Drug Distribution in the Human Eye

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Abstract

The drug therapy of the posterior segment of an eye is very challenging due to the difficult accessibility. At the moment, modern drugs often are large molecules, such as peptides, antibodies or oligonucleotides which are administrated, e.g. by intravitreous injections which requires clinical conditions. Therefore, computer modeling can be helpful in designing new and less invasive routes of drug administration. COMSOL Multiphysics is used to study the spatiotemporal distribution of drugs in human eye after varying modes of administration. Factors affecting the distribution include mobility, partition and permeability coefficients between different parts of an eye, as well as protein binding, metabolism and transport proteins. Our COMSOL model uses laminar flow in choroid and in the anterior chamber, and transport of diluted species in the entire eye. In this particular study, the clearance of drugs from vitreous humor is simulated and compared with experimental data of 46 molecules. The effect of various parameters on the drug concentration on retina, in particular, is reported. The geometry of the model is shown in Figure 1, highlighting the different parts of the eye. Figure 2 shows an example of the effect of the partition coefficient between retina and vitreous humor on the outflux of drug from choroid.
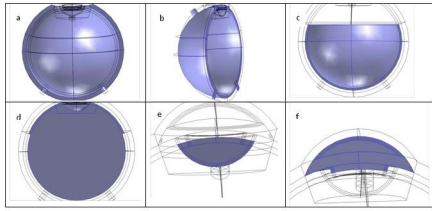
Figures used in the abstract

Figure 1: Geometry of an eye: a) sclera, b) choroid, c) retina, d) vitreous humor, e) lens, f) anterior chamber.
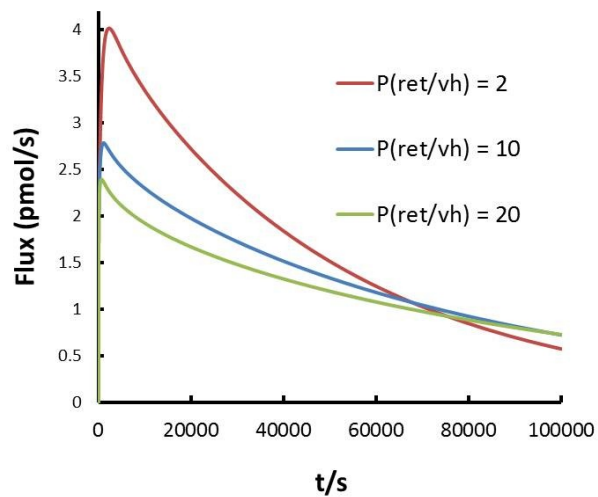

Figure 2: Effect of retina-vitreous humor partition coefficient on the outflux of drug.