

Asymptomatic Cardiac abnormality in Patients Undergoing Low to Intermediate Risk Elective Noncardiac Surgery, Is it a Relevant Clinical Dilemma?

Hazem Mansour*, Ahmed El-Sayed Ali Darwish, Mona Rayan, Ahmed Ibrahim El Desoky khalil

Department of Cardiology, Faculty of Medicine, Ain Shams University, Egypt

*Corresponding author: Hazem Mansour, Mobile: (+20)1000540100, Email: hazemmansour79@gmail.com

ABSTRACT

Background: Preoperative cardiovascular problems might be an important cause for morbidity and mortality in individuals undergoing noncardiac surgery. One patient from every 33 hospitalizations is exposed for noncardiac surgery major cardiovascular and cerebrovascular problems such as mortality, myocardial infarction, or stroke.

Objective: The aim of the current work was to uncover hidden cardiac problems that may cause complications during and after low to intermediate elective noncardiac surgeries.

Patients and Methods: This prospective, observational, cross-sectional study included a total of 250 asymptomatic adult patients referred to Department of Cardiology, Ain Shams University Hospitals for preoperative cardiac assessment before undergoing low to intermediate risk noncardiac surgery.

Results: Most of the study group were males (68%) with a mean age of 47.1 ± 15.5 years. Diabetes and hypertension were found in 45% and 41% of patients respectively. Most patients had gastrointestinal tract (GIT) operations (34%) followed by cataract extractions (14%), orthopedic operations were done in 11% of patients. Clinical examination was normal in 97.2% of patients whereas 2% of patients had atrial fibrillation (AF), 0.8% had systolic murmur. Significantly abnormal electrocardiogram (ECG) was found in 10% of patients. Preoperative significantly abnormal transthoracic echocardiography (TTE) was detected in 9% of patients. Post-operative cardiovascular complications occurred in 7% of patients who had completely normal preoperative clinical, ECG and echocardiographic data. Most of these patients had orthopedic operations and hysterectomy.

Conclusion: It could be concluded that the clinical and predictive value of routine preoperative ECG and echocardiography for major cardiac adverse events in low-risk patient undergoing low to intermediate risk surgery is limited. However, it helps uncovering of hidden conditions that may alter patient's plan of treatment. The type of surgery might be an important factor for occurrence of post-operative complications in low-risk groups.

Keywords: Preoperative assessment, Asymptomatic patients, Noncardiac operation, ECG, Echocardiography.

INTRODUCTION

Almost 312 million major surgical procedures are performed annually across the world. In the US, five million major noncardiac procedures are carried out yearly⁽¹⁾.

Moreover, it is appreciated that noncardiac surgery has a complication rate around 11%, and approximately 42% of these complications are cardiovascular in nature. Furthermore, cardiovascular problems are the main cause of perioperative death within 30 days following noncardiac surgery, with a global prevalence of 1.7% in the United States. Although the frequency of perioperative adverse cardiovascular events has decreased over the past ten years, the continued rise in population age and the accompanying co-morbidities make it progressively challenging to reduce surgical risk in these higher-risk patients⁽²⁾.

The aim of study was to uncover hidden cardiac problems that may cause complications during and after noncardiac major surgery.

PATIENTS AND METHODS

This prospective, observational, cross-sectional study included a total of 250 asymptomatic adult patients referred to Department of Cardiology, Ain Shams University Hospitals for preoperative cardiac assessment before undergoing low to intermediate risk noncardiac surgery.

We included elective operations whether open or laparoscopic.

We excluded patients <18 years of age, patients known to have documented or known coronary artery disease, structural heart diseases, history of previous cardiac surgery or intervention, patients with trauma or traffic road accident and patients who refuse to participate in the study.

All patients underwent:

- 1- Full history taking that included demographic data, medical history and to exclude the presence of cardiac symptoms or documented cardiac diseases.
- 2- Focused general and cardiac examination that included pulse examination, blood pressure evaluation and local cardiac auscultation for abnormal sounds or murmurs.
- 3- Preoperative 12-Lead surface electrocardiography (ECG) and Transthoracic echocardiography (TTE).

