A Mathematical Method to Solve the Inverse Problem of a Hemodynamics Model

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Abstract

Dynamic indexes play an important role in the cerebral circulation. In many cerebrovascular diseases, the hemodynamic parameter varies significantly from its normal range. Based on the characters of the Willis circulation such as four entrances and three communicating arteries, we have established a hemodynamic model with lumped parameters to study the cerebral circulation. Considering the electrical equivalent diagram of these models, the governing equations and the method to calculate the dynamic indexes were proposed. After analyzing the obtained data from clinical study, we attempted to build a mathematical method to solve the inverse problem equation and get the value of model parameters and dynamic indexes. For example: resistance parameters can be calculated by the steady fluid equation, and the compliance parameters can be obtained from the frequency spectrum analysis. In order to test this method, a typical case of SAH was studied carefully and the statistical calculating results of 30 cases from Huashang hospital were discussed. The comparison between the theoretical results and the clinical diagnoses showed that they were identical, which means the presented method can be considered as a new non-invasive method in clinical application.