Pharmacodynamic Prediction Model Using Physicochemical Properties of Antidepressant

Chung, Guhyun (School: Saint Paul Preparatory Seoul)

Drug development processes are burdened with a critical problem that only 9.6% of tested drugs are qualified for commercialization while each clinical trial phase of experimental drugs heavily requires both temporal and economic investment. Accordingly, the need for a system that simulates in vivo actions of drugs emerged in order to estimate the biochemical actions of drugs prior to clinical trials on animals and humans. This study was performed to implement a mathematical programming model that uses certain chemical properties, certified to manipulate the actions of the drug, as the input data to obtain estimations of pharmacokinetic parameters while making it easier to use for everyone compared to existing solutions. In detail, half-life and mean residential time (MRT) were elicited from the model, and differential equations were sequentially used to make possible the calculation of plasma concentration. Ultimately, the drug plasma concentration over time is schematized through the PK curve, visualizing the overall pharmacokinetic metabolistic process of the drug. Major elements that can change the in vivo action of a drug and seven physicochemical factors were selected as the input data of drugs. Using multiple algorithmic models as the candidate for the prediction model of drug half-life and MRT, the Randomforest regression model was finally selected based on low mean square error. Using the PK parameters from the initial models, the concentration of the drug and plasma absorption and removal constants were mathematically obtained, and the PK curve was completed. Through serially modulating each factor and determining the transition of half-life, we concluded that SSRI antidepressants required a larger logP for their elongation of in vivo residential time.

Awards Won: