PRE-OPERATIVE STATUS OF SERUM SODIUM, POTASSIUM, BLOOD UREA NITROGEN AND CREATININE IN HYPERTENSIVE PATIENTS SCHEDULED FOR ELECTIVE NON-CARDIAC SURGERY

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ABSTRACT

Objective:

- To assess frequency of abnormal values of pre-operative serum sodium, potassium, BUN and creatinine
- Their association with surgical delay, consult generated and additional cost in hypertensive patients planned for elective non-cardiac surgery.

Methods: This cross-sectional study was performed in Agha Khan university hospital, Karachi Pakistan, from 18.11.2020 to 18.07.2021. Patients 19 and above, ASA class I-III who were diagnosed to have hypertension at least 6 months and longer and undergoing elective non-cardiac surgery were included in the study. Patients with the following were excluded: acute or chronic kidney disease, having electrolyte imbalance secondary to endocrine disorders and those having poor cardiac reserve {ejection fraction of less than 40 percent or having regional wall motion abnormalities}. A total of 177 patients who met the inclusion and exclusion criteria were enrolled. Details of all study participants who visited the pre-operative anesthesia clinic and diagnosed to have hypertension were retrieved at the end of the day by checking their pre-operative forms for demographic data, past medical and drug history, laboratory workup and surgical outcomes.

Results: 177 patients undergoing elective non-cardiac surgery were assessed. Mean age of participants was 58.73 years (SD 11.23). Most patients were ASA class II (70.6%). Most frequent pre-operative laboratory abnormality was BUN (13.6%) followed by potassium (10.7%), then sodium (5.6%) and lastly creatinine (2.3%). 89.8% patients proceeded to surgery without delay and 4% had delays but due to reasons apart from preoperative abnormalities. Only 1.1% patients faced postponement due to preoperative abnormalities.

Conclusion: The study revealed significant abnormalities in laboratory values only some of which led to surgical delay and generated additional consultation.

Keywords: Pre-anesthesia assessment, surgical outcomes, serum sodium, potassium, BUN, creatinine, consultation

INTRODUCTION

The preoperative anesthesia assessment is defined as the process of evaluation before administering anesthesia for surgical and nonsurgical procedures and includes the detailed history, physical examination, and laboratory tests[1] with the objective of optimizing patient care and reducing morbidity[2].

In spite of the fact that laboratory testing is part of the initial evaluation, recent literature regards it as optional since most abnormal laboratory findings can be predicted from the history and physical assessment.[3]

Hypertension has become a major health problem in developed as well as developing countries while some studies stating it to be higher in low-income countries.[4] In Pakistan, the reported prevalence is between 14-19% [5,6]while the recent data showed significant increase in this number up to 35%.[7] The cross-sectional survey at our hospital reported the incidence of perioperative hypertension of around 54%.[8] As the part of pre-operative assessment, renal function and electrolyte testing are usually considered in most elective hypertensive patients. This is usually done because they are at higher risk of pathologies due to hypertension while anti-hypertensive drugs may cause electrolyte abnormalities.[9]

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There is a wide disagreement regarding the use of pre-operative tests as screening tools for health assessment prior to surgery. The main goal of pre anesthesia assessment is to reduce peri-operative morbidity and mortality.[10] Lab testing done on the basis of clinical indications may yield up to 30 percent abnormal tests that can often have profound changes in the surgical outcome.[11] Goal directed pre-operative testing depending on patient's clinical needs is a safe and efficient practice and often protects from many foreseeable complications.[12] Pre-operative assessment is often deemed vital and can have significant value in the management plan of the patient. Benarroch-Gampel et al. analyzed the utility of preoperative tests and was of the opinion that rather than routine testing, selective testing depending on patient history and physical findings might decrease the cost and improve patient satisfaction.[13]

In a study done by Geynisman-Tan et al., 8% of the patients had abnormal elevated creatinine, 5% had abnormal sodium levels and 6% had abnormal potassium levels. On further review it was concluded that none of the mentioned abnormalities were clinically significant and thus did not lead to any change in the surgical schedule.[14] Additionally, most of the time, an abnormal finding does not lead to a change in perioperative patient management and unnecessary investigations may cause harm to the patient due to over treatment.[15,16]

In our practice, we routinely order serum sodium, potassium, BUN, and creatinine for hypertensive patients at the time of pre-anesthesia evaluation. However, there is lack of literature available which shows whether these preoperative blood tests in hypertensive patients are of any benefit. Furthermore, these investigations also carry cost implications. Thus, this study was conducted to assess the frequency of abnormal laboratory values in hypertensive patients undergoing elective non cardiac surgery and to assess the effect of these abnormal laboratory values on surgical delay, additional consultation and added cost.

