

Clinical Predictors of Elevated Troponin Levels after Intramedullary Hip Nailing

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Received: October 01, 2020

Published: November 07, 2020

Introduction

Myocardial injury is a serious and frequent complication after non-cardiac surgery [1]. The reliable detection of patients at risk for cardiovascular adverse events during perioperative period is very important, as it may allow targeted interventions very early [2].

One easy way to reveal myocardial injury in perioperative setting is troponin concentration estimated in plasma [3]. However, the routine screening of troponin levels in absence of signs or symptoms indicative of myocardial ischaemia is not recommended [2]. However, assessment of clinical predictors of postoperative troponin raise would be helpful for patients risk stratification [4]. A better knowledge of the predictors of raised troponin levels could be useful to target the clinical choice of measuring troponin concentrations in the early postoperative period in specific high-risk population [2]. This important information may help clinicians with the challenging interpretation of raised troponin levels and to improve short and long-term outcomes.

The aim of this study was to find out parameters that predict the elevation in troponin I (cTnI) after intramedullary hip nailing. We hypothesized that age, ASA score; blood transfusion needing and history of cardiac risk factors independently predict post-race cTnI levels.

Materials & Methods

This is a prospectively conducted study that took place in a regional general hospital from February 2016 to January 2019. Informed written consent was taken from each patient before entry into the study. Criteria for inclusion in the study were those patients with clinical risk factors for Coronary Artery Disease (CAD) according to the revised cardiac risk index, undergoing hip intramedullary nailing for intertrochanteric hip fracture (a minimal invasive surgery with intermediate surgical risk), performed under spinal anesthesia, regardless of their gender [5,6]. Patients without risk factors for coronary artery disease were excluded as it has been proposed that routine use of cTnI should be discouraged in non-cardiac patients undergoing non cardiac surgery [7-9]. Similarly, patients with increased cTnI levels before surgery were also excluded, in order to determine the direct effect of surgery on troponin mea-

surements. Demographic data, history of risk factors for CAD, ASA score, surgery related parameters, functionality, ECG changes and medication, were recorded.

The criteria of 4th Universal Definition of Myocardial Infarction were used in this study [6].

Venous blood samples were obtained from all patients, prior to surgery, immediately after, six hours later and at 24, 48, 72, 96 and 120 hours for the estimation of cTnI levels. Cardiac Troponin was measured by a Baxter Stratus II analyzer (high sensitivity assay), which utilized two monoclonal antibodies. According to our laboratory standards, any values of cTnI levels greater than 15pg/ml were considered positive.

Descriptive statistics were used to present the results for continuous and discrete variables. Logistic regression analysis using a statistical model adjusted for confounding parameters was performed to test the association between post-operative raise of cTnI levels and various demographic and clinical parameters. Statistical significance was set at $p < 0.05$. Statistical analysis was performed with statistical packet STATA 7.0 (Stata Corp., College Station, TX).

Results

Sixty-two (46.96%) from the 132 patients participated in the study, had raised cTnI levels during the postoperative period. However, only 5 (8.06%) patients experienced myocardial infarction which was confirmed by clinical examination, ECG changes, positive two-dimensional echo or pharmaceutical echo stress.

The demographic and clinical data of the patients who underwent intramedullary hip nailing surgery for hip intertrochanteric fracture repair are presented in association with troponin levels at Table 1. Multivariate logistic regression analysis revealed an association of raised cTnI with age, ASA score, transfusion blood units needed, history of angina and heart failure stage C. Hip fractured patients who were transfused with more than 3 blood units during perioperative period, had a 2.25-fold increased risk of elevated cTnI (OR=2.25, 95% CI: 1.07-4.74, $p < 0.003$) while patients with ASA score > 2 had a 3-fold increased risk of elevated cTnI (OR=3.03, 95% CI: 1.49-6.18, $p < 0.003$). In addition, patients with history of angina had a 6-fold increased risk of elevated cTnI (OR=6.22,

Table 1: Characteristics of patients with elevated and normal troponin I levels after intramedullary hip nailing.

