Pravara Med Rev; March 2026, 18 (01), 84 – 92
DOI: 10.36848/PMR/2026/20000.11111

Original article

A study of Clinical profile, hs-CRP, Lipid profile with VEGF-2 gene expression in Coronary Artery disease

Ishwarya Mahendran[1], Krishnaeswari Veluchamy[2], Vadivel Mani[3]*, Damel Lakshmi Umapathi[4], Muninathan N[5]

[1]Department of Biochemistry, Sree Balaji Medical College & Hospital, BIHER, Chennai-600044, Tamil Nadu, India
[2]Department of Anatomy, PSP Medical College and Hospital and Research Institute, Oragadam, Kancheepuram District, Tamil Nadu - 631 604, India.
[3]Department of Biochemistry, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, East Godavari - 533201, Andhra Pradesh, India.
[4]Associate Professor, Department of Physiology, Sree Balaji Dental College and Hospital, Pallikaranai, Chennai-600100, Tamil Nadu, India.
[5]Scientist, Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research, Kanchipuram - 631552, Tamil Nadu, India.
**Corresponding Author: Dr. Vadivel Mani*

Abstract

In the present study was investigated that the clinical profile, hsCRP, lipid profile and VEGF-2 gene expression in C patients in tertiary care hospital. Coronary artery disease (CAD) is the leading cause of death in India and the leading cause of death worldwide. CAD accounts for 20% of al l deaths in the South Asian region (SAR). The present study is a case-control study comprising 50 cases and 50 controls who satisfied the inclusion and exclusion criteria. The mean values of T. Cholesterol, HDLc, LDLc, VLDLc and TGL in cases were 201.80±39.88, 40.56±6.03, 129.20±38.19, 29.94±12.04 and 149.26±60.32, respectively and of controls were 174.28±30.82, 39.28±6.44, 106.48±31.03, 27.34±11.17 and 135.52±56.61, respectively. The mean Hs-CRP of cases was 2.04±1.00 as compared to 0.85±0.35 in controls. All above mentioned datas were clearly mentioned that the Lipid profile, hsCRP levels were significantly increased in coronary artery disease patients compared with control healthy subjects. VEGF-2 gene protein and expression also significantly increased and correlated with control subjects. In the present study we conclude that VEGF-2 Gene expression is a one of the prognostic and diagnostic marker for coronary artery disease patients.

Key Words: *Coronary artery disease, Lipid Profile, VEGF-2 Gene Expression*

Introduction

In 2010, coronary artery disease (CAD) became the leading cause of death, resulting in 1.8 million deaths and accounting for more than half of all documented deaths and 10.6% of Cardiovascular disease (CVD) mortality. Cerebrovascular disease caused 6.8% of all deaths and 30% of deaths from CVD, amounting to a significant impact on mortality. Coronary heart disease (CHD) in the region led to the loss of more than 60.5 million disability-adjusted life years (DALYs), which is 10% of all DALYs lost. CHD caused almost twice as many DALYs as stroke, making up 4.6% of all CVD-related DALYs.[1] The area is experiencing increasing CVD death rates, posing a growing health concern. Studies in Pakistan and India show that CHD significantly contributes to morbidity and mortality in these countries. In 2010, an estimated 2.03 million individuals in India died from CHD, representing a substantial increase from 1990. CVD likely accounts for 25% of all fatalities in India, with men and city dwellers being more susceptible to CHD.[2] The prevalence of CHD in India is approximately 4.5% in rural areas and over 10% in urban areas, indicating a significant urban-rural disparity.[3] A recent CHD study in Pakistan revealed that active ischaemia occurred twice as often in women compared to men, with prevalence rates of almost 6% in men and 4% in women.[4] The study also indicated that one in five individuals in Pakistan's cities suffers from CHD, but only a quarter of them are aware of their condition and seek treatment. Recent data

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

suggests that individuals with lower socioeconomic status in the region initially experience a higher burden of CHD, contrasting with trends in high-income countries. The rise in urban dwellers in the region corresponds with a higher incidence of CHD, with 31% of the population currently residing in urban areas and a predicted increase in this percentage. The prevalence of CHD in urban populations has risen from about 4% to 12% between 1965 and 2005, and a similar trend is observed in rural communities.[5] Recent data from Andhra Pradesh in South India indicates a potentially higher prevalence of CHD in rural areas, challenging the notion of a rural-urban protective factor.[6] The economic burden of CHD mortality in the Indian subcontinent worsens due to the earlier onset of CHD compared to Western European and Latin American nations, impacting a significant percentage of the working-age population.

