Atherogenic Dyslipidaemia in Diabetes: Burden and Challenges

Ketut Suastika*

Department of Internal Medicine, Faculty of Medicine, Mahasaraswati University, Denpasar, Indonesia. Past-President, Indonesian Society of Endocrinology.

Corresponding Author:
Prof. Ketut Suastika, MD., PhD. Department of Internal Medicine, Faculty of Medicine, Mahasaraswati University. Jl. Kamboja No.11 A, Dangin Puri Kangin, Denpasar, Bali 80236, Indonesia. Past-President, Indonesian Society of Endocrinology. Email: ksuas@yahoo.com; ksuastika@unmas.ac.id.

According to the most recent IDF Atlas (2025), the prevalence of diabetes is on the rise in nearly all nations around the globe. A significant surge has been observed in regions such as the Middle East and North Africa, as well as Southeast Asia. When examining the adult population with diabetes, four out of the five most populous nations are located in Asia: China, India, the United States, Pakistan, and Indonesia.[1] Atherogenic dyslipidemia, also known as atherogenic lipoprotein, is a dyslipidemia phenotype commonly linked to cardiovascular diseases, predominantly found in individuals with insulin resistance, including those with obesity, metabolic syndrome, and type 2 diabetes (T2DM). Atherogenic dyslipidemia is marked by alterations in metabolism and lipid profiles, including elevated levels of triglyceride (TG)-rich lipoproteins, reduced levels of high-density lipoprotein cholesterol (HDL-C), the buildup of remnant lipoproteins, an increased quantity of small-dense low-density lipoprotein cholesterol (sdLDL) particles, and postprandial hyperlipidemia.[2]

A study conducted on diabetic patients in both primary and secondary care settings in Indonesia revealed that 60% of those affected (834 out of 1390) had dyslipidemia, and 74% (617 out of 834) were treated with hypolipidemic medications.[3] In a population survey involving 1840 individuals led by Suastika et al. in Bali, Indonesia, it was discovered that 79% of diabetic subjects had elevated LDL-C levels (≥ 100 mg/dL), 85.2% exhibited high non-HDL-C levels (≥ 130 mg/dL), 80% had increased ApoB levels (≥ 90 mg/dL), 42.2% had sdLDL (LDL-C/ApoB < 1.2), 34.9% showed low HDL levels (less than 40 mg/dL for men and less than 50 mg/dL for women), and 46.7% had high triglyceride levels (≥ 150 mg/dL). Overall, dyslipidemia is more prevalent in diabetic individuals compared to those with prediabetes and those with normal subjects.[4] Insulin plays a crucial role as a hormone in managing lipoprotein metabolism within the body. Insulin resistance, especially in type 2 diabetes mellitus (T2DM), significantly contributes to the emergence of dyslipidemia among individuals with this condition. The relationship between insulin resistance and the onset and mechanisms of atherogenic dyslipidemia has been thoroughly examined in reviews by Hirano[5] and Tomlinson et al.[6]

Beyond atherosclerotic cardiovascular disease (ASCVD), T2DM is linked to various other cardiac conditions, including heart failure and diabetic cardiomyopathy. These issues are typically related to hyperinsulinemia, resistance to insulin, and inflammation in individuals with T2DM.[7] In the SPRINT study, 11.3% (1095 out of 9361) of participants had atherogenic dyslipidemia, which correlated with a higher risk of cardiovascular disease (CVD) outcomes. Throughout the 3.8-year follow-up, 726 participants experienced a combination of major CVD events as the primary aim of the study. The occurrence of the primary outcome

among subjects with atherogenic dyslipidemia was recorded at 9.5%.[8] The TG/HDL-C index, derived by dividing TG by HDL-C, serves as an indicator of atherogenic dyslipidemia, has been utilized as a predictor of CVD events in individuals with T2DM in research conducted by Nakashima et al. This study revealed that during a median follow-up of 36.8 months, the incidence of CVD events was significantly greater among those with a high TG/HDL-C index (≥2.5) compared to those with a low index (<2.5) (HR 1.89, 95% CI 1.45–2.47, $p < 0.001$).[9] The atherogenic index of plasma (the logarithm of the TG/HDL-C ratio), another marker of atherogenic dyslipidemia in T2DM, can also aid in predicting complications of diabetic kidney disease[10] and diabetic retinopathy[11] in individuals with T2DM.

