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# Model and methods to assess hepatic function from indocyanine green fluorescence dynamical measurements of liver tissue

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**Abstract**

The indocyanine green (ICG) clearance, presented as plasma disappearance rate is, presently, a reliable method to estimate the hepatic "function". However, this technique is not instantaneously available and thus cannot been used intra-operatively (during liver surgery). Near-infrared spectroscopy enables to assess hepatic ICG concentration over time in the liver tissue. This article proposes to extract more information from the liver intensity dynamics by interpreting it through a dedicated pharmacokinetics model. In order to account for the different exchanges between the liver tissues, the proposed model includes three compartments for the liver model (sinusoids, hepatocytes and bile canaliculi). The model output dependency to parameters is studied with sensitivity analysis and solving an inverse problem on synthetic data. The estimation of model parameters is then performed with in-vivo measurements in rabbits (El-Desoky *et al.* 1999). Parameters for different liver states are estimated, and their link with liver function is investigated. A nonlinear (Michaelis-Menten type) excretion rate from the hepatocytes to the bile canaliculi was necessary to reproduce the measurements for different liver conditions. In case of bile duct ligation, the model suggests that this rate is reduced, and that the ICG is stored in the hepatocytes. Moreover, the level of ICG remains high in the blood following the ligation of the bile duct. The percentage of retention of indocyanine green in blood, which is a common test for hepatic function estimation, is also investigated with the model. The impact of bile duct ligation and reduced liver inflow on the percentage of ICG retention in blood is studied. The estimation of the pharmacokinetics model parameters may lead to an evaluation of different liver functions.

*Keywords:* Pharmacokinetics model; Sensitivity analysis; Parameter estimation; Indocyanine

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