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Original Article

Surgery Section

Assessment of Routine Preoperative Laboratory Testing Practice among Elective Surgical Patients at a Tertiary Care Institution, Addis Ababa, Ethiopia: A Retrospective Study

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ABSTRACT

Introduction: There are over 90,000 major elective surgeries performed each year in Ethiopia. Obtaining routine or baseline preoperative laboratory tests increases healthcare costs. Preoperative testing should be based on clear guiding principles. Hence, tests should be done only if results are likely to affect patient management and postoperative outcome.

Aim: To assess routine preoperative laboratory testing practice in patients who underwent elective surgery in a resource-limited setup at a tertiary care institution, Addis Ababa, Ethiopia.

Materials and Methods: The study was conducted in St. Paul's Hospital Millennium Medical College (SPHMMC), which is located in Addis Ababa, Ethiopia. A retrospective observational study of medical records was done with proportional sampling among preoperative elective surgical patients of different disciplines from March 2019 to May 2019 to assess the practice of preoperative laboratory testing, appropriateness of use and implied extra cost in comparison with the National Institute for Health and Clinical Excellence (NICE) guidelines.

Results: Total 353 patients were subjected to a 1567 test. About 643 (41%) of all tests were not indicated and 27 (4.2%) of these had abnormal results. The change in decision rate from unindicated tests were 29.6%. The total deviation rate from National Institute for Health and Care Excellence (NICE) Guideline was 26.5%. The proportion of tests done which conformed to the guidelines (58.9%) were significantly lower than the proportion of test not done but conformed (p-value <0.001). The extra cost incurred was 71.5% of the total cost for the tests.

Conclusion: The proportions of tests with expected abnormal results, unexpected abnormal results, and subsequent changes in the decision was low, which underlines the essence of a guideline that takes into account population characteristics.

Keywords: Guidelines, Healthcare costs, Health resources, Indicated tests, Postoperative period, Screening

INTRODUCTION

About half of the world population has no access to essential surgical care especially in low-income and middle-income countries. There are over 90,000 major elective surgeries performed in about 90 public hospitals alone each year in Ethiopia [1].

From the data on Ethiopian National Health Accounts, the 2017/2018 total health expenditure as a percentage of total government budget lies at 8.8%, far below the Abuja declaration of 15%, and the per-capita health expenditure was $29 USD (United States Dollar), which was far less than the recommended $86 USD required to deliver a package of basic services in low-income countries [2]. In Ethiopia, about one-third of the health services is out of pocket expenditure and half below the Abuja declaration of about 15% total budget expenditure on health [3].

Health access is not without delays and of the barriers to access for surgical services; one is related to direct and indirect costs including laboratory investigations that delays patients from seeking services at home collecting money [4,5]. Surgical conditions are among the most common causes of admissions to secondary and tertiary hospitals. According to global estimates, East Africa has one of the highest needs for surgical procedures with a reported 6,145 procedures per 100,000 populations [6-8].

Obtaining routine or baseline preoperative laboratory tests increases healthcare costs [9]. Hence, tests should be done only if results are likely to affect patient management and postoperative outcome [10].

Preoperative patient testing and evaluation depend on previous medical status, current morbidity and degree of invasiveness of proposed surgery. This may be affected by the adopted ways of patient evaluation and timing of evaluation [11]. Comorbidity specific testing based on clinical findings during history and physical examination and following review of the medical record is most effective. However, there are variations among regions, institutions and clinical covariates or comorbidities [12,13]. About 52.9% of all patients had at least one un-indicated laboratory test performed preoperatively [14].

With the presence of a great burden of surgically treatable diseases and the limited budgetary dividend to healthcare financing, standardised and evidence based patient evaluation and investigation is associated with cost effective and affordable care [2,3]. In healthcare setups with no previously established preoperative investigation guideline, this incurred total costs are estimated to be even much higher [6-8].

Considering the disproportionate health facility and high patient burden, this study assesses the status of the preoperative routine tests in elective surgical patients and it tries to look into the practice and its appropriateness against specific international standards in elective surgical patients. This will be an input for development of guidelines for preoperative screening of elective surgical patients so as to improve patient care. Findings can help health professionals engaged in patient care to propose and make use of appropriate tests based on local standards in improving healthcare.

MATERIALS AND METHODS

The retrospective observational study was conducted in Saint Paul Hospital Millenuim Medical College, which is located in Addis Ababa, Ethiopia, from March 2019 to May 2019. Data analysis was done from September 2019 to December 2019. It is the second biggest Hospital in Addis Ababa. Ethical approval was obtained from Saint Paul Hospital Millenuim Medical College Institutional Review Board (IRB) (Reference no.- pm23/363 at 3/5/2019). It serves as a referral

center for patients from Addis Ababa and all over the country with regular catchment area of 5 million people.

