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Case-controlled Study

Does more testing in routine preoperative evaluation benefit the orthopedic patient? Case control study from a resource-constrained setting

Obada Hasan [a], Shah Fahad [b,*], Mohammad Mustafa [c], Pervaiz Hashmi [d], Shahryar Noordin [d]

[a] Orthopaedic Oncology & Reconstruction Fellow, Department of Orthopaedics and Rehabilitation University of Iowa, Pakistan
[b] Resident in Orthopedic Surgery, Department of Surgery, Section of Orthopedics, The Aga Khan University Hospital, Pakistan
[c] Ex-Intern Aga Khan University, Pakistan
[d] Department of Surgery, Section of Orthopedics, The Aga Khan University Hospital, Pakistan

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ABSTRACT

Background: Routine preoperative tests in healthy patients not only cause extra anxiety, but may delay treatment without influencing surgical plan. This has worse impact in resource-constrained settings where fee for service rather than health insurance is the usual norm. Investigators aim to determine if "routine" pre-operative tests are justified in healthy orthopedic patients.

Methods: We conducted a non-commercialized, non-funded matched case control study in tertiary care university hospital and a level-1 trauma centre for healthy patients (ASA-1&2) admitted from January 2014–December 2016 for elective orthopedic intermediate and major procedures. Cases (patient who had a change in his/her surgical plan after admission) and controls were selected independently of the exposure of interest then matched randomly to cases on age, gender and procedure type. Primary exposure was the routine preoperative lab tests, as defined by the American Society of Anesthesiologist, which included 13 blood tests. Analysis was done using Principle Component Analysis and Conditional logistic regression at univariate and multivariable levels reporting matched adjusted Odds Ratios. The data was reported in line with STROCSS criteria.

Results: Overall, 7610 preoperative tests were done for 670 patients with 62% men among cases and 53% men among controls with mean age of 49.9±22.5 years and 41.1±23.0 years, respectively. There were 1076 (14%) abnormal result that influenced surgical plan in 0.96% cases only. Matched adjusted OR with 95% confidence interval of primary exposure was insignificant.

Conclusion: Routine preoperative tests were superfluous and did not influence the surgical plan when adjusted for other variables in the model as well as after matching on potential confounders. This study would be amongst first steps to move towards an evidence based surgical practice for preoperative evaluation.

1. Introduction

Exorbitant healthcare expenditures and prodigal provision of services are major issues in the developed world's healthcare system [1] and, in fact, up to 30% of all health care expenses have been reported to be wasted [2,3]. This burden is more than double in resource-constrained settings where majority of the patients belong to lower socio-economic status with fee for service rather than health insurance being the usual norm in these circumstances [4] The reason of ordering preoperative tests is to elucidate unknown pathology, confirm and further characterize known pathology of the patient and to assist in formulating an anesthesia plan for the patient. However, routine ordering of preoperative tests don't make an important contribution in asymptomatic patients so selective tests should be ordered according to specific history and physical examination of the patients [2]. Physicians and surgeons often order a list of "routine" tests in order to avoid delays in the risk assessment process, thereby sidestepping the guidelines [5]. Additional investigations may not only cause unnecessary financial but can also pose major psychological burdens. They may also result in delaying the surgery, with potential associated morbidity and mortality (e.g. complications due to unnecessary biopsies performed to follow up false positive lab tests) [6]. The American Society of Anesthesiologists (ASA) defines a *routine* test as a test ordered in the absence of a specific clinical indication or purpose. An *indicated* test is defined as a test that is

* Corresponding author. Department of Surgery, Section of Orthopedics, The Aga Khan University Hospital, Pakistan.
E-mail addresses: Obada.husseinali@gmail.com (O. Hasan), shahfahad_157@yahoo.com (S. Fahad), Mohammadmustafa493@gmail.com (M. Mustafa), pervaiz.hashmi@aku.edu (P. Hashmi), shahryar.noordin@aku.edu (S. Noordin).

