Postoperative Electrocardiograph Changes and its Relation to Troponin Elevation and Cardiac Complications After Lower Limb Surgery

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Samar Mohamed Abdel Twab

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List of Abbreviations

ACC : American College of Cardiology

ACC/AHA : American College of Cardiology/American Heart Association

ACE : Angiotensin converting enzyme inhibitors

ACS : Acute coronary syndrome.

AF : atrial fibrillation

ASA : American Society of Anesthesiologists

AUC : Area under the curve

BBs : Beta blockers

BNP : B-type natriuretic peptide

CAD : Coronary artery disease

CCBs : Calcium channel blockers

CHD : Coronary heart disease

CHF : Congestive heart failure

CKMB : Creatine kinase MB

COPD : Chronic obstructive airway disease

CT : Computerized tomography

CV : Coefficient of variation

CVP : Central venous pressure

DM : Diabetes mellitus

DVT : Deep venous thrombosis

ECG : Electrocardiographic

List of Abbreviations (Cont.)

ESC/ACC : European Society of Cardiology/American College of Cardiology

ESC/ACCF/AHA/WHF: European Society of Cardiology, American College of Cardiology Foundation, the American Heart Association, and the World Health Federation

GA : General anesthesia

GDS : Global Deterioration Scale

Hb : Hemoglobin

HF : Heart failure

HTN : Hypertension

ICU : Intensive care unit

IHD : Ischemic heart disease

LDH : Lactate dehydrogenase

AST : Aspartate aminotransferase

METs : Metabolic equivalents

NIBP : Non-invasive blood pressure

NSQIP : National Surgical Quality Improvement Program

NSTEMI : non-ST segment elevation myocardial infarctions

NT-proBNP: N-terminal fragment of BNP

PCA : Patient controlled analgesia

PMI : Perioperative myocardial infarction.

List of Abbreviations (Cont.)

PVC's	:	Premature ventricular contraction
RA	:	Regional anesthesia
RCRI	:	Revised Cardiac Risk Index
ROC	:	Receiver operators curve
TOE	:	Transoesophageal echocardiography

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Introduction

Patients who undergo non cardiac surgery may be at risk for cardiac morbidity, not only intra operatively but also during their recovery period. This risk applies particularly to those patients with known cardiac disease; however, it may be also applied to asymptomatic persons who are older than 50 years and who have the potential to develop atherosclerotic cardiovascular disease. Prevention and recognition of postoperative cardiac problems following non cardiac surgery is an area of intense clinical and economic interest in the perioperative and critical care environments. Cardiovascular problems occur with the highest frequency in patients with pre-existing cardiovascular disease and those undergoing major surgical procedures ***(Mastan et al., 2015).***

Following orthopaedic surgery, approximately 5% of patients sustain cardiac complications which lead to increased morbidity and mortality. The mortality rate after hip fracture is as high as 10% to 26% at 6 months and cardiac-related death are common. Cardiac injury is potentially treatable and therefore early detection of myocardial ischaemia is essential. The diagnosis of perioperative myocardial infarction (PMI) can be difficult to make following

orthopaedic surgery. The main difficulties with the diagnosis is that PMI often occurs silently, and with limited or subtle ECG changes ***(Landesberg et al., 2009)***.

Cardiac biomarkers are important diagnostic tools for addressing clinical problems. Recent changes in laboratory diagnostic power have resulted in these markers being incorporated into international guidelines and into the updated definition of myocardial infarction. An ideal biomarker for diagnosis myocardial infarction should possess high sensitivity and specificity, also rapidly released and slowly eliminated, for early and late diagnoses. In addition, such a biomarker should be cost-effective and simple to use, without affecting patients' outcome or impacting their therapy. The introduction of plasma troponin I analysis has markedly increased our ability to detect myocardial damage because plasma elevations in this protein are highly specific for cardiac injury and troponin I has been shown to be a more specific marker for a PMI than creatine kinase MB iso-enzyme (CKMB) after orthopedic surgery ***(Thygesen et al., 2012).***

Aim of the Work

The aim of this study is to determine the prevalence and risk factors for new ECG changes after major orthopedic surgery in elderly patients and identify their relation to troponin elevation and occurrence of postoperative cardiac complications which may include: acute coronary syndrome, congestive heart failure and cardiac arrest.

