Atherosclerosis: Open Access

Kwong, Atheroscler Open Access 2025, 10:1

Rapid Communication Open Access

The Gut-Heart Connection: How Microbiome Health Affects Atherosclerosis

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Introduction

In recent years, the connection between the gut microbiome and cardiovascular health has become an exciting area of research. The gut microbiome the complex community of trillions of bacteria, viruses, fungi, and other microorganisms residing in the digestive tract plays a crucial role in numerous bodily functions, from digestion and immune system regulation to mental health. Emerging studies have revealed that the health of the gut microbiome can influence the development of atherosclerosis, a condition in which plaque builds up in the arteries, increasing the risk of heart disease, stroke, and other cardiovascular issues. In this article, we will explore the fascinating relationship between the gut microbiome and atherosclerosis, shedding light on how an imbalance in gut bacteria may contribute to the progression of arterial disease and the potential for new treatments based on microbiome health [1].

Description

The role of the gut microbiome in overall health

The gut microbiome is home to a diverse population of microorganisms that play vital roles in digestion, nutrient absorption, immune system regulation, and even the production of certain vitamins. A healthy, balanced microbiome helps maintain the integrity of the gut lining, aids in the breakdown of complex carbohydrates, and prevents harmful bacteria from causing infections [2]. It also produces metabolites like short-chain fatty acids (SCFAs), which are essential for the health of the gut lining and for reducing inflammation throughout the body.

However, when the gut microbiome becomes imbalanced often due to factors like poor diet, stress, antibiotics, or environmental toxins the balance of beneficial and harmful bacteria shifts. This imbalance, known as dysbiosis, can have widespread effects on health, including promoting chronic inflammation and disrupting metabolic processes, both of which are closely linked to the development of cardiovascular diseases, including atherosclerosis.

How the gut microbiome contributes to atherosclerosis

Atherosclerosis is characterized by the buildup of fatty plaques on the walls of arteries, which can restrict blood flow and increase the risk of heart attacks and strokes. The development of this condition is influenced by several factors, including cholesterol levels, blood pressure, inflammation, and the health of blood vessel walls. Interestingly, recent research suggests that the gut microbiome plays a critical role in these processes, particularly in how the body processes fats and regulates inflammation [3].

Gut microbiome and lipid metabolism: One of the key ways the gut microbiome impacts atherosclerosis is by influencing lipid metabolism. The microbiome helps to digest certain types of dietary fats, and certain bacterial species can modify bile acids, which play a role in fat digestion and absorption. An imbalance in the gut bacteria can lead to dysregulated lipid metabolism, resulting in higher levels of LDL cholesterol (the "bad" cholesterol) and triglycerides in the bloodstream. Elevated LDL cholesterol contributes to the formation of fatty plaques in the arteries, promoting the development of atherosclerosis [4].

Inflammation and immune system activation: Chronic low-grade inflammation is a significant contributor to atherosclerosis, as it promotes the buildup of plaque in the arteries. The gut microbiome plays a crucial role in regulating inflammation through the gut's interaction with the immune system. A healthy microbiome helps to maintain the balance between pro-inflammatory and anti-inflammatory signals. However, dysbiosis can lead to an overactive immune response, which triggers inflammation and encourages the formation of arterial plaque. Studies have shown that certain gut bacteria can influence the production of inflammatory molecules, such as cytokines, which contribute to the development of atherosclerosis.

Endothelial function and blood vessel health: The endothelium is the thin layer of cells that line the blood vessels and is crucial for maintaining vascular health. It plays an important role in regulating blood flow and blood pressure [5]. An unhealthy microbiome can negatively affect endothelial function, leading to endothelial dysfunction a condition that is commonly seen in the early stages of atherosclerosis. Research has suggested that the metabolites produced by gut bacteria, such as SCFAs, can improve endothelial function and help prevent the damage to blood vessels that leads to plaque buildup.

TMAO (Trimethylamine-N-Oxide) production: One of the most well-documented mechanisms linking the gut microbiome to atherosclerosis is the production of TMAO. Certain gut bacteria are involved in the metabolism of dietary choline (found in foods like eggs, red meat, and dairy) and L-carnitine (found in red meat). These compounds are converted by the gut microbiome into trimethylamine (TMA), which is then converted into TMAO in the liver. High levels of TMAO in the blood have been associated with an increased risk of atherosclerosis, as TMAO promotes cholesterol deposition in the arterial walls and enhances the formation of plaque. Individuals with a higher abundance of TMA-producing bacteria may have an elevated risk of cardiovascular disease, particularly if their diet includes high levels of animal-based products [6].

Gut-heart axis: The gut-heart axis refers to the communication between the gut and the heart through the vagus nerve, which connects

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Received: 02-Jan-2025, Manuscript No. asoa-25-161219; **Editor assigned:** 04-Jan-2025, PreQC No. asoa-25-161219(PQ); **Reviewed:** 18-Jan-2025, QC No. asoa-25-161219; **Revised:** 22-Jan-2025, Manuscript No. asoa-25-161219(R); **Published:** 29-Jan-2025, DOI: 10.4172/asoa.1000300

Citation: Kwong TW (2025) The Gut-Heart Connection: How Microbiome Health Affects Atherosclerosis. Atheroscler Open Access 10: 300.