MATERIALS AND METHODS

The study was a descriptive study conducted at Aga Khan University Hospital, Karachi from 18th November, 2020 to 18th July 2021 on a sample population of 177 patients meeting the inclusion and exclusion criteria. The study protocol was approved by the Departmental Review Board of Anesthesia department, and Ethical Review Committee, Aga Khan University Hospital. The data collection required prospective review of patient's medical record by the primary investigator. The details of patients who visited preoperative anesthesia clinic and diagnosed to have hypertension were retrieved at the end of day by checking the preoperative forms filled on that day. Patients fulfilling the inclusion criteria were included and their documentation was reviewed prospectively. The preoperative laboratory workup including the need of additional consultation was at the discretion of preoperative physician. Their preoperative assessment forms were reviewed for relevant information including demographics data, past medical and drug history. For study patients the record of requested laboratory workup, which included Serum electrolytes including Na, K, BUN and Cr, were also kept, and updated. During this time if any special consultation was requested based on electrolytes abnormalities, then that was also recorded. Once patient was admitted for surgery, their laboratory investigations were reviewed again. Normal as well as abnormal investigations were noted. If the abnormal investigations required any consultation or repetition of laboratory investigation, then that was followed and subsequently any delay or postponement of surgical schedule was recorded from the operating theatre list. All the data was recorded on a data collection form. Data was analyzed using SPSS version 19. Mean and standard deviation were calculated for age, weight, height, BMI. Frequency and percentage were calculated for gender, ASA status, co-morbid conditions (hypertension, diabetes, asthma/COPD, thyroid disease), abnormal laboratory values (sodium, potassium, BUN and creatinine), outcome (Additional consultation, delay or postponement of planned surgical procedure and additional cost spent on these investigations). Effect modifiers like age, gender, BMI, ASA status, comorbid conditions were addressed through stratification. Post stratification chi-square test was applied and P value ≤ 0.05 was taken as statistically significant.

RESULTS

A total of 177 patients undergoing elective non-cardiac surgery were evaluated to assess the prevalence and clinical impact of pre-operative abnormalities. The mean age of the participants was 58.73 years (SD 11.23) with 54.2% females and 45.8% males. The mean Body Mass Index (BMI) was 30.70 kg/m² (SD 6.34). Most patients were classified as ASA II (70.6%) while 29.4% were ASA class III. Apart from hypertension most common comorbidities included diabetes (37.3%) and asthma (4%). The majority of procedures were performed in

general surgery (25.4%), urology (21.5%), and orthopedic (14.7%) specialties.

Preoperative laboratory assessment included serum sodium, potassium, blood urea nitrogen (BUN), and creatinine. BUN abnormalities were the most frequent, occurring in 13.6% (n=24) of patients. This was followed by Serum Potassium: 10.7% (n=19), Serum Sodium: 5.6% (n=10), and Serum Creatinine: 2.3% (n=4). Most patients (89.8%, n=159) underwent surgery as scheduled. The mean cost of laboratory investigations was Rs. 3,068.93. Table 1 reviews the frequency of abnormal pre-operative laboratory values.

Table 1: Frequency of Abnormal Laboratory Values of Preoperative Serum Sodium, Potassium, Blood Urea Nitrogen and Creatinine in Hypertensive Patients Planned for Elective Non-Cardiac Surgery (n = 177)

Abnormal Laboratory Tests	Frequency	Percentage
Serum Sodium	10	5.6%
Serum Potassium	19	10.7%
Serum Blood urea nitrogen	24	13.6%
Serum Creatinine	4	2.3%

Overall, 89.8% of patients underwent surgery without delay, 4% experienced delays unrelated to laboratory abnormalities, and only 1.1% had postponement directly associated with abnormal results. Only abnormal serum sodium showed a statistically significant association with surgical delay ($p = 0.02$), whereas other parameters demonstrated no significant impact ($p > 0.05$). In most of the cases that were delayed there were problems regarding late admission of patients, change in OR schedule or patient was called in late for surgery. Postponements occurred in only 1.1% (n=2) of cases, with one due to a positive COVID-19 test and another related to a combination of abnormal thyroid function and electrolyte levels. Nine patients (5.1%) did not report for surgery despite completing preoperative testing (Table 2)

Table 2: Comparison of surgical delay and abnormal laboratory values

Laboratory values		Delay		Total	P-Value
		Yes	No		
Serum Sodium	Abnormal	2 (20.0%)	8 (80.0%)	10	0.023
	Normal	16 (9.6%)	151(90.4%)	167	
Serum Potassium	Abnormal	2 (10.6%)	17(89.4%)	19	0.169
	Normal	16 (10.1%)	142(89.9%)	158	
Serum BUN	Abnormal	5 (20.8%)	19(79.2%)	24	0.111
	Normal	13 (8.5%)	140(91.5%)	153	
Serum Creatinine	Abnormal	1 (25.0%)	3(75.0%)	4	0.522
	Normal	17 (9.8)	156(90.2%)	173	

