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Editorial Comment

Potential Biomarkers in Chronic Kidney Disease Related Atherosclerosis

Chao-Liang Chou [a,b] *

[a] *Department of Neurology, MacKay Memorial Hospital, Taipei, Taiwan,* [b] *Department of Medicine, MacKay Medical College, New Taipei City, Taiwan*

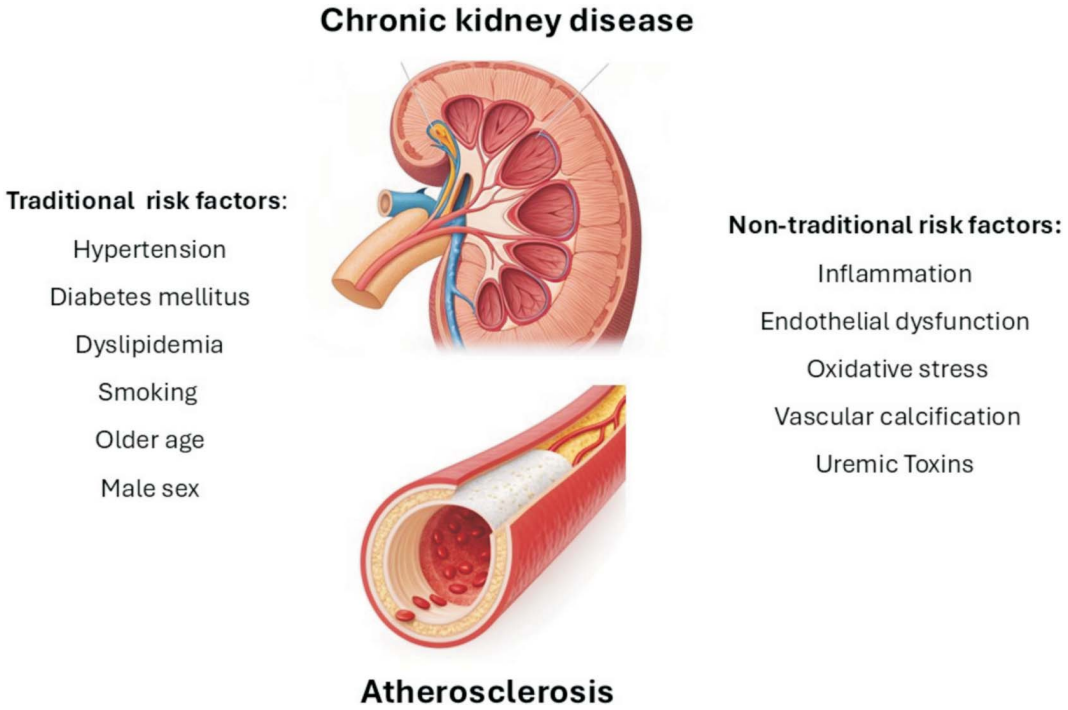

Figure 1. Risk factors contribute to atherosclerosis in CKD patients.

Corresponding Author.
Chao-Liang Chou
Department of Neurology,
MacKay Memorial Hospital,
Taipei, Taiwan.
E-mail address:
chaoliangchou@gmail.com

Chronic kidney disease (CKD) is a major independent risk factor for atherosclerosis.[1] It triggers multiple pathological processes that accelerate vascular disease, making CKD patients highly vulnerable to cardiovascular complications. Managing CKD aggressively — controlling blood pressure, reducing inflammation, and correcting metabolic imbalances — is crucial to slowing down atherosclerosis and reducing cardiovascular risk.

Traditional risk factors (Figure 1) contributing to the development of atherosclerosis in individuals with CKD include hypertension, dyslipidemia, diabetes mellitus, smoking, older age, and male sex.[2] In addition to these, there are several non-traditional risk factors specific to CKD-induced atherosclerosis, which play a critical role in inflammation, endothelial dysfunction, oxidative stress, and vascular calcification.[3] The most important biomarkers include:[4]

1. Inflammatory biomarkers

C-reactive protein (CRP) – Elevated in CKD and predicts cardiovascular events.

Interleukin-6 (IL-6) – A pro-inflammatory cytokine linked to endothelial dysfunction and plaque formation.

Tumor necrosis factor-alpha (TNF-α) – Promotes inflammation and vascular damage.

2. Oxidative stress biomarkers

F2-isoprostanes – Indicators of lipid peroxidation and oxidative stress.

Malondialdehyde (MDA) – A marker of oxidative damage to cell membranes.

3. Endothelial dysfunction biomarkers

Asymmetric dimethylarginine (ADMA) – Inhibits nitric oxide (NO) production, leading to reduced vasodilation and endothelial dysfunction.

Endothelin-1 (ET-1) – A vasoconstrictor that contributes to hypertension and arterial stiffness.

4. Vascular calcification & bone-mineral metabolism biomarkers

Fibroblast growth factor 23 (FGF-23) – Increased in CKD, linked

to vascular calcification and cardiovascular risk.[5]

Phosphate (PO_4^{3-}) & Calcium (Ca^{2+}) – High phosphate levels in CKD contribute to vascular calcification.

Parathyroid hormone (PTH) – Dysregulated in CKD, promoting arterial calcification.

Matrix Gla Protein (MGP) – An inhibitor of vascular calcification that becomes dysfunctional in CKD.[6]

Sclerostin-secreted by osteocytes, has been linked to increased vascular calcification and cardiovascular events, especially in CKD, osteoporosis, and aging populations.[7]

5. Uremic toxins & metabolic biomarkers

Indoxyl sulfate & p-cresyl sulfate – Uremic toxins that cause endothelial damage and inflammation.

Lipoprotein(a) – Elevated in CKD, associated with atherosclerosis risk.

Homocysteine – Increased in CKD and linked to endothelial dysfunction and thrombosis.

Conclusion

Managing these factors — such as reducing phosphate levels, controlling inflammation, and addressing uremic toxins — may help mitigate cardiovascular risks. Future research should focus on novel biomarkers, therapeutic targets, and molecular mechanisms to improve early detection, prevention, and treatment.

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