

Cardiovascular Risk in Patients with Coexisting Diabetes and Hypertension: A Comprehensive Review

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ABSTRACT

Cardiovascular diseases (CVDs) remained the leading cause of morbidity and mortality globally, with diabetes and hypertension serving as significant contributors to this burden. The coexistence of these two chronic conditions (diabetes and hypertension) exacerbated cardiovascular risk through complex pathophysiological interactions, including insulin resistance, endothelial dysfunction, chronic inflammation, and vascular remodeling. This review provided an in-depth analysis of the cardiovascular risks associated with the coexistence of diabetes and hypertension, emphasizing the multifaceted interplay between these conditions. Utilizing a comprehensive literature review and analysis of current clinical practices, the article explored key pathophysiological mechanisms, assessed cardiovascular risk assessment strategies, and evaluated management approaches. Effective management necessitated a combined approach of pharmacological treatment, lifestyle modifications, and integrated care strategies. Future research should focus on novel therapeutic agents and integrated management strategies to enhance our understanding and treatment of these interrelated conditions, aiming to reduce cardiovascular risk and improve patient outcomes.

Keywords: Cardiovascular Risk, Diabetes and Hypertension, Pathophysiological Mechanisms, Risk Assessment, Management Strategies.

INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality globally, with diabetes and hypertension serving as significant contributors to this burden[1]. The coexistence of these two chronic conditions (diabetes and hypertension) represents a particularly concerning clinical scenario due to their compounded effects on cardiovascular health[2]. Both conditions independently increase the risk of cardiovascular events, but their interplay exacerbates this risk, creating a complex challenge for healthcare providers[3]. Diabetes, particularly type 2 diabetes, is characterized by persistent hyperglycemia resulting from insulin resistance and beta-cell dysfunction[4]. This metabolic disorder accelerates the progression of atherosclerosis through mechanisms such as endothelial dysfunction, increased oxidative stress, and chronic inflammation. Hypertension, on the other hand, is defined by consistently elevated blood pressure, which imposes

excessive strain on the cardiovascular system, contributing to endothelial damage, left ventricular hypertrophy, and increased susceptibility to atherosclerotic plaque formation[5]. The convergence of diabetes and hypertension significantly amplifies cardiovascular risk through a multifaceted interplay of pathophysiological processes. Insulin resistance and hyperglycemia associated with diabetes can worsen blood pressure control, while elevated blood pressure exacerbates diabetic complications, creating a vicious cycle that heightens the risk of adverse cardiovascular events[6]. This dual burden challenges traditional management strategies and necessitates a nuanced approach to treatment and risk mitigation. Despite the growing recognition of the increased cardiovascular risk in patients with both diabetes and hypertension, there remains a need for a comprehensive understanding of how these conditions interact and influence patient

outcomes[7]. This review aims to provide an in-depth analysis of the cardiovascular risks associated with the coexistence of diabetes and hypertension. We will explore the shared pathophysiological mechanisms that underlie this increased risk, assess current strategies for risk assessment and

management, and discuss the implications for clinical practice. By highlighting the intricate relationship between these conditions, this review seeks to inform and guide the development of more effective, integrated approaches to managing cardiovascular risk in this high-risk population.

PATHOPHYSIOLOGICAL MECHANISMS

The pathophysiological mechanisms underlying cardiovascular risk in patients with coexisting diabetes and hypertension are complex and interrelated, involving several key processes that exacerbate cardiovascular damage.

Insulin Resistance and Hyperglycemia: In diabetes, insulin resistance leads to elevated blood glucose levels, which contribute to endothelial dysfunction. Chronic hyperglycemia induces oxidative stress and inflammation, damaging the vascular endothelium and promoting atherosclerosis. This damage impairs nitric oxide production, reducing vasodilation and increasing vascular resistance.[7, 8]

Endothelial Dysfunction: Both diabetes and hypertension independently cause endothelial dysfunction, but their coexistence significantly aggravates it. In diabetes, high glucose levels cause oxidative stress and inflammation, while hypertension increases shear stress on the endothelium. This dysfunction results in impaired vascular tone and increased arterial stiffness, further promoting atherosclerosis.

Chronic Inflammation: Chronic low-grade inflammation is a common feature in both conditions. Elevated levels of pro-inflammatory cytokines, such as TNF- α and IL-6, contribute to systemic inflammation, accelerate atherosclerotic plaque formation, and enhance vascular stiffness. This inflammatory environment exacerbates the

cardiovascular risks associated with both diabetes and hypertension.

