RESEARCH ARTICLE

DOI: 10.4274/ijca.2024.18291
Int J Cardiovasc Acad 2024;10(4):123-131

Impact of Atherosclerotic Burden on Long-term Major Adverse Cardiovascular and Cerebrovascular Events

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Abstract

Background and Aim: Atherosclerotic burden is a key determinant of long-term cardiovascular outcomes. The objective of this study was to investigate the association between atherosclerotic burden and the incidence of major adverse cardiovascular and cerebrovascular events (MACCE) in patients undergoing simultaneous diagnostic angiography of multiple vascular territories.

Materials and Methods: This retrospective study included 153 consecutive patients who underwent concurrent angiography of the coronary, peripheral, carotid, subclavian, and renal arteries at a tertiary care hospital between January 2010 and March 2020. The patients were divided into two groups based on their atherosclerotic burden: the low group (<4 points, n=95) and the high group (≥4 points, n=58). The primary outcome was all-cause long-term mortality over a median follow-up period of 5.97 years. The secondary endpoint was the occurrence of MACCE at long-term follow-up.

Results: A primary outcome event occurred in 34 of 58 patients (58.6%) in the high group and in 37 of 95 patients (38.9%) of 95 patients in the low group (P = 0.018). MACCE occurred in 40 of 58 patients (69.0%) in the high group and in 42 of 95 patients (44.2%) in the low group (P = 0.003). Propensity score matching demonstrated that the high group exhibited significantly higher primary outcome (59% vs. 33%, P = 0.007) and MACCE incidence (69% vs. 39%, P = 0.001) compared to the low group.

Conclusion: Among patients who underwent simultaneous diagnostic angiography of multiple vascular territories, those with a high atherosclerotic burden had a higher risk of MACCE and mortality than those with a low atherosclerotic burden over a median follow-up of 5.97 years.

Keywords: Atherosclerotic burden, major adverse cardiovascular and cerebrovascular events (MACCE), diagnostic angiography

INTRODUCTION

Atherosclerosis is a significant contributor to global morbidity and mortality, exerting a considerable impact on a range of cardiovascular diseases, including coronary artery disease (CAD), stroke, and peripheral artery disease (PAD).[1,2] Despite the advent of novel medical interventions, the prevalence of atherosclerosis continues to increase, underscoring the need for a more profound understanding of its influence on long-term cardiovascular outcomes.[3,4] The severity of arterial stenosis, often referred to as atherosclerotic burden, has emerged as a crucial determinant of outcomes.[5,6]

Recent studies have highlighted the strong correlation between elevated atherosclerotic burden and the risk of major adverse cardiovascular and cerebrovascular events (MACCE), including myocardial infarction (MI), stroke, and cardiovascular mortality.[7,8] This risk is particularly pronounced in patients with multivessel disease, in whom the likelihood of MACCE is significantly higher than that in those with single-vessel involvement.

To cite this article: Esin F, İnce HS, Kırış T, Çelik A, Karaca M. Impact of Atherosclerotic Burden on Long-term Major Adverse Cardiovascular and Cerebrovascular Events. Int J Cardiovasc Acad. 2024;10(4):123-131

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Received: 10.09.2024
Revised: 21.11.2024
Accepted: 25.11.2024
Published Online: 16.12.2024

[9] Assessment of atherosclerotic burden across different vascular territories, including the coronary, peripheral, carotid, subclavian, and renal arteries, provides a more comprehensive evaluation and may enhance the prediction of long-term outcomes.

It is of paramount importance to comprehend the implications of a high atherosclerotic burden, not only for the assessment of the risk of MACCE, but also for the effective addressing of the broader challenges it presents to healthcare systems on a global scale.[10,11] This knowledge is vital for the improvement of risk stratification techniques and the formulation of management strategies, particularly in high-risk populations identified through comprehensive diagnostic angiography.[12,13]

The current study aimed to evaluate the relationship between atherosclerotic burden and long-term MACCE among patients undergoing simultaneous diagnostic angiography of multiple vascular territories.