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ordered for a specific clinical feature or preexisting medical condition [7]. Globally, in the past twenty years numerous studies have proved that 70% of laboratory tests do not have a significant effect on the patient's course of treatment.6 Doing unnecessary laboratory tests diverts attention to issues that are unimportant for the preoperative assessment [8] Physicians and patients should understand that more care is not always better care and, in fact, it has the potential to cause harm. These tests, even if with abnormal results, change the surgical plan in less than 1% of cases and confer no added advantage in predicting or decreasing the perioperative events in particular for the healthy patients undergoing elective procedures.[9–11] Detailed history combined with clinical and physical assessment of the patient in addition to "relevant" investigations, represents the best method for screening diseases followed by few selective tests as guided by the index patients' health condition, invasiveness of planned surgery and the potential for blood loss [6]. In this study, our aim was to determine the predicting factors of change in surgical plan after admission to the hospital and whether routine preoperative tests resulted in a change in the surgical plan in healthy patients admitted for elective orthopaedic procedures. To best of the authors' knowledge, this is the first study to be conducted in the country and the region evaluating routine preoperative tests specifically in orthopedic patients and analyzing their clinical usefulness and impact on decision making on index surgical plan.

2. Patients and methodology

2.1. Study design and study setting

This is a single-hospital based case control study conducted at the section of orthopaedics in the department of surgery at the country's largest private referral tertiary care university hospital and a level-1 trauma centre which is a Joint Commission International (JCI) accredited hospital and has the only College of American Pathologists (CAP) accredited clinical laboratories in the country. After obtaining approval from the institute's Ethical Review Committee, medical records were reviewed for admitted patients from January 2014 to December 2016. Study is registered at clinicaltrials.gov (unique identifying number (UIN) NCT04196166). https://clinicaltrials.gov/ct2/show/NCT04196166 The research team included specialists in the fields of orthopaedic surgery, anesthesia, epidemiology and biostatistics. Data collectors were interns, who were graduates of the same institute and trained in data collection process and management. Protocol was developed before and available with the corresponding author on request.

2.2. Study population and eligibility criteria

To minimize selection bias and increase the internal validity of the study, controls were selected from same population which gave rise to the cases, and sampling of controls was independent of the exposure of interest. Patients' were selected from consecutive operation theatres' list to minimize the effect of surgeons' preference and practices as daily the OT list is run by different surgeons. The two data collectors were blinded from the objectives of the study to further minimize any sort of information/misclassification bias. The data was collected and reported in line with STROCSS criteria [22]. Patients irrespective of age and gender who were classified as ASA-1 and ASA-2 by the anesthesia team and who underwent intermediate and major primary elective orthopedic procedures were included. As there is no validated system for procedure complexity grading, we adopted the grading of NICE guideline Development group [12] (attached in appendix 1). Investigators excluded ambulatory care patients as well as those who were admitted for revision surgery. Exclusion criteria also included patients who had an additional surgery to the primary planned procedure under the same anesthesia and patients requiring orthopaedic procedure while admitted to other services, high care or intensive care units. Furthermore, to standardize the lab results, we excluded patients who had their preoperative lab tests done from laboratories outside the index hospital. Furthermore any patient with missing data in either the primary exposure or the outcome was also excluded.

2.3. The primary exposure, covariates and potential confounders

For the purpose of this study case was defined as a patient who had change in his surgical plan after hospital elective admission while controls were patients who did not have any change in their surgical plan. Change in surgical plan included delay in the planned surgery more than 24 h, or cancellation of the surgery after admission. The primary exposure included routine preoperative tests which primarily focused on Complete Blood Count (CBC), Erythrocyte Sedimentation Rate (ESR), Coagulation profile (PT, APTT and INR), blood Urea nitrogen and Creatinine (UC), serum Electrolytes (Sodium, Potassium, Chloride and Bicarbonate). Covariates studied included gender, ASA level, compliance with ASA guidelines and compliance with hospital guidelines (see Appendix 1 for details). Information on potential confounders i.e. age and procedure was also collected and controlled at analysis stage. Preoperative tests were taken as categorical variables with 3 levels (0 = Not advised, 1 = Normal and 2 = Abnormal). Abnormal tests were defined as higher or as lower than the normal range reported by the institute's laboratories.

2.4. Statistical analysis

Patients' demographics and background characteristics between the cases and controls were assessed for comparability. Distribution assessment for the continuous variables was done using Shapiro Wilk test and was skewed, hence median ± IQR was reported. To compare the medians between the two groups Mann Whitney *U* test was used. Qualitative variables were reported as frequency and each assessed for comparability between cases and controls by Chi-square and simple logistic regression. Any patient with missing data in either the primary exposure or the outcome was excluded.

