Circulating Tumor Cells (CTCs) in Early Cancer Detection, Prognosis Evaluation, and Monitoring Cancer Drug Efficacy

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Tumour metastasis refers to the spread of cancer cells from the initial site of primary tumor to a distant secondary location. Cancerous tumor usually possesses a very large number of cells with genetic mutations which motivate them to grow, proliferate, and then, invade the local surrounding tissues [1]. As the tumor grows larger, some of the cells are dislodged from the main tumor and carried away by the blood or lymphatic vessels. These "circulating tumor cells" or CTCs possess important information about the primary tumor from which they are detached [1-3]. In fact, the presence and quantity of CTCs in the cancer patients' blood stream have been known to correlate directly to the stage of cancer as well as the effectiveness of cancer therapies [4]. The ability to isolate and enrich a large number of intact CTCs for analysis and characterisation will be pivotal for deepening our understanding of the metastatic process [5]. However, the extremely low abundance of CTCs in the blood makes enumeration and characterisation a huge technical challenge [6]. As CTCs are closely related to the growth of primary tumor and development of metastasis, they have great potential values for early cancer detection, prognosis evaluation, and cancer drug efficacy monitoring. In comparison with hematologic cells, CTCs cannot be easily studied because of their rarity (i.e., in the order of 1 to 10 per mL of whole blood). Recent studies have shown that CTCs are different from other hematologic cells in terms of their surface molecules expression (EpCAM) [7], size [8], density [9], stiffness [10], adhesion [11], and electrical properties. As their isolation is still a major challenge, very rare information is available regarding their nature and behaviour.

A number of recent reports on their isolation and characterization have marked them as cells having proliferative potential and hypothesized that these cells are not just carcinoma cells but cancer stem cells who have left their origin for metastasis under the instructions of unknown regulatory mechanisms and cascades. Successful characterization of CTCs will help oncologists to treat cancer in better way which is a major health problem in the world.

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