

Research Assessment #3

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Subject: ISM (Independent Study and Mentorship)

MLA citation:

Chen, Liwen, et al. "Paracrine Factors of Mesenchymal Stem Cells Recruit Macrophages and Endothelial Lineage Cells and Enhance Wound Healing." PLOS ONE, Public Library of Science, journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0001886. Accessed 20 Sept. 2024.

Assessment: Research Assessment #3

I plan to research regenerative medicine and biomedical engineering this year for ISM. I plan to create a project focusing on stem cells and their regenerative properties. For my third research assessment, I found a study by Liwen Chen and their research team at the University of Alberta titled "Paracrine Factors of Mesenchymal Stem Cells Recruit Macrophages and Endothelial Lineage Cells and Enhance Wound Healing." Researchers explored the part stem cells play in wound healing; in this case, they worked with stem cells derived from bone marrow. The researchers claim that stem cells have been proven to aid wound healing and tissue regeneration in many previous studies. However, one of the main gaps in the research is that we need to know what stem cells produce that aid in this regeneration process. So, to try and find the actual things that aid in the process, they used many techniques, such as real-time PCR, antibody-based protein arrays, and a tool called ELISA to measure the cytokine and chemokine levels. They tested this on an in-vitro model of dermal fibroblasts and a mouse model.

As I read and annotated this article, I felt a wave of emotions; initially, I was surprised that such an essential part of the research was left unchecked. How could a necessary thing like those secreted by the stem cells be left unresearched? Moreover, this also brought an epiphany moment to me as I have done much research in this field before, and one of the common gaps that I am just realizing is that the

actual biomolecules aiding in the healing process were never mentioned. In most of the studies I have seen, they always say, "Our results show that stem cells aid in angiogenesis." This part of the paper cleared up many of the doubts I had about what my research project would be about this year. In the beginning, I wanted to put a bunch of stem cells onto a wound and see what happens, but now, since I found this significant gap in research, I want to focus a lot more on that aspect.

As I continued reading, I thoroughly annotated the procedure the researchers used for the experiment. I classified the procedure into a few simple steps that are simple to understand: Cell isolation and culture, Conditioned Medium Preparation, Cytokine and Chemokine analysis, Wound healing model, Cell Migration and proliferation, and finally, evaluation of the Wound healing process. To elaborate, they first isolate the BM-MSCs and culture them, allowing the cells to grow on a medium. Next, they analyzed the cytokines and chemokines that grew, and then they used mice to study the wound healing process. Finally, they measured the amount of cells that moved and raised on the mice and evaluated the whole process. Now, why is this relevant to my ISM journey?

I was interested in their methods and thought they could easily translate into my project. Their methodology and techniques were precise and thorough, so I wanted to emulate this information in my project. I plan to research further the methods they used in the experiment and build my project based on similar techniques. For example, how they isolated the stem cells was more straightforward than many other studies I researched. For my research project, I want to focus on the eye and diseases that relate to the eye, but even for that, I could easily use the isolation technique these researchers used. I also wanted to try to use the same methods they used for quantifying data; for example, I thought the way they incorporated flow cytometry and antibody-based protein arrays was inventive, and since I was not familiar with these specific methods before, this paper ignited my interest in them. I plan to use those techniques in my project as well.

Finally, I want to discuss the results and the end of this paper. The results section highlighted many of the cytokines and chemokines that were present while the wound was healing. This is helpful as it lets me know what specific cytokines and chemokines I need to look for in my project. However, I was disappointed when I read the discussion section of this paper. The discussion was informative; however, I would have enjoyed reading it. Most researchers took a better stance and explained their opinions and views based on the data. They kept repeating the experiment's results, which led me to form my own opinion, which in some ways is good, but I wanted to hear more from the researcher's perspective. The study also relies on animal models, which may not fully translate into human physiology, which may skew the results. Moreover, this study only focuses on the short-term effects of the stem cells; more research must be done to see if the stem cells integrate well into the patient after a while.

Overall, reflecting on this study was relevant to my topic and helped me gain insight into my project for the year. It enhanced my understanding of the current research on mesenchymal stem cells and the gaps in the existing research. I also learned a lot about the procedure of making the type of experiment; I admired their methods and techniques, so I want to research them further and use them in my project. I also recognized the gaps in the research paper and now know what I want to focus on to improve my project. With all this information I have learned, I know how to direct my future research. I want to direct my research into the methods that they used, such as flow cytometry and antibody-based protein array, which are both tools that they used to quantify the results they had. I also want to research how these techniques could be translated into diseases relating to the eye. In this paper's scenario, they used these stem cells to treat injuries to the skin cells. I want to research how these stem cells could be modified to integrate into the ocular environment. This research paper gave me much clarity about my research project for the year. The central gap I want to focus on is the actual factors that stem cells produce that aid in regeneration; I know what techniques I want to implement in research and what part of the body I want to do this experiment on. Using the perspective and information I gained from this paper helped me solidify my research plan for my year in ISM.