ECG was evaluated by a cardiologist for rate, rhythm, axis, the presence of abnormality. Using EHRA guidelines 2020⁽³⁾. The ECG was considered abnormal if one of the following was present: Left ventricular hypertrophy: (S wave in V1, R wave in V5 or V6, or R wave in AVL >11 mm; 35 mm). Bundle

branch block: a left or right bundle branch block having a QRS duration of more than 120 ms.

If atrial fibrillation is present or not. Left axis deviation more than 30 degrees, right axis deviation greater than 90 degrees. Pathological Q-waves are present when there is a negative deflection in two consecutive leads that precedes the R wave and has a duration of more than 40 MS and an amplitude more than 25% of the corresponding R wave. A QTc of >440 Ms and a ST segment depression of >1 mm or a T wave inversion in V5/V6 are both considered to be signs of ventricular strain.

Transthoracic echocardiography using ASE guidelines⁽⁴⁾ 2015 to evaluate left and right ventricular size and function and to exclude the presence of segmental wall motion and structural heart disease. The echocardiographic was considered abnormal if there was segmental wall motion abnormality, abnormal LV size or function, abnormal RV dysfunction, structural heart disease (moderate to severe valvular affection), significant pericardial effusion. Significant ECG and or echocardiographic study was defined when the abnormal findings led to change the patient plan in the form of the referral for further sophisticated investigations or procedures or led to delay or cancellation of the operation.

Ethical committee:

The protocol was approved by the Local Research Committee, and the Ethical Committee in Ain Shams University hospital. All patients provided their written consent to utilize their data without disclosing any of their personal information. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Statistical analysis

The data were assembled, evaluated, encoded, and put into IBM SPSS version 23 of the Statistical Package for Social Science. The mean± standard deviations, and ranges for the quantitative data were shown. Quantitative information was presented as mean SD (Standard deviation). Qualitative factors were also represented by numbers and percentages.

RESULTS

The study included 250 patients with a mean age of 47.1 ± 15.5 years, 68% of patients were males. Diabetes and hypertension were reported in 45% and 41% of patients respectively. This shown in table (1).

Table (1): demographic and risk factors profile of the study

Variables	N=250	%
Male	170	68%
Female	80	32%
Hypertension	102	40.8%
Diabetes mellitus	112	44.8%
Obesity	34	13.6%
Smoking	102	40.8%
Positive family history	77	30.8%

Forty patients underwent GIT endoscopy 35 (14%), 35 patients underwent cataract extraction (14%), 27 patients underwent orthopedic surgery (11%) table (2).

Table (2): Surgeries performed in the cases of the study

Operations	Study subjects N = 250	
	Number	Percent (%)
Cataract	35	14%
GIT Endoscope	35	14%
Hernia	22	8.8%
Fracture	18	7.2%
Perianal Abscess	16	6.4%
Varicocele	16	6.4%
Fibroidectomy	13	5.2%
AV Shunt	13	5.2%
Cholecystectomy	11	4.4%
Mastectomy	8	3.2%
Appendectomy	5	2%
Breast removal	7	2.8%
Gastric sleeve	5	2%
Hip replacement	5	2%
Lipoma	5	2%
Pilonidal sinus	7	2.8%
Urethrectomy	5	2%
Perianal fistula	5	2%
Carpel tunnel	2	0.8%
Hysterectomy	2	0.8%
Neck femur fracture	2	0.8%
Prostatic surgery	2	0.8%
Spine fixation	2	0.8%
Thyroidectomy	2	0.8%

Focused general and local examination was normal in 97.2% of patients. Irregular pulse was found in 5 patients (2%) and systolic murmur was auscultated in 2 patients only (0.8%). Resting 12 lead ECG was normal in 62% of patients, 38% of patients had abnormal ECG and 10% had significant abnormality. Significant abnormal ECG was defined when the abnormal findings led to change patient plan. There was a patient who was discovered to have Wolff-Parkinson-White (WPW) syndrome and 2 patients with long QT table (3).