Univariate analysis using simple logistic regression was done reporting crude odds ratio (OR), confidence interval (C.I.) and *p value*. Primary exposure, which was a composite of 13 correlated variables and lab tests, was reduced to 5 meaningful variables using principle component analysis. After a univariate analysis, we included the primary exposure and all variables with *p* value of 0.25 or less for the multivariable model where we followed a stepwise approach reporting adjusted OR, C.I. and *p* value 0.05 or less which was considered significant. Plausible interactions were checked in the final model between age and procedure, age and primary exposure and between gender and primary exposure. We ran the conditional logistic regression analysis at univariate followed by multivariable models after matching the cases and controls with respect to age, gender and procedure and reported matched OR (MOR) and matched adjusted OR (MaOR). Analysis was done by the primary investigator using STATA V14.

3. Results

3.1. Description of study participants

A total number of 7155 procedures were done for ASA-I and ASA-II patents from January 2014 to December 2016. After screening for eligibility criteria, 670 patients (with 7610 preoperative tests) were eligible for the final unmatched simple logistic regression analysis. At second stage of analysis, controls were exactly matched randomly to cases on age, gender and procedure in a ratio of maximum 1:5. A total of 66 cases and 171 controls were included in the final conditional logistic regression model. Flowchart of data extraction is shown in Fig. 1.

Both groups had equal distribution of all variables except age, procedure and preoperative tests (Sodium, Chloride, PT and INR).