Researchers conducted a study in rural India that found that 51% of all cardiovascular disease (CVD) fatalities were among individuals under the age of 70.[7] The blockage of the coronary arteries due to atherosclerosis primarily causes coronary artery disease (CAD). Experts now understand atherosclerosis, once thought to be a benign disorder related to fat accumulation that narrows artery passages, as a chronic inflammatory disease that can begin at a young age. Researchers recognise inflammation as playing a crucial role in every stage of atherosclerosis, from the early phases of a lesion to the formation of a fully developed atheromatous plaque.[8] Inflammation, key to atheroma, is associated with the activation and proliferation of smooth muscle cells, endothelial cells, and macrophages. The process of forming new blood vessels from pre-existing ones, known as angiogenesis, relies on Vascular Endothelial Growth Factor (VEGF), also known as Vascular Permeability Factor (VPF).[9] Macrophages and tumour cells produce VEGF, which stimulates the migration and proliferation of endothelial cells, crucial for capillary development. In addition to increasing vascular permeability, VEGF aids in waste removal and facilitates the delivery of nutrients and oxygen to tissues and works synergistically with other growth factors such as angiopoietins and fibroblast growth factors (FGFs) to enhance the angiogenic process. VEGF not only contributes to the stability and integrity of the vascular network by preventing cell death but also serves as a key regulator of angiogenesis, involved in blood vessel formation and maintenance of vascular integrity. Studies show that a significant proportion of vascular events occur in individuals who do not exhibit symptoms of extremely high cholesterol, highlighting the need for improved risk classification techniques for the sizable and diverse intermediate risk category.[10] Researchers consider high-sensitivity C-reactive protein (hs-CRP), a marker of low-grade vascular inflammation, as one of the most promising and reliable risk factors currently available, with appealing test features suitable for clinical application.

MATERIALS AND METHODS

Study Population & Study Design

The present study is a case–control study that included 50 consecutive adult patients with ACS admitted to the coronary care unit at the Konaseema Institute of Medical Science and Research Foundation, a tertiary care hospital, Amalapuram, East-Godavari, that is considered one of the referral centers and attached with many rural centers (MedUnited) for the East-Godavari region of Andhra Pradesh, during the period from January 2025 till July 2025. The controls were 50 age- and gender- matched subjects free from previous CVD recruited from the attendants or relatives of noncardiac patients. We included adult patients (age >18 years old) with ACS. We excluded patients with chronic coronary syndrome, pregnancy, malignancy, thyroid disease, advanced chronic kidney disease (stage 4 or 5), and liver disease.

This is observational case control study. After getting ethical clearance from the institution and the ethical committee study was started from March 2024. Patients who fit within the inclusion and exclusion criteria were explained about the study and the consent form was given. Those who were willing to participate were recruited. Information was collected through prepared proforma from each patient and control. A detailed history of chest pain, site, duration, nature, radiation, aggravating and reliving factors were elicited. Family history of IHD & dyslipidemia was asked for general physical examination and systemic examination of the patients was carried out. Blood samples were drawn from patients and controls for biochemical and gene expression study.

Ethics:

The protocol was approved by the Institution Committee of Ethics in Human Research, which is a division of the Konaseema Institute of Medical Sciences & Research Foundation, in accordance with Indian Council of Medical Research regulations (Ref No. IEC/PR/2023:48/02.11.2024). Each patient who wished to participate in the research signed a written informed permission form after being informed.

