

ASSOCIATION BETWEEN ROUTINE
PREOPERATIVE ELECTROCARDIOGRAM (ECG)
FINDINGS WITH PERIOPERATIVE ECG CHANGES
IN NONCARDIAC SURGERIES AMONG LOW
CARDIAC RISK PATIENTS: A CROSS-SECTIONAL
STUDY

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ABSTRAK

Latar Belakang

Elektrokardiogram (EKG) prapembedahan memainkan peranan yang penting dalam mengesan sebarang masalah jantung yang tidak diketahui. Bukti terkini juga menjurus untuk melakukan EKG prapembedahan pada pesakit yang mempunyai gejala dan berisiko untuk masalah jantung. Walau bagaimanapun, untuk memeriksa semua pesakit terutama mereka yang tidak mempunyai gejala dan risiko masalah jantung mungkin menambah kepada beban kos kesihatan yang semakin meningkat hari demi hari.

Tujuan

Untuk menentukan perkadaran ECG prapembedahan yang tidak normal dikalangan pesakit rendah risiko jantung yang berumur 40 tahun keatas dan faktor yang berkaitan dengannya dan juga perkaitannya dengan EKG yang abnormal sekitar pembedahan (perioperatif) pada pesakit yang menjalani pembedahan selain jantung secara bius am atau bius separa.

Kaedah

Penyelidikan secara kajian rentas digunakan. Sebanyak 406 subjek direkrut dalam kajian ini. Mereka berumur 40 tahun dan keatas, ASA 2 dan kebawah, NYHA kelas 2 dan kebawah serta pesakit yang mempunyai indeks risiko jantung revisi (RCRI) yang rendah dimasukkan ke wad bagi tujuan pembedahan selain jantung di HUSM. Sampel kajian dipilih dengan persampelan mudah. EKG prapembedahan dilakukan semasa pemeriksaan rutin bius sebelum pembedahan. Penilaian EKG berikutnya dilakukan pada 1) setelah induksi anestesia, 2) sekiranya berlaku apa-apa perubahan dalam pemantauan

rentak nadi jantung, 3) satu jam selepas pembedahan. EKG yang tidak normal adalah penyimpangan paksi, fibrilasi atrium, blok cabang bundle, hipertrofi ventrikel kiri, kompleks ventricle pramatang lebih daripada 6 denyutan seminit, gelombang Q, perubahan segmen S-T, takikardia sinus atau bradikardia, takikardia supraventrikular, takikardia ventrikel dan fibrilasi ventrikel. Semua keputusan diagnosa EKG dilakukan oleh pakar kardiologi berdasarkan cadangan AHA/ACCF/HRS. Regresi logistic berganda digunakan untuk menentukan hubungan antara penemuan EKG prapembedahan dan perubahan EKG perioperatif samada baru mahupun semakin meneruk.

Keputusan

Sebanyak 132 pesakit (32.5%) mempunyai EKG pra pembedahan yang tidak normal dan 92 pesakit (22.7%) mengalami perubahan EKG yang baru yang abnormal atau semakin memburuk sekitar pembedahan (perioperatif). Faktor yang berkaitan dengan EKG prapembedahan yang tidak normal adalah 1) Umur ($RR=1.02$, 95%CI 1.01,1.03, $P<0.001$), 2) Lelaki ($RR=1.41$, 95%CI 1.13,1.77, $P<0.05$), 3) Perokok ($RR=1.62$, 95%CI 1.04,2.52, $P<0.05$), 4) Penyakit tekanan darah tinggi ($RR=1.28$, 95%CI 1.01,1.62, $P<0.05$). Pesakit yang mengalami perubahan EKG prapembedahan yang tidak normal mempunyai perkaitan yang lebih tinggi untuk mengalami perubahan baru mahupun semakin memburuk pada EKG perioperatif jika dibandingkan dengan pesakit yang mempunyai penemuan EKG prapembedahan yang normal (40.2% vs 14.2%, χ^2 (df) = 34.15 (1), $p = <0.001$). Penemuan EKG yang paling biasa ialah penyimpangan paksi kiri (praoperatif, $n = 69$ (17%), perioperatif, $n = 71$ (17.5%)) dan T inversi (praoperatif, $n = 44$ (10.8%), perioperatif, $n = 53$ (13.1%)). Setelah disesuaikan dengan kovariat, kemungkinan terjadinya perubahan EKG perioperatif baru atau semakin

memburuk didapati lebih tinggi pada pesakit yang mempunyai enemuan EKG prapembedahan yang tidak normal (OR:4.41, 95%CI 2.62,7.39, $p<0.001$) dan kadar rentak nadi jantung intraoperatif yang rendah (OR:2.71, 95%CI 1.55,2.74, $p<0.001$). Diantara pesakit dengan penemuan EKG prapembedahan yang tidak normal, penemuan perubahan EKG baru yang paling biasa semasa intraoperatif dan pasca pembedahan adalah sinus bradikardia, masing-masing 16 pesakit (13.5%) dan 20 pesakit (16.8%).