Increased Sympathetic Nervous System Activity: Hypertension often leads to increased sympathetic nervous system activity, which can be further intensified by insulin resistance. This heightened activity increases heart rate and blood pressure, contributing to increased cardiac workload and further cardiovascular risk.

Renal Dysfunction: Both diabetes and hypertension can lead to renal impairment, which further compounds cardiovascular risk. Diabetes-induced nephropathy and hypertension-related kidney damage both contribute to elevated blood pressure and increased cardiovascular strain. Renal dysfunction also impairs the body's ability to regulate blood pressure and fluid balance.

Vascular Remodeling: Hypertension induces vascular remodeling, characterized by thickening of the arterial walls and increased vascular stiffness. This remodeling process is exacerbated by diabetes, which accelerates atherosclerotic changes and leads to a more rapid progression of vascular damage.

The pathophysiological mechanisms linking diabetes and hypertension to cardiovascular risk involve a synergistic interplay of endothelial dysfunction, chronic inflammation, increased sympathetic activity, and vascular remodeling. [9] Understanding these mechanisms is crucial for developing targeted interventions to manage cardiovascular risk in patients with both conditions.

CARDIOVASCULAR RISK ASSESSMENT

Cardiovascular risk assessment is a critical component in managing patients with coexisting diabetes and hypertension due to their elevated risk of adverse cardiovascular events. Effective risk assessment involves evaluating multiple factors that contribute to cardiovascular disease (CVD) and tailoring interventions accordingly[10]. Several tools and algorithms are used to estimate cardiovascular risk, such as the Framingham Risk Score, ASCVD Risk Calculator, and the European SCORE system[11]. These tools typically incorporate factors such as age, sex, blood pressure, cholesterol levels, smoking status, and diabetes status to estimate the risk of events like heart attack and stroke over a specific period. In patients with

both diabetes and hypertension, these tools are often adjusted to account for the increased baseline risk associated with the dual diagnosis[12]. Diabetes is a major independent risk factor for CVD, significantly increasing the likelihood of coronary artery disease, heart failure, and stroke. Hypertension further compounds this risk by contributing to vascular damage and increasing cardiac workload[13]. The combination of these conditions accelerates atherosclerosis and increases the probability of adverse cardiovascular outcomes. Beyond diabetes and hypertension, other risk factors such as dyslipidemia, obesity, smoking, and family history of cardiovascular disease also play a crucial role. A comprehensive risk assessment should include

evaluating these additional factors to provide a complete picture of a patient's cardiovascular risk profile. Advanced biomarkers, including high-sensitivity C-reactive protein (hs-CRP) and cardiac troponins, can offer insights into inflammatory and cardiac stress levels. Imaging techniques, such as coronary artery calcium scoring and carotid intima-media thickness measurements, can help identify subclinical atherosclerosis and further refine risk estimates.[14, 15] Effective cardiovascular risk assessment in patients with diabetes and hypertension requires an integrative approach that combines traditional risk scores with individual

patient characteristics and advanced diagnostic tools. This holistic assessment aids in identifying high-risk patients and guiding personalized treatment strategies aimed at reducing cardiovascular events. Overall, a thorough cardiovascular risk assessment is essential for optimizing management and improving outcomes in patients with coexisting diabetes and hypertension. By incorporating multiple risk factors and leveraging advanced diagnostic tools, healthcare providers can better stratify risk and tailor interventions to mitigate cardiovascular complications.

MANAGEMENT STRATEGIES

Pharmacological Interventions: Managing cardiovascular risk in patients with diabetes and hypertension requires a careful selection of medications. First-line antihypertensive agents include ACE inhibitors and angiotensin II receptor blockers (ARBs), which offer renal protective benefits and can help in controlling blood pressure and mitigating cardiovascular risk. For diabetes management, medications such as SGLT-2 inhibitors and GLP-1 receptor agonists provide cardiovascular benefits beyond glycemic control. It is essential to monitor for potential drug interactions and side effects, particularly in patients with polypharmacy[16].

Lifestyle Modifications: Lifestyle interventions are pivotal in reducing cardiovascular risk. Dietary changes, such as reducing sodium intake and increasing the consumption of fruits, vegetables, and

whole grains, can help manage both blood pressure and blood glucose levels. Regular physical activity, weight management, smoking cessation, and stress reduction further contribute to cardiovascular health. Patient education and support for behavior change are crucial for the successful implementation of these interventions[17, 18].