	Troponin (+)	Troponin (-)	p-value
Age (ys)	84.1	78.3	0.02*
Female Gender (%)	47/15	28/42	0.78
ASA score>2	38	24	0.003*
Functional capacity before fracture (METs<4)	22	26	0.98
Time from fracture to surgery (>48h)	22	24	0.96
Duration of surgery (>45min)	46	44	0.22
Blood transfusion (>2units)	26	17	0.032*
History of atrial fibrillation	14	18	0.82
New ECG changes	35	32	0.29
Medication			
Beta-blocker	28	34	0.82
Statins	16	20	0.95
Aspirin	13	15	0.88
Diuretic	26	28	0.96
ACE inhibitor	17	20	0.92
Calcium channel inhibitor	12	8	0.3
History of angina (n pts)	39	15	0.00001*
History of previous myocardial infarction (n pts)	8	6	0.64
History of heart failure (n pts)			
Stage A	11	13	0.91
Stage B	7	5	0.6
Stage C	8	1	0.023*
Stage D	2	1	0.91
History of stroke or transient ischemia (n pts)	11	10	0.96
History of diabetes mellitus requiring insulin therapy (n pts)	13	18	0.66
Preoperative creatinine levels>2mg/dl	14	18	0.93

95% CI: 2.88-13.42).

Discussion

It is well known that postoperative troponin levels raise, is one of the most important predictors of short- and long-term morbidity and mortality after non cardiac surgery [2,3,8]. Also the elevated troponin levels are highly associated with length and cost of hospitalization [2,7]. So screening of those patients with clinical predictors of postoperative troponin raise, probably will improve overall clinical outcomes.

Current studies examine the clinical predictors of cTnI after different types of surgery, enhanced the heterogeneity among patients. To the best of our knowledge, this study is the first in the literature which examines patients underwent hip intramedullary nailing exclusively. In this study population, we found a significant association between raised postoperative troponin levels after hip intramedullary nailing and clinical parameters such as age, ASA score, transfusion blood units needed, history of angina and heart failure stage C. Older patients, with ASA score>3 undergoing hip intramedullary nailing and transfused with more than 3 units of blood during perioperative period, suffering from angina or heart failure, have high risk to present elevated troponin levels after surgery.

These findings are in accordance with other studies [8-10]. Abbott et al in Vision trial reported that patients older than 75

years with history of coronary disease are associated with elevated troponin levels [8]. Chong et al examined 102 patients participated in emergency orthopedic surgery and reported that the most significant predictor of troponin levels raise was the transfusion needing in perioperative setting [9]. In addition, they mentioned that old age, history of ischaemic heart disease, congestive cardiac failure and renal failure as significant predictors of postoperative troponin levels raise [9]. In contrast, our study did not reveal any association between renal failure and elevated troponin levels. According to the aforementioned study of Chong et al., renal failure defined as an increase in creatinine above the normal reference range (chronic known elevations in the case of pre-morbid renal failure and acute elevations in the case of post-operative renal failure) [9]. In our study, only the chronic cases of renal failure were included in regression analysis model and this is in accordance with another study [2]. Fisher et al examined 238 patients sustained hip fractures undergone hip surgery and they reported that the 88% of patients with elevated postoperative troponin levels had ASA score>3 [10]. Moreover, the authors found that age, coronary artery disease, stroke and smoking are highly associated with elevated troponin levels [10]. Conti et al found 21 (7.58%) among 277 patients with elevated troponin levels after non cardiac surgery and significant predictors of raised troponin levels were age, diabetes mellitus and urgent type of surgery [2]. Once again our study did not reveal any association between diabetes and elevated troponin levels, but this finding was evidenced in other studies [9,10]. Interestingly cardiovascular medication was not associated with raised postoperative troponin levels [8-10].

The observation that perioperative myocardial injury occurs after prolonged imbalance between oxygen demands and supply in response to the stress of surgery, explains the fact why the older age patients with impaired respiratory function and increased blood loss perioperatively, have a high risk to present elevated troponin levels [7].

Limitations of this study include a relatively small cohort of patients, which probably limited the ability to identify other independent predictors of elevated postoperative troponin levels. In addition, patients with raised troponin levels preoperatively were excluded. These elevated levels would be expected to increase in the setting of additional ischemia in the perioperative period. Probably this is the reason of no significant association of renal failure and diabetes with troponin levels, found in our study, as we know these diseases are characterized by chronically raised troponin levels. Conversely, the major strength of the study is that only patients underwent hip intramedullary nailing were participated in this report.

Taking in consideration that most cases of perioperative ischaemia are presented without symptoms, screening at risk patients in routine clinical practice will improve outcomes following non-cardiac surgery. Postoperative troponin levels should be routinely measured in older patients with ASA score>3, history of angina or heart failure and transfused with more than 3 units, after intramedullary hip nailing in order to initiate proper interventions very early.

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