Inclusion and Exclusion criteria: Patients who were above the age of 15 years, admitted and underwent elective surgical procedures in the study period sampled proportionally from surgical disciplines of general surgery, Ear, Nose and Throat (ENT), urology, gynaecology and ophthalmology were included in the study population. Patients who had previous admission for another procedure over the last three months were excluded from analysis to avoid redundancy.

Sample size calculation: Using sample calculation formula {$n=z^2p\times(1-p)/w^2$} for population with margin of error 5%, confidence interval 95% and 50% proportion and correction factor, 384 patient medical records were needed for the study. Then, random samples of 353 medical records were taken based on proportional method from each of the five surgical disciplines mentioned based on annual case flow of elective patients in the same year and studied.

Data collection method: Data extraction format having the specified variables was used to collect data from a patient's chart. Variables included were socio-demographic and clinical characteristics, Surgical and laboratory data and other relevant information related to the subject. Data were collected from patient's medical records, laboratory test slips, and preanaesthesia assessment forms. The investigations reviewed were Complete Blood Count (CBC), Serum electrolytes, Renal function test (Urea/Creatinine), Random Blood Sugar (RBS), Coagulation profile- Prothrombin Time (PT) and Partial Thromboplastin Time (PTT), Blood Group (BG) and Rhesus factor (Rh), Chest X-ray (CXR) and Electrocardiography (ECG).

Data Analysis

Data grouping for analysis was done in three steps as described below-

1. Terms used in this study were operationalised as follows:

'Surgical patient' was any patient who was admitted and underwent an operation under the Department of General Surgery, ENT, Urology, Gynaecology or Ophthalmology.

- If the procedures were done under general anaesthesia which is invasive, it was classified under 'major Surgery', and
- If done under local anaesthesia or sedation like excision of skin lesion, myringotomy were put under 'minor surgery'
- While those who were operated under spinal or general anaesthesia but limited invasiveness like hernia repair, tonsillectomy were grouped under 'intermediate surgery'.

Conformity to guideline was defined based on whether a test is done or not done based on recommendation of National Institute for Health and Care Excellence (NICE) guidelines [15].

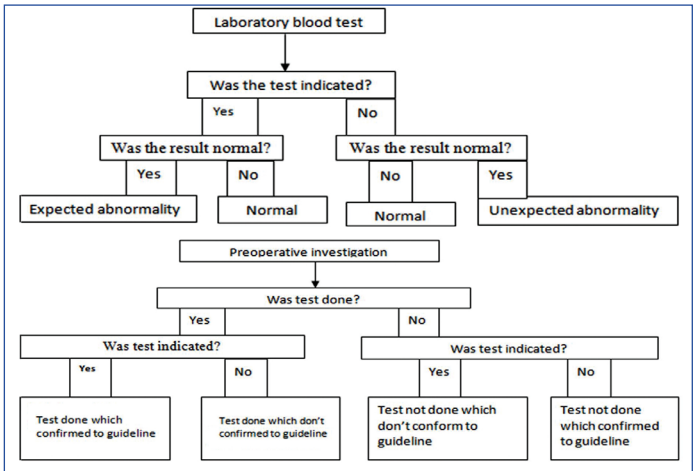
Routine test is a test done based on American society of Anaesthesiology (ASA) status of patients as a screening test preoperatively in elective patients.

- Of these tests, those tests done based on NICE guidelines were classified as indicated tests. Among these, abnormal results obtained were categorised as expected abnormal results.
- Tests that were done though they were not put on NICE guideline were categorised as unindicated tests. Among these, abnormal results obtained were categorised as unexpected abnormal results.

For cost analysis and payment issue, Health insurance (payment) was when cost was covered by a third party with a deal to the service delivering hospital. Related to this, direct cost is a cost only related to payment to the test done, not inclusive of cost related to delays or manpower.

Change in decision means any change in patient management or a subsequent need for another investigation after detection of an abnormal result.

2. Tests appropriateness: This was checked for every individual surgical patient based on National Institute of Health Excellence (NICE) classification [15]. Tests done and results identified were categorised based on an algorithm depicted in the [Table/Fig-1] below.



[Table/Fig-1]: Algorithm for Classifying laboratory tests and the Investigation Results, St. Paul's Hospital Millennium Medical College (SPHMMC), March 2019 to May 2019.