Integrated Care Approaches: A multidisciplinary approach involving primary care physicians, endocrinologists, cardiologists, and dietitians is essential for managing patients with diabetes and hypertension. Coordinated care ensures that all aspects of the patient's health are addressed, from glycemic control to blood pressure management and cardiovascular risk reduction. [19] Regular monitoring and adjustment of treatment plans are necessary to achieve optimal outcomes.

CONCLUSION

Diabetes and hypertension pose a significant challenge in managing cardiovascular risk due to their interconnected pathophysiological mechanisms. This dual burden accelerates atherosclerosis, exacerbates endothelial dysfunction, and increases systemic inflammation, leading to an increased risk of adverse cardiovascular events. Effective management requires a multifaceted approach that includes pharmacological interventions, lifestyle modifications, and coordinated care. First-line antihypertensive therapies and diabetes medications

are essential for mitigating risk. Lifestyle changes, including dietary adjustments, physical activity, and behavioral support, also reduce cardiovascular risk. A collaborative care approach involving multidisciplinary teams optimizes patient outcomes. Future research should focus on developing targeted therapies and exploring the long-term efficacy of integrated management strategies. Utilizing emerging technologies for personalized care and continuous monitoring will be crucial for advancing patient care and reducing cardiovascular risk.

FUTURE DIRECTIONS

Future research should explore the development of targeted therapies that address the underlying mechanisms linking diabetes and hypertension. Additionally, investigating the long-term effects of

integrated management approaches and leveraging emerging technologies for monitoring and personalized care will be crucial in advancing patient care and reducing cardiovascular risk.

REFERENCES

1. Uti, D.E., Ibiam, U.A., Omang, W.A., Udeozor, P.A., Umoru, G.U., Nwadium, S.K., Bawa, I., Alum, E.U., Mordi, J.C., Okoro, E.O., Obeten, U.N., Onwe, E.N., Zakari, S., Opotu, O.R., Aja, P.M.: *Buchholzia coriacea* Leaves Attenuated Dyslipidemia and Oxidative Stress in Hyperlipidemic Rats and Its Potential