Table (3): ECG findings in the cases of the study

ECG variables	N=250	%
Normal ECG	155	62%
Abnormal ECG	95	38%
Significant abnormal ECG	24	9.6%
Variables	N=250	%
Normal axis	203	81.2%
Right axis deviation	17	6.8%
LT axis deviation	30	12%
PVC	12	4.8%
Wide QRS	2	0.8%
Pathological Q wave	6	2.4%
R BBB	10	4%
L BBB	3	1.2%
PR interval <0.12sec	2	0.8%
QTc>440 msec	2	0.8%

Transthoracic echocardiography was normal in 38% of patients, 53% of patients had age related accepted minor abnormality such as sclerotic aortic valve with normal flow and or mild aortic regurge, degenerative mitral valve disease and mild mitral regurge and 9% of patients had significant abnormality tables (4 & 5).

Table (4): M-mode and 2D Echocardiographic parameters of the study group.

Variables	N = 250	
Ejection fraction (%)		
Mean ± SD	63.01 ± 6.67%	
Normal ejection fracture	238	95.2%
mild impairment	12	4.8%
Diastolic dysfunction		
Normal diastolic functions	100	40%
Diastolic dysfunction grade 1	135	54%
Related to age >50 year	92	36.8%
Related to age (50 :40) year	26	10.4%
Related to age <40 year	17	6.8%
Diastolic dysfunction grade 2	13	5.2%
Diastolic dysfunction grade 3	2	0.8%
Dilated LVEDD	27	10.8%
Dilated LVESD	27	10.8%
Left ventricular hypertrophy (LVH)	27	10.8%
Age >40 year	17	6.8 %
Variable Age	10	(known Hypertensive Patient 4% (Not known Hypertensive Patients)
Regional wall motion abnormality	20	8%
Dilated LA	57	22.8%
Age related >50 year	29	11.6%
Age related (50:40) year	18	7.2%
Age <40 year	10	4%
Dilated aorta in <40 year	2	0.8%
Dilated RV	5	2%
Rim of Pericardial effusion	2	0.8%

Table (5): CFM and Doppler data of the study group.

Variables	N=250	Percent
Completely Normal ECHO	95	38%
Abnormal ECHO	155	62%
Related to Age (insignificant)	132	52.8%
Significant abnormality	23	9.2%
Moderate MR	8	3.2%
Severe MR	2	0.8%
Moderate TR	5	2%
Moderate AR	5	2%
Mild AS	2	0.8%
Mild PR	2	0.8%
SPAP Mean ± SD	47.09 ± was deferred for further assessment 15.45	
SPAP >35 mmHg.	5	2%

Significant abnormal Echo was defined when the abnormal findings deferred the surgery for further assessment. Twelve patients showed mild impairment of EF by Echo assessment (4.8%), 2 patients were referred for coronary angiography (0.8%), 5 patients were referred for C.T coronary angiography (2%), 5 patients were risk stratified as low risk and proceeded for their operations (2%).

Besides, 20 patients showed regional wall motion abnormalities in the form of hypokinesia in left ventricle (8%), 3 of them had pathological Q wave by ECG and these patients were referred for further assessment by C.T coronary angiography (1.2%).

Post-operative complications occurred in 18 patients (7) %, the details are shown in table (6). On revising the preoperative data of these patients, all patients had normal physical examination, normal ECG and echo data. Half of these patients had orthopedic operations such as fracture neck femur, hip replacement and spine fixation. Cataract extraction, hernia and GIT endoscope had no complications.

Table (6): Complications in the cases of the study

Variables	Study cases N = 250	
	N	%
Cardiac complications	18	7%
Hypotension	3	1.2%
Pulmonary embolism	2	0.8%
Sinus tachycardia	8	3.2%
SVT	1	0.4%
AF	2	0.8%
Arrested	1	0.4%
Venous thrombosis	1	0.4%

DISCUSSION

Major adverse cardiovascular events are the main presentation for perioperative morbidity and mortality which occur approximately in 5% of patients undergoing elective non cardiac surgery. To optimize

patients’ risk stratification and reduce surgical complications, preoperative assessment clinics are essential components ⁽⁵⁾.