Kesimpulan

Perkadaran EKG yang tidak normal pada pesakit rendah risiko jantung yang berumur 50 tahun ke atas adalah sangat ketara. Mereka yang mempunyai EKG yang tidak normal mempunyai perkaitang yang signifikasi dengan perubahan EKG semasa perioperatif.

Kata kunci: Elektrokardiogram, Rendah risiko jantung, Prapembedahan, Perioperatif

ABSTRACT

Background

Preoperative ECG plays a big role in detecting any underlying myocardial pathology. Recent evidence also suggests for pre-operative ECG in patients with symptoms and at increased cardiac risk undergoing non-cardiac surgeries. However, to screen all patients especially those without symptoms with low cardiac risk might add burden to the burgeoning healthcare cost.

Objective

To determine the proportion of abnormal preoperative ECG in low cardiac risk patients aged 40 years and above and factors associated with it and its association with actual development of perioperative ECG abnormalities in patient undergoing non-cardiac surgery under general or regional anaesthesia.

Method

A cross-sectional study design was adopted in this research. A total of 406 subjects were recruited in this study. They were aged 40 years old and above, ASA 2 and below, NYHA class 2 and below as well as patient who had low Revised Cardiac Risk Index (RCRI) that were admitted for non-cardiac surgeries in HUSM. Study sample were selected by convenient sampling. Preoperative ECG was done during routine preoperative anaesthetic assessment. Subsequent ECG assessments were done at 1) after induction of anaesthesia, 2) any changes in the cardiac monitoring, 3) one hour post-extubation period. ECG abnormalities include axis deviation, atrial fibrillation, bundle branch block, left ventricular hypertrophy, premature ventricular complexes more than 6 beats per minutes, Q wave, S-T segment changes, sinus tachycardia or bradycardia,

supraventricular tachycardia, ventricular tachycardia and ventricular fibrillations. All ECG diagnoses were done by cardiologist following the recommendation by AHA/ACCF/HRS. Multiple logistic regression was used to determine the association between preoperative ECG findings and new or worsening perioperative ECG changes.

Result

A total of 132 patients (32.5%) had abnormal preoperative ECG and of this abnormal preoperative ECG, 53 patients (40.2%) experienced new or worsening ECG perioperatively. Factors associated with abnormal preoperative ECG were 1) Age ($RR=1.02$, 95%CI 1.01,1.03, $P<0.001$), 2) Male ($RR=1.41$, 95%CI 1.13,1.77, $P<0.05$), 3) Smoker ($RR=1.62$, 95%CI 1.04,2.52, $P<0.05$), 4) Hypertension ($RR=1.28$, 95%CI 1.01,1.62, $P<0.05$). Patients who had abnormal preoperative ECG changes were associated with higher incidence of developing new or worsening ECG perioperatively than patients with normal preoperative ECG findings (40.2 % vs 14.2 %, $\chi^2(df)=34.15(1)$, $p<0.001$). The most common ECG findings were Left axis deviation (Preoperative, n=69 (17%), Perioperative, n=71 (17.5%)) and T Wave inversion (Preoperative, n=44 (10.8%), Perioperative, n=53 (13.1%)). After adjusting for covariates, the odds of developing new or worsening perioperative ECG were found to be higher in patients who had abnormal preoperative ECG findings (OR:4.41, 95%CI 2.62,7.39, $p<0.001$) and lower intraoperative heart rate (OR:2.71, 95%CI 1.55,2.74, $p<0.001$). Among patients with abnormal preoperative ECG findings, the most common new ECG findings during intraoperative and postoperative was sinus bradycardia, 16 patients (13.5%) and 20 patients (16.8%) respectively.

Conclusion

Proportion of abnormal ECG in low cardiac risk patient age 50 and above is considerably significant. Those with abnormal preoperative ECG were significantly associated with new or worsening perioperative ECG abnormalities.

