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Inflammatory Cytokines and Liver Enzymes as Physiological Predictors of Coronary Artery Disease Severity

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ABSTRACT

Objective: *The sternness of presumed coronary artery disease can affect the function and inflammatory status of the heart.* ***Method:*** *The study consisted of sisty patients which were confirmed to have the coronary artery disease which later categorised into a single-vessel disease (SVD, n=30) and relative multivessel disease (MVD, n=30). Biochemical, clinical, and immunological tendencies were measured between the two groups.* ***Results:*** *The MVD patients displayed an essentially lower left ventricular expulsion with a fraction and maximum levels of NT-proBNP; CK-MB; CRP; IL-6; and IL-4 in comparison with SVD inclined-patients ($p < 0.05$). Liver enzymes were elevated significantly within the MVD category.* ***Novelty:*** *Multivessel disease is linked to greater heart malfunction and supplementary activity, to indicate more stern disease advancement.*

INTRODUCTION

Coronary artery disease (CAD) is a severe advancement in cardiovascular disorder that moves and develops atherosclerotic signs within the projected coronary arteries and eventually cause flow of blood as well as ischemia of the myocardium. Atherosclerosis is not passive but a difficult interface among the lipids, immune-inclined inflammation and endothelial disfunction and in thinning the plaque and its growth. Smoking, age, hypertension, diabetes, dyslipidemia, and sedentary lifestyle are considered to be traditional risk factors of CAD; they all contribute to the onset and severity of the disease [1], [2]. The role of inflammation in CAD pathogenesis is a critical factor, and the inflammatory cytokine consisting interleukin-6; (IL-6) with interleukin-4 (IL-4) attaches the contribution from the beginning and the growth of atherosclerotic lesions [3]. Maximum stages of IL-6 has been connected to unsteadiness of plague and heightened cardiovascular danger [4], [5]. Similarly, biotic signs like high-sensitivity C-reactive protein (hs-CRP), are systemic indicators of inflammatory activity which is associated with poor cardiac events. Measurement of physiological and immunological parameters can better inform the knowledge of the severity of CAD particularly when comparing single-vessel and multivessel disease patients, which could inform the risk stratification and treatment.

RESEARCH METHOD

Study Design and Population

The cross-sectional relative study was conducted in the assigned Medical City Teaching Hospital, Baghdad, Iraq, between April 1, 2025, and January 1, 2026. The study was conducted on 60 patients with an established coronary artery disease (CAD) who had diagnostic coronary angiography. The presumed patients were grouped into two distinct angiography results; single-vessel disease where (SVD, n = 30) and the projected multivessel disease. (MVD, n = 30).

Inclusion and Exclusion Procedure

The study comprised of patients who had angiographically established CAD with ages of 18 years and above. Patients who were chronically liver diseased, had renal failure, autoimmune diseases, acute infections, had malignancy or were under immunosuppressive treatment were excluded to reduce the possible confounding variables.

Clinical and Demographic Assessment

The population information comprised of age, sex, smoking tendency, and history of diabetes mellitus, were recorded for all participants. A complete clinical examination was performed, and medical histories were obtained from hospital records.

Echocardiographic and Angiographic Evaluation

All patients were exposed to transthoracic echocardiography to determine left ventricular ejection fraction (LVEF) under conventional methods. This was followed by coronary angiography done by skilled cardiologists through Judkins technique. The degree of coronary artery ailment was summed using the number of vessels that were significantly narrowed (40 percent or more of luminal diameter), and the patients were categorised under SVD or MVD.

Laboratory Investigations

Venous sampled blood were gathered following an overnight prescribed fasting. Theserum was separated by centrifugation at 3000 rpm for 15 min and stored at −20°Cuntil biochemical analysis. were assessed with standard computerized analyzers. Immunological and inflammatory markers were regulated with enzyme-associated immunosorbent assay (ELISA) content kits based on the manufacturers' based instructions.

Ethical Considerations

The study procedure was accepted by the assigned ethical committee of the college under study of the College of Science and Medical City Teaching Hospital, Baghdad. There was a consent form obtainable for the particiapnats before they were enrolled. The study was carried out based on the principles of the Helsinki Declaration.