Cardiac problems following noncardiac surgery depend on a variety of risk factors, as well as the kind of operation and the circumstances surrounding it. Together with changes in body core temperature, blood loss, and fluid shifts, surgical variables that affect cardiac risk include the urgency, size, nature, and length of the treatment ⁽⁶⁾.

As most surgeries are elective, there is the chance to apply approaches to lessen that risk. The patient medical history is important in delineating cardiac problems or comorbidities and hence to stratify the patients’ surgical risk ⁽⁷⁾.

The mean age of this study patients was 47.09 ± 15.45 years ranging from 19 to 82 years. More than half of the study patients were males (68%). The most performed noncardiac surgeries, the most performed surgeries were cataract, GIT Endoscope and Hernia. DM followed by hypertension was prevalent among the study patients. This finding was supported by **Sunny et al.** ⁽⁸⁾ who found that DM and hypertension were the most reported risk factors among patients undergoing non cardiac surgery.

In this study, 97.2% of patients had normal general and local cardiac examination that stratified patients as low risk group. The abnormal findings were AF and systolic murmur in 2.8% of patients. This finding is supported by the study of **Higuchi et al.** ⁽⁹⁾, who concluded that the majority of preoperative clinical examination was normal.

In the current work, normal ECG was reported in 60% of patients, 10% had significant abnormality. This finding is supported by observational studies which showed 4.6% to 44.9% of asymptomatic individuals had aberrant ECG readings ⁽¹⁰⁾.

Teruel et al. ⁽¹¹⁾ performed a research on 761 individuals who had low-risk outpatient surgical procedures, 9.4 % of the ECGs evaluated during the preoperative assessment considered as ‘potentially significant’, prompting further evaluation.

In the present study, 9% of patients had abnormal echocardiographic study, 6% of which had valve abnormalities, 5% had mildly impaired LV systolic function and 2% had elevated PASP.

A systematic review included preoperative echocardiographic studies on patients undergoing noncardiac surgeries showed; Low ejection fraction (EF) (25.4%), aortic valve disease (24.4%), mitral valve disease (20.0%), and RV failure (6.6%) were listed as the most frequent diagnosis ⁽¹²⁾.

Cardiac complications were detected in 7% of the study patients, 3.2% of them had sinus tachycardia, 1.2% of them had hypotension, pulmonary embolism in 0.8%, AF in 0.8% and supraventricular tachycardia (SVT) in 0.4%,0.4% arrested and 0.4% had venous thrombosis.

A large study evaluated a cohort of 108,593 patients who underwent surgery in a Dutch University Hospital From 1991–2000, showed 1877 mortalities (1.7%) with cardiovascular causes in 543 instances (0.5%) of these deaths⁽¹³⁾.

A study of 4315 patients who underwent major, elective, noncardiac procedures in a teaching hospital for tertiary care from 1989 to 1994. They found that 92 individuals (2.1%) experienced serious cardiac problems, such as cardiac mortality and myocardial infarction (MI)⁽¹⁴⁾.

A cohort of 3893 surgical patients participated in the Dutch Echocardiographic Cardiac Risk Evaluating Using Stress Echo (DECREASE) I, II, and IV studies between 1996 and 2008, showed that 136 (3.5%) of these patients had perioperative cardiac mortality or MI⁽¹⁵⁾. The perioperative ischemic assessment (POISE) experiment, which was carried out between 2002 and 2007 and recruited 8351 patients underwent noncardiac surgery, revealed that 226 patients (2.7%) had perioperative mortality, of whom 133 (1.6%) passed away from cardiovascular causes. While 367 (4.4%) patients experienced non-fatal MI⁽¹⁶⁾.

In concordance with the current study, according to **Lai et al.**⁽¹⁷⁾ who studied case-matched control patients undergoing non cardiac surgeries, it was found that postoperative cardiovascular morbidities were found in 5.4%. Transient intraoperative hypotension developed in 37.1% and bradycardia in 10.8%.

According to the present study findings, we postulated that the clinical and predictive value of routine preoperative ECG and echocardiography for major cardiac adverse events is limited in patients undergoing low to intermediate risk elective noncardiac Surgery, as it was found that all the patients who developed post-operative cardiac complications had normal pre-operative ECG and Echocardiography.