METHODS

Study Design and Population

This retrospective study was conducted at a single tertiary care hospital with the objective of assessing the impact of atherosclerotic burden on long-term MACCE. The study population consisted of 153 consecutive patients aged 18 years or older who underwent simultaneous diagnostic angiography of the coronary, peripheral, carotid, subclavian, and renal arteries between January 2010 and March 2020. Patients were excluded from the study if their medical records were incomplete, if they had a known diagnosis of congenital heart disease, or if they had significant valvular heart disease to minimize the potential confounding effects of these factors. Incomplete medical records, particularly those lacking comprehensive diagnostic data, may obscure the true extent of atherosclerotic burden, leading to potential misclassification. Similarly, congenital or valvular heart disease can independently influence the risk of MACCE, which may complicate the interpretation of the results. The study protocol was reviewed and approved by the Ethics Committee of İzmir Katip Çelebi University and the participating hospital (decision number: 0213, date: 25.04.2024). In view of the retrospective nature of the study, the requirement for informed consent was waived.

Data Collection

A comprehensive data set comprising demographic information, clinical characteristics, and laboratory parameters extracted from the hospital's electronic health records. A two-step verification process was employed to ensure the accuracy of the data, thereby reducing the risk of data entry errors and misclassification. This process involved the initial extraction of data, which was then subjected to independent review by a second member of the research team. Furthermore, the use of medications was recorded to account for potential confounding factors.

Atherosclerotic Burden

The extent of atherosclerosis was quantified based on the degree of stenosis observed in angiographic assessments of the coronary, peripheral, carotid, subclavian, and renal arteries.[14] A standardized scoring system was used for each vascular territory.

- Coronary arteries: The burden of CAD was evaluated by examining the major coronary arteries, namely the left main coronary artery, left anterior descending artery, left circumflex artery, and right coronary artery. A single coronary artery with a degree of stenosis of at least 50% was awarded a score of 1, whereas stenosis of at least 50% in two or more coronary arteries was awarded a score of 2.

The assessment of peripheral arteries was conducted in a similar manner. The same scoring system was applied to the peripheral arteries (e.g., femoral and iliac arteries), whereby one point was assigned for each artery with a minimum of 50% stenosis and two points for bilateral stenosis.

- Carotid, subclavian, and renal arteries: Similarly, these territories were evaluated, and stenosis scores were assigned based on the extent of narrowing observed. A score of 1 point was assigned for a minimum of 50% stenosis in any of the aforementioned arteries, while a score of 2 points was assigned for bilateral stenosis.

The total number of points awarded across all vascular territories was calculated for each patient, resulting in their categorization into two groups: those with a low atherosclerotic burden (less than four points, n=95) and those with a high atherosclerotic burden (equal to or greater than four points, n=58).

Angiographic Procedures

All angiographic procedures were performed by experienced interventional cardiologists in accordance with standard techniques. Coronary angiography was conducted via femoral or radial access, while peripheral, carotid, subclavian, and renal angiography was performed using selective catheterization and contrast injection. All angiographic examinations were conducted using the Siemens Artis zee floor angiography system (Siemens Healthineers, Erlangen, Germany). The latest developments in digital subtraction angiography have enhanced imaging quality while reducing radiation exposure, and these advances have been integrated into our protocols. The angiographic images were analyzed by two independent reviewers who were unaware of the patient outcomes, thereby

ensuring an objective assessment of the degree of stenosis in each vascular territory. Any discrepancies in the interpretation of images were resolved through consensus.

Angiographic severity of peripeheric artery lesions was evaluated using the Trans-Atlantic Inter-Society Consensus II classification.[15] The carotid artery stenosis on carotid angiography was measured at the most stenotic segment of the internal carotid artery according to NASCET methods using electronic calipers on a picture archiving and communication system image.[16] Between the anterior-posterior and lateral views of the CAS, the more stenotic view was selected for the measurement of CAS%. CAD and renal artery disease were determined on the basis of visual assessment of stenosis severity by the operator performing the procedure.