Laboratory Data:

Blood samples were collected from the study subjects under aseptic measures by venipuncture within 24 h of admission. The EDTA and Serum sample was collected. Serum samples were immediately centrifuged on- site at 2000×g for 10 minutes at 4°C and then stored at −70°C until the analysis. Serum samples were thawed at room temperature just before analysis. Biochemical tests involved Fasting Blood glucose (FBG) (estimated by GOD-POD method; Trinder, 1969)[11], Serum Triglycerides (Enzymatic GPO method; Jacobs et al., 1960)[12], and Total Serum Cholesterol (CHOD-PAP method; Allain et al., 1974)[13], LDL and HDL on a fully-automatic analyzer (Erba EM 360). Serum samples were analyzed at the Central Laboratory of KIMS&RF teaching Hospital. The COBAS 602 automated platform, which utilises Chemiluminescent Immunoassay (CLIA) technology, was employed to analyse hs-CRP levels. 2 ml of Ethylene Diamine Tetra-acetic Acid (EDTA) blood sample was collected and buffy coat separated from all the study participants for Deoxyribo Nucleic Acid (DNA) extraction.

VEGF-2 mRNA expression analysis:

VEGF-2 Gene Expression were analyzed by RTPCR method.[14]

Total RNA Isolation, cDNA conversion and real-time PCR:

DNA extraction from EDTA blood samples for PCR analysis typically involves lysing the blood cells, removing cellular debris, and then purifying the DNA.

Total RNA was extracted from control and experimental samples using a TRIR kit (Total RNA Isolation Reagent Invitrogen). In brief, 1 ml of TRIR was added to 100 µl buffy coat. The contents were immediately transferred to a microcentrifuge tube, where they were mixed with 0.2 ml of chloroform, vortexed for 1 minute, and kept at 4°C for 5 minutes. The contents were then centrifuged for 15 minutes at 4°C at 12,000g. The top layer of the aqueous phase was carefully transferred to a new microfuge tube, and an equal amount of isopropanol was added, vortexed for 15 seconds, and then put on ice for 10 minutes. The supernatant was separated after centrifugation of the content at 12000g for 10 minutes at 4°C. The vortex was used to wash the RNA pellet in 1 ml of 75% ethanol. Using Fourney's et al. method, the isolated RNA was spectrometrically estimated. The amount of RNA in each sample was measured in micrograms. Complementary DNA (cDNA) was synthesized from 2 micrograms of total RNA according to the manufacturer's protocol using a reverse transcriptase kit from Eurogentec (Seraing, Belgium). To perform real-time PCR, a 45 µl reaction mixture including 2x reaction buffer (Takara SyBr green master mix), forward and reverse primers for the target and housekeeping genes, water and β2-microglobulin (primer sequences are provided in (Table 1) was prepared. In individual PCR vials, about 5 µl of control DNA for positive control, 5 µl of water for negative control and 5 µl of template cDNA for samples were taken and reaction mixture (45 µl) was added. 40 cycles (95°C for 5 min, 95°C for 5 s, 60°C for 20 s and 72°C for 40 s) was set up for the reaction. Results were plotted using the PCR machine (Stratagene MX 3000P, Agilent Technologies, 530l, Stevens Creek Blvd, Santa Clara CA, 95051). Relative quantification was calculated from the melt and amplification curves analysis.

Name of the gene	Primer Sequence	Reference
VEGF-2	Sense primer: 5'- ACGATCGATACAGAAACCACG-3' Anti-sense primer: 5'- CTCTGCGCAGAGTCTCCTCT-3'	(Panutsopulos et al., 2003)[15]
β2-microglobulin	Sense primer: 5'- TCCAACATCAACATCTTGGT-3' Anti-sense primer: 5'- TCCCCCAAATTCTAAGCAGA-3'	(Panutsopulos et al., 2003)[15]

Statistical Analysis

For each parameter mean and standard deviation was calculated. The value of $p<0.05$ was taken as significant. The qualitative variables were compared using $\chi 2$ test. The statistical software system SPSS version 22 for windows was used for analysis. Univariate and bivariate correlation was made using Kendall`s tau method to confirm the significance of variables with Hs-CRP and lipid profile.

Results:
In the present study mean age of cases was 51.24 ± 7.89, mean age of control was 52.18 ± 7.36. The minimum age was 33 for cases and 37 for control. The maximum age of cases and controls were 69 and 68 respectively. Majority of cases were > 40 years of age. (Table.1)

Table.1 Age wise distribution of cases and controls

Age in years	No. of cases	No. of control subjects
30-40	5	4
41-50	19	19
Above 50	26	27

Distribution of cases and control by BMI
Table.2 showed that this study 42 cases were having BMI > 25 as compared to 26 in the control group. Higher BMI was associated with IHD and high Hs-CRP.

