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Effect of graphene-based nanomaterials treatment in kidney fibrosis

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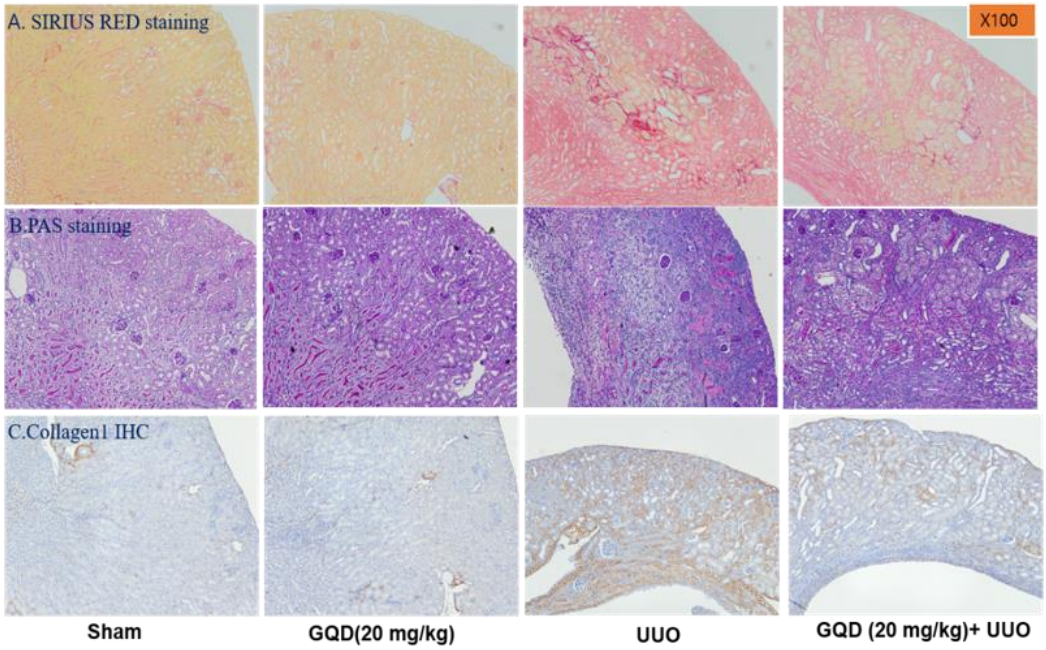
Objectives: Graphene derivatives - Graphene quantum dots (GQDs) have drawn much attention for its biomedical applications, such as bioimaging, drug delivery, gene delivery, and tissue engineering. At present, the role of GQDs in fibrotic diseases remains unclear. Fibrosis is a common pathological feature in most kinds of chronic kidney disease (CKD). Therefore, in this study, we aim to further determine whether GQDs can attenuate renal fibrosis by reducing tubulointerstitial injury in the CKD and in the progression of acute kidney injury to kidney fibrosis.

Methods: Unilateral ureteral obstruction (UUO) and unilateral ischemia-reperfusion injury (UIRI) were induced in 7- to 8-wk-old male wild-type C57BL6 mice. GQDs were injected in both kidney fibrosis models through the tail vein. Histopathological examination was performed on the kidneys using Masson's trichrome stain, Sirius red stain, PAS stain and immunohistochemistry. TGF-β1 was used in vitro experiments to induced human kidney primary tubule epithelial cells. Real-time PCR and western blot analysis were used to detect the expressions of related molecules.

Results: Histopathological examination showed that GQDs treatment significantly attenuated interstitial fibrosis in the both kidney disease models. GQDs administration significantly reduced the expression of α-smooth muscle actin, collagen I, and fibronectin, however, it increased the expression of E-cadherin. In addition, GQDs also significantly reduced TGF-β1 and p-Smad2/3, on the other hand increased the expression level of Smad7.

Conclusions: GQDs may protect against kidney fibrosis by inhibition of TGF-β1/Smad signaling pathway.

Figure: A.SIRIUS RED staining; B.PAS staining; C.Collagen1 IHC of kidney tissue


A. SIRIUS RED staining
X100
B.PAS staining
C.Collagen1 IHC
Sham
GQD(20 mg/kg)
UUO
GQD (20 mg/kg)+ UUO