3. Calculations of proportions and percentages were done as follows:

a) Proportion of expected abnormal results is the number of expected abnormal results divided by total number of indicated tests done.

b) Proportion of unexpected abnormal results is the number of unexpected abnormal results divided by total number of not indicated blood tests done.

c) Total deviation rate is the number of tests that did not conform divided by total number of tests (done and not done) multiplied by 100%.

STATISTICAL ANALYSIS

Data were checked for completeness, consistency and entered using computerised statistical program, Statistical Package for the Social Sciences (SPSS) version 25.0. Then proportion of expected abnormal results, proportion of unexpected abnormal results, yield of preoperative investigations and total deviation rate were calculated. The cost implications were analysed. In summary, analysed data were presented in tables and graphs. Differences between proportions were compared using Chi-square test and a p-value <0.05 was considered significant.

RESULTS

Clinical and Socio-demographic Factors:

From a total of 384 charts taken, 353 (91.6%) fulfilled data completeness assessment were reviewed. The age of subjects ranged from 18 to 82 years with mean 40.9±14.7 years and median 40 years. Nearly half of the study subjects were below the age of 40 years. Close to 70% of patients were self-paying. The socio-demographic data are outlined in [Table/Fig-2].

A total of 71 (20.1%) had co-morbid conditions and 32 (9.1%) had previous surgery (>3 months back). The most common co-morbidities encountered were cardiovascular disease including hypertension in 21 (29.6%) and Human Immunodeficiency Virus/ Acquire Immunodeficiency Syndrome (HIV/AIDS) in 13 (18.3%) [Table/Fig-3].

About 267 (75.6%), 77 (21.8%), 7 (2.0%) and 2 (0.6%) were in classes I, II, III and IV as per American Society of Anaesthesiology (ASA) classification, respectively [16].

Characteristics	Frequency (N=353)	Percentage (%)
Age (years)		
18-29	88	24.9
30-39	86	24.3
40-49	75	21.2
50-59	60	16.9
60-69	24	6.8
>69	20	5.9
Sex		
Male	152	43.1
Female	201	56.9
Way of payment		
Self-paying (out of pocket)	244	69.1
Health insurance	109	30.9

[Table/Fig-2]: Socio-demographic characteristics of patients admitted and operated.

Co-morbidities	Frequency	Percentage (%)
Diabetes mellitus	12	16.9
Hypertension	15	21.2
Renal disease	2	2.8
Cardiovascular disease	6	8.4
Pulmonary disease	7	9.8
HIV/AIDS	13	18.3
Multiple at a time*	13	18.3
Psychiatric disorder	3	4.3
Total	71	20.1

[Table/Fig-3]: Types of co morbidities diagnosed among patients admitted and operated.
*Multiple at a time means patients who have hypertension, diabetes mellitus and cardiovascular disease; ; HIV/AIDS: Human immunodeficiency virus/Acquire immunodeficiency syndrome

Nearly one-fourth, 90 (25.5%), were taking one or more drugs for an associated co-morbidity. Total 302 (85.6%), 49 (13.9%) and 2 (0.6%) had undergone major, intermediate, and minor surgeries, respectively.

Yield of preoperative investigations: Out of 1567 preoperative investigations, 1266 (80.8%) were blood tests while the remaining were instrumental tests (ECG, CXR). About 643 (41%) of all tests were not indicated and done based on NICE guideline. Among these, only 27 (4.2%) had abnormal results. The highest percentage of unexpected abnormal results was seen in ECG, where there were 5 (6.8%) abnormal results out of 73 tests that were not indicated followed by CXR (5.9%).

Expected abnormal results were detected in 230 tests (37.4%) out of 614 (BG and Rh status excluded as it cannot be classified as normal or abnormal) tests which were done based on the NICE guideline recommendation. The details on indicated and unindicated tests along with proportions are presented below [Table/Fig-4].

Rate of decision change from abnormal results was calculated by taking the proportion of tests that resulted in subsequent change in management plan or further need for workup among the overall abnormal results. The rate of decision change based on abnormal results was low but relatively better in unexpected abnormal test results as shown below [Table/Fig-5].

Type of abnormal test	Abnormal results that change decision		Total
	Yes	No	
Expected abnormal	11 (4.8%)	219 (95.2%)	230 (100%)
Unexpected abnormal	8 (29.6%)	19 (70.4%)	27 (100%)
Total	19 (7.4%)	238 (92.6%)	257 (100%)

[Table/Fig-5]: Expected and unexpected abnormal results versus change in decision to patients admitted and operated.

