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Cancer stem cells

Linkon Saha

Cancer stem cells are a subpopulation of tumour cells that possess some characteristics of stem cells, such as self-renewal ability and the ability to differentiate into a heterogeneous population of cancer cells. These cells were first identified in acute myeloid leukaemia in the late 1990s and have been an intense focus of cancer research since then. Cancer stem cells (CSCs) have some unique characteristics in comparison to other cancer cells, such as self-renewal, tumourigenicity, enhanced resistance to drugs and radiation therapy, insensitivity to anti-growth signals, evasion of programmed cell death and metastasis. Although cancer stem cells cause cancer, the rate of their uncontrolled proliferation is slower than the normal cancer cells. The main problem faced due to CSCs is that they are immune to radiation treatment. They gain such resistance due to reasons, such as increased activation of drug-efflux pumps, enhanced capacity of DNA damage repair, dysregulation of growth and development of signalling pathways, alterations of cellular metabolism, their environmental niche as well as due to the impaired apoptotic response. CSCs have been found in many solid and nonsolid tumours and they have the tendency to transdifferentiate into other multilineage cells to regulate tumorigenesis. The CSCs have been identified so far in leukaemia, breast cancer, brain, colon, head and neck, pancreas and central nervous system tumours. Although radiation and chemotherapy treatment do not work on CSCs due to their self-renewal property and drug resistance, there are some treatment methods that target specific pathways and signals to treat cancer stem cells. Some of these target pathways include notch pathway, Hedgehog (HH) pathway, wingless-related integration site (Wnt) signalling and epithelial–mesenchymal transition (EMT) pathway. MicroRNA (miRNA) can be used as a CSC-based therapeutic agent in cancer immunotherapy. The CSC markers that are utilised as targets for immunotherapy are cluster of differentiation 44 (CD44), CD133, epithelial cell adhesion molecule (EpCAM) and human epidermal growth factor receptor 2 (HER2). The presence of cancer stem cells has made it more difficult to treat cancer, hence further research must be carried out to develop and optimise better treatment methods by targeting the signalling pathways and using the CSC markers in immunotherapy approaches.

Keywords: Tumourigenicity, Metastasis, Radiation therapy, Cancer stem cells, Signalling pathways, Cancer immunotherapy

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