surgeons, which can in turn help modify them.

## 6. Source of Funding

Nil.

## 7. Conflicts of Interest

There are no conflicts of interest.

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