CHAPTER FIVE

5.0 SUMMARY OF FINDINGS

1. **The development of a mathematical model describing flow of blood in distensible blood vessels.**

   A model of one-dimensional non-linear equations of blood flow was developed from Navier-Stokes and Saint –Venant equations.

2. **The development of a numerical model for the solution of the blood flow models.**

   A new approach for the solution of the one-dimensional non-linear equations of blood flow using the Riemann based methods constructed within the finite volume framework was developed and then applied to the blood flow equations.

3. **The development of computer software for detecting artherosclerosis, stenosis and differentiation of haemorrhagic and ischaemic strokes for stroke management from simple measurements.**

   The software is also capable of computing the Siriraj and the Allen scores. The Allen and Siriraj clinical scores have been proposed to help clinicians in making decisions while waiting for results of computerized tomography, hence clinicians can start antithrombotic treatment while waiting for the scan result. The software is capable of simulating Stenosis at different position and depth of flow along the arterial length, and can be used for diagnosis.

4. **The development of a model for Glucose-Insulin system in Human.**

   A model of the gut and blood stream was developed by describing the body as a compartment/tank with a basal concentration of glucose and insulin by using mathematical equations. The gut-blood system is modeled as an infinite number of continuous stirred tanks in series, which could be used as simulators of the entire blood glucose-insulin system and the pathway for diabetes development.

5. **The development of software for therapeutic management of diabetes.**

   Software was developed using the model of the gut-blood system proposed. Every individual with or without diabetes can know his diabetes status by inputting the required data such as age, sex, height, weight and the blood glucose concentration through the interface. It is expected that with use of the interface, appropriate management can be initiated in order to prevent other diabetic complications.

5.1 CONTRIBUTIONS TO KNOWLEDGE

The contributions to knowledge of this research work are listed below.

1. **The development of a mathematical Model Using Saint-Venant and Navier-Stokes equations and numerical model of Blood flow in distensible blood vessel using Roe-Riemann scheme constructed within the finite volume frame work.**

2. **The development of a model of Glucose- Insulin system in Human using three continuous stirred reactors in series.**

3. **The development of software from the model of blood flow therapeutic management of stroke; the development of software from the model of glucose insulin system for screening and therapeutic management of diabetes.**

CHAPTER SIX

6.1 CONCLUSION

The study carried out on the SITT data shows that the flow of glucose-insulin out of the blood compartment follows first order kinetics in most cases as the SITT data are satisfactorily linear in almost all the plots for first order kinetics tests. The results obtained other kinetics such as Michaelis-Menten and second are not linear. The analyses also indicate that there is no significant difference between the model derived values of k and the corresponding values calculated from the first order plots. From the developed mass transport equations, transport of LDL to the endothelial surface of the arteries and computed Damkohler and Sherwood numbers of a particular patient indicates that the Damkohler number is always greater than Sherwood number. This shows that the transport is not limited by kinetic or mass transfer coefficient, but limited by fluid phase transport.

In conclusion, a new approach to solve the one-dimensional non-linear equations of blood flow using the Riemann based methods constructed within the finite volume framework and the Roe's scheme has been developed. Such methods are noted for their good conservation and shock capturing capabilities and have a number of desirable properties, most noticeably the ability to predict continuities in the solution. It was able to capture the wave propagation phenomenon in the arterial system, and the analysis conducted matches closely with measured data, the well-posedness problem of the system of partial differential equations, that is, the existence, uniqueness and the continuous dependence on initial and boundary data of the solution was established.

This study describes a promising non-invasive method for evaluating atherosclerosis progression with different degree of stenting in the large arteries in a steady flow region, which could eventually lead to the development of an index of plaque vulnerability to used in the diagnosis and decision making processes regarding patients with different degrees of atherosclerosis progression. Software was developed for therapeutic management of stroke.

In this work, a model for the determination of glucose effectiveness and insulin sensitivity in individuals using infinite mixed reactors in series was also developed. It is capable of generating profiles of interstitial insulin, plasma glucose and insulin. The flow of glucose out of the blood compartment follows a first order kinetics as the solved model fitted the SITT data satisfactorily in all the plots. The exit age distribution and the mean residence times were determined. The results of the statistical analyses indicated that there was no significant difference between the model derived values of k and the measured values. Finally we developed software Glucosim 1.0 to simulate and estimate the Glucose-Insulin parameters. Furthermore, the software package will assist clinicians in early screening of patients at risk and treatment procedures for diabetic patients in any crisis situations.

6.2 RECOMMENDATIONS

I wish to recommend the use of the developed computer software by professionals and non-professionals in hospitals for therapeutic management of patients. These softwares can also be used in community clinics after due training workshops.

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