Chapter 18
Recent Research and Development in Stem Cell Therapy for Cancer Treatment: Promising Future and Challenges

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ABSTRACT

Cancer is the most prevalent and dangerous disease, and it leads to millions of deaths worldwide. Generally, metastatic cancer cells are not eradication by conventional surgical operative or chemotherapy-based treatment. New pathways have been established in various arenas such as unique biology, modulators regulatory mechanism, directional migration, self-renewal, etc. The individual pathways can be employed as therapeutic carriers, specific drug targeting, generation of acquiring nature immune cells, and re-generative medicine. The present scenario, stem cell therapy, focused on a promising tool for targeted cancer treatment. Stem cells also utilized as viruses and nanoparticles carry to enhance the primary therapeutic application in various dimensions such as cancer target therapy, regenerative medicine, immune-modulating therapy, and anticancer drugs screening. Furthermore, the rapid development in next-generation sequencing techniques and cancer genomics and proteomics analysis approaches are making therapeutics targeting organ-specific cancer more precise and efficient.

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INTRODUCTION

Cancer is a group of diseases, which is characterized by the uncontrolled rapid growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Although the causes of cancer are not completely understood, numerous factors are known to increase the disease's occurrence, including many that are modifiable (e.g., tobacco use and excess body weight) and others that are not (e.g., inherited genetic mutations). The latter process is called metastasizing and is a major cause of death from cancer. A neoplasm and malignant tumour are other common names for cancer (WHO, 2020). These risk factors may act simultaneously or in sequence to initiate and/or promote cancer growth (American Cancer Society; 2020). Cancer is a leading motive of dying in each developed and growing nation (Siegel et al., 2019). Cancer is the second leading cause of death globally, accounting for an estimated 9.6 million deaths, or one in six deaths, in 2018. Lung, prostate, colorectal, stomach and liver cancer are the most common types of cancer in men, while breast, colorectal, lung, cervical and thyroid cancer are the most common among women (WHO, 2020). The cancer burden continues to grow globally, exerting tremendous physical, emotional, and financial strain on individuals, families, communities, and health systems, due to rapid population growth and aging, etc. (Siegel et al., 2019). Many health systems in low- and middle-income countries are least prepared to manage this burden, and large numbers of cancer patients globally do not have access to timely quality diagnosis and treatment (WHO, 2020). Cancer is mainly treated by the usage of radiotherapy, chemotherapy and solid tissue removal by surgical procedure. The procedure of therapy preferably based on the nature of cancerous (Siegel et al., 2019). In fact, the most metastatic cancers cannot be operated by using contemporary techniques. Scientists and academic societies are constantly working towards innovation and indeed the creation of new techniques for treatment for cancer (Zhang et al., 2017). Conventional treatment has only effectual for specific malignant cancers (Sun, 2015).

Tissues such as the intestinal epithelium and the hematopoietic system continuously self-renew through the activity of a dedicated population of tissue-specific stem cells, also known as adult stem cells (Clever, 2013).

PROPERTIES AND SOURCES OF STEM CELLS

1. Normal Stem Cells

The stem cells in different tissues share two common properties, the ability to self-renew, for example, to divide and form at least one new stem cell, as well as to differentiate into the mature cells of the organ in which it resides (Zhang et al., 2017). Although some studies suggested that plasticity allowed stem cells from different tissues such as the brain or blood system to trans differentiate and form mature cells of many different tissues, it is now clear that such plasticity is frequently the result of a rare fusion of the stem cell or its progeny with a cell of another organ (Wang et al., 2003). The ability of stem cells to expand in number is under tight genetic constraints. This is not surprising since unlimited stem cell expansion, coupled with the ability of the stem cells to enter the circulation (essentially metastasize), would result in a cell with a phenotype similar to that of a cancer cell. All that would be lacking would be the property of tissue invasion (Al-Hajj and Clarke, 2004). Recent evidence has demonstrated that cancers can be viewed as an abnormal organ in which tumour growth is driven by a population of can-