Keywords: Electrocardiogram, Low cardiac risk, Preoperative, Perioperative

ABBREVIATIONS

ASA – American society of anaesthesiologists

ACC/AHA – American college of anesthesiologists / American heart association

CHD – Coronary heart disease

CI – Confidence Interval

CRF – Case report form

ECG – Electrocardiogram

EKG - Elektrokardiogram

etCO₂ – End tidal carbon dioxide monitoring

HUSM – Hospital University Sains Malaysia

HR – Heart Rate

MAP – Mean Arterial Pressure

MINS – Myocardial injury after noncardiac surgeries

NIBP – Noninvasive blood pressure monitoring

OR – Odds Ratio

PCE – Postoperative Cardiac Events

RCRI – Revised cardiac risk index

SD - Standard deviation

SpO₂ – Saturation of peripheral oxygen

USPTF – United states preventive task force

CHAPTER 1: INTRODUCTION

1.1 SCIENTIFIC BACKGROUND

Anaesthetic practice has vastly changed over a few decades with the emergence of evidence-based medicines. This includes pre-operative testing for patient who are admitted for elective or emergency surgery under general or regional anaesthesia. Evaluation of patient readiness for the surgical procedure, optimizing patient's health status before surgery to reduce morbidity and return the patient to their usual functions post-operatively usually done during preoperative assessment (1). Pre-operative testing is used to detect any underlying illnesses that could affect the patient outcome from general or regional anaesthesia that is not evident from history and clinical examination. This includes electrocardiogram (ECG) testing. ECG routinely done for male more than 40 years old and female more than 50 years old (2). This includes low cardiac risk patients who are admitted for elective or emergency procedure under general or regional anaesthesia.

A major cause of perioperative morbidity and mortality is cardiovascular complications in patients undergoing noncardiac surgery (3). Many literatures done evaluating postoperative cardiac events (PCE) in noncardiac surgery mainly in vascular surgery patient, with little clinical data on noncardiac, nonvascular surgery patients (3). Furthermore, the predictive value of ECG in detecting PCE remains unclear in patient undergoing noncardiac and nonvascular surgery (3).

Preoperative cardiac screening is also done during preoperative evaluations, in order to predict and appropriately managed the patient according to the risk. The Revised Cardiac Risk Index (RCRI) mainly used during preoperative assessment in order to

assess the myocardial risk of the patient (4). Moreover, ECG is routinely performed to screen for asymptomatic coronary artery disease in patients aged over 50 years old (4). Furthermore, abnormalities in resting ECG shown to be independently associated with incident of coronary heart disease (CHD) and cardiovascular disease events (5).

ECG has its advantages as it is low cost, widely use and safe and can be considered as good for risk stratification of asymptomatic patients (5). However, routinely performing ECG in asymptomatic patients is not supported by current evidence (5). Furthermore, the effect of ECG as a method of reporting the prognostic properties of markers for cardiovascular risk on net reclassification of the patients has not been properly examined (5). Moreover, recent studies advocates to selective ordering of test instead of routine testing (1).

Intraoperative tachycardia and hypotension also associated with myocardial injury after noncardiac surgery (MINS). It has been reported as independent factors that are associated with MINS. Abbot TEF et al (6) reported that HR more than 100 associated with higher risk of MINS. Walsh M et al (7) reported that MAP less than 55 were associated with myocardial injury. Hence in our study, we will also look at the mean MAP and mean HR in patients who develop intraoperative new ECG changes or worsening ECG changes.

1.2 PROBLEM STATEMENT

Preoperative assessment is a major part of anaesthesia practice. Preoperative testing is an adjunct to preoperative assessment in order to guide with anaesthesia management intraoperatively and post-operatively. However, routine preoperative ECG testing is

commonplace nowadays in anaesthesia practice in Hospital Universiti Sains Malaysia (HUSM) especially for low cardiac risk individual 40 years old and above that it could add on to the health care cost and burden.

1.3 STUDY RATIONALE

This study will look at the proportion of abnormal screening preoperative ECG in low cardiac risk patients aged 40 years old and above and factors associated with it, who came for elective or emergency surgery under general or regional anaesthesia and its association with development of perioperative ECG abnormalities.

CHAPTER 2: STUDY OBJECTIVES

2.1 General Objective

To determine the association between routine preoperative ECG findings in low cardiac risk patients age 40 years old and above with actual development of perioperative ECG abnormalities in patient undergoing non-cardiac surgery under general or regional anaesthesia.

2.2 Specific Objectives

1. To determine the proportion of abnormal preoperative ECG in low cardiac risk patients.
2. To determine the proportion of new or worsening perioperative ECG changes among patients with abnormal preoperative ECG in low cardiac risk patients.
3. To determine the associations between preoperative ECG findings with new or worsening perioperative ECG changes.
4. To determine the association between intraoperative mean heart rate (HR) and mean arterial pressure (MAP) and new or worsening perioperative ECG changes.

2.3 Hypothesis

2.3.1 Null Hypothesis

1. There is no association between preoperative ECG findings and new or worsening perioperative ECG changes.
2. There is no association between intraoperative mean heart rate (HR) and mean arterial pressure (MAP) and new or worsening perioperative ECG changes.