Table. 2. Distributions of cases and control by BMI

BMI	Cases	Control
<18.5	Nil	Nil
18.6-24.9	8	24
>25	42	26

Distribution of cases & controls based on systolic BP
Table.3 indicates that this study mean systolic BP in cases was 162.40±20.36, and 48 cases had systolic BP > 140mmHg. Of which 16 cases had SBP ≥ 180mmHg, as compared with the control group in which 35 controls had SBP < 140mmHg.

Table.3 Distribution of cases & controls based on systolic BP

SBP(mm Hg)	Cases	Controls
<140	2	35
140-159	18	11
160-179	14	4
>180	16	Nil

Distribution of cases & controls based on diastolic BP
In this study 42 cases had DBP > 90mmHg, as compared to the control group which had 19 controls with DBP > 90mmHg. There were 12 cases as compared to nil controls with DBP ≥ 110mmHg (Table.4).

Table.4 Distribution of cases & controls based on diastolic BP

DBP(mm Hg)	Cases	Controls
<90	8	31
90-99	14	18
100-109	16	1
>110	12	Nil

PMR P ISSN: 0975-0533, E ISSN: 0976-0164

Lipid profile in coronary Artery disease

Lipid profile was estimated for all study subjects. Cholesterol, TGL, VLDL, LDL concentration were significantly ($p > 0.001$) ($p>0.01$) increased in coronary artery disease patients compared with normal subjects In HDLc levels were estimated in all the patients. HDL concentration was significantly ($p > 0.001$) decreased in coronary artery disease patients compared with control normal subjects (Table 5).

Table.5 Lipid profile in Coronary Artery disease

Lipid Profile	Coronary Artery Disease	Control
Total Cholesterol	279.69 ± 27.5**	168.85±16.7
Triglycerides	185.76 ± 18.9**	115.65 ± 11.8
HDL	35.9 ± 4.2*	55.6±5.8
LDL	144.8±15.6**	56.72 ± 6.1
VLDL	45.61±4.62*	30.7 ±3.2

*, ** indicates statistical significance at $p<0.01$ and $p<0.001$, respectively.

hsCRP Level in Coronary Artery disease

In this study, 37 cases had hsCRP in the range of 1 – 3mg/L and 6 cases were > 3mg/L as compared to the control group which had 36 subjects with values < 1mg/L and 14 in the range of 1 – 3mg/L. Serum hsCRP levels was significantly increased in coronary artery disease patients when compared with control subjects (Table 6).

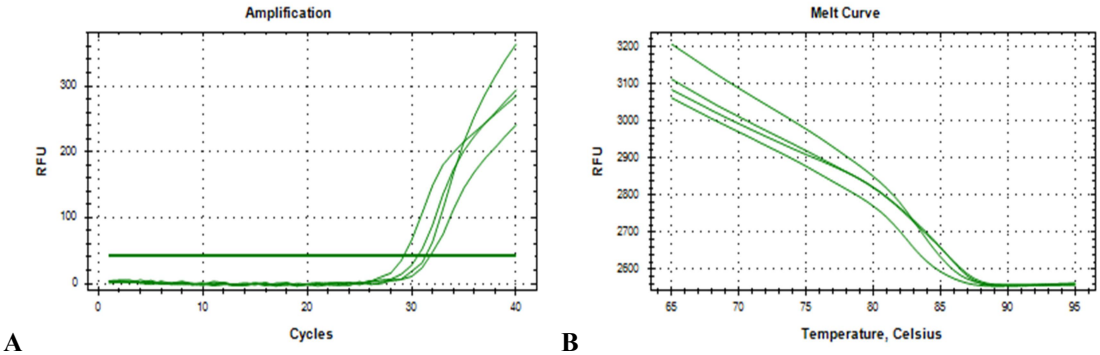
Table.6 hsCRP Level in coronary Artery disease

Particulars	Coronary Artery Disease	Control
hsCRP (mgs/L)	3.8 ± 0.35**	0.5 ± 0.01