- Targets in Silico. *Pharmaceutical Fronts*. 05, e141–e152 (2023). <https://doi.org/10.1055/s-0043-1772607>
2. Aja, P.M., Chiadikaobi, C.D., Agu, P.C., Ale, B.A., Ani, O.G., Ekpono, E.U., Ogwoni, H.A., Awoke, J.N., Ogbu, P.N., Aja, L., Nwite, F.E., Ukachi, O.U., Orji, O.U., Nweke, P.C., Egwu, C.O., Ekpono, E.U., Ewa, G.O., Igwenyi, I.O., Tusubira, D., Offor, C.E., Maduagwuna, E.K., Alum, E.U., Uti, D.E., Njoku, A., Atoki, V.A., Awuchi, C.G.: Cucumeropsis mannii seed oil ameliorates Bisphenol-A-induced adipokines dysfunctions and dyslipidemia. *Food Sci Nutr*. 11, 2642–2653 (2023). <https://doi.org/10.1002/fsn3.3271>
 3. Ali, W., Bakris, G.L.: How to Manage Hypertension in People With Diabetes. *American Journal of Hypertension*. 33, 935–943(2020). <https://doi.org/10.1093/ajh/hpaa067>
 4. Anwar, K.R., Badruddeen, Akhtar, J., Khan, M.I., Ahmad, M.: An Outlook on Pathological Pathways of Diabetes and Molecular Mechanisms of Anti-diabetic Phytobioactives. *LFF*. 1, e180723218858 (2023). <https://doi.org/10.2174/2666939001666230718142652>
 5. Owusu, M.F., Basu, A., Barnett, P.: Hypertension and diabetes management: a policy perspective from Ghana. *JHOM*. 33, 35–50 (2019). <https://doi.org/10.1108/JHOM-03-2018-0076>
 6. Liu, X., Yan, L., Xue, F.: The associations of lipids and lipid ratios with stroke: A prospective cohort study. *J Clin Hypertens (Greenwich)*. 21, 127–135 (2018). <https://doi.org/10.1111/jch.13441>
 7. Cook-Huynh, M., Ansong, D., Steckelberg, R.C., Boakye, I., Seligman, K., Appiah, L., Kumar, N., Amuasi, J.: Prevalence of hypertension and diabetes mellitus in adults from a rural community in Ghana. *Ethnicity & disease*. (2012)
 8. Iheagwam, F.N., Iheagwam, O.T., Onuoha, M.K., Ogunlana, O.O., Chinedu, S.N.: Terminalia catappa aqueous leaf extract reverses insulin resistance, improves glucose transport and activates PI3K/AKT signalling in high fat/streptozotocin-induced diabetic rats. *Sci Rep*. 12, 10711 (2022). <https://doi.org/10.1038/s41598-022-15114-9>
 9. Damaskos, C., Garmpis, N., Kollia, P., Mitsiopoulos, G., Barlampa, D., Drosos, A., Patsouras, A., Gravvanis, N., Antoniou, V., Litos, A., Diamantis, E.: Assessing Cardiovascular Risk in Patients with Diabetes: An Update. *CCR*. 16, 266–274 (2021). <https://doi.org/10.2174/1573403X15666191111123622>
 10. Elyamani, R., Soulaymani, A., Serhirer, Z., Hami, H.: Cardiovascular Risk Factors Assessment Among Diabetic and Hypertensive Subjects in Morocco. *Pakistan Heart Journal*. (2020)
 11. Elbasiouny, H., Darwesh, M., Elbeltagy, H., Abo-alhamd, F.G., Amer, A.A., Elsegaïy, M.A., Khattab, I.A., Elsharawy, E.A., Ebehiry, F., El-Ramady, H., Brevik, E.C.: Ecofriendly remediation technologies for wastewater contaminated with heavy metals with special focus on using water hyacinth and black tea wastes: a review. *Environ Monit Assess*. 193, 449 (2021). <https://doi.org/10.1007/s10661-021-09236-2>
 12. Zhang, Y., Miao, H., Chia, Y., Buranakitjaroen, P., Siddique, S., Shin, J., Turana, Y., Park, S., Tsoi, K., Chen, C., Cheng, H., Li, Y., Minh, H.V., Nagai, M., Nales, J., Sison, J., Soenarta, A.A., Sogunuru, G.P., Sukonthasarn, A., Tay, J.C., Teo, B.W., Verma, N., Wang, T., Hoshida, S., Kario, K., Wang, J.: Cardiovascular risk assessment tools in Asia. *J Clin Hypertens (Greenwich)*. 24, 369–377 (2022). <https://doi.org/10.1111/jch.14336>
 13. Anshika, Pandey, R., Singh, L., Kumar, S., Singh, P., Pathak, M., Jain, S.: Plant bioactive compounds and their mechanistic approaches in the treatment of diabetes: a review. *Future Journal of Pharmaceutical Sciences*. (2022)
 14. Leite, L., Matos, P., Leon-Justel, A., Espírito-Santo, C., Rodríguez-Padial, L., Rodrigues, F., Orozco, D., Redon, J.: High sensitivity troponins: A potential biomarker of cardiovascular risk for primary prevention. *Front Cardiovasc Med*. 9, 1054959 (2022). <https://doi.org/10.3389/fcvm.2022.1054959>

15. Arroyo-Espliguero, R., Viana-Llamas, M.C., Silva-Obregón, A., Avanzas, P.: The Role of C-reactive Protein in Patient Risk Stratification and Treatment. *Eur Cardiol.* 16,e28(2021).
<https://doi.org/10.15420/ecr.2020.49>
16. Martins, E.B., Lima, E.G., Pitta, F.G., Carvalho, L.N.S., Queiroz, T.D.D., Serrano Júnior, C.V.: Pharmacological therapy and cardiovascular risk reduction for type 2 diabetes. *Rev. Assoc. Med. Bras.* 66, 1283–1288(2020). <https://doi.org/10.1590/1806-9282.66.9.1283>
17. Correia, E.T.D.O.: Lifestyle Medicine Interventions to Manage Hypertension in Brazilian Patients With Type 2 Diabetes. *American Journal of Lifestyle Medicine.* 15598276231197619(2023).
<https://doi.org/10.1177/15598276231197619>
18. Wilcox, T., De Block, C., Schwartzbard, A.Z., Newman, J.D.: Diabetic Agents, From Metformin to SGLT2 Inhibitors and GLP1 Receptor Agonists. *Journal of the American College of Cardiology.* 75, 1956–1974 (2020).
<https://doi.org/10.1016/j.jacc.2020.02.056>
19. Dhindsa, D.S., Sandesara, P.B., Shapiro, M.D.: The Intersection of Diabetes and Cardiovascular Disease—A Focus on New Therapies. *Front. Cardiovasc. Med.* 5, 160 (2018).
<https://doi.org/10.3389/fcvm.2018.00160>

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