ORIGINAL ARTICLE

Prognostic value of preoperative electrocardiography in predicting myocardial injury after vascular surgery

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ABSTRACT

Background: The current European guidelines recommend that a preoperative electrocardiogram (ECG) should be performed routinely in patients scheduled for high-risk surgery. However, the evidence regarding ECG as a predictor of perioperative cardiac complications is weak.

Aim: To evaluate the association of preoperative ECG with short- and long-term outcomes in patients undergoing high-risk vascular procedures.

Methods: This was a substudy of the international Vascular events In noncardiac Surgery patIents cohort evaluatioN (VISION) Study and included consecutive patients undergoing vascular procedures in a single tertiary center. In each patient, a preoperative 12-lead ECG was evaluated by two experienced clinicians following the Polish Cardiac Society recommendations. We performed routine perioperative troponin monitoring at five time points (one preoperative and four postoperative measurements) to evaluate whether preoperative ECG abnormalities are associated with myocardial injury after noncardiac surgery (MINS) and 1-year major adverse cardiovascular events (MACE) including cardiac death, myocardial infarction, and stroke.

Results: The study group comprised 348 patients, 80.5% of whom were male and the median age (interquartile range [IQR]) was 65 (59–72) years. The incidence of MINS and 1-year MACE was 18.7% and 14.4%, respectively. Multivariable analysis showed that none of the predefined ECG abnormalities (ST depression, left axis deviation, atrial fibrillation, and bundle branch block) was associated with the incidence of MINS or 1-year MACE.

Conclusion: This study confirmed that preoperative ECG abnormalities are frequent in patients undergoing high-risk vascular surgery. However, we did not find evidence supporting the relation between preoperative ECG abnormalities and postoperative adverse cardiac outcomes in high-risk patients.

Key words: major adverse cardiovascular events, myocardial injury after noncardiac surgery, preoperative electrocardiography

INTRODUCTION

Cardiac perioperative complications including myocardial infarction and myocardial injury after noncardiac surgery (MINS) are common complications following noncardiac surgery [1–7]. Large prospective cohort studies with routine troponin monitoring around non-cardiac procedures demonstrated that 13%–25% of participants developed MINS with the majority of cases being asymptomatic and not fulfilling myocardial infarction criteria according to the universal definition of myocardial infarction [1, 2, 8]. These studies also showed that MINS is associated with poorer short- and long-term outcomes [1–3].

Due to advanced age and multimorbidity, patients undergoing vascular procedures are particularly prone to developing postoperative cardiac complications. This is well reflected in the current perioperative care guidelines

WHAT'S NEW

This study confirmed that preoperative electrocardiographic abnormalities are common in patients undergoing high-risk vascular surgery. However, abnormal electrocardiographic findings were not associated with myocardial injury after noncardiac surgery or major adverse cardiovascular events within 1 year after the procedure. This prospective study suggests that a preoperative electrocardiogram has low utility in predicting postoperative cardiac complications. Nevertheless, due to its value as a reference in case of postoperative suspicion of myocardial injury or infarction, we strongly believe that a preoperative electrocardiogram should be routinely performed in patients scheduled for high-risk procedures.

which classify the majority of vascular surgeries as intermediate- to high-risk surgery in terms of cardiovascular complications [9]. Therefore, proper cardiac evaluation and risk reduction strategies are of critical importance to improve outcomes in this population.

The current guidelines issued by the European Society of Cardiology (ESC)/European Society of Anesthesiology (ASA) recommend that a preoperative electrocardiogram (ECG) should be performed routinely in patients who have risk factors and are scheduled for intermediate- or high-risk surgery [9]. However, to date, there is a lack of high-quality data on the value of preoperative electrocardiography as a predictor of both MINS and other major perioperative cardiac complications [1].

In this substudy of a large prospective cohort study with perioperative troponin monitoring, we aimed to evaluate whether preoperative electrocardiographic abnormalities are linked to short- and long-term outcomes in patients undergoing a vascular procedure.

METHODS

Study population

This study was undertaken between October 2010 and November 2013 in Poland as a substudy of the international Vascular events In noncardiac Surgery patIents cohort evaluatioN (VISION) Study [1, 10]. VISION was a prospective cohort study of a representative sample of adults who underwent in-hospital noncardiac surgery aiming to determine the incidence of major perioperative vascular events after noncardiac surgery. Inclusion criteria were patients ≥45 years of age who received general or regional anesthesia for noncardiac surgery and stayed at least overnight in the hospital after the procedure. For this substudy, we recruited consecutive patients undergoing high-risk vascular surgeries for peripheral artery disease, abdominal aortic aneurysm, or other high-risk vascular surgeries in a single tertiary care center — the Vascular Surgery Department, St. John Grande Hospital, Kraków, Poland. The study was approved by the local ethics committee. The protocol complied with the Helsinki Declaration. All participants had provided written informed consent before they were enrolled.

Data acquisition

Previous reports from the VISION study have described in detail the screening, enrolment, and data collection processes [1, 10]. Study personnel gathered detailed demographic and clinical data upon enrolment in the study. Patients were followed throughout their hospitalization and contacted 30 days and 1 year after surgery to determine the incidence of the outcomes of interest. In all patients, high-sensitivity troponin T (hs TnT; Elecsys 2010 analyzer; Roche Diagnostics, Meylan, France) was measured before surgery, 6 to 12 hours postoperatively and on the first, second, and third days after the surgery. The 99th percentile threshold for hsTnT in the healthy population is 14 ng/l.

In each study participant, 12-lead electrocardiography with a paper speed of 25 mm/sec and a standard calibration (1 mV = 10 mm) was performed within 24 hours before the index surgery. ECG recordings were obtained by nurses with a standard placement of 4 limb and 6 precordial electrodes. The examination was performed in a supine position after the patient rested for at least 5 minutes. Each ECG recording was manually evaluated by two experienced clinicians following the Polish Cardiac Society recommendations; both were blinded regarding the study outcomes [11]. In case of disagreement between the evaluators, a consensus was reached after consulting a senior clinician. The detailed information about classification criteria for main electrocardiographic diagnoses is presented in Supplementary material, *Table S1*.

Study outcomes

Two primary outcomes were assessed: (1) myocardial injury after noncardiac surgery (MINS) defined as an absolute postoperative hsTnT level ≥65 ng/l or an elevation of at least 5 ng/l from the baseline with postoperative troponin level in the range of 20–64 ng/l (MINS events were adjudicated by the VISION Adjudication Committee); and (2) major adverse cardiovascular event (MACE), defined as a combination of myocardial infarction (defined according to the third universal definition of myocardial infarction) and/or stroke (defined as a new focal neurological deficit thought to be vascular in origin with signs and symptoms lasting more than 24 hours) and/or cardiac death in 1-year follow-up.

Table 1. Baseline characteristics of the entire cohort and comparison of study groups

