Open Access Full Text Article

LETTER

Advancing Infected Bone Defect Treatment: Integrating Natural Products into Hydrogel Drug Delivery Systems [Letter]

Fuzhou Yang, Xiangchang Cao

Department of Hand and Podiatric, Microsurgery, Huizhou Central People's Hospital, Huizhou, People's Republic of China

Correspondence: Xiangchang Cao, Email 670603893@qq.com

Dear editor

We found Sun et al's article¹ on vancomycin-loaded PEG/ODEX hydrogels for the treatment of infected bone defects highly intriguing. The authors describe a novel drug delivery system using PEG/ODEX hydrogels loaded with vancomycin to treat infected bone defects. While we commend the authors for their innovative approach, we would like to offer some comments and suggest potential avenues for future research, drawing upon our own ongoing work in the field.

Firstly, the study highlights the importance of developing effective local antibiotic delivery systems to address the challenges posed by infected bone defects. The use of hydrogels as a drug delivery vehicle is particularly appealing due to their ability to mimic the extracellular matrix, providing a conducive environment for cell growth and differentiation. The PEG/ODEX hydrogels utilized in this study exhibit good gelling properties, biodegradability, and a sustained release profile of vancomycin, which is crucial for maintaining therapeutic antibiotic concentrations at the infection site.

However, we believe that there is still room for improvement in the design of such drug delivery systems. For instance, while vancomycin is widely used as an antibiotic for bone infections, it is not devoid of limitations. A recent case report,² which reviewed pertinent cases in the literature, highlights the crucial importance of recognizing this rare adverse reaction. However, natural products hold significant promise in the realm of therapeutic agents, particularly those possessing osteogenic properties. Among these, artemisinin stands out as a notable example, showcasing impressive results in preclinical studies. Specifically, artesunate exhibits anti-inflammatory and osteogenic effects, positioning it as a potential candidate for bone tissue engineering applications.^{3,4} Recent review⁵ suggest that artemisinin may down-regulate RANKL expression in osteoblasts, thus promoting osteogenesis and reducing bone resorption. This mechanism offers an additional therapeutic advantage over traditional antibiotic-based systems by targeting both the infection and the bone healing process. In light of these considerations, we suggest that future research could explore the integration of artemisinin or other bioactive molecules with hydrogel-based drug delivery systems to enhance their therapeutic efficacy. By combining antibiotics with agents that promote bone regeneration and modulate bone turnover, it may be possible to develop more comprehensive treatment strategies for infected bone defects.⁶

Finally, while the rat model used in this study provides valuable insights, the translation of these findings to human patients will require further validation in larger animal models and eventually clinical trials. Additionally, the long-term effects of the hydrogel-based delivery system on bone quality and function should be thoroughly evaluated to ensure the safety and efficacy of this approach.

In conclusion, we commend the authors for their innovative work in the field of bone tissue engineering and antibacterial drug delivery. We believe that by continuing to explore alternative therapeutic agents and combining them with advanced biomaterial systems, it may be achieve even greater improvements in the treatment of infected bone defects.

© 2024 Yang and Cao. This work is published and licensed by Dove Medical Press Limited. The full terms of this license are available at https://www.dovepress.com/terms work you hereby accept the Terms. Non-commercial uses of the work are permitted without any further permission from Dove Medical Press Limited, provided the work is properly attributed. For permission for commercial use of this work, please see paragraphs A2 and 5 of our Terms (https://www.dovepress.com/terms.php).

Disclosure

The authors declare no conflicts of interest in this communication.

References

- 1. Sun S, Wang Q, Zhang B, et al. Vancomycin-loaded in situ gelled hydrogel as an antibacterial system for enhancing repair of infected bone defects. *Int J Nanomed.* 2024;19:10227–10245. PMID: 39411352; PMCID: PMC11476785. doi:10.2147/IJN.S448876
- 2. Wen Y, Chen Y, Xiao G. A rare occurrence of Vancomycin-induced gastrointestinal hemorrhage without thrombocytopenia: a case report and literature review. *BMC Infect Dis.* 2024;24(1):1105. PMID: 39367298; PMCID: PMC11451159. doi:10.1186/s12879-024-09949-y
- 3. Wang Z, Feng X, Zhang G, et al. Artesunate ameliorates ligature-induced periodontitis by attenuating NLRP3 inflammasome-mediated osteoclastogenesis and enhancing osteogenic differentiation. *Int Immunopharmacol.* 2023;123:110749. PMID: 37531830. doi:10.1016/j.intimp.2023.110749
- 4. Luo J, Liang C, Chen K, et al. Artesunate-loaded thermosensitive chitosan hydrogel promotes osteogenesis of maxillary tooth extraction through regulating T lymphocytes in type 2 diabetic rats. *BMC Oral Health*. 2024;24(1):356. PMID: 38509482; PMCID: PMC10953264. doi:10.1186/s12903-024-04127-7
- Long Z, Xiang W, Xiao W, et al. Advances in the study of artemisinin and its derivatives for the treatment of rheumatic skeletal disorders, autoimmune inflammatory diseases, and autoimmune disorders: a comprehensive review. *Front Immunol.* 2024;15:1432625. PMID: 39524446; PMCID: PMC11543433. doi:10.3389/fimmu.2024.1432625
- 6. Charlie-Silva I, Fraceto LF, de Melo NFS. Progress in nano-drug delivery of artemisinin and its derivatives: towards to use in immunomodulatory approaches. *Artif Cells Nanomed Biotechnol.* 2018;46(sup3):S611–S620. PMID: 30444132. doi:10.1080/21691401.2018.1505739

Dove Medical Press encourages responsible, free and frank academic debate. The contentTxt of the International Journal of Nanomedicine 'letters to the editor' section does not necessarily represent the views of Dove Medical Press, its officers, agents, employees, related entities or the International Journal of Nanomedicine editors. While all reasonable steps have been taken to confirm the contentTxt of each letter, Dove Medical Press accepts no liability in respect of the contentTxt of any letter, nor is it responsible for the contentTxt and accuracy of any letter to the editor.

International Journal of Nanomedicine

Dovepress

Publish your work in this journal

The International Journal of Nanomedicine is an international, peer-reviewed journal focusing on the application of nanotechnology in diagnostics, therapeutics, and drug delivery systems throughout the biomedical field. This journal is indexed on PubMed Central, MedLine, CAS, SciSearch[®], Current Contents[®]/Clinical Medicine, Journal Citation Reports/Science Edition, EMBase, Scopus and the Elsevier Bibliographic databases. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit http://www.dovepress.com/testimonials.php to read real quotes from published authors.

Submit your manuscript here: https://www.dovepress.com/international-journal-of-nanomedicine-journal

https://doi.org/10.2147/IJN.S511198

13948 🖪 😏 in 🕨 DovePress