Outcome Measures

The primary endpoint was all-cause long-term mortality. The secondary endpoint was the occurrence of long-term MACCE at a median follow-up period. MACCE was defined as a composite of all-cause mortality, myocardial reinfarction [defined as either ST elevation myocardial infarction (STEMI) or non-STEMI target vessel revascularization, defined as any repeat revascularization in the epicardial vessel, main branch or side branches], hospitalization with heart failure, and cerebrovascular events (including the occurrence of new neurological deficits such as stroke or transient ischemic attack, confirmed through radiological imaging). The composite endpoint was evaluated based on the time to initial occurrence. Clinical follow-up information was obtained by reviewing medical records or telephone interviews. Clinical visits were conducted in person or via telephone at 3-month intervals during the initial 12-month period following MI, and at six-month intervals thereafter. In the event of loss to follow-up, data pertaining to mortality or MACCE were confirmed by consulting the National Death Records and National Social Security Institution.

Statistical Analysis

Continuous variables were presented as the mean ± standard deviation, and categorical variables were presented as number of patients and percentage of the total number. The Student's t-test or the Mann-Whitney U test was used to compare values between the two groups, as appropriate. The chi-square test was used to compare categorical variables. Propensity score matching was used to create a matched dataset comprising low and high groups. The following covariates were considered to achieve a balance between the groups: diabetes mellitus (DM), hypertension (HT), chronic kidney disease (CKD), beta blocker usage at discharge, mineralocorticoid receptor antagonist (MRA) usage at discharge, creatinine (Cr), and total cholesterol at admission. Propensity score matching yielded a sample of 57 and 58 patients in the low group and 58 patients in the high group. The cumulative incidence of the primary and secondary endpoints was estimated using the Kaplan-Meier method. A two-sided *P*-value of 0.05 was considered to indicate statistical significance. All statistical analyses were performed using SPSS version 26 (SPSS Inc., Chicago, IL, USA) and R software.

RESULTS

The mean age of the low atherosclerotic burden group (95 patients) was 63.34±8.50 years, whereas the high atherosclerotic burden group (58 patients) had a mean age of 64.83±7.95 years ($P = 0.282$). Among the included patients, 85.6% were male ($P = 0.113$). The median follow-up period was 5.97 years (interquartile range: 3.77-7.82 years).

The demographic characteristics of the patients before matching are presented in Table 1. Patients with a high atherosclerotic burden were more likely to have HT (83% vs. 53%, $P < 0.001$), DM (52% vs. 35%, $P = 0.038$), and CKD (16% vs. 3%, $P = 0.006$) than those with a low atherosclerotic burden. The prevalence of CAD was significantly higher in the group with a high atherosclerotic burden (95% vs. 52%, $P < 0.001$), as was the prevalence of carotid artery stenosis (100% vs. 38%, $P < 0.001$). Furthermore, patients with a high burden exhibited a lower left ventricular ejection fraction (LV EF%) (54.91±9.62% vs. 57.42±6.31%, $P = 0.053$) and were more frequently on beta-blocker therapy (74.1% vs. 49.5%, $P = 0.003$).

Table 2 presents the laboratory characteristics of the study population. The laboratory findings indicated that patients in the high-burden group exhibited elevated Cr levels (1.00±0.24 mg/dL vs. 0.87±0.20 mg/dL, $P < 0.001$). Furthermore, there were statistically significant differences in the levels of total cholesterol (222.07±57.69 mg/dL vs. 185.02±43.27 mg/dL, $P < 0.001$) and low-density lipoprotein cholesterol (137.22±45.73 mg/dL vs. 111.42±39.70 mg/dL, $P < 0.001$) between the two groups (Table 2).