Characteristics	Entire cohort (n = 348)	Non–MINS (n = 283)	MINS (n = 65)	*P*-value	Non–MACE (n = 298)	MACE (n = 50)	*P*-value
Age, years	65.0 (59.0–72.0)	64.0 (58.0–70.0)	71.0 (64.0–76.0)	<0.001	64.0 (58.0–70.0)	71.0 (65.0–76.75)	<0.001
Male gender	280 (80.5)	227 (80.2)	53 (81.5)	0.94	240 (80.5)	40 (80.0)	1.00
Reason for surgery				0.001			0.24
Abdominal aortic aneurysm	67 (19.3)	44 (15.5)	23 (35.4)		53 (17.8)	14 (28.0)	
Peripheral artery disease	266 (76.4)	228 (80.6)	38 (58.5)		232 (77.9)	34 (68.0)	
Other	15 (4.3)	11 (3.9)	4 (6.2)		13 (4.4)	2 (4.0)	
BMI, kg/m^2	24.5 (22.5–27.7)	24.5 (22.5–27.7)	23.9 (22.1–27.7)	0.59	24.5 (22.6 –27.7)	23.7 (22.1–27.6)	0.31
Smoking status				0.340			0.183
Current smoker	140 (40.2)	119 (42.0)	21 (32.3)		122 (40.9)	18 (36.0)	
Former smoker	191 (54.9)	151 (53.4)	40 (61.5)		164 (55.0)	27 (54.0)	
Never smoker	17 (4.9)	13 (4.6)	4 (6.2)		12 (4.0)	5 (10.0)	
Atrial fibrillation	20 (5.7)	15 (5.3)	5 (7.7)	0.65	16 (5.4)	4 (8.0)	0.68
Congestive heart failure	39 (11.2)	28 (9.9)	11 (16.9)	0.16	32 (10.7)	7 (14.0)	0.66
Coronary artery disease	151 (43.4)	118 (41.7)	33 (50.8)	0.23	125 (41.9)	26 (52.0)	0.24
Stroke/TIA	33 (9.5)	25 (8.8)	8 (12.3)	0.53	27 (9.1)	6 (12.0)	0.69
Peripheral artery disease	322 (92.5)	264 (93.3)	58 (89.2)	0.39	279 (93.6)	43 (86.0)	0.11
Hypertension	253 (72.7)	204 (72.1)	49 (75.4)	0.70	216 (72.5)	37 (74.0)	0.96
COPD	134 (38.5)	101 (35.7)	33 (50.8)	0.04	107 (35.9)	27 (54.0)	0.02
Diabetes mellitus	73 (21.0)	63 (22.3)	10 (15.4)	0.29	65 (21.8)	8 (16.0)	0.45
Active cancer	5 (1.4)	2 (0.7)	3 (4.6)	0.07	2 (0.7)	3 (6.0)	0.02
ASA	262 (75.3)	213 (75.3)	49 (75.4)	0.99	225 (75.5)	37 (74.0)	0.959
β-blockers	195 (56.0)	160 (56.5)	35 (53.8)	0.80	165 (55.4)	30 (60.0)	0.65
Calcium channel blockers	8 (2.3)	6 (2.1)	2 (3.1)	0.99	7 (2.3)	1 (2.0)	1.00
Statin	297 (85.3)	243 (85.9)	54 (83.1)	0.71	256 (85.9)	41 (82.0)	0.612

Categorical variables are presented as numbers (%). Continuous variables are presented as median (interquartile range [IQR])

Abbreviations: ASA, acetylsalicylic acid; BMI, body mass index; COPD, chronic obstructive pulmonary disease; MACE, major adverse cardiovascular event; MINS, myocardial injury after noncardiac surgery; TIA, transient ischemic attack

Statistical analysis

Categorical variables are presented as numbers and percentages while continuous variables are presented as medians and interquartile ranges (IQR) unless otherwise specified. Comparisons of categorical variables were performed using the χ^2 test or Fisher's exact test as appropriate. Comparisons of continuous variables were performed using the Mann-Whitney test. Multivariable analysis was performed using logistic regression. Based on our knowledge and the available literature, we selected several predefined ECG abnormalities potentially associated with perioperative outcomes (ST segment depression, left axis deviation, atrial fibrillation, bundle branch block) to be included as independent variables in the multivariable analysis. Each of the mentioned ECG abnormalities was assessed in a separate model for each of the outcomes of interest. Every model included the following independent variables aside from the ECG abnormality: age, sex, history of coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), diabetes, and reason for surgery. This was a complete case analysis. Statistical analysis was conducted using R, CRAN version 4.1.0 (packages: rms). A two-sided *P*-value < 0.05 was considered statistically significant.

RESULTS

Study population

This substudy included 348 patients undergoing high-risk vascular surgery. The majority of patients were male (280/348, 80.5%) at a median age (IQR) of 65 (59–72) years. The reasons for surgery were peripheral artery disease (266/348, 76.4%), abdominal aortic aneurysm (67/348, 19.3%), and others (15/348, 4.3%). Myocardial injury after noncardiac surgery was diagnosed in 65 (18.7%) patients. Patients in the MINS group were older (71.0 vs. 64.0 years; *P* <0.001) and more often suffered from COPD (50.8% vs. 35.7%; *P* = 0.04). Major cardiovascular events occurred in 50 patients (14.4%) within a year after index surgery. These patients were significantly older (71.0 vs. 64.0; *P* <0.001) and more often had a history of COPD (54.0% vs. 35.9%; *P* = 0.02) and active cancer (6.0% vs. 0.7%; *P* = 0.02) compared to the patients who did not experienced MACE. Detailed characteristics of the study group and subgroups are presented in Table 1.