DISCUSSION

Pre-operative lab investigations as part of pre-anesthesia assessment are carried out to detect any abnormality and form a key part of the pre anesthesia assessment prior to any surgical procedure.[15] Our study reports the prevalence of abnormal serum sodium (5.6%) and creatinine (2.3%) to be smaller in comparison to serum potassium (10.7%) and blood urea nitrogen (13.6%). Julia Geynisman et al. reported 19 abnormalities in serum sodium and 24 abnormalities in serum potassium in a study conducted on 836 urogynecological cases undergoing both major and minor surgical procedures. 31 women (8%) reported abnormal elevations in creatinine

levels; 90% of those with an elevated creatinine level had a known history of hypertension however none of them ended in surgical delay.[14]The findings of the study conducted by Geynisman et al. are consistent with ours however the study conducted by Geynisman et al. was primarily confined to patients of urogynecological surgeries, with a wider disease spectrum and laboratory reference ranges regarded as abnormal were also different from the range set in our study. Any evidence of renal dysfunction in hypertension can be predicted by elevated markers of kidney function such as serum creatinine and BUN. Out of the total 177 patients in our sample, 24 had abnormal BUN and 4 had abnormal serum creatinine. In a study conducted by Meyers N et al. on 47,111 patients who underwent spinal surgery, 14.1% patients had abnormal BUN 7.2% had abnormal creatinine while 3.2% had abnormal sodium levels. [17] Findings of the study done by Meyers N et al. revealed the most prevalent co-morbidity as hypertension and reported the highest incidence of BUN abnormality in comparison to other laboratory parameters which is in coherence with our study, however the study conducted by Meyers N et al. was conducted on an extremely large sample, with multiple comorbidities apart from hypertension and only considered patients undergoing a single kind of surgery. On the contrary, our study included patients belonging to various surgical categories. Out of the 177 patients in our study, 159 were on time while 9 faced delay. 7 cases were delayed due to reasons other than abnormal laboratory values and 2 were postponed (1 patient had abnormal laboratory values while the other tested positive for COVID-19). In most of these cases late patient admission, change in OR schedule and late arrival in the OR served as major causes compatible with previous studies done in this regard. Mean cost of investigation was found out to be Rs. 3068.93. In low income and underdeveloped countries such as ours, this added cost becomes an extra burden on the patient. A surgical audit conducted on 201 patients reporting for emergency surgical procedures at the emergency department at Khyber Teaching Hospital, Peshawar it was estimated on average around 25,675 rupees was spent on unnecessary investigations. Not only does this amount add to overall cost but in some cases may also increase hospital stay of the patients which shall also augment the financial burden.[18] Although majority of the tests conducted in our study were indication based but the process could be made more cost effective by conducting further studies in this regard keeping in mind the impact of abnormal laboratory values on outcomes such as surgical delay, morbidity and mortality.

STRENGTHS AND LIMITATIONS

The study significantly demonstrates the need for indication-based investigations. Although majority of the tests conducted in our study were indication based but the process could be made more cost effective by conducting further studies in this regard keeping in mind the impact of abnormal laboratory values on outcomes such as surgical delay, morbidity and mortality. Our study was primarily based on hypertensive population however further studies need to be conducted including patients with a multitude of co-morbidities. Also, our study is a single center study with a small sample size so the results cannot be generalized. No assessment with regards to adverse post-operative outcomes was made in our study. This study only relates surgical delay to reasons other than laboratory abnormalities but does not ascertain the exact other causes.

CONCLUSION

In conclusion there is a significant frequency of laboratory abnormalities in hypertensive patients undergoing elective non cardiac surgery. But only a few of these led to surgical delay and generated further consultation. However, investigations that are carried out as pre-operative screening add to the overall cost on the patient and also increase their financial burden. This may serve as a problem in population like ours where health resources are limited. This warrants a need for precise and indication-based testing in accordance with updated guidelines.

DECLARATIONS

Authors contributions: We wish to bring the editor's attention to the fact that this manuscript has been written, read and approved by all the authors and this article is solely an original piece of work that has not been replicated.

Conflicts of Interests: We wish to confirm that there is no conflict of interest associated with this publication.

Funding: We also further confirm that there has been no significant financial support for this work.

Acknowledgements: To the best of our knowledge this article contains no material which has been previously published and due acknowledgements have been made in the article. The corresponding author is the sole contact for the editorial process and current

email address provided is correct and accessible by the corresponding author.

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