2.3.2 Alternative Hypothesis

1. There is an association between preoperative ECG findings and new or worsening perioperative ECG changes.
2. There is an association between intraoperative mean heart rate (HR) and mean arterial pressure (MAP) and new or worsening ECG changes.

CHAPTER 3: MANUSCRIPT

3.1 Title page

3.1.1 ARTICLE TITLE

PROPORTION OF ABNORMAL ELECTROCARDIOGRAM (ECG) DURING PREOPERATIVE ECG SCREENING AND ITS ASSOCIATION WITH PERIOPERATIVE ECG ABNORMALITIES AMONG LOW CARDIAC RISK PATIENTS IN NONCARDIAC SURGERIES: A PROSPECTIVE CROSS-SECTIONAL STUDY

3.1.2 RUNNING HEAD

ASSOCIATION BETWEEN PREOPERATIVE ECG SCREENING WITH PERIOPERATIVE ECG CHANGES IN PATIENT UNDERGOING NONCARDIAC SURGERIES

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3.2 Abstract

Background

Routine electrocardiogram (ECG) among low cardiac risk patients are not standard practiced. However, it is common in our hospital to screen all patients age 40 years and above with ECG. The aim of our study is to evaluate the merit of preoperative ECG pertaining to this.

Method

This was a cross-sectional study conducted among all patients aged 40 years and above with low cardiac risk during preoperative assessment and underwent ECG screening. Subsequent ECG assessments were done at 1) after induction of anaesthesia, 2) any changes in the cardiac monitoring, 3) one hour post-extubation period. ECG abnormalities include axis deviation, atrial fibrillation, bundle branch block, left ventricular hypertrophy, premature ventricular complexes more than 6 beats per minutes, Q wave, S-T segment changes, sinus tachycardia or bradycardia, supraventricular tachycardia, ventricular tachycardia and ventricular fibrillations. All ECG diagnoses were done by cardiologist following the recommendation by AHA/ACCF/HRS. Multiple logistic regression was used to determine the association between preoperative ECG findings and new or worsening perioperative ECG changes.

Result

A total of 406 patients were included in the study. The proportions of abnormal preoperative ECG were 32.5% (132 patients). Factors associated with abnormal preoperative ECG were 1) Age ($RR=1.02$, 95%CI 1.01,1.03, $P<0.001$), 2) Male ($RR=1.41$, 95%CI 1.13,1.77, $P<0.05$), 3) Smoker ($RR=1.62$, 95%CI 1.04,2.52, $P<0.05$),

4) Hypertension ($RR=1.28$, 95%CI 1.01,1.62, $P<0.05$). The percentage of patients who developed new or worsening ECG perioperatively were higher in patients with abnormal preoperative ECG changes (40.2 % vs 14.2 %, $\chi^2(df)= 34.15(1)$, $P<0.001$).

Conclusion

Proportion of abnormal ECG in low cardiac risk patient age 50 and above is considerably significant. Those with abnormal preoperative ECG were significantly associated with new or worsening perioperative ECG abnormalities.

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Keywords: Electrocardiogram, Low cardiac risk, Preoperative, Perioperative

(250 words)

3.3 Introduction

Evaluation of patient readiness for the surgical procedure, optimizing patient's health status before surgery to reduce morbidity and return the patient to their usual functions post-operatively usually done during preoperative assessment (1). Preoperative testing is done to supplement anaesthetist on top of history and physical examinations in order to formulate the best anaesthetic plan for the patient's safety. This includes electrocardiogram (ECG) testing. The role of routine preoperative electrocardiogram (ECG) anaesthetic practice has vastly changed over a few decades with the emergence of evidence-based medicines. However, preoperative ECG is still routinely done in Hospital University Sains Malaysia (HUSM) for patient 40 years old and above. This includes healthy, asymptomatic patients who are admitted for elective or emergency procedure under general or regional anaesthesia.

A major cause of perioperative morbidity and mortality is cardiovascular complications in patients undergoing noncardiac surgery (2). Many literatures done evaluating postoperative cardiac events in noncardiac surgery mainly in vascular surgery patient, with little clinical data on noncardiac, nonvascular surgery patients (2). Furthermore, the predictive value of ECG in detecting perioperative cardiac event (PCE) remains unclear in patient undergoing noncardiac and nonvascular surgery (2). Preoperative cardiac screening is also done during preoperative evaluations, in order to predict and appropriately managed the patient according to the risk. The Revised Cardiac Risk Index (RCRI) mainly used during preoperative assessment in order to assess the myocardial risk of the patient (3). Moreover, ECG is routinely performed to screen for asymptomatic coronary artery disease in patients aged over 50 years old (3).