Association between preoperative electrocardiographic abnormalities and MINS

The majority of patients who developed MINS were in sinus rhythm (57/65, 87.7%), whereas arrhythmia was found in

Table 2. Comparison of electrocardiogram abnormalities between the groups

ECG abnormality	Entire cohort (n = 348)	Non-MINS (n = 283)	MINS (n = 65)	*P*-value	Non-MACE (n = 298)	MACE (n = 50)	*P*-value
HR, beats/min	75.8 (66.4–89.3)	75.8 (66.5–89.3)	75.0 (64.7–88.2)	0.97	75.8 (66.5–88.2)	75.8 (65.7–96.2)	0.66
Tachycardia	39 (11.2)	30 (10.6)	9 (13.8)	0.60	31 (10.4)	8 (16.0)	0.36
Bradycardia	4 (1.1)	2 (0.7)	2 (3.1)	0.33	2 (0.7)	2 (4.0)	0.18
QRS interval, ms	90.0 (80.0–100.0)	90.0 (80.0–100.0)	90.0 (80.0–100.0)	0.65	90.0 (80.0–100.0)	90.0 (80.0–100.0)	0.31
PQ interval, ms	160.0 (140.0–169.2)	160.0 (140.0–166.7)	160.0 (140.0–170.0)	0.93	160.0 (140.0–166.7)	160.0 (140.0–175.0)	0.65
QT interval, ms	370.0 (358.8–400.0)	370.0 (360.0–400.0)	370.0 (350.0–400.0)	0.99	370.0 (350.0–400.0)	380.0 (360.0–400.0)	0.45
QTc interval, ms	420.2 (398.2–446.6)	420.7 (397.2–446.8)	416.7 (399.6–443.7)	0.94	420.2 (397.6–445.3)	421.6 (400.7–460.2)	0.29
Sinus rhythm	318 (91.4)	261 (92.2)	57 (87.7)	0.35	271 (90.9)	47 (94.0)	0.66
Atrial rhythm	1 (0.3)	1 (0.4)	0 (0.0)	1.00	1 (0.3)	0 (0.0)	1.00
Atrial fibrillation	19 (5.5)	14 (5.0)	5 (7.7)	0.57	17 (5.7)	2 (4.0)	0.87
Atrial flutter	5 (1.4)	3 (1.1)	2 (3.1)	0.51	5 (1.7)	0 (0.0)	0.78
Paroxysmal atrial tachycardia	1 (0.3)	0 (0.0)	1 (1.5)	0.42	1 (0.3)	0 (0.0)	1.00
Pacemaker rhythm	6 (1.7)	5 (1.8)	1 (1.5)	1.00	6 (2.0)	0 (0.0)	0.67
Axis				0.41			0.04
Normal axis	285 (82.1)	236 (83.4)	49 (76.6)		247 (83.2)	38 (76.0)	
Left axis deviation	56 (16.1)	43 (15.2)	13 (20.3)		45 (15.2)	11 (22.0)	
Right axis deviation	5 (1.4)	3 (1.1)	2 (3.1)		5 (1.7)	0 (0.0)	
Extreme axis deviation	1 (0.3)	1 (0.4)	0 (0.0)		0 (0.0)	1 (2.0)	
Ventricular extrasystoles	26 (7.5)	19 (6.7)	7 (10.9)	0.37	21 (7.1)	5 (10.0)	0.66
Frequent ventricular extrasystoles	10 (2.9)	8 (2.8)	2 (3.1)	1.00	8 (2.7)	2 (4.0)	0.96
Supraventricular extrasystoles	18 (5.2)	10 (3.5)	8 (12.5)	0.01	14 (4.7)	4 (8.0)	0.53
Left ventricular hypertrophy	4 (1.2)	2 (0.7)	2 (3.2)	0.33	2 (0.7)	2 (4.2)	0.19
Right ventricular hypertrophy	1 (0.3)	0 (0.0)	1 (1.6)	0.42	1 (0.3)	0 (0.0)	1.00
LBBB	5 (1.5)	3 (1.1)	2 (3.1)	0.51	4 (1.4)	1 (2.0)	1.00
RBBB	14 (4.1)	10 (3.6)	4 (6.2)	0.53	10 (3.4)	4 (8.0)	0.26
LAH	47 (13.7)	34 (12.1)	13 (20.3)	0.13	38 (12.9)	9 (18.0)	0.46
LPH	4 (1.2)	3 (1.1)	1 (1.6)	1.00	4 (1.4)	0 (0.0)	0.91
Atrio-ventricular block	24 (7.0)	20 (7.1)	4 (6.2)	1.00	20 (6.8)	4 (8.0)	0.99
Pathologic Q wave	159 (45.8)	136 (48.2)	23 (35.4)	0.08	135 (45.5)	24 (48.0)	0.86
ST depression	66 (20.0)	58 (21.5)	8 (13.3)	0.21	62 (21.9)	4 (8.5)	0.05
ST elevation	15 (4.5)	13 (4.8)	2 (3.3)	0.88	15 (5.3)	0 (0.0)	0.22
Negative T wave	61 (18.5)	52 (19.3)	9 (15.0)	0.56	52 (18.4)	9 (19.1)	1.00
Peaked T wave	5 (1.5)	4 (1.5)	1 (1.7)	1.00	5 (1.8)	0 (0.0)	0.78
Biphasic T wave	13 (3.9)	9 (3.3)	4 (6.7)	0.40	10 (3.5)	3 (6.4)	0.60
Bifid T wave	2 (0.6)	1 (0.4)	1 (1.7)	0.79	1 (0.4)	1 (2.1)	0.66