Statistical Analysis

Numerical package popularly called (SPSS) software version 26.0was utilized for data analysis (IBM Corp., obtained from Armonk, NY, USA). Mean ± standard deviation (SD) was employed to express progressive and identified variables as well as frenquencies and percentages. continuous. Continuous variables were compared with

independent t-test, and Chi-square test was appleid with specific variables. A p-value below 0.05 was considered to be significant.

RESULT AND DISCUSSION

Results

Table 1. Baseline and Clinical Features of Study Groups

Parameter	SVD (n=30)	MVD (n=30)	P-value
Age (years)	56.9 ± 8.6	66.2 ± 8.5	<0.001
Sex (Male/Female)	19/11 (63.3% / 36.7%)	21/9 (70.0% / 30.0%)	0.59
Smoking (Yes/No)	21/9 (70.0% / 30.0%)	21/9 (70.0% / 30.0%)	1.00
Diabetes (Yes/No)	18/12 (60.0% / 40.0%)	20/10 (66.7% / 33.3%)	0.59
LVEF (%)	61.0 ± 3.8	46.7 ± 3.2	<0.001

The baseline and clinical features of the participants are regulated and explained in table 1. Patients in the MVD category were essentially older compared to the SVD category (66.2 ± 8.5 vs. 56.9 ± 8.6 years, $p < 0.001$). Concerning sex grouping, males seem to be dominant in all the two groups with numerically essential variation between SVD and MVD patients (63.3% vs. 70.0%, $p = 0.59$). Similarly, smoking prevalence was identical in both groups, with 70.0% of patients being current smokers ($p = 1.00$). The proportion of patients with diabetes mellitus did not vary essentially between the MVD and the SVD categories (60.0%, versus 66.7%, p=0.59). In divergence, their was an ejection of fraction as vividly reduced in patients containing single-vessel involvement (46.7 ± 3.2% vs. 61.0 ± 3.8%, $p < 0.001$), indicating significantly impaired cardiac systolic function in the MVD group.

Table 2. Comparative Analysis of Cardiac and Biochemical Parameters between SVD and MVD Groups

Parameter	SVD (Mean ± SD)	MVD (Mean ± SD)	P-value
NT-proBNP (pg/mL)	171.0 ± 23.4	263.5 ± 41.8	<0.001
CK-MB (U/L)	14.5 ± 3.6	23.4 ± 7.1	<0.001
ALT (U/L)	54.6 ± 6.7	61.5 ± 6.1	<0.001
AST (U/L)	53.9 ± 4.8	63.4 ± 12.6	<0.001
ALP (U/L)	50.7 ± 3.6	143.6 ± 19.4	<0.001

Cardiac and biochemical parameters are accessible in Table 2. An essential supplement in NT-proBNP stages was noticed in the category of MVD in comparison with SVD caregory at (263.5 ± 41.8 versus 171.0 ± 23.4 pg/.mL, $p < 0.001$), which reflects additional cardiac malfunction and ventricular wall stress in patients with general coronary engrossment. Likewise, CK-MB absorptions were essentially higher in MVD patients compared to SVD patients (23.4 ± 7.1 vs. 14.5 ± 3.6 U/L, $p < 0.001$), suggesting a greater degree of myocardial injury in the multivessel group. Regarding hepatic

biomarkers, ALT and AST levels were significantly elevated in MVD patients compared with SVD patients (ALT: 61.5 ± 6.1 vs. 54.6 ± 6.7 U/L, $p < 0.001$; AST: 63.4 ± 12.6 vs. 53.9 ± 4.8 U/L, $p < 0.001$). Additionally, ALP levels observed a higher mark in the MVD cluster (143.6 ± 19.4 versus 50.7 ± 3.6 U/L, $p < 0.001$), to indicate obvious metabolic and hepatic issues with related coronary artery disease.

