pISSN:2349-5707 Volume:13,Issue 3, March -2026 eISSN:2349-5715

THE PATHOGENESIS AND PROGRESSION OF ATHEROSCLEROSIS

Department of Propedeutics of internal diseases for the Faculty of Pediatrics
Assistant
Primkulova G.N.
Andijan State Medical Institute

Abstract: The increasing prevalence of modifiable risk factors such as unhealthy diets, lack of physical activity, psychosocial stress, and insufficient sleep is a significant concern for cardiovascular health. These factors contribute to chronic inflammation, which plays a crucial role in the development of atherosclerosis, the buildup of plaques in the arteries. This condition can lead to serious cardiovascular events like myocardial infarction (heart attack) and stroke. It is essential to address these risk factors through lifestyle changes and interventions that promote healthy eating, regular exercise, stress management, and adequate sleep. By doing so, individuals can significantly reduce their risk of cardiovascular disease and improve their overall health. Atherosclerosis is a complex process influenced by various modifiable risk factors that can lead to serious cardiovascular events such as myocardial infarction and stroke. Recent insights have highlighted the significance of factors like diet, exercise, and stress management in mitigating the progression of atherosclerosis. Inflammation plays a pivotal role in the development of atherosclerotic plaques, and conditions such as dyslipidemia and hypertension are key contributors to this inflammatory process. Studies have shown that an unhealthy diet, lack of physical activity, psychosocial stress, and insufficient sleep are increasingly prevalent risk factors that exacerbate chronic inflammation within arterial walls, thereby accelerating atherosclerosis. Furthermore, emerging research suggests that novel indicators, including inflammatory parameters like C-reactive protein, blood smear ratios, and uric acid levels, are significant in assessing the complexity of coronary artery disease. Additionally, alterations in microbiota, vitamin D deficiency, and obstructive sleep apnea have also been identified as predictors of disease severity. The interdisciplinary approach to managing these modifiable risk factors, including regular assessment of lipid profiles and monitoring of cardiovascular risks, is crucial for secondary prevention among patients at risk of coronary atherosclerosis progression. It is imperative that healthcare providers incorporate these insights into patient care to improve cardiovascular outcomes. The integration of these recent findings into clinical practice can potentially reduce the incidence of myocardial infarction and stroke, thereby alleviating the global burden of cardiovascular diseases.

Key words: Atherosclerosis; hematopoiesis; macrophages; lifestyle; arteriosclerosis; inflammation;

Hyperlipidemia, characterized by elevated levels of lipids in the blood, is a well-established risk factor for various diseases, particularly cardiovascular diseases. It is increasingly recognized that hyperlipidemia does not act in isolation but interacts with the immune system in ways that can exacerbate disease progression. The immune system, when functioning optimally, serves to protect the body against pathogens and other harmful entities. However, in the presence of hyperlipidemia, the immune response can become maladaptive, contributing to the pathogenesis of diseases. This maladaptive response is often characterized by chronic inflammation, which is a common underlying factor in the development of atherosclerosis, a leading cause of cardiovascular events.Recent insights suggest that the interplay between lipids and the immune system is complex and bidirectional. For instance, certain lipoproteins have been found to modulate immune cell function, influencing the development of atherosclerotic plaques.