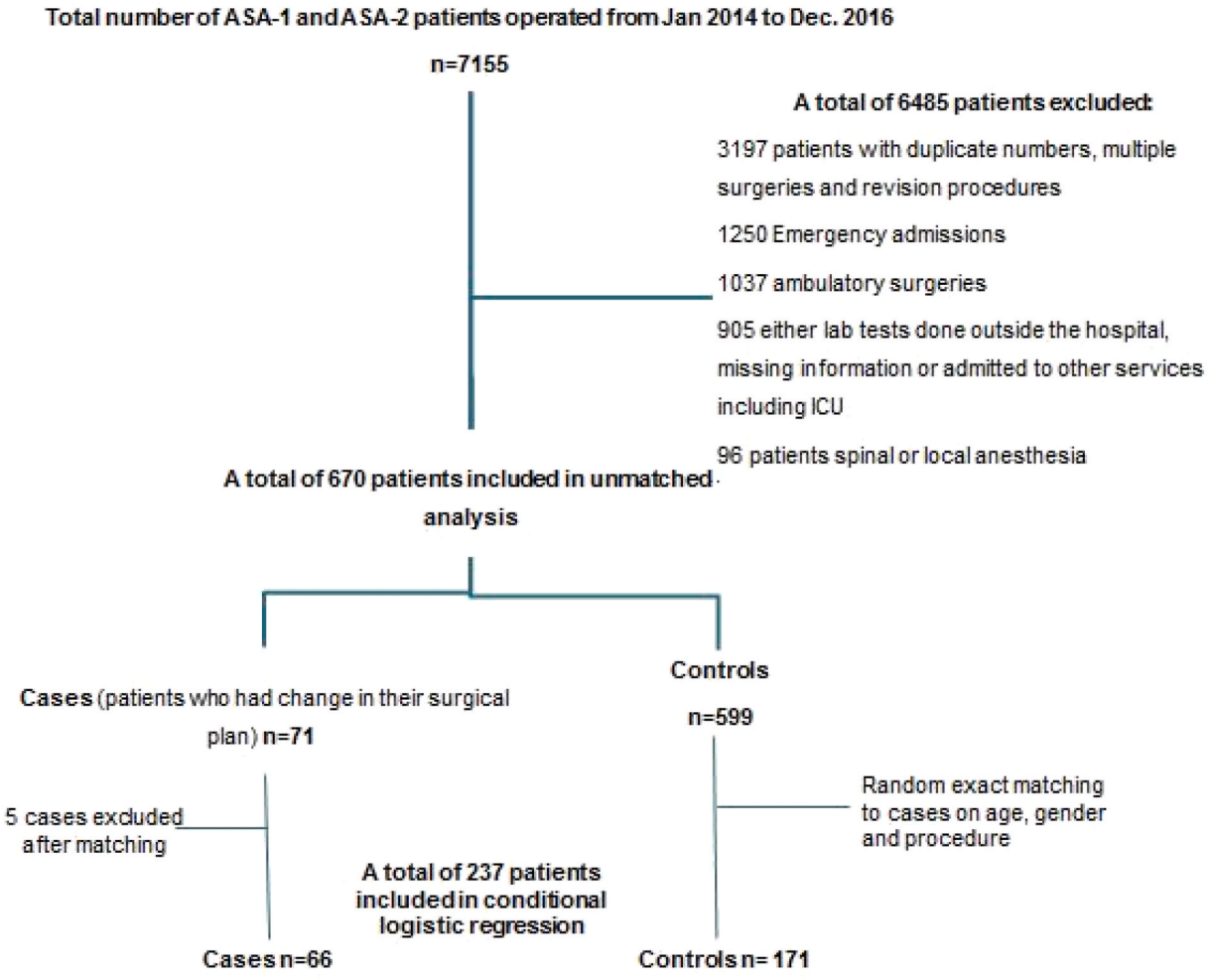

Fig. 1. Flow chart.

Compared with patients who did not have any change in their surgical plan after admission, patients who had change in surgical plans were more likely to be older, males and those who underwent oncology and trauma related procedures than arthroplasty. Gender was distributed equally between the groups with 62% men among cases and 53% men among controls. Intermediate and major surgical procedures i.e. arthroplasty, trauma, oncology and sports related, were significantly different between the groups with p value of <0.01. Overall, 184 (27%)

Table 1
Demographic and clinical characteristics of cases and controls.

Variables	Cases n = 71	Controls n = 599	P value[a] (0.05)	Variables	Cases n = 71	Controls n = 599	P value (0.05)
Hospital Stay LOS(days) median ± IQR	6±3.0	5.5±3.5	0.14				
	n(%) n(%)				**n(%) n(%)**		
Age (Years)			**<0.01**	**Overall compliance with ASA guidelines (22%)**			0.43
0–14 years	1 (1%)	101 (17%)		Compliance	13 (18%)	134 (22%)	
15–65 years	44 (62%)	386 (64%)		Non compliance	58 (82%)	465 (78%)	
65+ years	26 (37%)	112 (19%)		**Overall compliance with local guidelines (35%)**			0.13
Sex			0.17				
Male	44 (62%)	320 (53%)		Compliance	19 (27%)	215 (36%)	
Female	27 (38%)	279 (47%)		Non compliance	52 (73%)	384 (64%)	
Procedure			**<0.01**	**Procedure Complexity**			
Arthroplasty	6 (8%)	178 (30%)		Intermediate	45 (37%)	273 (46%)	**<0.01**
Trauma	46 (65%)	297 (50%)		Major	26 (63%)	325 (54%)	
Oncology	12 (17%)	69 (11%)		**ASA Level**			0.15
Sports	7 (10%)	55 (9%)		ASA-1	12 (17%)	148 (25%)	
				ASA-2	59 (83%)	451 (75%)	

[a] Proportions in the two groups are compared using Chi-square test and Wald $\chi 2$ test from simple logistic regression model, while median ± IQR for the skewed data (LOS) and their p value by Mann Whitney *U* test. P value of ≤0.05 is significant.

patients underwent arthroplasty, 343 (51%) trauma patients, 81 (12%) underwent orthopedic oncology procedures and 62 (9%) had sports related procedures. Overall compliance with ASA guidelines was around 18% in cases and 22% in controls. Investigators also studied the overall compliance with the institutional guidelines developed by the anesthesia department and found that guidelines were followed in cases and controls in 27% and 36% respectively (Table 1).

3.2. Prevalence of testing

For 670 patients a total of 7610 blood tests were advised, of which 1076 (14%) yielded an abnormal result. Of these, 73 (6.8%) tests were found among cases. Abnormal lab tests which influenced surgical plan were only found in 0.96% of all of the blood tests that were advised. Likewise, 342 (5%) of normal lab results were reported among cases. Amongst routine preoperative lab tests Hb level was advised in all patients. Patients who had change in surgical plan were more likely to have an abnormal Hb level (49% vs 37%; odds ratio [OR] 1.65; 95% CI, 1.01–2.71; *P* 0.05), abnormal serum sodium level (27% vs 13%; OR (CI) 4.05 (1.63–10.09); $P < 0.01$), abnormal serum chloride (27% vs 15%; OR (CI) 3.31 (1.39–7.90); *P* 0.02), normal coagulation profile (87% vs 73%; OR (CI) 2.43 (1.18–5.01); *P* 0.03) compared with controls who did not have any change in their surgical plan after admission.