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the digestive system with the brain and heart. Recent research has indicated that the gut microbiome can influence heart health through this neural pathway. By producing specific metabolites, the microbiome can send signals to the brain that influence heart rate, blood pressure, and even the body's stress response. Inflammation, as a result of microbiome imbalance, can affect this communication, leading to increased risk of atherosclerosis [7].

The potential for microbiome-based treatments

The discovery of the gut-heart connection has opened up exciting new possibilities for preventing and treating atherosclerosis. Researchers are exploring several ways in which manipulating the gut microbiome could potentially reduce the risk of cardiovascular disease:

Probiotics and prebiotics: Probiotics, or beneficial bacteria, and prebiotics, which are food for these beneficial microbes, are being studied for their potential to restore a healthy gut microbiome. By improving the balance of gut bacteria, these interventions could help regulate cholesterol levels, reduce inflammation, and enhance endothelial function, potentially preventing or slowing the progression of atherosclerosis [8].

Dietary changes: A diet rich in fiber, fruits, vegetables, and plant-based foods supports a diverse and healthy gut microbiome. Conversely, diets high in processed foods, red meat, and refined sugars promote dysbiosis. Focusing on foods that nourish beneficial gut bacteria such as fermented foods (e.g., yogurt, kimchi, sauerkraut) and high-fiber foods (e.g., legumes, whole grains) could help improve heart health by promoting a healthier gut microbiome.

Fecal microbiota transplantation (FMT): Although still in the experimental stages, fecal microbiota transplantation (FMT) is being studied as a potential treatment for gut-related conditions. FMT involves transferring healthy gut bacteria from a donor to a patient in an attempt to restore a balanced microbiome. While more research is needed, FMT could one day be a treatment option for patients with cardiovascular risk linked to microbiome imbalance.

Conclusion

The growing body of evidence highlighting the connection between the gut microbiome and atherosclerosis underscores the importance of maintaining a healthy gut for overall cardiovascular health. Dysbiosis, or an imbalance in gut bacteria, can contribute to lipid imbalances, inflammation, endothelial dysfunction, and the production of harmful metabolites, all of which promote the development of atherosclerosis. While much remains to be understood about the gut-heart axis, current research suggests that interventions aimed at improving microbiome health such as dietary changes, probiotics, and potentially fecal transplants could offer promising new approaches for preventing and treating atherosclerosis. By taking steps to support gut health, individuals may be able to reduce their risk of cardiovascular disease and improve their overall well-being.

Acknowledgement

None

Conflict of Interest

None

References

1. Johnson BD, Shaw LJ, Buchthal SD, Bairey Merz CN, Kim HW, et al. (2004) Prognosis in women with myocardial ischemia in the absence of obstructive coronary disease: Results from the National Institutes of Health-National Heart, Lung, and Blood Institute-Sponsored Women's Ischemia Syndrome Evaluation (WISE). Circulation 109: 2993-2999.
2. Lin FY, Shaw LJ, Dunning AM, LaBounty TM, Choi JH, et al. (2011) Mortality risk in symptomatic patients with nonobstructive coronary artery disease: A prospective 2-center study of 2583 patients undergoing 64-detector row coronary computed tomographic angiography. J Am Coll Cardiol 58: 510-519.
3. Lichtlen PR, Bargheer K, Wenzlaff P (1995) Long-term prognosis of patients with angina like chest pain and normal coronary angiographic findings. J Am Coll Cardiol 25: 1013-1018.
4. Elgendy IY, Pepine CJ (2019) Heart Failure With Preserved Ejection Fraction: Is Ischemia Due to Coronary Microvascular Dysfunction a Mechanistic Factor?. Am J Med 132: 692-697.
5. Ridker PM, Everett BM, Thuren T, MacFadyen JG, Chang WH, et al. (2017) Antiinflammatory Therapy with Canakinumab for Atherosclerotic Disease. N Engl J Med 377: 1119-1131.
6. Tardif JC, Kouz S, Waters DD, Bertrand OF, Diaz R, et al. (2019) Efficacy and Safety of Low-Dose Colchicine after Myocardial Infarction. N Engl J Med 381: 2497-2505.
7. Sagris M, Antonopoulos AS, Theofilis P, Oikonomou E, Siasos G (2022) Risk factors profile of young and older patients with Myocardial Infarction. Cardiovasc Res 118: 2281-2292.
8. Zanatta E, Colombo C, D'Amico G, d'Humieres T, Dal Lin C, et al. (2019) Inflammation and Coronary Microvascular Dysfunction in Autoimmune Rheumatic Diseases. Int J Mol Sci 20: 5563.