Opinion
Volume 10:05, 2024

Oral Health Case Reports

ISSN: 2471-8726 Open Access

Difficulties in Improving Nanoplatforms for Systemic and Local Delivery in the Oral Cavity

Ophelia Ravenswood*

Department of Oral Biology, University of Helsinki, Helsinki, Finland

Introduction

The development of nanoplatforms for drug delivery has opened new possibilities in targeting complex anatomical regions, such as the oral cavity. Characterized by a unique microenvironment with dynamic structures including the oral mucosa, salivary glands, and a host of microbial flora, the oral cavity presents both opportunities and obstacles for the administration of nanomedicines. The use of nanoplatforms can be particularly advantageous for treating a range of oral diseases like periodontal disease, oral cancers, and infections. By delivering therapeutic agents directly to the site of infection or inflammation, or systemically through the mucosal surfaces, nanoplatforms have the potential to improve therapeutic efficacy while reducing systemic side effects [1].

However, the complex anatomical and physiological barriers of the oral cavity, coupled with the necessity for sustained release and enhanced bioavailability, impose considerable challenges for nanoplatform development. Factors such as the continuous presence of saliva, fluctuating pH levels, and the need to bypass various cellular and tissue barriers make it difficult for drugs to maintain their efficacy. Moreover, advancements in nanotechnology have led to the creation of innovative nanocarriers such as liposomes, dendrimers, and polymeric nanoparticles, each with unique properties, yet each faces unique challenges when applied in the oral cavity. This article explores these difficulties in detail, examining the factors that hinder the progress of nanoplatforms for effective systemic and local delivery within the oral cavity and highlighting potential solutions to address these issues [2].

Description

The oral cavity's complex environment presents several physiological barriers that complicate effective drug delivery via nanoplatforms. Saliva, a continuous fluid in the mouth, plays a critical role in digestion, protection against microbial threats, and maintaining oral homeostasis. However, it also acts as a barrier for drug delivery systems, causing rapid clearance of administered nanomedicines and reducing their retention time at the target site. Saliva's composition, with enzymes such as amylase and lysozyme, can break down or degrade many nanoscale formulations before they achieve therapeutic concentrations. Furthermore, the oral mucosa, comprising non-keratinized epithelium in areas such as the inner cheeks and keratinized tissue in regions like the gums, provides only limited permeability for most drug-loaded nanoparticles. This limits the extent to which drugs can penetrate and enter systemic circulation through the oral mucosa, thereby posing a significant barrier to systemic delivery [3].

For nanoplatforms to be effective in the oral cavity, they must remain stable in a highly dynamic environment, where exposure to enzymes, fluctuations in pH, and temperature variations could reduce their efficacy. Achieving stability in such conditions is particularly challenging, as many nanoparticles are prone to aggregation or degradation in response to environmental stressors. This instability leads to the premature release of active agents, which significantly affects the bioavailability of the drug at the desired site. Furthermore, the highly vascularized nature of the oral cavity provides rapid clearance, as nanoparticles can be quickly absorbed into the bloodstream and removed from the target site. Encapsulation techniques have been explored to improve the stability of nanoparticles in oral applications. Polymeric coatings, such as those made from chitosan or Polyethylene Glycol (PEG), can shield nanoparticles from enzymatic degradation, thereby prolonging their stability [4].

One of the most challenging aspects of using nanoplatforms in the oral cavity is the difficulty in achieving deep tissue penetration and targeting specificity. While nanoparticles can be tailored to target specific cells or tissues, the oral cavity poses unique challenges due to its diverse tissue structures, which vary in permeability and receptiveness to nanoparticles. For example, the thick, keratinized layers of the gingiva limit the penetration of nanoparticles, making it difficult to reach sub-epithelial tissues or target deeper periodontal structures. Additionally, targeting specific cell types, such as cancerous cells in oral tumors or infected periodontal cells, requires precise engineering of nanoparticles to recognize and bind to target cells, which is often complex to achieve in a highly populated microbial and cellular environmen0074 [5].

Conclusion

The development of nanoplatforms for drug delivery in the oral cavity holds immense potential for enhancing therapeutic outcomes in treating oral diseases. However, multiple challenges—including the dynamic and protective environment of the oral cavity, physiological barriers, and issues surrounding nanoparticle stability and biocompatibility—need to be addressed to make these technologies viable for clinical use. Recent advancements, such as mucoadhesive nanoparticles, encapsulation techniques, and biocompatible materials, are promising strategies that offer solutions to some of these obstacles. However, further research is necessary to optimize these strategies, particularly in understanding the long-term effects and developing nanoplatforms that balance stability, targeting, and safety.

In conclusion, while the journey to developing effective nanoplatforms for systemic and local delivery in the oral cavity is challenging, the progress in this field offers hope for novel treatments that could dramatically improve oral healthcare outcomes. As research continues, collaborative efforts between nanotechnology, material science, and clinical research are essential to overcoming the remaining barriers and bringing effective nanomedicine solutions to clinical practice.

Acknowledgement

None.

Conflict of Interest

None.

***Address for Correspondence:** *Ophelia Ravenswood, Department of Oral Biology, University of Helsinki, Helsinki, Finland; E-mail: ophelia2950@gmail.com*

Received: 14 August, 2024, Manuscript No. OHCR-24-151965; **Editor Assigned:** 16 August, 2024, PreQC No. P-151965; **Reviewed:** 28 August, 2024, QC No. Q-151965; **Revised:** 02 September, 2024, Manuscript No. R-151965; **Published:** 09 September 2024, DOI: 10.37421/2471-8726.2024.10.159

References

1. Grimaudo, Maria Aurora, Angel Concheiro and Carmen Alvarez-Lorenzo. "Nanogels for regenerative medicine." *J Control Release* 313 (2019): 148-160.
2. Liang, Jingou, Xinyu Peng, Xuedong Zhou and Jing Zou, et al. "Emerging applications of drug delivery systems in oral infectious diseases prevention and treatment." *Molecule* 25 (2020): 516.
3. Pickering, Gisèle and Camille Lucchini. "Topical treatment of localized neuropathic pain in the elderly." *Drugs & Aging* 37 (2020): 83-89.
4. Ichigaya, Narumi, Norishige Kawanishi, Takuya Adachi and Masahiro Sugimoto, et al. "Effects of denture treatment on salivary metabolites: A pilot study." *Int J Mol Sci* 24 (2023): 13959.
5. Derwich, Marcin, Maria Mitus-Kenig and Elzbieta Pawlowska. "Interdisciplinary approach to the temporomandibular joint osteoarthritis—Review of the literature." *Med* 56 (2020): 225.

How to cite this article: Ravenswood, Ophelia. "Difficulties in Improving Nanoplatforms for Systemic and Local Delivery in the Oral Cavity." *Oral Health Case Rep* 10 (2024): 159.