Furthermore, abnormalities in resting ECG shown to be independently associated with incident of CHD and cardiovascular disease events (4).

ECG has its advantages as it is low cost, widely used and safe and can be considered as good for risk stratification of asymptomatic patients (4). However, routinely performing ECG in asymptomatic patients is not supported by current evidence (4). Furthermore, the effect of ECG as a method of reporting the prognostic properties of markers for cardiovascular risk on net reclassification of the patients has not been properly examined (4). Moreover, recent studies advocates to selective ordering of test instead of routine testing (1). United States Preventive Task Force (USPTF) (5) also recommends against screening with resting or exercise ECG to prevent cardiovascular disease event in asymptomatic low cardiac risk patients.

However, age cannot be eliminated as a screening factor for abnormal preoperative ECG (6). There still vague guideline regarding the age threshold for preoperative ECG testings (6,7). Also, not many studies directly assess the prevalence or incidence of abnormal ECG in low cardiac risk patients. Furthermore, ischemia from postoperative ECG done in the recovery room is predictive of a major cardiac complication later during the hospital stay (8). Hence, the aim of our study was to determine the proportion of abnormal preoperative ECG in patient's aged 40 years and above with factors associated with it and evaluate the association between preoperative ECG findings with perioperative ECG changes in low cardiac risk patients.

Study Author	Conclusion
Fritsch G et al	This study against routine use of ECG for preoperative testing. The study recommends abandoning routine use of preoperative testing (ECG included) in favour of a more selective ordering of tests.
Biteker M et al	This study was inconclusive. The study recommended to look at prolongation of QTc interval on the preoperative ECG was related with PCE in patients undergoing nonvascular and noncardiac surgery.
Van Klei WA et al	This study against preoperative ECG testing for screening asymptomatic individuals undergoing a variety of surgical procedures.
Auer R et al	This study in favour for the use of ECG as a screening for future coronary heart disease (CHD) events. They conclude that major and minor ECG abnormalities among older adults were associated with an increased risk of coronary heart disease (CHD) events.
Curry SJ et al	The US Preventive Services Task Force (USPSTF) recommended against screening with resting or exercise ECG to prevent CVD events in asymptomatic adults at low risk of CVD events. (D recommendation.
Correl DJ et al	This study suggests for selected criteria in order to use ECG as a screening tool preoperatively. The criteria are age greater than 65 years, as it remains an independent predictor for

	significant preoperative electrocardiograms abnormalities. Other criterias are history of angina, congestive cardiac failure, high cholesterol, myocardial infarction or severe valvular disease.
Rinfret S et al	This study mainly advocates the use of ECG in the postoperative period. This study concludes that the immediate postoperative electrocardiogram is a valuable tool to adjust risk stratification, even in patients who have lower risks when undergoing noncardiac surgery.
Noordzij PG et al	This study advocate to the use of preoperative ECG as it provides prognostic information in addition to clinical characteristics and the type of surgery. However, this study questioned the use of ECG for low-risk surgery.
Fleisher AL et al	This study suggests for selected use of preoperative ECG screening and against using preoperative ECG for low cardiac risk patients. This study concludes that preoperative resting 12 lead electrocardiogram is reasonable for patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease, except for those undergoing low-risk surgery. (Class IIa, level of evidence: B).
Liu LL et al	This study also against the use of screening preoperative ECG. This study concludes that abnormalities on preoperative ECGs are common but are of limited value in predicting postoperative cardiac complications in older patients undergoing noncardiac

	surgery. These results suggest that obtaining preoperative ECGs based on an age cutoff alone may not be indicated, because ECG abnormalities in older people are prevalent but nonspecific and less useful than the presence and severity of comorbidities in predicting postoperative cardiac complications.
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3.4 Methodology

Study Design

A cross-sectional study design was adopted in this research.

Sampling Method

Convenience sampling method was adopted to screen all patients who were scheduled for nonvascular and noncardiac surgeries at HUSM. Patients would be recruited in the study if they were aged 40 years old and above and asymptomatic from cardiac related symptoms such as chest pain, breathlessness, palpitation and diaphoresis, revised Cardiac Risk Index Class (RCRI) of 0.9% and less (≤ 1 points), any type of surgery except vascular and cardiac surgeries, metabolic equivalent of task (METs) more than 4, American Society of Anaesthesiologist (ASA) class 1 & 2 and New York Heart Association (NYHA) class 1 & 2. Patients who were treated with beta antagonists and patients who underwent ophthalmic surgery and subsequently developed oculocardiac reflex were also excluded from this study.