Regarding clinical outcomes, the mortality rate prior to matching was higher in this group (58.6% vs. 38.9%, $P = 0.018$, Table 1, Figure 1). The incidence of MACCE was significantly higher in the high atherosclerotic burden group before matching (69.0% vs. 44.2%, $p = 0.003$, Table 1, Figure 2). The matching process based on propensity scores yielded 57 and 58 patients in the low group and 58 patients in the high group (Tables 3, 4). The results demonstrated that the mortality and MACCE rates remained higher in the high group than in the low group (59% vs. 33%, $P = 0.007$; 69% vs. 39%, $P = 0.001$, respectively; Table 3, Figures 3, 4).

Table 1: Baseline demographics and clinical characteristics stratified by atherosclerotic burden before matching

Parameters	Atherosclerotic burden <4 (n=95)	Atherosclerotic burden ≥4 (n=58)	*P*-value
Age (years)	63.34±8.50	64.83±7.95	0.282
Gender (male) n (%)	78 (82.1%)	53 (91.4%)	0.113
Diabetes mellitus, n (%)	33 (35)	30 (52)	0.038
Hypertension, n (%)	50 (53)	47 (83)	<0.001
Stroke history n (%)	34 (36)	27 (47)	0.187
Smoking frequency (%)	53 (55.8)	34 (59.6)	0.641
COPD incidence (%)	10 (10.5)	12 (20.7)	0.082
Chronic kidney disease (%)	3 (3)	8 (16)	0.006
Peripheral arterial disease (%)	63 (66)	58 (100)	<0.001
Peripheral arterial intervention n (%)	23 (24)	14 (24)	0.872
Coronary artery disease (%)	49 (52)	55 (95)	<0.001
Coronary intervention n (%)	24 (25)	24 (42)	0.007
Renal artery stenosis (%)	5 (5)	1 (2)	0.274
Subclavian artery stenosis (%)	7 (7)	3 (5)	0.594
Carotid artery stenosis, n (%)	36 (38)	58 (100)	<0.001
Carotid artery intervention, n (%)	20 (21)	35 (61)	<0.001
LVEF (%) mean ± SD	57.42±6.31	54.91±9.62	0.053
History of MI n (%)	11 (11.6)	8 (13.8)	0.687
Antiplatelet therapy, n (%)			0.067
Acetylsalicylic acid n (%)	17 (18)	2 (3)	
Acetylsalicylic acid plus clopidogrel (%)	60 (63)	45 (78)	
Clopidogrel	11 (12)	7 (12)	
Anticoagulant levels (%)	2 (2.1)	0 (0)	0.266
ACE inhibitors, n (%)	29 (30.5)	20 (34.5)	0.611
ARBs n (%)	17 (17.9)	8 (13.8)	0.506
MRA n (%)	1 (1.1)	5 (8.6)	0.019
Beta-blockers n (%)	47 (49.5)	43 (74.1)	0.003
Statin level (%)	57 (60)	42 (74)	0.578
MACCE, n (%)	42 (44.2)	40 (69.0)	0.003
Mortality n (%)	37 (38.9)	34 (58.6)	0.018
Coronary revascularization rate (%)	3 (3.2)	9 (15.5)	0.006
Hospitalization for heart failure, n (%)	1 (1.1)	5 (8.6)	0.019
Follow-up stroke or TIA, n (%)	3 (3.2)	1 (1.7)	0.590
Recurrent MI n (%)	5 (5.3)	4 (6.9)	0.677

COPD: Chronic obstructive pulmonary disease, LVEF: Left ventricular ejection fraction, MI: Myocardial infarction, ACE inhibitors: Angiotensin-converting enzyme inhibitors, ARBs: Angiotensin receptor blockers, MRA: Mineralocorticoid receptor antagonists, MACCE: Major adverse cardiac and cerebrovascular events, TIA: Transient ischemic attack

DISCUSSION

The results of this retrospective analysis showed a significant correlation between an elevated atherosclerotic burden and an increased risk of long-term MACCE and all-cause mortality in patients undergoing simultaneous diagnostic angiography of multiple vascular territories over a median follow-up of 5.97 years.

