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Graphene quantum dots suppress kidney fibrosis by affecting the pericytes damage in chronic kidney disease.

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Objectives: Renal pericytes are important in the pathogenesis of kidney disease. They are key to vascular survival and contribute to glomerular and interstitial fibrosis. Graphene quantum dots (GQDs) are novel nanomaterials with excellent biocompatibility; they provide anti-oxidation, inhibition of inflammatory response and regulation of immune function. This study demonstrates that GQDs can inhibit pericyte damage, thereby suppressing the occurrence of renal fibrosis and inhibiting the process of chronic kidney disease.

Methods: Unilateral ischemia-reperfusion injury (UIRI) was induced in 7- to 8-wk-old male wild-type C57BL6 mice. GQDs were injected in kidney fibrosis models through the tail vein. Kidney histopathological examination was performed using Masson's trichrome staining, and pericyte detection in tissue by immunofluorescence. TGF-β1 was used in vitro experiments to induce pericyte injury. Western blot analysis was used to detect the expression of fibrotic markers.

Results: Histopathological examination showed that GQDs treatment significantly attenuated interstitial fibrosis in UIRI models. GQDs administration significantly reduced the expression of α-smooth muscle actin, collagen I, fibronectin, TGF-β1, and Bax, while increasing the expression of E-cadherin, smad7, and bcl2. In addition, the expression of PDGFR in the UIRI group was significantly increased compared to the control group, however its overlap with NG2 was significantly less and isolated from the endothelial cells in comparison to the normal group. Relative to the UIRI group, the expression of PDGFR was significantly decreased after GQDs treatment, and the overlap of PDGFR and NG2 was increased. Pericytes were observed closer to the endothelial cells. TGF-β1 was used in vitro experiments to induce pericyte damage, increasing the expression of a-SMA and collagen 1a1 compared to the control group. Dose-dependent decrease of the above fibrotic markers was evident after GQDs treatment at various concentrations.

Conclusions: We found that non-toxic doses of GQDs reduce pericyte damage, thus playing an important role in anti-fibrotic processes.