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Original Article

Perioperative cardiac optimization in patients with lower limb critical ischemia and ischemic heart disease

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Abstract

Aim: Patients with chronic limb-threatening ischemia (CLTI) and concomitant ischemic heart disease (IHD) are at high risk of perioperative cardiovascular complications following vascular interventions. The impact of preoperative coronary revascularization on short-term postoperative outcomes remains controversial. To evaluate the association between preoperative coronary revascularization and perioperative major cardiac events (MCEs), myocardial infarction (MI), and mortality in patients with CLTI and concomitant IHD undergoing vascular surgery.
Material and Methods: This retrospective study included 963 patients with CLTI treated between 2017 and 2023. Among them, 312 patients had concomitant IHD. Preoperative coronary revascularization was performed in 101 patients (main group), while 211 patients received medical management without coronary revascularization (control group). The primary outcome was the occurrence of MCEs within 30 days after surgery, including myocardial infarction, acute heart failure, unstable angina, major arrhythmias, and all-cause mortality.
Results: MCEs occurred in 6 patients (5.9%) in the coronary revascularization group compared with 39 patients (18.5%) in the control group ($p < 0.01$). Myocardial infarction occurred in 3 (3.0%) versus 15 (7.1%) patients, while mortality was observed in 3 (3.0%) and 11 (5.2%) patients, respectively. All patients received guideline-directed medical therapy for cardiovascular risk reduction during the perioperative period.
Conclusion: In this retrospective cohort, preoperative coronary revascularization was associated with a lower incidence of perioperative MCEs, myocardial infarction, and 30-day mortality in patients with concomitant CLTI and IHD. Prospective, multicenter studies are warranted to confirm these findings.

Keywords: Lower limb critical ischemia, peripheral arterial disease, ischemic heart disease, coronary revascularization, major cardiac events, myocardial infarction

INTRODUCTION

Peripheral arterial disease (PAD) is a progressive manifestation of systemic atherosclerosis affecting millions of individuals worldwide and is associated with substantial cardiovascular morbidity and mortality (1-3). Chronic limb-threatening ischemia (CLTI), the most severe clinical presentation of PAD, develops when arterial perfusion becomes insufficient to maintain tissue viability, resulting in ischemic rest pain, non-healing wounds, or gangrene (2,4). Although contemporary surgical and endovascular techniques have improved limb salvage, patients with CLTI continue to face an unfavorable prognosis because of persistent risks of major cardiovascular events, limb loss, and death (5-7).

Because atherosclerosis simultaneously affects multiple arterial territories, patients presenting with CLTI frequently have concomitant coronary artery disease. The coexistence of lower-extremity PAD and ischemic heart disease reflects an advanced systemic atherosclerotic burden and is strongly associated with adverse perioperative and long-term clinical outcomes (8-12).

Careful cardiovascular evaluation before major vascular intervention has become an integral part of perioperative management in patients with CLTI. Current evidence supports optimization of medical therapy together with selective cardiac investigation according to the patient's clinical status and estimated operative risk (2,13). Nevertheless, whether coronary revascularization should be performed before lower-extremity vascular surgery remains an unresolved clinical question because previous studies have yielded conflicting results (14-18).

Owing to these uncertainties, additional clinical evidence is required to better define the role of preoperative coronary revascularization in patients with concomitant CLTI and ischemic heart disease. Clarifying its potential contribution to perioperative cardiovascular protection may improve treatment strategies for this particularly high-risk patient population.

Therefore, the present study aimed to evaluate the association between preoperative coronary revascularization and the incidence of major cardiac events (MCEs), myocardial infarction, and 30-day mortality in patients with concomitant CLTI and ischemic heart disease (IHD) undergoing vascular surgical treatment.

MATERIAL AND METHODS

Study Design and Patients

A retrospective cohort analysis was performed using data obtained from the M.A. Topchubashov Scientific Surgery Center, Baku, Azerbaijan. Consecutive patients treated surgically for CLTI between January 2017 and December 2023 were identified through institutional medical records and included in the analysis according to the predefined eligibility criteria.

During the study period, 963 patients underwent treatment for CLTI. Of these, 312 patients with documented concomitant IHD met the inclusion criteria. The study population was subsequently divided according to whether coronary revascularization had been performed before the planned vascular procedure.

Preoperative Cardiovascular Assessment

Before vascular intervention, all participants underwent standardized cardiovascular assessment consisting of medical history, physical examination, electrocardiography, transthoracic echocardiography, and routine laboratory investigations. Additional diagnostic procedures, including coronary angiography, were requested whenever clinically indicated by the attending cardiology team.

The decision to perform coronary revascularization was individualized after multidisciplinary evaluation and was based on coronary anatomy, myocardial function, symptom burden, associated comorbidities, and the urgency of lower-limb revascularization. Patients requiring coronary intervention underwent either percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) before vascular surgery, whereas the remaining patients proceeded directly to vascular intervention under optimized medical treatment (19,20).