Data Collection Method

Potential patients were identified for study recruitment during preoperative assessment by respective anaesthesia medical officer in-charge. Prior to the study visit, preoperative ECG screenings were done one day prior to the anaesthesia and analysed. A developed patient information sheet was used to brief patients thoroughly regarding this research and ample time were allocated for patients to decide for study enrolment. A signed consent form was obtained in the operating theatre on the day of the surgery.

In the theatre, patient was put on 5 lead cardiac monitoring to detect any abnormalities that might occur post-induction of anaesthesia and during the surgery. Intra-operative

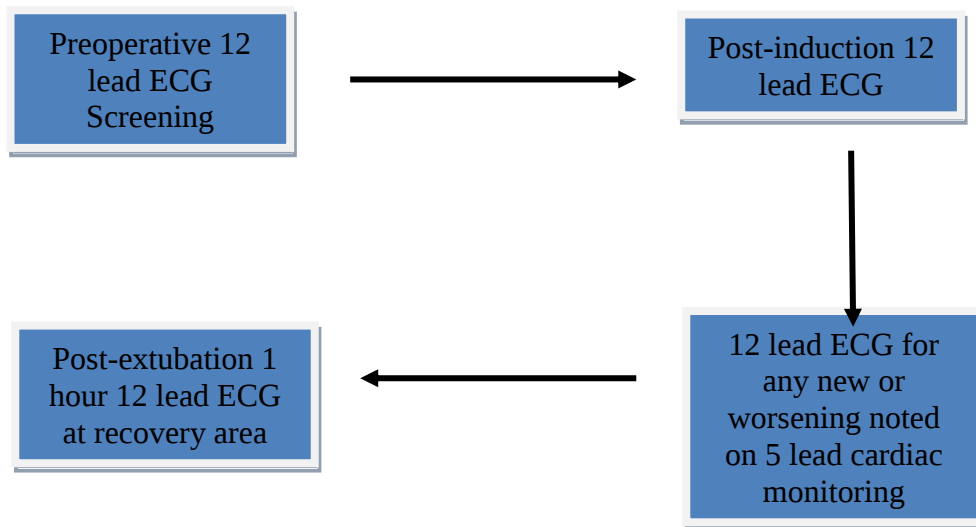
12 lead ECG was done post-induction of anaesthesia before surgical incision and if any cardiac event noted on cardiac monitoring during the surgery. Other standard anaesthesia monitorings were applied as per managing team (SpO₂, etCO₂, NIBP etc). The mean HR and MAP (calculated based on 10 minutes HR and MAP charting post-induction till extubation) were recorded in the data collection sheet once the surgery finished and patient emerged from anaesthesia. The patient demographic details, type of anaesthesia, type of surgery, estimated blood loss and duration of anaesthesia and surgery were recorded in the case report form (CRF).

One hour postoperative, 12 lead ECG was done at the recovery room or any high dependency unit should the patient require it as per anaesthesia managing team. All the ECG done will be attached together with the CRF.

Measurements

12 lead ECG was recorded at a speed of 25mm/second. The ECG was then interpreted by the cardiologist who was blinded. The ECG interpretation followed the recommendation by AHA/ACCF/HRS recommendations on standardization of ECG interpretations. Corrected QT interval was calculated by using Bazett formula. The ECG results showing axis deviation, atrial fibrillation, left or right bundle branch block, LVH, frequent premature ventricular complexes more than 6 beats per minutes, Q wave, S-T segment changes, sinus tachycardia or bradycardia, supraventricular tachycardia, ventricular tachycardia and ventricular fibrillations were classified as abnormal.

Study Flow Chart



3.5 Ethics Approval

Approval was obtained from the Ethics Committee's and Research Ethics Committee (Human) (JEPeM) of Universiti Sains Malaysia (HUSM)(JEPeM code: USM/JEPeM/18120803) and the study was conducted according to good clinical practice. A total of 406 patients underwent nonvascular and noncardiac surgeries were recruited for this study.

3.6 Measurement tools

Electrocardiogram

- i. Kenz Cardico 1215
- ii. Philips Page Writer TC20

3.7 Study Outcomes

Primary outcomes were 1) The proportion of abnormal preoperative ECG screening in low cardiac risk patients and, 2) The incidence of new or worsening perioperative ECG

changes among patients with abnormal preoperative ECG findings in low cardiac risk patients undergoing non-cardiac surgeries.

Secondary outcomes were the associations between preoperative ECG screening with new or worsening perioperative ECG changes.

