Module 11: Case Study- Regeneration of peripheral nerve by Arghya Sharma 11/12/21

There have been studies indicating that optogenetics has been able to trigger axonal growth upon stimulation of dorsal root ganglion cells. Furthermore, this stimulation increases expression of NGFs and BDNFs that have a positive effect on the schwann cells [3].

Aim: To propose a technique that can promote the proliferation of schwann cells and axonal growth after a nerve damage.

Preface: Two groups of rats. Group 1 (Control Group)- Rats that have their sciatic nerve intact. Group 2- Rats whose sciatic nerve will be surgically damaged and left unrepaired. Neurotmesis will be performed because it will cause severe damage to the nerve (but the cell body should be kept intact) and if my proposed method manages to repair this damage it is most likely to be an effective method for axonotmesis or any other kind of peripheral nerve damage.

Research Model: For the purpose of this study I will use an in vivo rat model. As mentioned in the lecture rat will be a better choice for this study because the larger physical size of rat nerves will reduce the complexity of the surgical procedure that will be performed in this study for creating a lesion in the sciatic nerve of the rat. The choice of this specific nerve is done because of the fact that it is the longest and largest nerve in the body, it originates from the L4-L6 spinal segments and runs down to the back of each leg. In group 2 rats, sciatic nerve transection will be performed a little above the ramification of the sciatic nerve into its terminal branches. This lesion procedure aka surgery will take place in a sterile condition using microsurgical scissors.

I will use optogenetics to stimulate axonal growth in the damaged sciatic nerve cells. In this technique a virus containing a promoter and the gene that encodes for the channelrhodopsin protein will be introduced in the affected area of damage. Once the gene is delivered, the chosen subsets of the neurons will activate the promoter and the channelrhodopsin will be able to produce in the cell. This protein will be activated using blue light (473 nm) that will be delivered by a fibre optic cable. The stimulation will occur at the left over cell body of the sciatic nerve cells.

After a period of recovery of 1 month for group 2 rats, motor and sensory functions of the group 1 and group 2 rats will be recorded to compare how efficiently the sciatic nerve has been repaired/recovered.

Application Schwann cells play a huge role in peripheral nerve regeneration proliferation of schwann cells, and at the same time if axonal growth is also promoted this will make the process of nerve repair faster and more efficient since we can control the process of repair by light.

Citations:

[1] Heidi Moawad, M. D. (2020, February 10). *The anatomy of the sciatic nerve*. Verywell Health. Retrieved November 12, 2021, from https://www.verywellhealth.com/sciatic-nerve-anatomy-4588667.

[2] Pereira, T., Gärtner, A., Amorim, I., Almeida, A., Caseiro, A. R., Armada-da-Silva, P. A. S., Amado, S., Fregnan, F., Varejão, A. S. P., Santos, J. D., Bartolo, P. J., Geuna, S., Luís, A. L., & Mauricio, A. C. (2014, July 10). *Promoting nerve regeneration in a neurotmesis rat model using poly(DL-lactide--caprolactone) membranes and mesenchymal stem cells from the Wharton's jelly: In vitro and in vivo analysis*. BioMed Research International. Retrieved November 12, 2021, from https://www.hindawi.com/journals/bmri/2014/302659/.

[3] Xu, X., Mee, T., & Jia, X. (2020, February). *New Era of optogenetics: From the central to peripheral nervous system*. Critical reviews in biochemistry and molecular biology. Retrieved November 12, 2021, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7252884/.