Proceeding Series of the Brazilian Society of Computational and Applied Mathematics

Modelling of High Salt Intake Effect on Renal Interstitial Fibrosis

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1 Introduction

Renal fibrosis is the deposition of extracellular matrix (ECM) in the kidney during tissue repair or as a response to inflammation. Nowadays, renal failure and specially renal fibrosis diagnosis are increasing in Paraguay and the cause is not clear yet. However, there are strong evidences that high dietary intake of salt promotes the fibrogenic process by unclear mechanisms [2]. This work is part of a more a ambitious one to develop a mathematical model to simulate the progression of renal interstitial fibrosis under different salt concentrations. To this end, a previous model for renal fibrosis from the literature [3] is modified to consider salt concentration. A flow chart is shown in Figure 1.

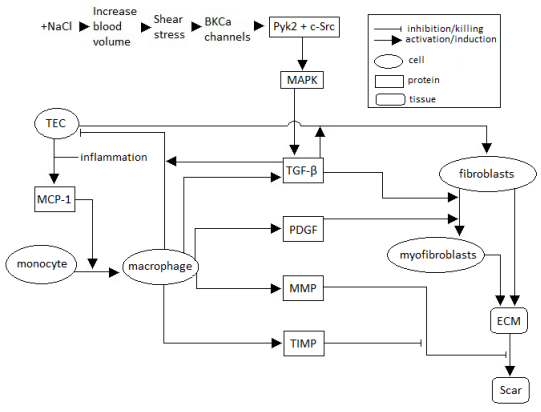

Figure 1: Salt-induced renal fibrosis network, modified from [3]

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2 Model

The mechanism for fibrosis due to salt is not well understood. However, according to [1,4], there is a possible mechanism where high salt concentration increases the production of TGF-β through MAPK pathways. In this work, a system of 2D reaction-diffusion equations are solved in a squared section of the renal cortex with an initial damaged area

$$\frac{\partial C_i}{\partial t} - D_{C_i}\nabla^2 C_i = f_{C_i}, \tag{1}$$

where C_i is the concentration for $i = 1, ..., k$, D_{C_i} is the diffusion coefficient and f_{C_i} represents the interactions between the species. The salt effect is introduced in the TGF-β equation as a function of the NaCl concentration, ϕC_{NaCl}, where $\phi = \frac{k_1 \cdot (1 - r_p)}{K_m + (1 - r_p)}$. The values of k_1 and K_m are kinetic constants obtained from the literature and r_p is the fraction of TGF-β which is activated due to the NaCl [4].

3 Conclusion

In the simulation, some parameters are obtained from the literature and others extracted from experimental values. The analysis of the simulation identifies situations when the pathology can be accentuated due to salt consumption and orientates the experimental validation, which is now necessary in order to verify the hypothetical salt dependence relation.

Acknowledgements

To PRONII-CONACyT-Paraguay. This work is partially supported by CIMA through CONACyT grant 14-INV-186.

References

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