Conformity to NICE Guideline: The conformity of tests is compared against the recommendation from the NICE guideline which is reviewed and recommended by World Health Organization (WHO). Of the 1567 pre-operative investigations, 924 (58.9%) conformed to the NICE guidelines. More than 91% of tests not done conformed to the guideline and in 8% of tests there was actually an indication, but the tests were not done [Table/Fig-6]. With regard to appropriate use of investigations, the NICE guideline conformity was 73.5% with a total deviation rate was 26.5%. The proportion of tests done which conformed to the guidelines (58.9%) was significantly lower than the proportion of test not done which conformed (91.7%); Chi-square= 380.7, df=1, p-value<0.001) [Table/Fig-6].

Test	Conform to guideline	Do not conform to guideline	Total
Done	924 (58.9%)	643 (41.1%)	1567 (100%)
Not Done	1153 (91.7%)	104 (8.3%)	1257 (100%)

[Table/Fig-6]: Number of investigations done according to NICE Guideline.
Chi-sqaure= 380.7, degree of freedom= 1, p-value<0.001 (p-value<0.005 was considered as statistically significant)

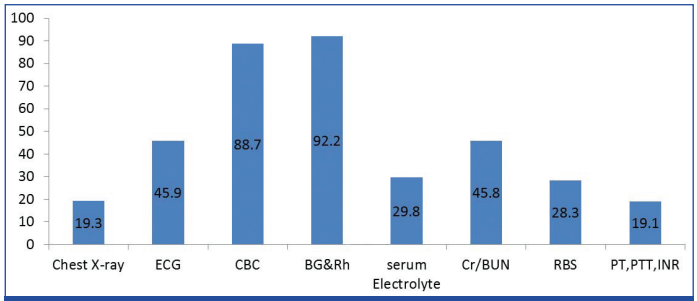
The highest conformity was seen in blood group and Rh factor test (92.2.%) and CBC test (88.7%). On the other hand, the most overused test was the coagulation profile (PT, PTT, and INR) where only about 19.1% of tests done followed the guidelines [Table/Fig-7]. The conformity level in each test is presented in [Table/Fig-7,8].

Repeated Investigations: Investigations repeated within 3 months with no documented reason for the repetition were analysed. There were 478 repeated tests of clear reason. Most repeated investigations were CBC, serum creatinine/Blood urea nitrogen, CXR and ECG with frequencies of 383 (80.1%), 81 (16.9%), 8 (1.7%), and 6 (1.3%), respectively.

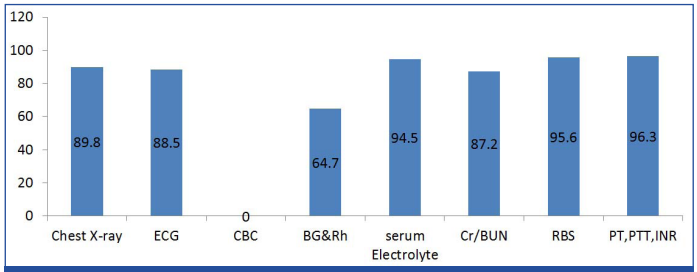
Cost Implications: Tests which were not indicated but done (643 tests) and repeated tests (478 tests) are taken as extra costs incurred on patients or healthcare system. These unindicated and inappropriately repeated tests had increased the direct cost from preoperative tests by 71.5%.

Investigation	Done				Abnormal Results			
					Expected		Unexpected	
	Indicated	Not indicate	Total	Normal	Frequency	Percent	Frequency	Percent
CXR	32	134	166	142	16	50	8	5.9
ECG	62	73	135	105	25	40.3	5	6.8
CBC	308	39	347	248	99	32.1	0	0
Serum Electrolyte	45	106	151	124	22	48.8	5	4.7
SerumCr/BUN	126	149	275	215	54	42.9	6	4.0
RBS	28	71	99	86	10	35.7	3	4.2
Coagulation Profile (PT, PTT, INR)	13	45	58	54	4	30.7	0	0
Total	924	643	1567	1310	230	37.4	27	4.2

[Table/Fig-4]: Preoperative Investigations done to admitted and operated elective surgical patients.
CXR: Chest X-ray; ECG: Electrocardiography; CBC: Complete blood count; Serum Cr/BUN: Creatinine/blood urea nitrogen; RBS: Random blood sugar, PT: Prothrombin time; PTT: Partial thromboplastin time; INR: International normalized ratio



[Table/Fig-7]: Percentage of tests done and conformed to guideline.