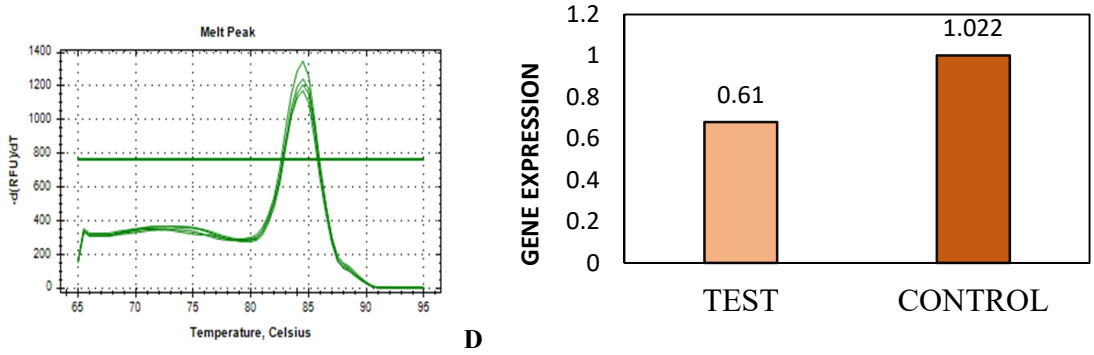
** indicates statistical significance at $p<0.001$.

VEGF Gene Expression

Figure 1 shows that the VEGF gene expression in coronary artery disease patients. In the present study shows that the coronary artery disease patients VEGF gene expression were significantly ($p<0.001$) decreased when compared with control normal healthy subjects.



A **B**



C D

Figure 1: A; Amplification Curve, B; Melting curve, C; Melting peak curve, D; Relative Intensity of VEGF mRNA level. Expression of VEGF mRNA Expression level in Coronary Artery Disease.

Discussion

In this study 50 patients diagnosed as coronary artery disease by ECG, Echocardiogram, and cardiac enzymes who satisfied the inclusion and exclusion criteria were taken as cases and 50 age and sex matched controls satisfying the exclusion criteria were taken as controls, cardiac and clinical profile was assessed in both groups and a correlation was made between clinical profile, Lipid profile and Hs-CRP. The study was carried out for 6 months from January 2025 to June 2025.

The mean age of case was 51.24 ± 7.89, mean age of control was 52.18 ± 7.36 majorities of cases were > 40yrs of age. There was a female preponderance in the study with 34(68%) females and 16(32%) male, as smokers were excluded based on the exclusion criteria.

The mean BMI of cases and control were 26.11±1.35 and 25.16±1.48 respectively. The correlation between BMI of cases and control was statistically significant ($p<0.001$), similar results have been published by The Framingham Offspring Study.[16] There was a statistically significant correlation between BMI and Hs-CRP, $p<0.001$ by applying Kendal`s tau equation. BL Preeti et al demonstrated similar results correlating BMI and Hs-CRP.[17]

Lipid profile in CAD

The mean value of T. cholesterol was high in cases as compared to controls, and was statistically significant, $p<0.001$. In a study done by Scudeler et al.[18] there was strong association between CAD and hypercholesterolemia. Comparing HDLc, LDLc, VLDLc and TGL between cases and controls, there was no significant correlation except for LDLc which was statistically significant $p<0.002$. In line with the present study case control studies reported within India have also reported high total cholesterol , HDL cholesterol and triglyceride levels in patients suffering from CAD. Vashist et al. from Delhi studied 702 clinically documented CAD and 186 normal healthy controls and reported that total LDL cholesterol, and triglyceride levels were significantly higher in cases while HDL cholesterol level was not different.[19]

Rajeev Gupta et al from Delhi, Pradeepa et al from Madras, and Kaur et al from Chandigarh[20] have reported that total cholesterol levels were 20-40% more in patients with CHD compared to the hospital-based controls ($p<0.05$).

Hs-CRP in CAD

In the present study 43 cases had Hs-CRP> 1mg/L as compared to 14 controls. Among the 43 cases, 6 had Hs-CRP values > 3mg/L. The mean Hs-CRP levels was higher among cases compared to control, and it was statistically significant ($p<0.001$). This data suggests a strong correlation between high Hs-CRP and CAD. Various studies done across the world have projected similar results. Sabatine et al.[21] measured Hs-CRP in 3771 patients with stable coronary artery disease, Patients were followed up for a median of 4.8 years for cardiovascular death, myocardial infarction, or stroke.