3.3. Univariate analysis

We observed that cases had a lower mean age in years (OR = 1.02; 95% C.I. 1.01–1.03) than controls and for every decade increase in age, the odds of having change in surgical plan after admission was 20% higher as compared to controls i.e. who did not have any change in their surgical plan after admission (Table 2). The odds of being a female amongst cases was 30% less as compared to controls (OR = 0.70; 95% C. I. 0.42–1.17). Furthermore, there was a significant higher odds of change in surgical plan for the patients admitted for trauma, orthopedic oncology and sports related procedures than arthroplasty procedures with OR equal to 4.59, 5.15 and 3.78, respectively. In addition to our primary exposure (routine preoperative lab tests), age and ASA level were also associated with change in surgical plan at p value ≤ 0.25 and were included in the multivariable analysis after checking for multicollinearity.

Table 2
Unconditional logistic regression analysis at the Univariate level for the factors associated with change in surgical plan after admission reporting crude odds ratio OR and 95% confidence interval C.I..

Variables	Cases n = 71	Controls n = 599	OR (C.I)	*P* value (0.25)
Age(years)	49.92±22.50	41.14±23.00	1.02 (1.01–1.03)	**<0.01**
LOS(days)	5.96±3.31	5.46±3.52	1.04 (0.97–1.11)	0.26
n(%) n(%)				
Sex				**0.17**
Male (Ref.)	44 (62%)	320 (53%)	1	
Female	27 (38%)	279 (47%)	0.70 (0.42–1.17)	
Procedure				**<0.01**
Arthroplasty (Ref.)	6 (8%)	178 (30%)	1	
Trauma	46 (65%)	297 (50%)	4.59 (1.92–10.98)	
Oncology	12 (17%)	69 (11%)	5.15 (1.86–14.29)	
Sports	7 (10%)	55 (9%)	3.78 (1.22–11.71)	
ASA Level				**0.13**
ASA-1(Ref.)	12 (17%)	148 (25%)	1	
ASA-2	59 (83%)	451 (75%)	1.61 (0.84–3.08)	
Hb level[a]				**0.05**
Normal **((Ref.)**	36 (51%)	376 (63%)	1	
Abnormal	35 (49%)	221 (37%)	1.65 (1.01–2.71)	
ESR				**0.17**
Not Advised **(Ref.)**	55 (77%)	465 (78%)	1	
Normal	3 (4%)	56 (9%)	0.45 (0.13–1.50)	
Abnormal	13 (18%)	78 (13%)	1.41 (0.74–2.70)	

[a] Hb level test was advised to all patients.

3.4. Multivariable analysis

After a stepwise approach in multivariable analysis which included the primary exposure (Hb level, acute inflammatory indicators, ESR, UCE & Coagulation profile), age in years, gender and procedure. Routine preoperative tests were found to be highly insignificant predictors for change in surgical plan after controlling for other variables in the model (p value 0.3–0.9). In comparison to the univariate model, other covariates became insignificant except for the age, gender and procedure. Women, older aged and patients undergoing procedures related to trauma, oncology and sports medicine were more likely to have a change in their surgical plan (Table 3). The odds of being a woman among cases is 45% less as compared to controls (OR = 0.55; 95% C.I. 0.30–1.00). Furthermore, there was a significant higher odds of change in surgical plan for patients admitted for trauma, orthopedic oncology and sports related procedures than arthroplasty procedures with OR equal to 7.44, 9.76 and 6.40, respectively. All possible plausible interactions were checked and found insignificant (p value > 0.1). The Pearson goodness of fit test for the final model was ($\chi 2 = 632$, p = 0.60) indicating that the model fits well.

3.5. Matching on potential confounders

Conditional logistic regression was used at univariate and multivariable levels and summarized in Table 4 after matching the cases and controls on age, gender and procedure. None of the variables was a significant predictor of change in surgical plan (Table 4).

Table 3
Final model after multivariable analysis for factors associated with change in surgical plan.