[Table/Fig-8]: Percentages of tests not done and conformed to guideline.

DISCUSSION

The mean age of patients in this study was 40.9 years which is comparatively younger than the finding by Antwi-Kusi A et al., in Ghana which was 50 years [17]. The likelihood to get abnormal results was higher in older patients among elective surgical patients. The finding of a low percentage of change in decisions from abnormal results, 8 (29.6%), in this may be related to relatively young age in this study [18].

Laboratory tests should only be done if results are likely to affect patient management and postoperative care [10]. This can be more effective when preoperative laboratory testing is based on existing comorbidity from preoperative clinical evaluation result. The aim of preoperative testing is to pick unseen comorbidities preoperatively [19]. In this study, 71 (20.1%) of patients had one or more comorbidities which was less than reported by Juliana H et al., (29.1%) [20]. This may be partly explained by the relative younger age (nearly half are below age of 40 years) population in this study.

The most ordered test was Complete Blood Test (CBC) in all cases which were comparable to the same study in Ghana by Juliana H et al., which was 98.8% [20]. This study found that CXR was unindicated in (134/166) 80.7%, coagulation profile in (45/58) 77.6% but CBC was indicated better with only (39/347) 11.3% is unindicated unlike the finding by Antwi-Kusi A et al., put creatinine (54.4%) and serum electrolyte (40.4%) were commonly not indicated [17].

Preoperative tests were abnormal in only 4.2% of cases and change in management decision was only suggested by 7.4% of abnormal tests. This is lower than the report by Juliana H et al., which had 35% abnormal test results and 0-8% rate of change in management decision [20] and 3.3% by Mantha S et al., [21]. The change in management decision from abnormal values encountered in the present study is low. This may be a signal to have a strict guideline adherence, collaboration and continuous effort [22].

In this study, all patients had at least one unnecessary preoperative test done. This is higher than the finding by Onuoha OC et al., which was 52.9% [14]. In this study, about (643/1567) 41% of tests were unindicated and 29.6% of unexpected abnormal values resulted in change in management and this lower than the finding by a South Indian study by Mantha S et al., which showed unindicated tests in 63.3% and 0.91% of unexpected abnormal values that result in change in management [21]. The lower percentages of unindicated tests but higher percentage of unexpected abnormal values that resulted in change in management found in the present study might be because of how 'indicated' and 'abnormal values' were defined. While most researchers assessed clinically but laboratory tests done in the present study were assigned as indicated with gross recommendation by the NICE guideline [15].

In using preoperative investigations, among tests done 58.9% has conformed to NICE guideline which was better than the study by Juliana H et al., and Buley HE et al., that has only 26% guideline conformity [20,23]. About half of recommended tests were actually not done and most non recommended tests were done; a 26.5% deviation from NICE guidelines was seen. The proportion of tests done which conformed to the guidelines was significantly lower than the proportion of test not done which conformed (p-value=0.001). The low conformity in the present study could be caused by the physicians not being aware that such guidelines exist or poor implementation of it. This indicates that it might not be the mere lack of investigation that results in inappropriate testing, but the available tests were not used for the desired intention [23,24].

Unindicated and inappropriately repeated tests increased the direct cost from preoperative tests by 71.5% which could have been avoided by having appropriate use of guidelines. This was relatively higher than reported by Ranasinghe P et al., which revealed a 63% increased cost [25].

Awareness about health and health related issues depends on different factors. There are disparities in public health access among urban and rural population [26,27]. Diseases that have an impact on postoperative outcome might be endemic in some countries [21]. Thus, test appropriateness may be different for a given situation which brings an essence for further validation and customisation of NICE guideline for local use.

Limitation (s)

Cost calculation was not inclusive of the indirect costs related to delayed admission, procedure or burden in laboratory unit and may not show the overall burden. It was the investigators recommendation to have a prospective study for assessment as a whole. 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.

CONCLUSION(S)

The proportions of tests with expected abnormal results, unexpected abnormal results, and subsequent change in the decision was low. Furthermore, there was extra cost incurred (71.5%) from inappropriate and repeated tests that have no relevance in decision. Based on the results of this study, unnecessary testing can be reduced by introducing patient specific, disease specific and need based laboratory testing guideline pertinent to a specific setup. The cost savings from such optimal preoperative tests could also be significant.

Author's Contributions: MD and BT wrote the initial design and report. After then, all authors have equally participated in design of the study, analysis and interpretation of the data and writing of the manuscript. All authors read and approved the final manuscript.

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