Vascular Assessment and Surgical Procedures

The diagnosis of CLTI was confirmed using clinical findings together with non-invasive vascular investigations, including duplex ultrasonography, Doppler examination, transcutaneous oxygen pressure ($TcPO_2$), and cross-sectional vascular imaging when clinically appropriate. Digital subtraction angiography was performed whenever additional anatomical information was required before intervention (2,4).

The type of vascular intervention was selected according to the anatomical distribution of arterial disease, lesion characteristics, and the patient's overall clinical condition.

Perioperative Medical Management

All patients received contemporary guideline-directed medical therapy, including antiplatelet therapy, statins, antihypertensive treatment, glucose-lowering therapy when indicated, and other cardiovascular medications according to individual clinical requirements (2,21). Perioperative medical management was optimized before vascular intervention whenever possible.

Study Outcomes

The primary outcome was the occurrence of MCEs within 30 days after vascular surgery. MCEs included myocardial infarction, acute heart failure, unstable angina requiring treatment, clinically significant cardiac arrhythmias, and all-cause mortality.

Secondary outcomes included individual rates of myocardial infarction and all-cause mortality during the 30-day postoperative period.

Ethical Approval

The study protocol was reviewed and approved by the Ethics Commission of the M.A. Topchubashov Scientific Surgery Center, Baku, Azerbaijan (Approval No. 168; February 11, 2024). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Given the retrospective nature of the study, the requirement for informed consent was waived by the Ethics Commission.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics software (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD), whereas categorical variables are expressed as frequencies and percentages. Comparisons between groups were performed using the independent-samples t test or Mann–Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. A two-sided p value of <0.05 was considered statistically significant.

RESULTS

Patient Population

During the study period, 963 patients with CLTI underwent vascular treatment. Among them, 312 patients (32.4%) had concomitant IHD and were included in the present study. Of these, 101 patients (32.4%) underwent preoperative coronary revascularization, whereas 211 patients (67.6%) received medical therapy without coronary revascularization.

Vascular Procedures

A total of 312 vascular procedures were performed in the study population. Open surgical revascularization was the most frequently performed procedure, accounting for 93 interventions (29.8%), including 33 patients in the coronary revascularization group and 60 patients in the medical therapy group. Hybrid procedures (endovascular plus open surgical revascularization) were performed in 16 patients (5.1%), while isolated endovascular interventions were performed in 26 patients (8.3%).

Lumbar sympathectomy was performed in 8 patients (2.6%), and lumbar sympathectomy combined with minor amputation was performed in 3 patients (1.0%). Minor amputation with necrectomy was required in 74 patients (23.7%), whereas major amputation was performed in 64 patients (20.5%). The distribution of vascular procedures is presented in Table 1.

Table 1. Distribution of vascular procedures according to study groups

Procedure	Total, n (%)	Coronary revascularization group (n = 101)	Medical therapy group (n = 211)	p value
Open surgical revascularization	93 (29.8)	33	60	NS*
Hybrid revascularization (Open + Endovascular)	16 (5.1)	5	11	NS*
Endovascular intervention	26 (8.3)	12	14	NS*
Lumbar sympathectomy	8 (2.6)	3	5	NS*
Lumbar sympathectomy + minor amputation	3 (1.0)	1	2	NS*
Minor amputation + necrectomy	74 (23.7)	25	49	NS*
ROT†	28 (9.0)	9	19	NS*
Major amputation	64 (20.5)	13	51	NS*
Total	**312 (100)**	**101 (32.4)**	**211 (67.6)**	

Data are presented as n (%); Percentages in the Total column were calculated based on the total study population (n = 312); Hybrid revascularization included combined open surgical and endovascular procedures; Percentages in the study groups were calculated according to the number of patients in each group; †ROT: Revascularizing osteotrepanation

Perioperative Major Cardiac Events

Within the 30-day postoperative period, MCEs occurred in 6 patients (5.9%) in the coronary revascularization group compared with 39 patients (18.5%) in the medical therapy group.

Myocardial infarction developed in 3 patients (3.0%) in the coronary revascularization group and in 15 patients (7.1%) in the medical therapy group. All-cause mortality occurred in 3 patients (3.0%) and 11 patients (5.2%), respectively. Episodes of unstable angina, major cardiac arrhythmias, or acute heart failure were observed only in the medical therapy group (13 patients, 6.2%). Detailed perioperative cardiac outcomes are summarized in Table 2.