pISSN:2349-5707 Volume:13,Issue 3, March -2026 eISSN:2349-5715

Conversely, immune cells can influence lipid metabolism, affecting the levels and types of lipoproteins in circulation. This dynamic relationship means that changes in lipid levels can alter immune responses, and immune responses can, in turn, affect lipid levels, creating a feedback loop that can either protect against or promote disease progression.The innate immune system, in particular, plays a crucial role in this interaction. Innate immunity is the body's first line of defense and involves various cells and mechanisms that respond quickly to potential threats. However, in the context of hyperlipidemia, innate immune cells such as macrophages can take up excess lipids, transforming into foam cells that contribute to the formation of atherosclerotic plaques. Additionally, the activation of inflammatory pathways in response to lipid accumulation can lead to the release of cytokines and other inflammatory mediators that further drive the disease process.Understanding the mechanisms by which hyperlipidemia influences innate immunity is crucial for developing therapeutic strategies[3]. Modulating the immune response to hyperlipidemia has the potential to become a novel approach in treating related diseases. For example, therapies aimed at reducing lipid levels could also have beneficial effects on immune function, while immunomodulatory therapies could potentially influence lipid metabolism and reduce the risk of disease progression.Furthermore, lifestyle interventions such as exercise have been shown to have both lipid-lowering and anti-inflammatory effects, suggesting that they could be an effective strategy for simultaneously addressing hyperlipidemia and maladaptive immune responses. Such interventions could be particularly valuable as they address multiple modifiable risk factors and have the potential to improve overall health outcomes. Macrophages, white blood cells that are part of the innate immune system, are found in large numbers in all healthy organs, where they closely interact with their surroundings79, 80 . During homeostasis, macrophages self-renew through local proliferation, with only a small proportion arising from monocyte recruitment. Macrophages' primary functions involve removing debris and pathogens. Over the past decade, it has become clear that macrophages pursue many additional functions, which depend on their origins, microenvironment and phenotype. For example, macrophages support cardiac conduction by interacting with cardiomyocytes81. Yolk sac-derived embryonic macrophages promote coronary artery development82 and aortic LYVE-1+ macrophages moderate steady-state arterial tone by interfacing with with smooth muscle cells and collagen83. These tasks may be disrupted during inflammatory conditions such as myocardial infarction and atherosclerosis, when local resident macrophages die84 and inflammatory, monocyte-derived macrophages engage with surrounding stromal and immune cells, secreting proinflammatory molecules that contribute to tissue repair or destruction[5]. After myocardial infarction, tissue-resident macrophage numbers and phenotypes also shift in remote, uninjured organs such as the lung, liver, brain and kidney86. Other systemic inflammatory conditions, particularly sepsis, likewise evoke systemic macrophage adaptations that may affect cardiovascular health86. It is largely unknown how lifestyle factors shape resident leukocytes in tissue. The pathogenesis and progression of atherosclerosis are closely linked to inflammatory processes within the arterial wall, where modified lipoproteins are rendered proinflammatory and activate the overlying endothelium[4]. The consequence is a chronic, low-grade immune response that recruits additional leukocytes, including monocyte-derived phagocytes, into the subendothelial space. During atherosclerosis development, increased levels of circulating LDL cholesterol lead to vascular wall deposits, which are taken up by macrophages that then become foam cells. These cholesterol-laden plaque macrophages do not readily remove the lipid material from the vascular wall. Rather, these cells accumulate locally, enhance inflammatory processes and eventually die, contributing to the formation of the necrotic core often seen in ruptured plaques[2,1].

In conclusion, the relationship between hyperlipidemia and the immune system is a critical area of research with significant implications for disease prevention and management. By gaining a deeper understanding of how these factors interact, it may be possible to develop more effective strategies for reducing the risk of adverse events and improving patient outcomes.

pISSN:2349-5707 Volume:13,Issue 3, March -2026 eISSN:2349-5715

Ongoing research in this field continues to uncover new insights that could lead to innovative treatments targeting the nexus of lipid metabolism and immune function. Epidemiology research established a strong correlation between modifiable risk factors and cardiovascular outcomes. Motivated by these clinical data, and by the insight that atherosclerosis is not only a lipid storage but also an inflammatory disease, the field has begun to investigate how lifestyle-related behavior influences pathways that involve immunity. While these studies clarify that leukocyte production and phenotype are shaped by exposure to stress, diet choice and sleep hygiene, to date the uncovered mechanisms have relied on cellular and molecular components well known from work in neuroscience, metabolism, hematology and immunology. Connecting these fields in interdisciplinary teams reveals those cross-cutting pathways. However, the currently known mechanisms are unlikely to be the only important players; rather, they establish a proof-of-principle. The experimental platforms described herein, including sleep disruption, chronic mild stress and voluntary exercise are robust, have been used in their respective fields for multiple years and are straightforward to implement in any laboratory. We posit that these tools can serve as discovery platforms in the search for currently unknown pathways and targets that build resilience against cardiovascular inflammation

References

1. Libby P Inflammation in atherosclerosis. Nature. 2002;420(6917):868–874.

2. Moore KJ, Tabas I. Macrophages in the pathogenesis of atherosclerosis. Cell. 2011;145(3):341–355.

3. Randolph GJ. The fate of monocytes in atherosclerosis. J Thromb Haemost. 2009;7 Suppl 1:28–30.

4. Swirski FK, Nahrendorf M. Leukocyte behavior in atherosclerosis, myocardial infarction, and heart failure. Science. 2013;339(6116):161–166.

5. Ridker PM. Residual inflammatory risk: addressing the obverse side of the atherosclerosis prevention coin. Eur Heart J. 2016;37(22):1720–1722.