After adjustment for baseline characteristics and treatments, higher Hs-CRP levels, even >1 mg/L, were associated with a significantly greater risk of cardiovascular death, myocardial infarction, or stroke (Hs-CRP 1

to 3 mg/L: adjusted hazard rat io, 1.39; 95% CI, 1.06 to 1.81; *P*=0.016; Hs-CRP>3 mg/L: adjusted hazard ratio, 1.52; 95% CI, 1.15 to 2.02; *P*=0.003).

Taniguchi et al.[22] studied the associations of plasma C-reactive protein levels with the presence and extent of coronary stenosis in patients with stable coronary artery disease. They investigated the association between Hs-CRP levels and the extent of coronary stenosis in 273 patients undergoing elective coronary angiography. Plasma Hs-CRP levels were higher in patients with CAD than in those without CAD (0.70 mg/ l versus 0.56 mg/ l, *P*< 0.02).

Tanveer, 2016[23] in their study on men with angiographically documented CHD, there was a highly significant (p<0.0001) difference in CRP values between cases and controls. Mean CRP value among cases was 3.4 mg/ l as compared to 1.5 mg/ l among controls.

Lipid profile and Hs-CRP in CAD

In the present study, there was a statistically significant correlation between Hs-CRP and T.Cholesterol (p<0.001), TGL (p<0.005), LDLc (p<0.004) and VLDLc (p<0.007). There was no statistically significant correlation of Hs-CRP with HDLc. Habib & Masri demonstrated that CAD patients had significantly higher Hs-CRP levels and higher TGL than controls.[24] Linear regression analysis between Hs-CRP and CAD severity determined by Gensini scores showed a significant positive correlation (r=0.423, p=0.018).

Chianeh et al[25]studied Hs-CRP and the Lipid profile parameters in thirty two patients who visited the Kasturba Hospital, Manipal. The results obtained indicate a strong significant positive correlation of total cholesterol (p value =0.0001) and triglycerides (p value= 0.023) with HS-CRP.

Li et al[26] concluded that Hs-CRP, total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL) levels, were found significantly high in coronary heart disease patients as compared to heal thy subjects. Therefore these biomarkers may be useful in diagnosis of coronary heart disease.

VEGF Gene expression

Vascular endothelial growth factor (VEGF) is essential for angiogenesis, forming new blood vessels from existing ones, and disruptions in VEGF signaling can significantly impact this process, contributing to various cardiovascular diseases. Such disruptions may stem from factors like genetic mutations, inflammation, hypoxia, obesity, and metabolic disorders. For instance, mutations in VEGF or its receptors can hinder normal signaling pathways, resulting in diminished angiogenic responses. Additionally, chronic inflammation can modify VEGF expression and receptor sensitivity, affecting the angiogenic process to form coronary artery disease. Although hypoxia usually stimulates VEGF production, prolonged or severe hypoxic conditions can lead to dysfunctional angiogenesis as compensatory mechanisms become impaired. Furthermore, obesity and metabolic disorders can disrupt the normal production and function of VEGF, compromising vascular health and angiogenesis.[27]

In this study, we observed that VEGF mRNA expression was significantly decreased in Peripheral Blood Mononuclear Cell from individuals with coronary artery disease compared to those healthy individuals. Our reports were in line with Bates et al. in 2010, the study examined the impact of coronary artery disease (CAD) on human coronary microvascular responses to vascular endothelial growth factor (VEGF) in 48 patients. Results showed that VEGF reduced in microvessels from CAD patients. These findings may have implications for the efficacy of endogenous and exogenous VEGF in patients with CAD risk factors. Additinally, Study by Amoli et al. in 2012 the study examined the expression of vascular endothelium growth factor (VEGF) mRNA in peripheral blood mononuclear cells of patients with and without coronary artery disease (CAD). It found that VEGF mRNA expression decreased in CAD+ patients.[29] VEGF expression influence by microvessel alteration in individuals undergoing coronary angiography due to chest pain. Impaired VEGF signaling can exacerbate ischemic heart disease by resulting in insufficient angiogenesis, leading to myocardial infarction and coronary artery disease due to inadequate blood supply, which compromises heart function.