The role of atherosclerotic burden as a predictor of adverse cardiovascular outcomes is well established, and its involvement in the development of ischemic heart disease, stroke, and PAD has been extensively documented in the literature.[17,18] Angiographic studies have revealed that patients with 50% or greater stenosis have a much higher event rate than those with non-obstructive disease. In our study, CAD was more common in patients with a higher atherosclerotic burden.[19,20]

Table 2: Comprehensive laboratory and clinical parameters stratified by atherosclerotic burden before matching

Parameter	Atherosclerotic burden <4 (n=95)	Atherosclerotic burden ≥ 4 (n=58)	*P*-value
WBC (x10^3/µL) mean ± SD	8.57±2.12	8.62±2.17	0.893
HB (g/dL) mean ± SD	13.37±1.90	12.98±2.24	0.260
PLT (x10^3/µL) mean ± SD	254.65±84.40	265.07±76.89	0.445
CR (mg/dL) mean ± SD	0.87±0.20	1.00±0.24	<0.001
Total cholesterol level (mg/dL) mean ± SD	185.02±43.27	222.07±57.69	<0.001
HDL (mg/dL) mean ± SD	40.64±13.20	40.92±14.95	0.906
LDL (mg/dL) mean ± SD	111.42±39.70	137.22±45.73	<0.001
TRI (mg/dL) mean ± SD	172.85±126.07	188.55±92.03	0.412

WBC: White blood cells, HB: Hemoglobin, PLT: Platelet count, Cr: Creatinine, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TRI: Triglycerides