Table 2. Perioperative major cardiac events within 30 days after vascular surgery

Outcome	Coronary revascularization group (n = 101)	Medical therapy group (n = 211)	p value
Myocardial infarction	3 (3.0)	15 (7.1)	
All-cause mortality	3 (3.0)	11 (5.2)	
Unstable angina / major arrhythmias / acute heart failure	0	13 (6.2)	
Major cardiac events (total)	**6 (5.9)**	**39 (18.5)**	**< 0.01**

Data are presented as n (%); Percentages were calculated according to the total number of patients in each study group; Major cardiac events (MCEs) included myocardial infarction, all-cause mortality, unstable angina, major cardiac arrhythmias, and acute heart failure

Coronary Revascularization

Among the 101 patients who underwent preoperative coronary revascularization, coronary artery bypass grafting (CABG) was performed in 52 patients (51.5%), whereas percutaneous coronary intervention (PCI) was performed in 49 patients (48.5%) (Table 3).

Table 3. Type of coronary revascularization performed before vascular surgery

Procedure	n (%)
Coronary artery bypass grafting (CABG)	52 (51.5)
Percutaneous coronary intervention (PCI)	49 (48.5)
Total	**101 (100)**

DISCUSSION

The present retrospective cohort study investigated the relationship between preoperative coronary revascularization and early postoperative cardiovascular outcomes in patients with concomitant CLTI and IHD undergoing vascular intervention.

The principal observation was that patients who underwent coronary revascularization before vascular surgery experienced fewer perioperative MCEs, myocardial infarctions, and deaths within the first 30 postoperative days than those managed with medical therapy alone. Although these findings do not establish a causal relationship, they suggest that careful cardiac optimization before vascular intervention may contribute to improved short-term postoperative outcomes in selected high-risk patients.

Advanced peripheral arterial disease is rarely confined to the lower extremities. Most patients presenting with CLTI have diffuse atherosclerosis involving the coronary circulation, which substantially increases perioperative cardiac risk. (1,5,8). Previous investigations have consistently identified cardiovascular events as a leading cause of perioperative morbidity and mortality following major vascular procedures (2,4,6). Consequently, comprehensive preoperative cardiovascular assessment and risk stratification have become essential components of contemporary perioperative management (15).

Despite considerable advances in cardiovascular care, the role of prophylactic coronary revascularization before major vascular surgery remains controversial. Randomized studies, particularly the Coronary Artery Revascularization Prophylaxis (CARP) trial, did not demonstrate a significant reduction in perioperative cardiac events when coronary revascularization was performed solely to decrease surgical risk. Conversely, several observational studies have suggested that selected patients with extensive coronary artery disease may benefit from individualized coronary optimization before vascular intervention (10,11,16–18). Accordingly, current international guidelines recommend that coronary revascularization should be reserved for patients with an established indication independent of the planned non-cardiac surgery (15).

In our cohort, the lower incidence of postoperative cardiac complications observed among patients who underwent coronary revascularization may reflect improved myocardial perfusion and greater cardiovascular stability during the perioperative period. Nevertheless, these findings should be interpreted cautiously because treatment allocation was based on clinical decision-making rather than randomization. Residual confounding, differences in coronary disease severity, and physician selection bias may all have influenced the observed outcomes. Therefore, the apparent benefit cannot be interpreted as definitive evidence supporting routine coronary revascularization before vascular surgery.

The study has several strengths. It included a relatively large cohort of patients with concomitant CLTI and IHD treated at a high-volume tertiary vascular center over an extended study period. In addition, all patients underwent standardized perioperative cardiovascular evaluation and received guideline-directed medical therapy, providing a relatively consistent management strategy across the study population.

Several limitations should be acknowledged. First, this was a retrospective single-center study, making the findings susceptible to selection bias and residual confounding. Second, patients were not randomly assigned to treatment groups, and decisions regarding coronary revascularization were individualized according to clinical judgment. Third, multivariable adjustment or propensity score matching was not performed, limiting the ability to account for baseline differences between the study groups. Finally, postoperative outcomes were evaluated only during the first 30 days after surgery, and therefore the long-term impact of preoperative coronary revascularization remains uncertain.

Future prospective multicenter studies incorporating standardized patient selection criteria, contemporary cardiovascular risk stratification, and longer follow-up are needed to determine which subgroups of patients with CLTI derive the greatest benefit from coronary optimization before vascular surgery.

CONCLUSION

In patients with concomitant CLTI and IHD, preoperative coronary revascularization was associated with lower rates of perioperative major cardiac events, myocardial infarction, and 30-day mortality following vascular intervention. These findings highlight the importance of comprehensive cardiovascular assessment and individualized treatment planning before major vascular surgery. However, because of the retrospective observational design and the potential influence of selection bias and unmeasured confounding, the observed associations should be interpreted with caution. Large prospective multicenter studies are required to further define the role of coronary revascularization in optimizing perioperative outcomes in this high-risk patient population.

Conflict of Interest: The authors declare that there is no conflict of interest.

Financial Disclosure: The authors declare that they received no financial support.

Ethics Committee Approval: The study protocol was reviewed and approved by the Ethics Commission of the M.A. Topchubashov Scientific Surgery Center, Baku, Azerbaijan (Approval No. 168; February 11, 2024).

Informed Consent: Given the retrospective nature of the study, the requirement for informed consent was waived by the Ethics Commission.

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