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Application of Macrophage Cell Membrane Encapsulated Poly(Ferulic Acid) Nanoparticle Drug Delivery System in Acute Kidney Injury

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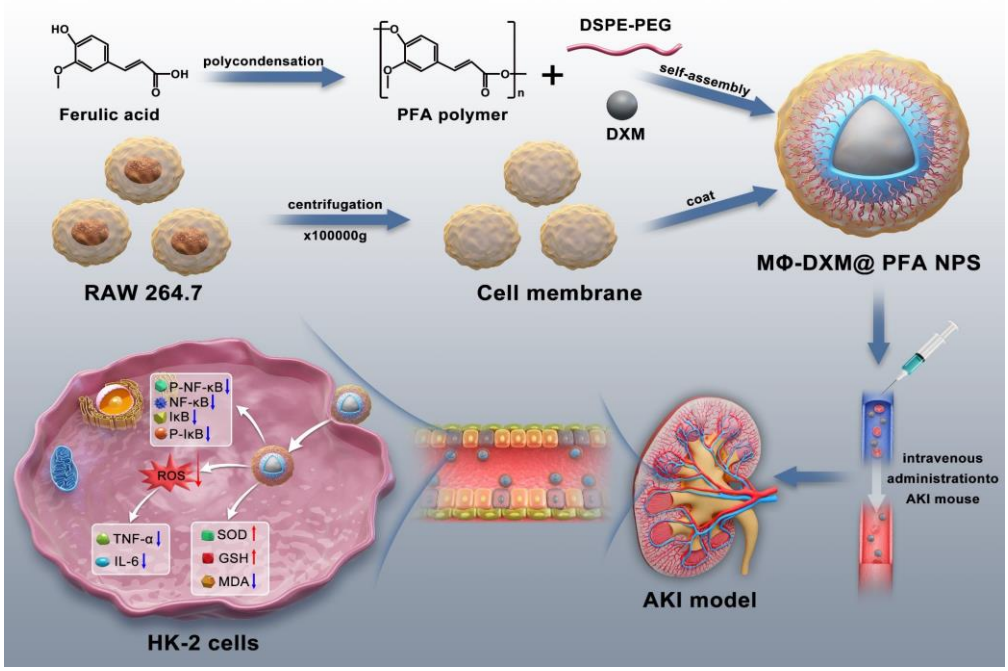
Objectives : Acute kidney injury (AKI) is the most common and serious complication of sepsis, with high mortality and heavy disease burden. Developing nanomedicine delivery platforms with efficacy targeting high renal accumulation is an emerging strategy for the prevention and treatment of AKI. A novel therapeutic nano drug delivery system based on polyferulic acid (PFA) was constructed to realize effective loading and controlled release of drugs (dexamethasone, DXM).Macrophage cell membrane(MΦ) coated drug delivery material (MΦ-DXM@PFA NPs) was used to target the site of inflammation while neutralizing endotoxins and pro-inflammatory cytokines for the treatment of septic AKI.In addition, DXM and PFA can play a synergistic therapeutic role.
Methods : A therapeutic polymer, poly (Ferulic Acid) (PFA), was prepared by polymerizing biologically active ferulic acid (FA). the prepared PFA was prepared into nanoparticles (PFA NPs) by nano-precipitation method, and the DXM was encapsulated to form PFA NPs loaded with DXM (DXM@PFA NPs). The final biomimetic nanoparticle (MΦ-DXM@PFA NPs) was obtained by co-extruding DXM@PFA NPs and MΦ through a porous polycarbonate membrane.MΦ-DXM@PFA NPs was then characterized and evaluated for efficacy.
Results : We have successfully constructed a novel therapeutic nano drug delivery system based on PFA materials to achieve effective loading and controlled release of DXM. For the first time, macrophage cell membrane was combined with therapeutic functional nanocarrier PFA. A biomimetic nanodrug delivery system (MΦ-DXM@PFA NPs) with targeting and therapeutic functions was preliminatively developed. This study further demonstrated the anti-inflammatory and antioxidant effects of macrophage cell membrane and PFA in septic AKI and its mechanism.
Conclusions : MΦ-DXM@PFA NPs, a biomimetic polymer nanoplatform with both targeting and multiple therapeutic properties, provides a new therapeutic strategy for AKI.

Illustration.jpg


Ferulic acid
polycondensation
PFA polymer
DSPE-PEG
DXM
self-assembly
MΦ-DXM@ PFA NPS
RAW 264.7
centrifugation
x100000g
Cell membrane
coat
intravenous
administrationto
AKI mouse
AKI model
P-NF-κB
NF-κB
IκB
P-IκB
ROS
TNF-α
IL-6
SOD
GSH
MDA
HK-2 cells