Categorical variables are presented as numbers (%). Continuous variables are presented as median (interquartile range [IQR])

Abbreviations: ECG, electrocardiogram; HR, heart rate; MACE, major adverse cardiac event; MINS, myocardial injury after noncardiac surgery; LAH, left anterior hemiblock; LBBB, left bundle branch block; LPH, left posterior hemiblock; RBBB, right bundle branch block

8 patients (12.3%). The most common ECG abnormalities were pathologic Q wave (35.4%), left anterior hemiblock (20.3%), and left axis deviation (20.3%).

Univariable comparison of the study groups revealed that patients who developed MINS more commonly had supraventricular extrasystoles on preoperative ECG (12.5% vs. 3.5%; $P = 0.01$). A detailed comparison of ECG abnormalities between patients who developed MINS and the remaining study participants is presented in Table 2.

Association between preoperative electrocardiographic abnormalities and MACE

The majority of patients were in sinus rhythm (47/50, 94.0%). The most common ECG abnormalities were pathologic Q wave (48.0%), left axis deviation (22.0%), and negative T wave (19.1%).

A univariable comparison of the study groups did not reveal any statistically significant differences between the groups apart from a different distribution of the ECG axis. A detailed comparison of ECG abnormalities between patients with 1-year MACE and those who did not develop this endpoint is presented in Table 2.

Association between preoperative electrocardiographic abnormalities and cardiac outcomes — a multivariable analysis

A multivariable analysis of the association between ST depression, left axis deviation, atrial fibrillation, and bun-

Table 3. Summary of multivariable analysis adjusted for electrocardiogram abnormalities

ECG abnormality	MINS		MACE	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
ST depression	0.690 (0.299–1.594)	0.38	0.366 (0.122–1.103)	0.07
Left axis deviation	1.556 (0.700–3.458)	0.28	1.197 (0.566–2.528)	0.64
Atrial fibrillation	1.717 (0.549–5.371)	0.35	0.511 (0.106–2.462)	0.40
Bundle branch block	2.581 (0.874–7.622)	0.09	2.297 (0.723–7.295)	0.16

Abbreviations: OR, odds ratio; other — see Tables 1 and 2

dle branch block adjusted for age, sex, CAD, diabetes, and COPD revealed that none of the evaluated ECG abnormalities was associated with increased risk of MINS or 1-year MACE. Detailed results of the multivariable analysis are summarized in Table 3.