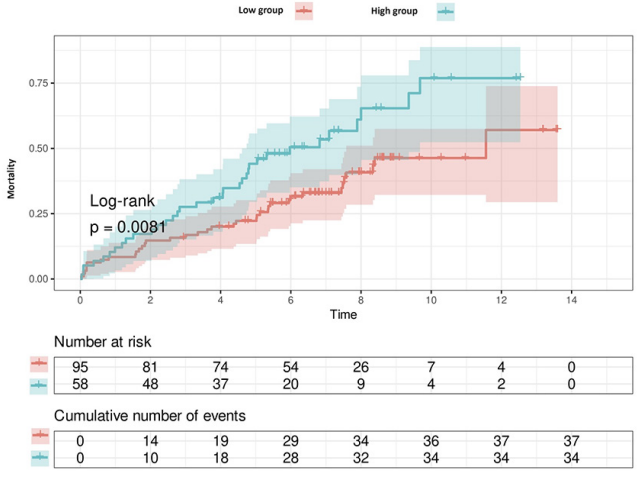

Figure 1: Mortality in all groups before matching

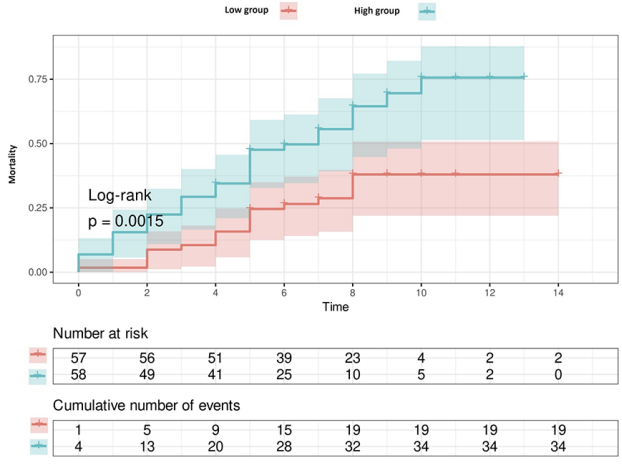

Figure 3. Mortality in all patients after matching

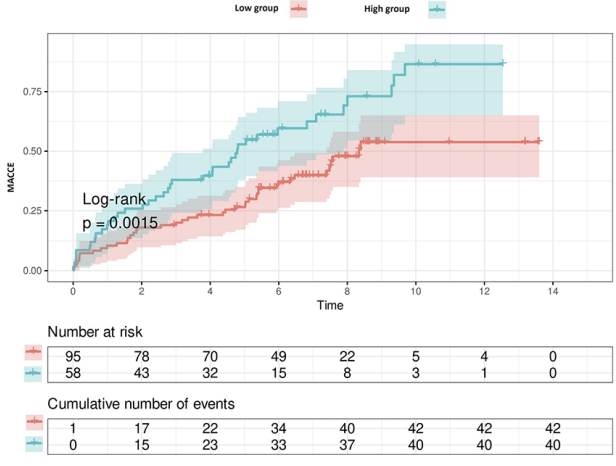

Figure 2: MACCE before matching

MACCE: Major adverse cardiovascular and cerebrovascular events

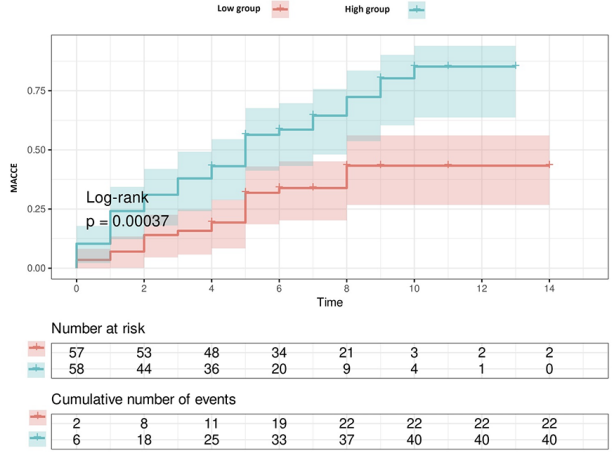

Figure 4: MACCE in all patients after matching

MACCE: Major adverse cardiovascular and cerebrovascular events

Table 3. Baseline demographics, clinical characteristics atherosclerotic burden after matching

Parameters	Atherosclerotic burden <4 (n=57)	Atherosclerotic burden ≥4 (n=58)	*P*-value
Age (years)	62.7±7.3	64.8±7.8	0.144
Gender (male) n (%)	52 (91)	53 (91)	0.977
Diabetes mellitus, n (%)	19 (33)	30 (52)	0.046
Hypertension, n (%)	27 (47)	48 (83)	<0.001
Stroke history n (%)	21 (37)	27 (47)	0.291
Smoking frequency (%)	35 (62)	34 (60)	0.7611
COPD incidence (%)	7(12)	12 (20.7%)	0.225
Chronic kidney disease (%)	1 (2)	8 (16)	0.009
Peripheral arterial disease (%)	37 (65)	58 (100)	<0.001
Peripheral arterial intervention n (%)	12 (21)	14 (24)	0.882
Coronary artery disease (%)	33 (58)	55 (95)	<0.001
Coronary intervention n (%)	17 (30)	24 (42)	0.192
Renal artery stenosis (%)	2 (4)	1 (2)	0.548
Subclavian artery stenosis (%)	4 (7)	3 (5)	0.679
Carotid artery stenosis, n (%)	19 (33)	58 (100)	<0.001
Carotid artery intervention, n (%)	11 (19)	35 (61)	<0.001
LVEF (%) Mean ± SD	57.5 ± 5.3	54.9 ± 9.6	0.072
History of MI n (%)	6 (11)	8 (14)	0.592
Antiplatelet therapy, n (%)			0.077
Acetylsalicylic acid n (%)	10 (18)	2 (3)	
Acetylsalicylic acid plus clopidogrel (%)	37 (65)	45 (78)	
Clopidogrel level (%)	8 (14)	7 (12)	
Anticoagulant levels (%)	0 (0)	0 (0)	-
ACE inhibitors, n (%)	19 (33)	20 (35)	0.896
ARBs n (%)	2 (14)	8 (14)	0.970
MRA n (%)	0 (0)	5 (9)	0.023
Beta-blockers n (%)	32 (56)	43 (74)	0.003
Statin level (%)	40 (71)	42 (74)	0.886
MACCE, n (%)	22 (39)	40 (69)	0.001
Mortality n (%)	19 (33)	34 (59)	0.007
Coronary revascularization rate (%)	3 (5)	9 (16)	0.072
Hospitalization for heart failure, n (%)	1 (2)	5 (9)	0.098
Follow-up stroke or TIA, n (%)	0 (0)	1 (2)	0.319
Recurrent MI n (%)	3 (5)	4 (7)	0.714