3.8 Statistical Analysis

All data were initially recorded in Microsoft Excel spreadsheet before it was transferred to and analysed by using STATA 12.0 (StataCorp, College Station, TX, USA). The distribution of all continuous data was evaluated by using histogram. Data was presented as mean and standard deviation if it was normally distributed and skewed continuous data was presented as median and Inter Quartile Range (IQR). Categorical data was presented as frequency and percentage. Both descriptive and univariate statistical analysis were adopted where appropriate. Categorical data was tabulated using contingency table and Pearson chi-square test was used to find any potential association between them. Multiple logistic regression analysis was used to determine the association between preoperative ECG findings and new or worsening perioperative ECG changes, adjusting for other risk factors. These risk factors were identified through literature reviews which were conducted *a priori*. Univariable analysis was conducted to evaluate the relationship between each risk factors and dependent variable, new or worsening perioperative ECG changes. Subsequently, variables were selected and multiple logistic regression was fit. The variable selection was based on statistics significant and clinical/biological plausibility. The model obtained was further evaluated for linearity, the present of interactions and multicollinearity. A *P*-value of less than 0.05 was considered statistically significant.

3.9 Results

It was noted that duration of surgery was highly correlated with duration of anaesthesia. Thus, duration of surgery was removed from the model. A preliminary final model was obtained. To ensure accurate effect estimation, all potential outliers were identified and influential outliers were removed from the model. All model assumptions were checked and assessed before interpretation of the final model. This included overall model evaluation, model specification analysis, model predictive accuracy and model adequacy assessment. All probability values were two-sided.

Demographic

A total of 406 patients were enrolled into the study. The mean age was 56.2 ± 10.6 years. Mean age for those with normal preoperative ECG was 54.8 ± 10.1 years and mean age for those with abnormal preoperative ECG was 59.1 ± 11.2 years. Table 1 showed patient baseline characteristics and comorbidities. Of the 406 patients, 112 underwent orthopaedic surgery, 79 underwent gynaecology surgery, 61 underwent general surgery, 46 underwent urology surgery, 28 underwent hepatobiliary surgery, 27 underwent breast surgery, 12 underwent plastic surgery and 40 underwent ophthalmic, ear/nose/throat and oromaxillofacial surgery. Age 59.1 ± 11.2 years ($RR=1.02$, 95% CI 1.01,1.03, $P<0.001$), male gender ($RR=1.41$, 95% CI 1.13,1.77, $P<0.05$), smoker ($RR=1.62$, 95% CI 1.04,2.52, $P<0.05$) and those with hypertension ($RR=1.28$, 95% CI 1.01,1.62, $P<0.05$) were significantly associated with abnormal preoperative ECG findings.

Primary outcomes

132 of 406 patients (32.5%) had ≥ 1 abnormality on their preoperative ECG and 53 patients (40.2%) experienced new or worsening ECG perioperatively (Table 2 & 3). The percentage of patients who developed new or worsening ECG perioperatively were higher in patients with abnormal preoperative ECG changes (40.2 % vs 14.2 %, $\chi^2(df)=34.15(1)$, $P<0.001$) (Table 4). The most frequent preoperative ECG abnormalities was left axis deviation (LAD) (17%) (Table 5).

Secondary Outcomes

There was significant association between those with abnormal preoperative ECG with the development of new or worsening ECG changes (Table 7). Multiple logistic regression analysis showed that patients with abnormal preoperative ECG had 4.41 higher odds of developing new or worsening perioperative ECG compare to patients with normal preoperative ECG (adj OR: 4.41, 95% CI 2.62,7.38, $P<0.01$), after adjusting for other risk factors. As compared to higher intraoperative heart rate (HR) (75-113 bpm), patients with lower intraoperative HR (42-74 bpm) was associated with higher odds of developing new or worsening perioperative ECG (adj OR: 2.71, 95% CI 1.55,4.74, $P<0.001$). There was no difference seen between one preoperative screening ECG abnormality and more than one preoperative ECG screening abnormalities with the development of perioperative ECG changes ($P>0.05$).

3.10 Discussion

The merit of routine use of ECG as part of preoperative evaluation and screening in low cardiac risk group and those underwent low risk surgery has been questioned (9). Abnormal preoperative ECG is said unlikely to influence pre and perioperative management for those with low cardiac risk and is not recommended in asymptomatic patients undergoing low risk surgery based on current guideline from the current American College of Cardiology/American Heart Association and US Preventive Task Force (5,10,11). A study by Correll et al (6) showed that age more than 65 years, history of angina or myocardial infarction (MI), congestive cardiac failure, high cholesterol level and severe valvular heart disease were predictors for significantly abnormal preoperative ECG. Liu et al (12) also emphasis that preoperative ECG are of limited value in predicting postoperative cardiac complications in older patients undergoing noncardiac surgery despite common abnormal preoperative ECG. This led to the question of whether preoperative ECG done beyond this group has become obsolete (10).

