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ANTI-INFLAMMATORY DRUG-LOADED POLYMERIC NANO-HYBRIDS HAVE SIGNIFICANT POTENTIAL IN THE FIELD OF DENTISTRY

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ABSTRACT

The role of anti-inflammatory drugs and polymer nano-hybrids in dentistry has attracted much interest. Nonsteroidal anti-inflammatory drugs (NSAIDs) are used in dentistry especially in pain management and gingival inflammation. These drugs have demonstrated their efficacy with acceptable and non-serious side effects. In addition, NSAIDs regulate the immune system and do not inhibit it, as occurs with steroid drugs. In dentistry, the combination of NSAIDs with polymer nano-hybrid molecules represents a new effective therapeutic treatment. Polymer nanohybrids are nanoscale materials composed of polymers and other compounds, and allow localized and sustained release of anti-inflammatory drugs, and increased retention in oral sites, with reduced toxicity. They modulate the immune system by targeting immune cells and other potentially inflammatory cells that release cytokines. Nanohybrids exert antimicrobial activity against bacterial biofilms. The ombination of NSAIDs with nanohybrid polymers improves therapeutic response in periodontal disease.

KEYWORDS: *Anti-inflammatory drugs, dentistry, polymeric nano-hybrid, immune response, inflammation*

INTRODUCTION

The mechanisms and pathways of anti-inflammatory drugs and polymer nano-hybrids in dentistry are very interesting (1). Nonsteroidal anti-inflammatory drugs (NSAIDs) are drugs applied in the management of acute pain in many conditions, including dentistry (2). They have long been used and are well known for both their efficacy and toxic effects. They usually exert a therapeutic effect of relief from inflammation and pain.

In otolaryngology, anti-inflammatory drugs in combination with polymeric nano-hybrids could offer promising advances for the treatment of inflammation and pain. They modulate the immune response and are very useful in the treatment of pulpitis, periodontal disease and peri-implantitis, all diseases where chronic inflammation plays a crucial role (3). In inflammatory reactions, mitogen-activated protein kinase (MAPK) and Toll-like receptor (TLR) signaling are implicated, which are important for the recognition of microbes and for the activation of the immune system. The NLRP3 inflammasome system is also activated in response to pathogens or cellular damage (4). These reactions induce the production of pro-inflammatory cytokines such as interleukin (IL)-1, tumor necrosis factor (TNF), and IL-6, and also stimulate the production of chemokines (5). In inflammation, the polarization of M1 (pro-inflammatory) and M2 (anti-

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inflammatory) macrophages occurs. In addition to macrophages, T cells also participate in balancing the activities of pro-inflammatory Th17 cells and anti-inflammatory Treg cells.

DISCUSSION

In dentistry, NSAIDs inhibit cyclooxygenase-2 (COX-2), preventing the downstream formation of prostaglandins (PGs) that play a key role in inflammatory and painful diseases. Differently, steroid drugs are potent anti-inflammatory drugs that act on the blockade of phospholipase A2 and suppress both PGs and leukotrienes. These, as they inhibit protein synthesis, have an inhibitory action on the synthesis of inflammatory cytokines such as IL-1, TNF, and IL-6. Steroidal anti-inflammatory drugs and NSAIDs are used to manage periodontitis, and to reduce soft tissue inflammation. They help control postoperative inflammation after dental procedures. In addition, anti-inflammatory drugs are used in adjunctive therapy for implant dentistry to mitigate inflammatory responses (6).

Polymeric Nanohybrids in Dentistry

Acrylic teeth are made using polymethyl methacrylate (PMMA) due to its biocompatibility, ease of processing, low cost, stability and acceptable aesthetics. Polymer nanohybrids are nanoscale materials composed of polymers and additional components such as ceramics, metals, or bioactive agents. They are characterized by controlled drug release, multifunctionality, bioadhesion, and biocompatibility. Polymer nanohybrids allow for localized and sustained release of anti-inflammatory drugs, increased retention at oral sites, reduced toxicity, and potential for simultaneous administration of multiple therapeutic agents (7). Nanohybrids deliver drugs directly into inflamed tissues, reducing drug dispersion to other tissues in the body. They modulate the immune system by targeting immune cells such as T and B lymphocytes, macrophages, and other potentially inflammatory cells that release cytokines. Nanohybrids exert antimicrobial activity by combating bacterial biofilms that increase inflammation levels. In addition, chitosan-based polymer nanohybrids promote wound healing and are bioadhesive, and poly (lactic-co-glycolic acid) provides controlled drug release. Hydrogel-based systems improve water retention and drug stability. Immune and inflammatory pathways in dentistry are involved through the activation of NF-kB with production of pro-inflammatory cytokines. It is pertinent to think that combination of anti-inflammatory drugs with bone regenerative factors can improve periodontal therapy.

Nano-hybrids are utilized as both drug carriers and tissue engineering platforms. The use of polymeric nanoparticles can facilitate RNA-based gene therapy that targets specific inflammatory genes, such as cytokines (8). In the future, it may also be possible to customize nano-hybrid formulations based on individual patient profiles to achieve optimal efficacy.

CONCLUSIONS

The use of anti-inflammatory drugs encapsulated in polymeric nano-hybrids represents a new therapeutic weapon against inflammation (periodontitis) in the field of dentistry. This new method acts with precision on inflammatory molecules such as cytokines and chemokines, proteins that regulate the immune system. The synergy between anti-inflammatory drugs and polymeric nano-hybrids minimizes side effects and is an important weapon in the field of dentistry.

Conflict of interest

The authors declare that they have no conflict of interest.

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