

A simple geometrical pattern for the branching distribution of the bronchial tree, useful to estimate optimality departures

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The design of the bronchial tree has largely been proposed as a model of optimal design from a physical-functional perspective. However, the distributive function of the airway may be more related to a geometrical than a physical problem. The bronchial tree must distribute a three dimensional volume of inspired air on a two dimensional alveolar surface, included in a limited volume. It is thus valid to ask whether an optimal bronchial tree from a physical perspective is also optimum from a geometrical point of view. In this paper we generate a simple geometric model for the branching pattern of the bronchial tree, deducing relationships that permit estimation of the departures from the geometrical optimum of each bifurcation. We also, for comparative purposes, estimate the departures from the physical optimum. From the geometrical assumptions: i) a symmetrical dichotomic fractal design, ii) with minimum volume and iii) maximum dispersion of the terminal points, and several simulations