Epidemiology and Risk Factor for Postoperative Cardiac complications

Cardiac complications constitute the most common cause of postoperative morbidity and mortality, having considerable impact on the length and cost of hospitalization. As the population ages increase, more high-risk cardiac patients will undergo surgery, and perioperative cardiac complications can be an increasing problem. American College of Cardiology/American Heart Association ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for non-cardiac Surgery reported the prevalence of cardiovascular disease increases with age, and it is estimated that the number of persons older than 60 years in the United States will increase 25% to 35% over the next 30 years. ***(Fleisher et al., 2007)***.

More than 230 million major surgeries are performed annually worldwide, and this number grows continuously. The 30-day mortality associated with moderate- to high-risk non-cardiac surgery in large cohorts and population-based studies exceeds 2%and up to 5% in patients at high cardiac risk. Following orthopaedic surgery, approximately 5% of patients sustain cardiac complications which leads to increased morbidity and mortality. The mortality rate after hip fracture is as high as 10% to 26% at 6 months. In high risk patients, the incidence of postoperative myocardial

ischemia and infarction has been reported to be as high as 42% ***(Calderaro et al., 2010)***.

Coincidentally, this is the same age group in which the largest number of surgical procedures is performed. Thus, it is conceivable that the number of non-cardiac surgical procedures performed in older persons will increase from the current 6 million to nearly 12 million per year, and nearly one fourth of these-major intra-abdominal, thoracic, vascular, and orthopedic procedures-have been associated with significant perioperative cardiovascular morbidity and mortality. Perioperative cardiac morbidity represents the major risk after non-cardiac surgery ***(Devereux et al., 2011)***.

The incidence of perioperative myocardial infarction (MI) in low-risk patients with no history of coronary artery disease (CAD) ranges from 0.3% to 3%, but can reach 33% in high-risk patients with history of CAD. That large variation in the incidence of perioperative MI can be explained not only by the type of the population assessed and the surgery performed, but also by the lack of uniformity in the diagnostic criteria adopted by the studies. In addition, perioperative MI can pass unnoticed if monitoring with serial electrocardiogram and postoperative measurement of troponin are not performed ***(MaFalls et al., 2008)***.

The acute mortality rate among inpatients after elective joint replacement surgery ranges from 0.3% to 0.95%, with a 1-year mortality rate around 2%. Acute mortality rates following surgery for hip fracture are significantly higher. A population-based study of patients undergoing elective, primary total knee replacement surgery documented a 0.8% risk of myocardial infarction (MI) within 90 days of surgery ***(Botto et al., 2014)***.

A multifactorial index examining potential clinical predictors of cardiac risk was originally proposed in 1977 and has since undergone further refinement. Surgical predictors of outcome include the intrinsic risk of the surgical procedure, with vascular surgery categorized as high risk, most orthopedic surgery as intermediate risk, and endoscopic procedures as low risk. Previous studies did not distinguish higher risk from lower risk orthopedic procedures. In the particular case of total joint arthroplasty, there is little information on the risks of primary versus revision or bilateral procedures. Functional capacity in patients undergoing joint replacement surgery is predictably poor (usually, <4 METS, or metabolic equivalents, a standardized measure of energy expenditure), making it a suboptimal predictor of cardiac complications ***(Egaele et al., 2006)***.

Clinical predictors of perioperative risk:

The 2007 (ACC/AHA) guidelines (not changed in the 2009) summarized clinical predictors of increased perioperative risk for myocardial infarction (MI), heart failure (HF), and cardiac death. These predictors (Table 1), which are derived from the history, physical examination, and resting electrocardiogram (ECG), help the clinician decide which patients may benefit most from further evaluation and aggressive management (medical or coronary revascularization) ***(Fleisher et al., 2014)***.

Table (1): Clinical predictors of perioperative risk:

Major Predictors
Unstable coronary syndromes
Acute or recent MI with evidence of important ischemic risk by clinical symptoms or noninvasive study
Unstable or severe angina (Canadian Class III or IV)
Decompensated heart failure
Significant arrhythmias
High-grade atrioventricular block
Symptomatic ventricular arrhythmias in the presence of underlying heart disease
Supraventricular arrhythmias with uncontrolled ventricular rate
Severe valvular disease
Intermediate Predictors
Mild angina pectoris (Canadian Class I or II)
Previous MI by history or pathologic Q waves
Compensated or prior heart failure
Diabetes mellitus (especially insulin-dependent type)