Modeling Predicts Kidney Function for Patients after a Kidney Transplant

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Background: The first week after a kidney transplant is critical as poor kidney function during this period can be detrimental to the effective long term functioning of the graft. We have found that creatinine clearance varies over time after a kidney transplant as a result of Acute Kidney Injury. Additional fluctuations in creatinine concentration can occur due to factors such as muscle activity and medication. The goal was to develop a robust model, which would predict creatinine concentration for a patient post-transplant.

Methods: A solute transport model in the kidney was developed using a set of ordinary differential equations and two compartment model. The existing two compartment models for kidney function in literature were improved by making the clearance as a function of time using the Hill equation. Several optimization techniques, such as Levenberg-Marquardt were used to estimate the unknown parameters defining clearance function. Clinical data was obtained from Aarhus University Hospital in Denmark, creatinine concentration in serum was measured over 30 days after kidney transplant. The average parameter values obtained were used to predict creatinine concentration for other patients.

Results: The parameters in the hill equation were most sensitive and were good candidates for the optimization study for most patients in this study. The model was able to predict creatinine concentration within 40mmole for the all patient data used in this study. The current model works well in estimating patient specific parameters and Hill function was found to be the most suitable equation to describe change in creatinine clearance over time.

Conclusions: The Delayed Graft Function of a subject can be described by Hill coefficient. Our model can be used to estimate creatinine concentration for a kidney transplant patient upto 700hours using first 100hours creatinine measurements.