Variables	aOR (C.I)	*P*-VALUE
Hb Level		0.28
Normal (Ref.)	1	
Abnormal	1.30 (0.79–2.30)	
Acute Inflam. Markers*	1.07 (0.83–1.39)	0.59
Coagulation Profile*	1.10 (0.89–1.35)	0.37
UCE*	1.01 (0.84–1.22)	0.90
ESR		0.78
Not advices (Ref.)	1	
Normal	0.84 (0.24–2.95)	
Abnormal	1.80 (0.87–3.74)	
Age	1.03 (1.01–1.04)	**<0.01**
Procedure		**<0.01**
Arthroplasty (Ref.)	1	
Trauma	7.44 (2.89–19.15)	
Oncology	9.76 (3.26–29.20)	
Sports	6.40 (1.98–20.75)	
Sex		**0.05**
Male (Ref.)	1	
Female	0.55 (0.30–1.00)	

aOR: Adjusted Odds Ratio. C.I.: 95% Confidence Interval. P value of ≤0.05 is significant.

* Variables after principal component analysis; Acute Inflammatory Markers (WBC & Platelets), Coagulation profile (PT, APTT, INR) and UCE (Urea, Creatinine, serum Electrolytes = Sodium, Potassium, Chloride and Bicarbonate).

Table 4
Conditional logistic regression was used at univariate and multivariable levels after matching the cases and controls on age, gender and procedure.

Primary exposure	MOR (C.I) Cases = 66 Controls = 171	*P* value	MaOR (C.I.) Cases = 66 Controls = 171	*P* value
Hb Level		0.06		0.08
Normal (Ref.)	1		1	
Abnormal	1.85 (0.98–3.49)		1.78 (0.93–3.43)	
Acute Inflam. Markers	1.21 (0.89–1.64)	0.22	1.18 (0.86–1.60)	0.31
Coagulation Profile	1.07 (0.85–1.36)	0.55	1.10 (0.85–1.43)	0.48
UCE	0.95 (0.78–1.15)	0.60	0.89 (0.71–1.12)	0.32
ESR		0.08		0.44
Not advices (Ref.)	1		1	
Normal	0.47 (0.13–1.76)		0.60 (0.16–2.24)	
Abnormal	2.28 (0.89–5.90)		2.23 (0.85–5.84)	

MOR: crude Matched Odds Ratio. MaOR: Matched Adjusted Odds Ratio in multivariable model. C.I.: 95% Confidence Interval. P value of ≤0.05 is significant for the primary exposure.

4. Discussion

4.1. Discussion

Overall we found high prevalence of superfluous preoperative testing for the healthy patients (ASA-1 and ASA-2) undergoing elective orthopedic procedures with a total of 7160 tests being done. Despite the fact that we could detect 14% abnormality in these tests, the surgical plan was changed only in <1% due to these lab results. None of these patients had any adverse events in the perioperative period. These results question the clinical utility and cost-effectiveness of these preoperative ordering practices and may compound the problem by raising the matter of increased legal accountability of physicians. This question was raised previously by Kaplan et al., in 1985 [13]. They published a retrospective cohort study in the Journal of American Medical Association reporting that only 0.2% of the abnormal lab results could change the surgical plan and advised to eliminate these tests unless indicated. Of the 7160 tests done in our study, 6534 (84%) yielded normal results and could have been anticipated on the basis of detailed patient's history and clinical examination. Likewise, normal preoperative test results did not decrease the chances of change in surgical plan after admission as 342 (5%) normal tests were found among cases. It is important to point out that most of these lab tests are based on a normal range which is defined as the central 95% range in a Gaussian distribution of a group of healthy volunteers, and hence one always has a 5% chance of an abnormal lab result, no matter how healthy the person may be and the possibility that the results of 1 of 6 tests will be abnormal is 26%.[14, 15].

In our study we found age to be an independent factor strongly associated with change in surgical plan, and whether that was due to age per se or the aging process with its consequences on comorbids remains a dilemma. Interestingly age is neither included in the criteria for ASA status nor in the revised cardiac risk index published by the American Heart Association and American College of Cardiology [16].

