

METHOD FOR OBTAINING ACCURATE GEOMETRICAL COORDINATES OF NASAL AIRWAYS FOR COMPUTER DOSIMETRY MODELING AND LESION MAPPING

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Abstract

Recently, finite-element computer simulation of airflow in rat nasal airways has been used to predict local and global xenobiotic mass transport. These computer simulations have the capability to facilitate the extrapolation of experimental data from rats to humans for risk assessment. Implementation of similar models of other species requires accurate and detailed geometrical coordinates of airways. This article presents a sectioning method for acquisition of airway coordinates and morphometric data from fixed tissues. Using this method, airway tissue specimens are embedded in a frozen, contrast-enhancing medium and serially sectioned. Video images are digitized from photographs of the block face, and image analysis is used to obtain geometrical coordinates of the nasal passage perimeters. Calibration images and embedded alignment marks are used to scale and align sequential sections. Data resulting from the application of this method to a rhesus monkey specimen are reported, including a three-dimensional computer reconstruction of the data. Airway coordinates are also used to generate a set of diagrams suitable for lesion mapping for comparison with local dosimetry data derived from numerical simulations. This method improves on previously reported methods. Undistorted airway geometry is obtained by photographing the cut block face. Automatic thresholding to obtain coordinates during image analysis is made possible by the contrast-enhancing medium. Automatic scaling and alignment of sections is facilitated by the use of calibration images and alignment marks. This coordinate acquisition method has applicability to other complex biological passageways.