COPD: Chronic obstructive pulmonary disease, LVEF: Left ventricular ejection fraction, MI: Myocardial infarction, ACE inhibitors: Angiotensin-converting enzyme inhibitors, ARBs: Angiotensin receptor blockers, MRA: Mineralocorticoid receptor antagonists, MACCE: Major adverse cardiac and cerebrovascular events, TIA: Transient ischemic attack

The underlying pathophysiological mechanisms driving these associations include chronic inflammation, endothelial dysfunction, and plaque instability, all of which contribute to the progression of atherosclerosis and the subsequent occurrence of cardiovascular events.[20,21] It is of great importance to assess the extent of atherosclerotic burden across multiple vascular territories, as significant atherosclerosis in one region is typically indicative of widespread disease, thereby amplifying the overall risk of cardiovascular complications.[21,22] These findings highlight the importance of comprehensive cardiovascular risk assessment in clinical practice, particularly for patients with multi-territory vascular involvement.

The Reduction of Atherothrombosis for Continued Health (REACH) Registry, an international registry, found that 15% of stable outpatients with atherothrombosis or multiple risk factors for atherothrombosis exhibited polyvalvular disease.[23]

Table 4: comprehensive laboratory and clinical parameters stratified by atherosclerotic burden after matching

Parameter	Atherosclerotic burden <4 (n=57)	Atherosclerotic burden ≥4 (n=58)	*P*-value
WBC (x10^3/µL) Mean ± SD	8.5±2.0	8.6±2.2	0.654
HB (g/dL) Mean ± SD	13.6±1.7	13.0±2.2	0.091
PLT (x10^3/µL) Mean ± SD	256.4±83.1	265.1±76.9	0.560
CR (mg/dL) Mean ± SD	0.90±0.2	1.00±0.24	<0.001
Total cholesterol level (mg/dL) Mean ± SD	187.6±46.4	222.1±57.7	<0.001
HDL (mg/dL) Mean ± SD	40.4±12.9	40.9±15.0	0.828
LDL (mg/dL) Mean ± SD	112.6±42.4	137.2±45.7	0.003
TRI (mg/dL) Mean ± SD	185.3±148.8	188.6±92.0	0.889

WBC: White blood cells, HB: Hemoglobin, PLT: Platelet count, Cr: Creatinine, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TRI: Triglycerides

The REACH registry indicated that the presence of polyvalvular disease was associated with a 99% increased risk of MACE at the 4-year follow-up in these patients.[23] The prospective, randomized trials, including Liraglutide Effect and Action in Diabetes: The Evaluation of Cardiovascular Results and Saxagliptin Assessment of Vascular Outcomes Recorded in Patients with Diabetes Mellitus-Thrombolysis in Myocardial Infarction 53, demonstrated an elevated risk of major adverse cardiovascular events in patients with DM and polyvalvular disease.[24-27] As in the aforementioned studies, patients with a high atherosclerotic burden in our study were associated with an increased incidence of poor cardiovascular outcomes in patients undergoing simultaneous diagnostic angiography of multiple vascular territories. In contrast to other studies, our study included patients who underwent simultaneous angiography for coronary, carotid, and peripheral arteries.