Our study did not focus on the consequences of conducting unnecessary lab tests other than the change in surgical plan after admission and length of hospital stay, which itself has an impact on patients' emotions and may add avoidable anxiety and stress to the already stressed surgical patient. Literature reports that over testing has a direct and indirect effect on patients which includes, and is not limited to, harms associated with testing procedures (e.g. pain, hemorrhage, bruise and radiation risk), extra unnecessary anxiety due to, mostly, false positive results which may lead to a cascade of investigations, incremental cost without added benefits, unnecessary change in surgical plan in the form of delay, cancellation and secondary consultation [17].

We found that the least chances of change in surgical plan after admission were amongst patients admitted for arthroplasty procedures 6 (8%) patients from all cases. This could be due to the fact that in our institute there is a designated preoperative nurse who is responsible for conducting preoperative tests at the outpatient department for all arthroplasty patients. This observation should be analyzed further as, if supported by sufficient evidence; it could be one of the solutions for other subspecialties of orthopedics and surgery in reducing the waste in healthcare services.

After running statistical efficient models including the multivariable modeling in logistic regression, PCA and matching on potential confounders we could find acceptable evidence that these routine tests studied were superfluous and did not influence the surgical plan with MaOR (95%CI) of 1.78 (0.93–3.43) for Hb level to 1.10 (0.85–1.43 for coagulation profile. This result should be interpreted with caution particularly in pediatrics and oncology patients. Neither age is considered in ASA classification nor the cancer status, so the best decision should be made after proper communication between physician and patient, irrespective of their ASA status. Other issue of our national health care system is that patient often visits the hospital first time in their lives for surgical procedure without previous records and that, sometime; it necessitates deviation from the guidelines. However this should not be the norm and following local guidelines would be encouraged.

Numerous studies of physician behaviors and practices have reported that physicians are more likely to follow guidelines that add a test or procedure rather than cutting down on the tests [18]. Experience of the developed countries encouraging the practice of "indicated" tests rather than "routine" testing and the lessons learnt should be taken into consideration especially for developing and resource-constrained nation like ours. The Choosing Wisely Initiative (CWI), an operation headed by the American Board of Internal Medicine organization, endorses physician-patient communication and cutting on waste in health care services [19]. This group has published widely on this topic with special focus on physicians' attitude and changing trends in following the guidelines [20, 21].

To the best of our knowledge, this study is the first of its kind in the country and amongst very few in the region comprehensively evaluating this underrated topic with highly efficient statistical analysis methods. However several caveats need to be pointed out. The major limitation of the study is that it is a single center study retrospective study. Furthermore, it depends on the quality of information recorded in patients' medical records and its completeness. The definition of outcome was based on lumping cancellation or delay in procedure more than 24 h. Although this duration was long enough to capture other forms of change in surgical plan like secondary consultation or repeated tests, however, specific reasons couldn't be ascertained. This could lead to non-differential misclassification bias which pulls the estimate (Odds Ratio) towards null value. Likewise grouping many procedures under the four major orthopedic subspecialties (arthroplasty, trauma, oncology and sports) can lead to over/underestimation of the results. Many procedures are in the sub-specialties of orthopedics and each subspecialty has different procedures and complexity. This issue was resolved by matching the participants on procedure type. Another important caveat is that information relating to the reasons why physicians ordered these extra tests and who ordered them (surgeon, resident or patient's request) was not available. We did not capture cases that had a change in their surgical plan before hospital admission or during their OPD visit; however, by choosing the cases to be from hospitalized patients, this reduced the selection bias and made the population under study more homogenous and comparable to international literature. Our population under study included the paediatric age group. This added the advantage of studying this special population that has received less attention in previous studies but at the cost of increasing the heterogeneity of the population. Furthermore, ASA guidelines do not consider cancer patients and thus applying this classification system to them is unfair. They definitely need more tests for

staging the disease regardless of their ASA status.

The findings of this study can be generalized to preoperative healthy patients (ASA-1 and ASA-2) undergoing orthopedic elective surgical procedures. This study will help in improving the practice of ordering preoperative tests when necessary and improve overall patient outcomes. Reducing cost of treatment is an added benefit. Also this study will help in guiding decision makers to define policies to reduce the financial burden on the healthcare system.

4.2. Future consideration and research suggestions

Large prospective RCTs with to demonstrate the no added benefits of this routine practice, specific to each surgical discipline. More focus on the latent consequences of these unnecessary tests on patients' satisfaction, emotional well-being and incremental cost and quality of life.

