MICHEL DELFOUR, Université de Montréal

Three-dimensional model of paclitaxel release from biodegradable polymer films

In order to achieve prescribed drug release kinetics in the wall and the lumen of blood vessels over long therapeutic periods, bi-phasic and possibly multi-phasic releases from blends of biodegradable polymers are currently envisioned. The modelling of drug release in the presence of degradation of the polymer matrix and surface erosion is quite complex. Yet, simple reliable mathematical models validated against experimental data are now available to classify neat polymers and to predict the release dynamics from polymer blends [Blanchet, Delfour, Garon, Quadratic models to fit experimental data of paclitaxel release kinetics from biodegradable polymers, SIAM J. on Applied Mathematics 71 (2011), 2269-2286]. We survey our two-parameter quadratic ODE model that has been validated against experimental data for the release of paclitaxel from a broad range of biodegradable polymers and our quadratic semi-permeable membrane PDE model that mimics the ODE model and readily extends to curved complex geometries of drug eluding stents [Garon, Delfour, Three-dimensional quadratic model of paclitaxel release from biodegradable polymer films, SIAM J. Appl. Math., 74 (5) (2014), 1354-1374]. This approach avoids resorting to time-dependent or nonlinear diffusion in the polymer. In the context of drug eluting stents, it is a practical and economical tool to theoretically and numerically simulate the 3D release of drug from the thin polymer film to the integrated wall and lumen of the blood vessel for evaluation and design [Delfour, Garon, Lamontagne, Three-Dimensional Drug Release in the Stent-Polymer-Wall-Lumen of a Blood Vessel, SIAM J. Appl. Math. 79 (2019), No. 5, 1850-1871].