DISCUSSION

This substudy of a large prospective cohort study confirmed that preoperative ECG in patients undergoing high-risk vascular surgery often reveals abnormalities. We did not find any significant relation between preoperative electrocardiographic abnormalities with MINS and 1-year MACE. Hence, this study suggests a low value of preoperative ECG in the prediction of postoperative cardiac outcomes

Electrocardiography is a relatively inexpensive, widely available, and non-invasive test, which is commonly used as part of the preoperative cardiac evaluation. Nevertheless, the approach to routine preoperative ECG differs depending on guidelines. On the one hand, ESC/ESA issued a strong recommendation to routinely perform preoperative ECG in patients undergoing intermediate- or high-risk surgeries [9]. On the other hand, the Canadian Cardiovascular Society does not suggest preoperative ECG in any patient undergoing noncardiac surgery [12]. Instead, the latter guidelines recommend that preoperative cardiac risk assessment should be based solely on the patient's age, the Revised Cardiac Risk Index score, and natriuretic peptides levels [12]. Importantly, the aforementioned ESC/ESA recommendation is based on a secondary analysis of a prospective study including 172 patients with CAD or at high risk of it, who underwent major noncardiac surgery [13]. In this study, ST depression and a faster heart rate were independent predictors of 2-year all-cause mortality, and a faster heart rate was associated with MACE (defined as rehospitalization for recurrent ischemia, nonfatal myocardial infarction, coronary revascularization, and/or cardiac death) incidence [13]. It clearly indicates a serious lack of high-quality evidence supporting the routine use of ECG in the preoperative cardiac risk assessment.

A thorough review of available literature revealed several studies evaluating the potential prognostic value of ECG in the noncardiac surgery setting. In a cohort of 2893 patients aged ≥50 years undergoing noncardiac procedures, Lee et al. [14] confirmed that the presence of a Q wave was associated with a 2.4-fold increased risk for major cardiac complications, however, ST-T wave changes were not associated with worse outcomes. Based on these results, the presence of Q waves was incorporated as a surrogate of ischemic heart disease in the Revised Cardiac Risk Index scale which is widely used in the perioperative risk assessment. However, it is crucial to realize that the diagnosis of myocardial infarction in this 1999 study was based on serial measurements of creatine kinase (CK) while CK-MB was measured only in the case of CK level elevation. This may, at least partially, explain differences in results compared to our study, which used serial measurements of high-sensitivity troponin, therefore, ensuring more precise identification of perioperative cardiac complications. Conversely, another study including 513 patients aged >70 years undergoing intermediate and high-risk surgeries, revealed that preoperative ECG abnormalities, analyzed using the Minnesota Codes, were not associated with an increased risk of postoperative cardiac complications [15]. Compared to our analysis, a study by Liu et al. [15] was also based on ECG analysis performed by two clinicians but lacked routine troponin monitoring, therefore, increasing the risk of underestimating cardiac complications incidence. Interestingly, a report by Liu et al. [15] was the only one to describe the frequency of supraventricular extrasystole (SVE) in preoperative ECG, however, they did not show evidence of the association between this finding and an increased risk of postoperative complications. The higher frequency of SVE in patients who developed MINS in our study is probably an accidental finding without any clinical implications and may, at least partially, be explained by more advanced age in this group.