A baseline electrocardiogram (ECG) examination is especially helpful if postoperative ECG results are aberrant, according to the study by Schein and colleagues. Yet among asymptomatic individuals without a documented history of cardiovascular disease who were scheduled for low-risk surgery, getting a preoperative ECG was seldom beneficial⁽¹⁸⁾.

Despite the fact that specific ECG abnormalities have been linked to postoperative ischemic events, these abnormalities did not increase the predictability of cardiovascular events beyond the usual risk⁽¹⁹⁾. Those with established cardiovascular disease or asymptomatic individuals having high-risk operations are better candidates for preoperative ECGs⁽²⁰⁾.

We should use echocardiography in clinical practice in ways that are both time- and money-efficient, taking into account the proper indications for preoperative echocardiogram that are outlined in a few recent guidelines. The following step is to evaluate each patient's risk based on the planned noncardiac surgical procedures and to rule out any active cardiac

problems that call for examination and treatment prior to noncardiac surgery.

In research by **Chang et al.**⁽²¹⁾, it was shown that perioperative significant adverse events were not associated with a routine assessment of the LV systolic function by echocardiography for patients undergoing planned abdominal surgery and orthopedic surgery. Just 63 patients (3%) were reported to have impaired LV systolic function (LVEF 50%), and moreover less than 10% of patients who experienced severe adverse events following surgery had decreased LVEF⁽²¹⁾. Our findings showed that major noncardiac surgery's cardiac risks could not be more accurately predicted by standard perioperative echocardiography, which evaluates LV systolic function. The American College of Cardiology and the American Heart Association guidelines, which declared that preoperative decreased LVEF has a poor sensitivity for the prediction of perioperative cardiac adverse events, were supported by this significant finding.

Current recommendations do not call for regular transthoracic echocardiography to assess heart function prior to noncardiac surgery. We should use echocardiography in clinical practice in a time- and money-efficient manner, considering the proper indications for preoperative echocardiogram in a few recent guidelines.

Cardiac problems following noncardiac surgery vary on the kind of operation and patient-related risk factors. Thus, it is important to evaluate each patient's unique cardiac risk profile in assembly to the surgical operation before contemplating a preoperative cardiac test, including echocardiography⁽²²⁾.

We proposed that the relevant criteria to be taken into account when determining cardiac risk are those specific to surgery, such as the kind of operation, whether it is urgent, how long it will take, and the potential for blood loss and fluid changes. According to the results of the current study, the kind of surgery is a significant factor in determining the likelihood of post-operative problems.

In the present study, hysterectomy and neck femur hip replacement surgeries were the most commonly detected procedures in patients with post-operative cardiac complications. While other operations such as cataract, hernia and gastrointestinal endoscope had no complications. The type of surgery may necessitate identifying which patients who are more likely to have underlying heart disease and whom are exposed to higher rates of perioperative morbidity and mortality. This is due to the possibility that the type of surgery will cause coronary or myocardial stressors (such as changes in heart rate, blood pressure, vascular volume, pain, or bleeding); the severity of these stressors influences the likelihood of perioperative cardiac events.

Vascular operations, such as aortic and other major vascular surgery, are at a significant cardiac risk since the reported cardiac risk is frequently > 5%, according

to **Paravastu and coworkers'** study⁽²²⁾. Nonetheless, there is a very minimal cardiac risk (1%) associated with endoscopic procedures, superficial procedures, cataract surgery, breast surgery, and routine ambulatory surgeries⁽²³⁾.

Finally, perioperative cardiac assessment in this study uncovered previously undiagnosed cardiac conditions that place patients at inconvenient risk for the proposed procedure and may necessitate further management or intervention.

CONCLUSION

It could be concluded that the clinical and predictive value of routine preoperative ECG and echocardiography for major cardiac adverse events in patients undergoing low to intermediate risk surgery is limited. However, it helps uncovering of hidden conditions that may alter patient's plan of treatment. The type of surgery might be an important factor for occurrence of post-operative complications in low-risk groups.

STUDY LIMITATIONS

The limited number of included patients is a major limitation.

No evaluation of functional capacity of patients which is important in risk stratification.

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Competing interests: Nil.

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