Patients with a higher atherosclerotic burden were more likely to have cardiovascular risk factors, such as tobacco use, HT, dyslipidemia, and diabetes. These risk factors are strongly associated with a higher atherosclerotic burden, suggesting a common underlying pathophysiology. Additionally, the prevalence of CKD was higher in these patients in the present study. CKD accelerates the progression of atherosclerosis through several mechanisms, including chronic inflammation and oxidative stress. Additionally, dysregulated mineral metabolism plays a role in this process, leading to vascular calcification and increased arterial stiffness. These processes can exacerbate vascular damage and enhance plaque vulnerability.[28] It remains unclear whether the elevated mortality rates are attributable to the presence of multiple comorbidities or the underlying atherosclerotic burden.

The present study revealed a significant association between atherosclerotic burden and the presence of PAD, CAD, and carotid artery stenosis. Each of these conditions was significantly correlated with an increased risk of MACCE. This finding is consistent with the observations of Curcio et al.,[29] who emphasized that PAD is not only a marker of systemic atherosclerosis but also a significant predictor of cardiovascular events such as MI and stroke, due to its involvement in both coronary and cerebral arteries. Similarly, it has been demonstrated that CAD and PAD are pivotal factors in elevated cardiovascular risks and adverse outcomes in patients with significant atherosclerotic burden.[30]

The present study identified significant associations between atherosclerotic burden and the use of specific medications, including beta-blockers and MRAs. Patients with a higher atherosclerotic burden were more frequently prescribed beta-blockers and MRAs, in accordance with current guidelines that recommend these therapies for high-risk cardiovascular patients. While beta-blockers are commonly prescribed for CAD, their benefits may be particularly pronounced in subgroups such as those with recent MI, as reported by Godoy et al.[31]. Furthermore, Andersson et al.[32] demonstrated that beta-blockers remain effective in reducing cardiovascular events across patients with significant atherosclerotic burden, thereby reinforcing their importance in this population. MRAs have also been demonstrated to markedly diminish adverse cardiovascular outcomes, particularly in patients with heart failure and extensive atherosclerosis.[31,33] Moreover, the importance of lipid management in reducing MACCE, particularly among high-risk populations with substantial atherosclerotic burden, has been well established in recent guidelines. Both Mach et al.[34] and Lloyd-Jones et al.[35] emphasize the pivotal role of intensive lipid-lowering therapies in preventing cardiovascular events, particularly in patients with extensive atherosclerosis across multiple vascular territories.

Study Limitations

It should be noted that the present study is not without limitations. First, as a retrospective study, there is the possibility of selection bias. Second, the relatively small number of patients may have reduced the statistical power of the analyses. Third, the study was conducted at a single center with a relatively small sample size, which may limit the generalizability of the

findings. Lastly, there are no data on inflammatory markers known to be associated with atherosclerotic burden and adverse cardiac events. It is recommended that future research address these issues to gain a more comprehensive understanding of the association between atherosclerotic burden and long-term cardiovascular outcomes in these patients.

CONCLUSION

In conclusion, the prognosis of patients with a higher atherosclerotic burden was significantly worse than that of patients with a lower atherosclerotic burden. It is important to improve the detection and treatment of these patients. It is incumbent upon clinicians to maximize the use of preventive therapies endorsed by societal guidelines in such patients.

Ethics

Ethics Committee Approval: The study protocol was reviewed and approved by the Ethics Committee of İzmir Katip Çelebi University and the participating hospital (decision number: 0213, date: 25.04.2024).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Concept: F.E., H.S.İ., T.K., A.Ç., M.K., Design: F.E., H.S.İ., T.K., A.Ç., M.K., Data Collection or Processing: F.E., H.S.İ., T.K., A.Ç., Analysis or Interpretation: T.K., M.K., Literature Search: F.E., A.Ç., Writing: F.E., H.S.İ., T.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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