Experimental Study on Pulsating Aerosols for Drug Delivery to the Maxillary Sinus for the Treatment of Rhinosinusitis

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Abstract

Background: Rhinosinusitis, also known as a sinus infection, is a costly burden in today's society. Remedies to treat the infection and its symptoms, including commercial nasal sprays, do not always give a "full relief" satisfaction due to small nasal passages to deliver the drug. A way to improve drug delivery to the sinus cavity is to incorporate generated frequencies and resonance frequency to guide the particles to the sinus cavity. This study aims to determine the best frequency to deliver drugs to a simulated sinus cavity; determine how different input diameters, bridge lengths and amplitudes effect the deposition to the sinus cavity; and to find the natural frequency of the bottle and sinus cavity model.

Objectives: This study aimed to understand the mechanism of aerosol deposition under pulsating flows using both experimental tests and theoretical analysis.

Methods: The experimental tests used simulated frequencies on a sinus cavity model under a variety of different testing conditions. A sinus cavity model was created using two bottles (a smaller bottle to represent the sinus cavity) connected by a small tube with a particular length and diameter. Two different nebulizers, a vibrating mesh and jet nebulizer were used in the tests. Geometry factors, such as the diameter and length of the connecting tube, were also considered. Theoretical analysis was conducted to find the resonance analysis and was compared to the experimental results.

Results: The tests concluded that optimal frequency to deliver drugs to the sinus cavity was 100 Hz. It was also determined that larger input and output diameters, and smaller bridge lengths delivered a greater dosage to the sinus cavity. The most significant deposition enhancement occurs when the input frequency was in harmonic with the resonance frequency of the sinus. Findings from this study can lead to improve medical dosages to the sinus cavity, which will reduce waste and costs of rhinosinusitis treatment.