In atherogenic dyslipidemia, which is associated with both primary and secondary prevention of CVD, the main goal of therapy is to reduce cholesterol levels in the plasma, specifically in LDL and remnant lipoprotein particles. In addition to lifestyle changes, commonly prescribed lipid-lowering medications to decrease plasma cholesterol include statins, ezetimibe, bempedoic acid, and PCSK9 inhibitors, used either individually or in combination as necessary. After reaching the desired cholesterol levels, if triglyceride levels remain elevated between 150-499 mg/dL, eicosapentaenoic acid (EPA) may be introduced.[12-14]

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 11th Edition 2025. diabetesatlas.org. ISBN: 978-2-930229-96-6.
2. Lorenzatti A, Toth PP. New perspectives on atherogenic dyslipidaemia and cardiovascular disease. *Eur Cardiol Rev* 2020;15:e04. DOI: https://doi.org/10.15420/ecr.2019.06.
3. Soewondo P, Soegondo S, Suastika K, Pranoto A, Soeatmadji DW, Tjokroprawiro A. The DiabCare Asia 2008 study – Outcomes on control and complications of type 2 diabetic patients in Indonesia. Med J Indones. 2010;19:235-44. https://doi.org/10.13181/mji.v19i4.412.
4. Suastika K, Semadi IMS, Dwipayana IMP, Saraswati MR, Gotera W, Budhiarta AAG, Matsumoto K, Kajiwara N, Taniguchi T. Dyslipidemia in diabetes: a population-based study in Bali. Internat J General Med 2019:12;313–21. http://doi.org/10.2147/IJGM.S215548.
5. Hirano T. Pathophysiology of diabetic dyslipidemia. J Atheroscler Thromb. 2018;25:771-82. http://doi.org/10.5551/jat.RV17023.
6. Tomlinson B, Chan P, Lam CWK. Postprandial hyperlipidemia as a risk factor in patients with type 2 diabetes. Expert Rev Endocrinol Metab. 2020. DOI: 10.1080/17446651.2020.1750949.
7. Giraldo-Gonzalez GC, Roman-Gonzalez A, Cañas F, Garcia A. Molecular mechanisms of type 2 diabetes-related heart disease and therapeutic insights. Int. J. Mol. Sci. 2025;26:4548. https://doi.org/ 10.3390/ijms26104548.
8. Kazibwe R, Jehopio J. Schaich CL, Rikhi R, Mirzai S, Chevli PA, Namutebi JH, Chebrolu S, O'Connor S, Yeboah J, Shapiro MD. Atherogenic dyslipidemia and incident cardiovascular events in high-risk hypertension. Progress Cardiovac 2025. https://doi.org/10.1016/j.pcad.2025.05.006.
9. Nakashima R, Ikeda S, Shinohara K, Matsumoto S, Yoshida D, Ono Y, Nakashima H, Miyamoto R, Matsushima S, Kishimoto J, Itoh H, Komuro I, Tsutsui H, Abe K. Triglyceride/high density lipoprotein cholesterol index and future cardiovascular events in diabetic patients without known cardiovascular disease. Scientific Reports. 2025; 15:9217. https://doi.org/10.1038/s41598-025-92933-6.
10. Zhang Y-Y, Yang X-Y, and Wan Q. Association between atherogenic Index of plasma and type 2 diabetic complications: a cross-sectional study. Front Endocrinol. 2025;16:1537303. Doi: 10.3389/fendo.2025.1537303.
11. Zhang Y, Chen G, and Jing Y. Correlation between the atherogenic index of plasma and risk of diabetic retinopathy. Front Med. 2025;12:1565414. Doi: 10.3389/fmed.2025.1565414.
12. Gaita L, Timar B, Timar R, Fras Z, Gaita D, Banach M. Lipid disorders management strategies (2024) in prediabetic and diabetic patients. Pharmaceuticals. 2024;17:219. https://doi.org/10.3390/ph17020219.
13. American Diabetes Association. Cardiovascular disease and risk management: Standards of care in diabetes—2025. Diabetes Care 2025;48 (Suppl 1): S207–S238. https://doi.org/10.2337/dc25-S010.
14. Patel SB, Wyne KL, Alfreen S, Belalcazar LM, Bird MD, Coles S, Marrs JC, Peng CCH, Pulipati VP, Sultan S, Zilbermint M. American Association of Clinical Endocrinology Clinical Practice Guideline on Pharmacologic Management of Adults with Dyslipidemia. Endocrine Pract 2025; 31: 236-262. http://doi.org/10.1016/j.eprac.2024.09.016.