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MATHEMATICAL MODEL OF MIXING DOPAMINE WITH HUMAN BLOOD ON AN ACTUAL DOMAIN

Ciro-Filemon Flores-Rivera, ciro.flores@itesm.mx
ITESM Campus Hidalgo, Mexico

Armando Flores-Moreno, afm_41091@hotmail.com
UAEH, Mexico

Saul Dominguez-Casasola, sadoka_do@hotmail.com
ITESM Campus Hidalgo, Mexico

Eden Mayor-Garcia, eden.mayor@live.com.mx
ITESM Campus Hidalgo, Mexico

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When a patient presents with a heart attack at a medical center, the first thing to look for is to reactivate the cardiac function. One way to accomplish this is by injection of neurotransmitters, such as dopamine, in the vein. If the patient reacts in less than twenty seconds, the application of the violent electroshock is avoided; preventing the usual adverse side effects to the brain (decreased motor skills amongst others). In the present study, the mixing of dopamine with human blood cells is studied assuming that the antibody ligands, which are responsible for such mixing, are located in the bloodstream. This is a real-life scenario from the biology perspective and is called the "bulk reaction". Good results are obtained in less than five seconds. The physical principles involved in this phenomenon include: electrostatics, heat and mass transfer, and fluid dynamics. The mathematical model leads to a complex system of six nonlinear, coupled, and time dependent partial differential equations. The model is numerically solved using the finite element method in an actual domain. This domain was obtained, at first, by means of a tomography vein taken to the right arm of a cardiac patient, and then digitally processing the image to get a proper mathematical domain, i.e., one formed by segments of differentiable curves. The present paper is the third part of a former investigation made by the same authors and completes it with more realistic assumptions. In the first part of that research, this phenomenon is modeled but in the simplified case of a simple, idealized domain and the assumption that the antibody ligands are located only on the surface of the vein. Whereas in the second part, the idealized domain is maintained but with consideration to the "bulk reaction". Comparisons among the three models are forwarded and some conclusions are obtained. Results are compared with other studies reported in the literature, allowing a better understanding of the phenomenon.