Conclusion:

In atherosclerosis, abnormal angiogenesis contributes to plaque instability, as inflammatory cytokines can alter VEGF expression and promote unstable neovascularization within plaques, increasing the risk of rupture and thrombus formation. In coronary artery disease, inadequate angiogenesis and reduced blood flow leads to further cardiac remodeling and dysfunction, as insufficient vascularization hampers effective tissue repair. Additionally, disrupted VEGF signaling in peripheral vascular disease results in inadequate blood supply to peripheral tissues,

causing conditions such as claudication and critical limb ischemia, which may necessitate surgical intervention[30].

References

1. Ritchey MD, Wall HK, George MG, Wright JS. US trends in premature heart disease mortality over the past 50 years: Where do we go from here? *Trends Cardiovasc Med*. 2020;30(6):364-374. doi:10.1016/j.tcm.2019.09.005
2. Babahajiani M, Zarepur E, Khosravi A, et al. Ethnic differences in the lifestyle behaviors and premature coronary artery disease: a multi-center study. *BMC Cardiovasc Disord*. 2023;23(1):170. Published 2023 Mar 29. doi:10.1186/s12872-023-03192-0
3. Bartlett ES, Flor LS, Medeiros DS, et al. Public knowledge of cardiovascular disease and response to acute cardiac events in three municipalities in Brazil. *Open Heart*. 2020;7(2):e001322. doi:10.1136/openhrt-2020-001322
4. Jafar TH, Qadri Z, Chaturvedi N. Coronary artery disease epidemic in Pakistan: more electrocardiographic evidence of ischaemia in women than in men. *Heart*. 2008;94(4):408-413. doi:10.1136/hrt.2007.120774
5. Schultz WM, Kelli HM, Lisko JC, et al. Socioeconomic Status and Cardiovascular Outcomes: Challenges and Interventions. *Circulation*. 2018;137(20):2166-2178. doi:10.1161/CIRCULATIONAHA.117.029652
6. Reddy KS, Prabhakaran D, Jeemon P, et al. Educational status and cardiovascular risk profile in Indians. *Proc Natl Acad Sci U S A*. 2007;104(41):16263-16268. doi:10.1073/pnas.0700933104
7. Abernethy TJ, Avery OT. The occurrence during acute infections of protein not normally present in the blood. First distribution of the reactive protein in patients sera and the effect of calcium ions on the flocculation reactive with C-polysaccharide of pneumococcus. J Exp Med 1941; 73-173.doi:10.1084/jem.73.2.173
8. Jan B, Dar MI, Choudhary B, Basist P, Khan R, Alhalmi A. Cardiovascular Diseases Among Indian Older Adults: A Comprehensive Review. *Cardiovasc Ther*. 2024;2024:6894693. Published 2024 Jun 25. doi:10.1155/2024/6894693
9. Shinkaruk S, Bayle M, Laïn G, Déléris G. Vascular endothelial cell growth factor (VEGF), an emerging target for cancer chemotherapy. *Curr Med Chem Anticancer Agents*. 2003;3(2):95-117. doi:10.2174/1568011033353452
10. Ridker PM, Hennekens CH, Buring JE, Rifai N. C-reactive protein and other markers of inflammation in the prediction of cardiovascular disease in women. *N Engl J Med*. 2000;342(12):836-843. doi:10.1056/NEJM200003233421202
11. P Trinder. Determination of blood glucose using an oxidase-peroxidase system with a non-carcinogenic chromogen. J Clin Pathol . 1969 Mar;22(2):158–161.
12. Carter T, Wilding P. Factors involved in the determination of triglycerides in serum: An international study. Clin Chim Acta.1976 ;70:433-447.
13. C C Allain, L S Poon, C S Chan, W Richmond, P C Fu. Enzymatic determination of total serum cholesterol. Clin Chem. 1974 Apr; 20(4):470-5.
14. Amirchaghmaghi E, Rezaei A, Moini A, Roghaei MA, Hafezi M, Aflatoonian R. Gene expression analysis of VEGF and its receptors and assessment of its serum level in unexplained recurrent spontaneous abortion. *Cell J*. 2015;16(4):538-545. doi:10.22074/cellj.2015.498
15. Panutsopulos, D., Zafiropoulos, A., Krambovitis, E., Kochiadakis, G. E., Igoumenidis, N. E., & Spandidos, D. A. (2003). Peripheral monocytes from diabetic patients with coronary artery disease display increased bFGF and VEGF mRNA expression. *Journal of Translational Medicine*, *1*(1). https://doi.org/10.1186/1479-5876-1-6
16. Mora S, Yanek LR, Moy TF, Fallin MD, Becker LC, Becker DM. Interaction of body mass index and framingham risk score in predicting incident coronary disease in families. *Circulation*. 2005;111(15):1871-1876. doi:10.1161/01.CIR.0000161956.75255.7B
17. B L Preethi; G Jaisri. RISK STRATIFICATION OF BODY MASS INDEX B L. *Natl J Med Res* **2014**, *4*, 1-6.
18. Scudeler TL, da Costa LMA, Nunes RAB, *et al.* Association between low-density lipoprotein cholesterol levels and all-cause mortality in patients with coronary artery disease: a real-world analysis using data from an international network. *Sci Rep* **14**, 29201 (2024). https://doi.org/10.1038/s41598-024-80578-w
19. Gupta R, Rao RS, Misra A, Sharma SK. Recent trends in epidemiology of dyslipidemias in India. *Indian Heart J*. 2017;69(3):382-392. doi:10.1016/j.ihj.2017.02.020.
20. Anjana RM, Unnikrishnan R, Deepa M, et al. Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). *Lancet Diabetes Endocrinol*. 2023;11(7):474-489. doi:10.1016/S2213-8587(23)00119-5
21. Sabatine MS, Morrow DA, Jablonski KA, et al. Prognostic significance of the Centers for Disease Control/American Heart Association high-sensitivity C-reactive protein cut points for cardiovascular and other outcomes in patients with stable coronary artery disease. *Circulation*. 2007;115(12):1528-1536. doi:10.1161/CIRCULATIONAHA.106.649939