Current recommendation from American Society of Anaesthesiologists Task Force on preanaesthesia evaluation that age alone should not be an indication for preoperative ECG testing (7). Furthermore, abnormal preoperative ECG is common in older age and is considered clinically non-significant (6). Also, the selection of age threshold for preoperative ECG testing remains arbitrary (6). However, study conducted by Correll et al (6) showed that age is an independent risk factor with increase odd ratio for age above 60 for predicting significant preoperative ECG abnormalities. In this study, we evaluated on patient demographic with the development of preoperative ECG abnormalities. Age more than 59 (± 11.2) years ($RR=1.02$, 95% CI 1.01,1.03, $P<0.001$),

being a male ($RR=1.41$, 95% CI 1.13,1.77, $P<0.05$), ASA score 2 ($RR=1.19$, 95% CI 1.03,1.37, $P<0.05$), patient who smoke ($RR=1.62$, 95% CI 1.04,2.52, $P<0.05$), and those with hypertension ($RR=1.28$, 95% CI 1.01,1.62, $P<0.05$) showed significant association with preoperative ECG abnormalities. There was no association between type of surgery (elective or emergency), risk of surgery, duration of surgery and anaesthesia, estimated blood loss and surgery discipline with the development of abnormal perioperative ECG changes. Therefore, we suggest looking at these risk factors as well during preoperative anaesthetic assessment in deciding for preoperative ECG testing.

Our study showed that among low cardiac risk patients, significantly high percentage of low cardiac risk patients of 32.5% (132 patients) develops abnormal preoperative ECG findings (Table 2). Of this, significant association was seen with perioperative ECG changes. There was no difference seen between those who had one preoperative ECG abnormalities with those who have more than one preoperative ECG abnormalities with the perioperative ECG changes (Table 9). Also, of those with abnormal preoperative ECG, 40.2% (53 patients) develop of new or worsening perioperative ECG changes (Table 3). This is of particular interest as previous recommendations suggest that patient with low cardiac risk and asymptomatic of cardiac disease does not warrant a preoperative ECG testing (5,6,7). Rinfret et al (8) further explained that perioperative ischaemic changes were at higher risk to develop cardiac complications later. However, the significant of the perioperative ECG changes with development of cardiac complications were not evaluated in this study. Hence, we suggest future studies to include cardiac enzyme evaluation to further explore on this.

Our study also showed that there is an association between abnormal preoperative ECG findings with the development of new or worsening ECG changes among low cardiac risk patients undergoing noncardiac surgeries. The commonest ECG abnormalities were left axis deviation in preoperative and perioperative ECG abnormalities (Preoperative, n=69 (17%), Perioperative, n=71 (17.5%)). Patient with abnormal preoperative ECG had 4.79 higher odds of having new or worsening perioperative ECG changes as compared to patient with normal preoperative ECG.

In our study, we also look at the mean HR and mean MAP intra-operatively. Mean HR of less than 75 had 2.71 higher odds of developing perioperative ECG changes; however, no association was seen between mean MAP with development of perioperative ECG changes. The commonest ECG abnormalities noted intraoperative and postoperatively is sinus bradycardia (13.45% and 16.81%) (Table 6). VISION study stated that HR > 100bpm was associated with myocardial injury after noncardiac surgery (MINS) and HR < 55 was protective of MINS (12). In our study, we did not measure the perioperative cardiac enzyme as the main aim was only to look at the ECG in detecting perioperative cardiac complications. We propose for further studies to be conducted to further delineate this. Types of anesthesia were not associated with perioperative ECG changes.

The limitation of current study is that the study was done in a single centre with majority of the sample size population were from Malay ethnic (91.6%). This is because of the demographic distribution of races in Kelantan whereby Malay ethnic are the majority races in Kelantan state. We proposed a multicentre site for future studies. Another limitation is that we only use ECG as a marker for perioperative cardiac

abnormality. Hence, we suggest including cardiac enzyme monitoring as well in future studies.

In conclusions, there was a significant association between preoperative ECG abnormalities with perioperative ECG changes in low cardiac risk patient. Factors that associated with abnormal ECG in low cardiac risk patient should help anaesthetist to further strengthen their justifications for ordering preoperative ECG testing. In view of low intraoperative HR (44-74 bpm) was significantly associated with new or worsening perioperative ECG, further studies is needed to further delineate this. The implications of this towards patient's preoperative evaluation cannot be overlooked and we proposed for future studies to look into the association between perioperative ECG changes with the development of myocardial injury among low cardiac risk patients.