Tocilizumab-Conjugated Polymer Nanoparticles for NIR-II Photoacoustic Imaging-Guided Therapy of Rheumatoid Arthritis

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Introduction

The progressive debilitating nature of rheumatoid arthritis (RA) combined with its unknown etiology and initial similarity to other inflammatory diseases makes early diagnosis a significant challenge. Early recognition and treatment of RA is essential for achieving effective therapeutic outcome. NIR-II photoacoustic (PA) molecular imaging (PMI) is emerging as a promising new strategy for effective diagnosis and treatment guidance of RA, owing to its high sensitivity and specificity at large penetration depth. Hence, FDA approved antirheumatic targeted drug tocilizumab (TCZ) is conjugated to polymer nanoparticles in this study to develop the first theranostic NIR-II nanoplatform named TCZ-PNPs for early diagnosis and NIR-II PA imaging-guided therapy of RA.

Methods

![Diagram of Tocilizumab-Conjugated Polymer Nanoparticles](image)

**Fig. 1** FDA approved antirheumatic targeted drug tocilizumab (TCZ) was conjugated to polymer nanoparticles to develop TCZ-PNPs for the NIR-II PA imaging-guided therapy of RA.

Results and Conclusions

![MAP PA/US images of forepaws](image)

**Fig. 2** MAP PA/US images of forepaws in Normal_TCZ-PNPs, RA model_PNPs and RA model_TCZ-PNPs groups.

![Representative PA images and corresponding statistical data](image)

**Fig. 3** (a and b) Representative PA images and corresponding statistical data of forepaws in saline- (normal and RA model), TCZ-, PNPs-, TCZ-PNPs-treated groups. (c) Representative micro-CT images of forepaws of normal and RA model treated with TCZ, PNPs, TCZ-PNPs at day 57 after immunization.

In conclusion, one-month treatment and 3D PA monitoring show TCZ-PNPs have excellent RA specificity and significant suppression effect. The developed TCZ-PNPs assisted NIR-II PA molecular imaging provide a new strategy for RA theranostics and therapeutic monitoring and the beyond.

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References