Three-dimensional Models of Paclitaxel Release from Biodegradable Polymer Films in the Wall/lumen System of Blood Vessels

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Abstract: The object of this paper is the modelling of the drug release in the wall and the lumen of blood vessels. The concept and equations of the *dose* have been developed for the integrated wall-lumen system in M. C. Delfour, A. Garon, and V. Longo [*Modeling and design of stents to optimize the effect of the dose*, SIAM J. on Applied Mathematics **65** (2005), 858–881], É. Bourgeois and M. C. Delfour [*General patterns and asymptotic dose in the design of coated stents*, Comput. Methods Biomech. Biomed. Eng. **11** (2008), 323–334], and M. C. Delfour, and A. Garon [*New equations for the dose under pulsative/periodic conditions in the design of coated stents*, Computer Methods in Biomechanics and Biomedical Engineering 13 (2010), No. 1, 19-34].

This paper focusses on a three-dimensional quadratic partial differential equation model of the drug release from a thin film of biodegradable polymer to a surrounding medium. Its very innovative feature is to go directly from the experimental normalized release curves of L. L. Lao and S. S. Venkatraman [*Adjustable paclitaxel release kinetics and its efficacy to inhibit smooth muscle cells proliferation*, J. Control. Release **130** (2008), 9–14] to a flux condition at the interface between the polymer and the medium that only requires the identification of the two parameters of the highly accurate ordinary differential equation model of G. Blanchet, M. C. Delfour, and A. Garon [*Quadratic models to fit experimental data of paclitaxel release kinetics from biodegradable polymers*, SIAM J. on Applied Mathematics **71** (2011), 2269–2286]. 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. This approach avoids resorting to time-dependent or nonlinear diffusion in the polymer. It is an improvement of an earlier 3-parameter PDE model of M. C. Delfour [*Drug release kinetics from biodegradable polymers via partial differential equations models*, Acta Applicandae Mathematicae **118** (2012), 161–183].

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