Table 3. Comparative Examination of Inflammatory and Immune Markers between SVD and MVD Groups

Parameter	SVD (Mean ± SD)	MVD (Mean ± SD)	P-value
CRP (mg/L)	15.0 ± 2.7	22.0 ± 3.1	<0.001
IL-6 (pg/mL)	12.3 ± 3.2	13.9 ± 3.1	0.03
IL-4 (pg/mL)	9.9 ± 1.9	13.8 ± 3.1	<0.001

Table 3 indicates the inflammatory profiles of the research cluster and the presumable profiles of the participants. Patients experiencing multivessel problems also contain greater serum CRP stages as against SVD (22.0 ± 3.1 versus 15.0 ± 2.7 mg/L, $p < 0.001$) which means that it is a prevalent engagement of coronary arteries. Similarly, IL-6 stages were very high in the MVD cluster in comparison with SVD category (13.9 ± 3.1 versus 12.3 ± 3.2, pg/mL, $p = 0.03$), showing the supplementary pro-inflammatory cytokines activity in multivessel disease patients. In addition, the level of IL-4 in MVD patients was significantly elevated compared to that of SVD patients (13.8 ± 3.1 vs. 9.9 ± 1.9 pg/mL, $p = 0.001$), which is indicative of a compensatory response to increased inflammatory load by anti-inflammatory and immune-regulatory pathways.

Table 4. Comparative Analysis of Lipid Profile Parameters between SVD and MVD Groups

Parameter	SVD (Mean ± SD)	MVD (Mean ± SD)	P-value
Total Cholesterol (mg/dL)	262.2 ± 19.8	267.3 ± 38.9	0.48
Triglycerides (mg/dL)	192.0 ± 23.5	177.3 ± 15.4	0.01
HDL (mg/dL)	51.8 ± 4.6	51.7 ± 6.0	0.95
LDL (mg/dL)	174.3 ± 14.1	182.3 ± 15.0	0.07

The lipid profiles of the study population are summarized in Table 4. No quantitatively essential difference was noticed in general cholesterol levels between the MVD and SVD clusters where (267.3 ± 38.9 versus 262.2 ± 19.8, mg/dL,, p=0.48,). Conversely, triglyceride stages were essentially lower in MVD cluster in comparison with SVD category (177.3 ± 15.4 vs. 192.0 ± 23.5 mg/dL, $p = 0.01$). This outcome may reflect variations in metabolic control andpharmacological treatment, as well as nutritional position between the two distinct patient clusters. High-density lipoprotein (HDL) concentrations were comparable between groups (51.7 ± 6.0 vs. 51.8 ± 4.6 mg/dL, $p = 0.95$), indicating no significant variation in protective lipoprotein levels. Although low-density lipoprotein (LDL) levels inclined to be higher in most MVD patients than in designated SVD participants (182.3 ± 15.0 vs. 174.3 ± 14.1 mg/dL), this variation did not

reach statistical importance of ($p = 0.07$), suggesting a borderline association between LDL cholesterol and disease severity.

Table 5. Distribution of Affected Coronary Arteries in SVD and MVD Groups

Coronary Artery	SVD (n=30)	MVD (n=30)
LAD	16 (53.3%)	14 (46.7%)
RCA	6 (20.0%)	8 (26.7%)
LCX	8 (26.7%)	8 (26.7%)
Total	30 (100%)	30 (100%)

The distribution of affected coronary arteries showed that LAD was the most commonly involved artery in both groups (53.3% in SVD vs. 46.7% in MVD), followed by LCX (26.7% in both groups) and RCA (20.0% in SVD vs. 26.7% in MVD) (Table 5).

Discussion

The current research has shown that multivessel coronary artery disease is characterized by worse clinical, biochemical, and immunological disorders than single-vessel disease. The age of designated patients with MVD was essentially higher in comparison with that of assumed patients with possible SVD because this is in line with other research works where aging was found to be a major cause of progressive atherosclerosis and multivessel involvement [6,7]. Whilst there was a visual prevalence of males in both groups no significant difference existed between the sex distribution was found, thereby indicating the well-established greater CAD prevalence in males yet indicating the rising burden in females [8]. Likewise, smoking and diabetes mellitus were very common in the two groups with no intergroup difference indicating their importance in being among the most critical risk factors of CAD development and progression [9,10]. MVD patients showed a marked decrease in LVEF and increased NT-proBNP and CK-MB levels in terms of cardiac functionality, which showed that patients had a higher level of myocardial dysfunction and continuous cardiac injury [11,12]. These outcomes are corroborated by earlier data which point to the adverse effects on an impaired ventricular performance and poor clinical outcomes in the presence of an extensive coronary involvement [13]. Moreover, the inflammatory and immune responses, such as CRP, IL-6, and IL-4, also showed a significant elevation in the MVD group, highlighting the centrality of immune-mediated inflammation in the instability of the plaque and disease development [14,15]. High IL-6 has been experimental to be connected with endothelial malfunction and hostile cardiovascular events whereas IL-4 can be involved in the vascular remodeling and the recruitment of immune cells in atherosclerotic lesions [16,17]. Moreover, ALT, AST and ALP had much more significant values in MVD patients, which proves the existence of the hepatic dysfunction associated with chronic cardiac dysfunction, systemic inflammation and metabolic stress [18,19]. There is growing evidence that liver enzymes can act as an indirect cardiovascular risk and vascular calcification [20]. As far as lipid metabolism is concerned, total cholesterol,

as well as LDL did not vary essentially between groups, however, triglycerides were higher in SVD patients whereas MVD patients tended to have higher LDL values which could be due to lipid-lowering therapy and lifestyle modifications [21, [22] Angiographic evaluation showed that LAD was the most commonly involved artery in both groups, which is in line with its anatomical significance and its involvement with unfavorable cardiac events [23]. The fact that LAD is largely involved in the severity and prognosis of the disease also contributes to the same. All of such findings suggest that the overall appraisal of demographic variables, conventional risk factors, cardiac biomarkers, inflammatory cytokines, liver enzymes, and angiographic parameters is an effective method of assessing the severity of CAD and determining high-risk patients. Though such findings have clinical implications, there are a number of limitations that need to be mentioned. Small sample size and design single-center study can be a weakness in terms of generalizability. The study is generally cross-sectional in nature and it is a causal inference. Also, the medication intake, especially statins and anti-inflammatory drugs were not fully regulated and might have affected the laboratory parameters. Additionally, inflammation of TNF-a and the IL-1b were nor assessed. Therefore, additional multicenter longitudinal examinations through borader cohorts and expanded biomarker panels are required to affirm these findings to investigate prognostic essence.

Limitations

The main constraints of this reserch may include the sample six=ze which is limited and the centre which is a single environment and this can affect the generalizability of the findings. Similarly the cross-sectional paradigm will not allow the presentations of the findings. Od causal association between the biomarkers and disease seriousness. Next, the possible compounding aspects may include the use of medication, physical activity and dietary habits, were not fully regulated. Fourth, the study did not assess additional inflammatory mediators such as TNF-α and IL-1β, which may additionally contribute to the atherosclerotic progression. Finally, prolonged clinical findings were not assessed. Future multicenter longitudinal studies containinglarger clusters and extended biomarker panels are suggested to confirm these results and determine their prognostic significance.

CONCLUSION

Fundamental Finding : In this research, multivessel coronary artery disease is found to have much more cardiac malfunction, systemic inflammation and hepatic enzyme activity than single-vessel disease. The combination of inflammatory cytokines (IL-6 and IL-4), cardiac (NT-proBNP and CK-MB), and liver enzymes is a new way to assess the severity of the potential disease in patients with assumed coronary artery disease. **Implication :** The present study in contrast to earlier literature which concentrated more on the standard risk factors or separately measured biomarkers emphasizes the joint prognostic importance of immunological, cardiac and metabolic measures in defining the disease progression. **Limitation :** These data indicate that the addition of inflammatory and hepatic parameters to the standard clinical examination

can help in the early risk stratification. **Future Research :** These data indicate that the addition of inflammatory and hepatic parameters to the standard clinical examination can help in the early risk stratification and provide individual therapeutic approaches to patients with advanced coronary artery disease.

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