22. Taniguchi H, Momiyama Y, Ohmori R, et al. Associations of plasma C-reactive protein levels with the presence and extent of coronary stenosis in patients with stable coronary artery disease. *Atherosclerosis*. 2005;178(1):173-177. doi:10.1016/j.atherosclerosis.2004.08.012
23. Tanveer S, Banu S, Jabir NR, et al. Clinical and angiographic correlation of high-sensitivity C-reactive protein with acute ST elevation myocardial infarction. *Exp Ther Med*. 2016;12(6):4089-4098. doi:10.3892/etm.2016.3882
24. Habib SS, A Al Masri A. Relationship of high sensitivity C-reactive protein with presence and severity of coronary artery disease. *Pak J Med Sci*. 2013;29(6):1425-1429. doi:10.12669/pjms.296.3302
25. Chianeh Y, Prabhu K, Bhat V, Udupa P, Bagheri A, Baliga S, Chelikani R. High-sensitive C-reactive protein levels in diabetes associated with dyslipidemia. *National Journal of Physiology Pharmacy and Pharmacology.* 2016. *6*(5), 480. https://doi.org/10.5455/njppp.2016.6.0615715072016
26. Li J, Sun H, He R, Qu Y, Yue X. Significance of lipoprotein a and high-sensitivity CRP combined assay in diagnosing coronary heart disease and their relationship with coronary lesion severity. *Am J Transl Res*. 2025;17(1):645-651. Published 2025 Jan 15. doi:10.62347/CTSP7747
27. di Somma M, Vliora M, Grillo E, et al. Role of VEGFs in metabolic disorders. *Angiogenesis*. 2020;23(2):119-130. doi:10.1007/s10456-019-09700-1
28. Bates D. O. Vascular endothelial growth factors and vascular permeability. Cardiovascular Research. 2010;87(2):262–271. doi: 10.1093/cvr/cvq105.
29. Amoli, M. M., Amiri, P., Alborzi, A., Larijani, B., Saba, S., & Tavakkoly-Bazzaz, J. (2012). VEGF gene mRNA expression in patients with coronary artery disease. *Molecular biology reports*, *39*(9), 8595–8599. https://doi.org/10.1007/s11033-012-1713-x
30. Han J, Luo L, Marcelina O, Kasim V, Wu S. Therapeutic angiogenesis-based strategy for peripheral artery disease. *Theranostics*. 2022;12(11):5015-5033. Published 2022 Jun 27. doi:10.7150/thno.74785