Jonah Hottinger

Biol288

April 27, 2018

Enhancing Neural Regeneration

Imagine a world where no one suffers from paralysis or crippling diseases that attack the brain and nerves like Huntington’s disease. Many believe that this is not possible, and those afflicted only carry a small glimmer of hope. This is largely due to a common misconception that when a person’s nerves are damaged they cannot repair themselves. This is why paralysis due to spinal cord injuries is often permanent. However, nerves do actually heal and repair themselves. The issue is that human nerves cannot repair themselves effectively, but the fact that healing and repair goes on at all means that we can enhance that healing through a number of different treatments. All over the world, researchers are working together to find the best treatments for neural damage and applying them in the lab.

**Preventative treatments**

These potential treatments can be divided into two main groups. One type is preventative in nature, and the other is regenerative. The role of a preventative treatment is to stop major damage. Imagine a football game. A player goes for a tackle leading with his helmet, and after the hit, he cannot move. He has suffered a spinal injury in his upper vertebrae. This type of scenario is when we can see the use of our preventative treatments. Dr. Narin and colleagues have discovered that a drug called Topirimate is highly effective in these situations. When it is administered soon after injury, it prevents any further damage done to the nerves, and overall, it significantly reduces the amount of damage that occurs. Dr. Trakhtenburg and colleagues have found another very promising preventative treatment in zinc chelation and the introduction of an inhibitor. What this essentially means is that we can target specific genes in a cell and give them instructions. In this treatment, we are stalling necrosis, the death of the nerve cells, by instructing the cells to repair early damage before things worsen and enhancing them with the zinc. This has been found to significantly reduce the amount of necrosis that occurs and also promotes regeneration of the damaged nerves. Because of this, this potential treatment can be thought of as both preventative and regenerative in nature.

**Regenerative treatments**

If preventative treatments are not successful or need to be combined with something else, we can turn to regenerative treatments. However, these treatments are more difficult because we are trying to repair damage that has already taken place. At this point, some cells are more likely to have died, and the damage tends to be more complete.

Dr. Lin and colleagues have been looking at a potential solution for necrosis and irreversible damage through synthetic cell transplantation. What they are doing is genetically engineering nerve cells and injecting them at the site of injury. These engineered cells then have the ability to navigate the damaged areas and reestablish nerve connections that were lost. This kind of treatment would be applicable to people who’s nerve cells have died and resulted in paralysis.

**Nerve connections, the last obstacle**

Unfortunately, all of these potentially life change treatments still require further research. This is because of the neural gap. Between every nerve cell is a gap through which the cells send each other information and establish connections. When nerve damage occurs, these gaps must be overcome for us to reestablish the connections between nerves. However, all of these researchers are applying their treatments to rats. This is an issue because humans have neural gaps up to 30 times larger than a rat’s. Before these treatments can go into clinical trials, this gap issue must be addressed.

Thankfully, Dr. Su and colleagues have recently found a potential treatment through stem cell and conduit transplantation. The stem cells themselves promote regeneration and healing while the conduits can act as a pathway to establish connections across the neural gap. This research study has been done with mini-pigs which have vastly more similar neural gaps to humans than rats do. Because of this, this treatment is much closer to clinical trials than the others.

**What we need to do now**

As we continue to perfect these treatments and discover new ones, we need to strive to bridge the neural gap. In order to do this, I suggest that we perform trials with primates after a treatment shows high levels of success in trials on rodents like the ones above do. We also need to question how these neural regeneration treatments could be used for those who suffer from nerve attacking diseases. For example, a successful regeneration treatment would at least slow down Huntington’s disease which destroys the nerve cells in the brain.

Works Cited

Kaplan H., Mishra P. and Kohn J. 2015. The overwhelming use of rat models in nerve

regeneration research may compromise designs of nerve guidance conduits for humans.

Journals of Material Science. Materials in Medicine 26: 226.

Lin C., Liu C., Zhang C., Huang Z., Zhao P., Chen R., Pang M., Chen Z., He L., Rong L. and Li

B. 2018. Interaction of iPSC-derived neural stem cells on poly(L-lactic acid) nanofibrous

scaffolds for possible use in neural tissue engineering. International Journal of Molecular

Medicine 41: 697-708.

Narin F., Hanalioglu S., Ustun H., Kilinc K. and Bilginer B. 2017. Topiramate as a

neuroprotective agent in a rat model of spinal cord injury. Neural Regeneration Research 12: 2071-2076.

Trakhtenberg EF., Lia Y., Fenga Q., Tsoa J., Rosenberg PA., Goldberge JL. and Benowitz LI.

2018. Zinc chelation and Klf9 knockdown cooperatively promote axon regeneration after optic nerve injury. Experimental neurology 300: 22-29.

Su CF., Chang LH., Kao CY., Lee DC., Cho KH., Kuo LW., Chang H., Wang YH. And Chiu

IM. 2018. Application of amniotic fluid stem cells in repairing sciatic nerve injury in

minipigs. Brain Research 397-406.