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Scientific Literacy: Background Essay

Squamous cell carcinoma is a form of skin cancer that is fairly common. This form of skin cancer specifically develops in the squamous cells found in the layers of skin. Like many forms of skin cancer, squamous cell carcinoma can be caused by exposure to ultraviolet radiation. Squamous cells can be found in the skin's layers anywhere on the body. Although squamous cell carcinoma can technically be found anywhere where squamous cells are found, this particular type of cancer is typically found on parts of the body that are exposed to the sun's radiation (Mayo Clinic Staff, 2023). Squamous cell carcinoma has a high risk of metastasizing or spreading to other parts of the body. This form of skin cancer may start as a small nodule on the skin, but if it is not caught and treated then it has the potential to increase in size and become an ulcer on the skin. Once squamous cell carcinoma enlarges and becomes necrotic the chances of the cancer metastasizing increases (Wikipedia Contributors, 2023). Squamous cell carcinoma develops due to mutations within the DNA of the squamous cells found in the layers of skin. Due to the mutations within the DNA of the cells, the squamous cells begin to multiply and grow at an extensive rate. DNA contains the instructions or directions for the cells to follow, so when mutations take place in the DNA of cells the instructions for the cells to follow will also change. In the particular case of squamous cell carcinoma, the mutations cause the squamous cells to multiply excessively, and the cells fail to adhere to the cell cycle, and instead continue to live past their intended time (Mayo Clinic Staff, 2023). When observing skin exposed to squamous cell carcinoma, one may observe hyperkeratosis or parakeratosis within the epidermal layer of the skin (Wikipedia Contributors, 2023).

Collagen type III is a specific type of extracellular matrix protein found in humans. Collagen type III in humans is found to be encoded by the COL3A1 gene. There are three total alpha 1 chains that make up collagen type III. This means that this type of collagen molecule contains a long triple helical domain. Collagen type III is a major component in hollow organs and plays a vital role in the structure or hollow organs such as the uterus or bowel (Kuivaniemi & Tromp, 2019). It has been found that this particular type of collagen is synthesized by cells and considered to be pre-procollagen.

It has been discovered that there is a relationship between cancer and collagen type III. Collagen type III, specifically, is required to sustain dormancy within cancer cells. However, in order for the collagen type III to successfully be used to sustain dormancy of cancerous tumors, the collagen type III must be tumor derived. In addition, the process from dormancy to reactivation of the cancer cells is also affected by changes within the collagen type III. Specifically, changes in the abundance and architecture of the collagen type III are what affects

the reactivation of the cancer cells. Data also illustrates that there are increased levels of collagen type III found in patients with squamous cell carcinoma (Di Martino et al., 2022).

Extracellular matrix is a network of proteins that contributes to fueling the progression of tumor cells and increasing metastatic growth. In addition, research shows that extracellular matrix produces type III collagen which aids in tumor dormancy. The ECM has a direct correlation to the varying aggression associated with the invasiveness of a tumor (Di Martino, et al., 2022). This means that the extracellular matrix contributes to how much a tumor may disperse to other parts of the body and how aggressive the tumor is. The invasiveness and aggression levels of a tumor is an essential factor in determining treatment plans and survival tactics for individuals with a tumor present. The differences observed within the extracellular matrix for dormant tumor cell lines and proliferative tumor cell lines involved the presence of type III collagen. Type III collagen is produced and found in dormant tumor cells to promote tumor dormancy. Dormant tumor cell lines are going to acquire an increased presence of type III collagen within the extracellular matrix, in order to promote and aid in tumor cell dormancy. In comparison, proliferative tumor cell lines are not going to have an increased presence of type III collagen, in order to avoid dormancy and continue to promote metastatic growth of a tumor (Di Martino et al., 2022).

Most cells undergo a very specific cell cycle involving genetic information getting processed and transferred through the production of daughter cells. However, with metastatic tumor cells during the cell cycle process mutations occur within the process leading to the overproduction of cells or increased proliferation of cells. When a mutation occurs within the cell cycle that causes the cells to proliferate uncontrollably or at an increased level it will typically lead to the development of cancer and metastatic tumors. Specifically in metastatic tumors the absence of suppressor genes or failed regulatory functions would be observed, which is what may cause the development of cancer and tumors (Mercadante & Kasi, 2023).

Collagen III is produced in the extracellular matrix and is associated with promoting and aiding in tumor cell dormancy. Due to collagen III directly affecting tumor cell dormancy, higher levels of collagen type III would typically be observed in single cells to promote dormancy in comparison to metastatic tumor cells. Metastatic tumor cells would have a decreased level of type III collagen due to the metastatic growth or increased proliferation (Di Martino et al., 2022).

Research shows that when using the proliferative T-HEp3 cell line the presence of collagen type III resulted in smaller sized tumors in comparison to other variations of collagen tested (Di Martino et al., 2022).

Due to collagen type III aiding in cell dormancy within tumor cell lines, it was observed that collagen type III was able to decrease the increased proliferation of metastatic tumor cells. Collagen type III ability to decrease proliferation means that a smaller number of cells are able to successfully go through the S phase and G2 phase of the cell cycle (Di Martino et al., 2022).

This paper discussed how specific stands of collagen related to the ECM affects the proliferation of metastatic tumor cells. The research discussed in this paper identifies the functions of the extracellular matrix and how proteins, specifically collagen, related to the ECM

may affect cell dormancy or growth rates. In addition, there are many topics discussed within this appear that relate to course content such as the functions of extracellular matrix, protein relation to extracellular matrix, and the cell cycle and how mutations within the cell cycle may affect cell outcomes.

References

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