The available evidence also includes two large studies based on computer analysis of electrocardiographs with further verification by a physician. First, Noordzij et al. [16] demonstrated that abnormal preoperative ECG (showing atrial fibrillation, left or right bundle branch block, left ventricular hypertrophy, premature ventricular complexes, pacemaker rhythm or Q-wave or ST-segment changes) was independently associated with 4.5-fold higher cardiovascular mortality compared to normal ECG in a sample of 28 457 patients undergoing intermediate to high-risk surgeries. Moreover, in a study including 2967 patients scheduled for predominantly high-risk general or vascular procedures, van Klein et al. [17] showed that bundle branch blocks detected on the preoperative ECG were related to a higher incidence of postoperative myocardial infarction and increased in-hospital mortality, but they did not improve prediction compared to the model including only risk factors identified in the patient's history. Importantly, both mentioned studies lacked routine perioperative troponin measurement and used automatic ECG analysis with verification by a single physician, which makes them prone not only to understating the number of perioperative events but also carries a higher risk of ECG misinterpretation.

Routine cardiac biomarker monitoring was performed by Biteker et al. [18] who evaluated 660 ECGs of patients undergoing non-cardiac non-vascular surgeries. In this study, each ECG was assessed by two investigators. Analysis showed that a prolonged QTc interval was an independent predictor of perioperative cardiovascular events including severe arrhythmias, heart failure, acute coronary syndrome, pulmonary thromboembolism, stroke, nonfatal cardiac arrest, and death [18]. Our study showed that ECG abnormalities are common in patients undergoing high-risk vascular surgery. However, we did not find any evidence suggesting that they are related to short and long-term cardiac complications.

There are several factors potentially leading to different conclusions reported by Biteker et al. [18] and our group. First, ours concerns only high-risk vascular surgery patients, while the other group included only patients undergoing non-vascular non-cardiac procedures that are associated with a lower risk of perioperative complications. Second, there were significant differences in the studied endpoints i.e., our report focuses on MINS and MACE including myocardial infarction, stroke, or cardiac death, while the primary endpoint in the previous study covered a wider array of perioperative complications. Finally, the follow-up period in our report was 30 days for MINS and 1 year for MACE, while Biteker and colleagues evaluated the incidence of perioperative complications only during the index hospitalization.

Even though this study shows that abnormalities found on the preoperative ECG are not related to perioperative cardiac complications in a population of patients undergoing high-risk vascular surgeries, one must not omit the indisputable clinical usefulness of ECG readings. For example, the availability of preoperative ECG is necessary to determine whether postoperative ECG abnormalities are new. This, in turn, may determine the diagnosis made by clinicians and influence further clinical approaches. Moreover, abnormalities found on a preoperative ECG may be an indication for further cardiac tests before surgery, e.g. exercise electrocardiography, echocardiography, or coronary angiography. Preoperative identification of heart disease followed by an introduction and optimization of its management may potentially improve patients' outcomes. In conclusion, the authors believe that preoperative ECG should be performed routinely in this population according to the ESC/ESA guidelines, although clinicians should be aware that preoperative ECG abnormalities probably add little information about a patient's risk of postoperative cardiac complications.

The main strength of this study is not only a blinded ECG assessment by two clinicians and routine perioperative high-sensitivity troponin measurement but also a comprehensive prospective evaluation of short and long-term perioperative cardiac complications. Moreover, to our knowledge, it is the first attempt to look for a link between preoperative ECG abnormalities and MINS, which is gaining more recognition in perioperative research and clinical practice.

We are aware of several limitations of this study. First, a relatively low study sample and several events limited our ability to perform a multivariable analysis including all the known perioperative complications risk factors. Second, a focus on patients undergoing high-risk vascular surgery limits the generalizability of the presented results to all noncardiac surgery populations. Third, we did not categorize the exact depth of ST depressions as we utilized criteria including two cut-off points depending on a lead (0.5 or 1 mm). Finally, we did not collect data on additional cardiac tests performed based on preoperative ECG abnormalities, which could provide us with interesting and clinically relevant observations.

CONCLUSION

This prospective observational study showed that preoperative ECG abnormalities are common among patients undergoing vascular surgery. We found no association between them and MINS or 1-year MACE incidence. This suggests that preoperative ECG is probably not a useful tool in evaluating a patient's risk of developing postoperative cardiac complications. Nevertheless, we acknowledge the clinical utility of preoperative ECG recordings in the context of a diagnosis of postoperative cardiac complications and revealing abnormalities warranting further diagnostic tests before the surgical procedure.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

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