5. Conclusion

Routine preoperative tests did not influence the surgical plan when adjusted for other variables in the model as well as after matching on potential confounders. Our study will serve as the base and nidus for future studies and, with this detailed methodology, can be replicable in different disciplines of surgery. Implementing the recommended preoperative guidelines maybe difficult and definitely will be met with some resistance due to the long term practice of routine testing. However, this local data would be amongst first steps to move towards an evidence based surgical practice.

Ethical Approval

Yes given by the Aga Khan University Ethical Review Committee, ERC # 4226 Sur-Jun16.

Author contribution

Obada Hasan: Design of the protocol, conducting the study, analysis and manuscript writing and final approval, Shah Fahad: Design of the protocol, conducting the study, analysis and manuscript writing and final approval, Mohammad Mustafa: Design of the protocol, conducting the study and data collection, manuscript writing and final approval, Pervaiz Hashmi: Design and manuscript review and final approval, Shahryar Noordin: Design and manuscript review and final approval.

Declaration of competing interest

None.

Research Registration Unique Identifying Number (UIN)

Name of the registry: Clinicaltrails.gov
Unique Identifying number or registration ID: NCT04196166
Hyperlink to the registration (must be publicly accessible): https://register.clinicaltrials.gov/prs/app/action/SelectProtocol?sid=S0009FKF&selectaction=Edit&uid=U0004FJE&ts=2&cx=-gg0sz5.

Guarantor

All Authors take responsibility.

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Appendix 1. ASA guidelines followed by the institutional guidelines

If Intermediate Surgery:

	ASA 1	ASA2
Full blood count	Not routinely	Not routinely
Haemostasis	Not routinely	Not routinely
Kidney Function	Not routinely	Consider in people at risk of AKI
ECG	Not routinely	Consider for people with cardiovascular, renal or diabetes comorbidities

If Major/Complex Surgery:

	ASA 1	ASA2
Full blood count	Yes	Yes
Haemostasis	Not routinely	Not routinely
Kidney Function	Consider in people at risk of AKI	Yes
ECG	Consider for people aged over 65 if no ECG results available from past 12 months	Yes

- NICE (April 2016). Routine preoperative tests for elective tests for elective surgery
- National Institute for Health and Care Excellence. Preoperative tests (update). Routine preoperative tests for elective surgery. www.nice.org.uk/guidance/ng45 (Accessed on July 28, 2016)

Preoperative Investigations Guidelines

Investigation	Indications	
Full Blood Count: **May not be required** For Diagnostic imaging studies (C.T scans/MRI etc) For ASA I patients listed for minor day care surgical procedures.	• Age 60 years • For intermediate and major surgery • Known or suspected anemia • Chronic blood loss	• Known or suspected cardiovascular or chest disease • Known renal impairment • Presence of chronic diseases like RA,CLD etc
Blood Urea Nitrogen & Serum Creatinine:	• Over 50 years • Major surgical procedure • Systemic hypertension • Diabetes Mellitus	• Other cardiovascular disease • Renal disease • Prolonged NSAID use • On steroids, theophylline, diuretics, digoxin etc
Serum Electrolytes	• Over 60 years • Intermediate or major surgery • Systemic hypertension • Diabetes Mellitus • Other cardiovascular disease • On steroids, theophylline, diuretics, digoxin, lithum or other dysrhythmics	• Renal disease • Hepatic disease • Gastrointestinal losses • Advanced malignancy • Presence of Cardiac Pace Maker
Fasting Blood Sugar	• Over 50 years • Known diabetics • Family history of DM	• On steroids • Peripheral vascular surgery, hepatic surgery and pancreatic surgery.
Hemoglobin A1C	• History of Diabetes Mellitus • On steroids if RBS is > 200 mg/dl • BMI >35 and RBS >200 mg/dl	
Coagulation Profile	• Inherited factor deficiency and/or history of abnormal bleeding • On anticoagulants. • Chronic renal disease and /or on hemodialysis. • Known or suspected liver disease	• Surgery that causes a hemostasis abnormality or surgery likely to cause a large blood loss with a consequent requirement for transfusion. • Patients planned for bowel resection, arterial reconstruction, cardiac surgery, neurosurgery and patients having surgery for cancer. • Major joint surgery if significant CVS comorbidity is also present.

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