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Anticancer Natural Terpenoids

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6.1 Introduction

Cancer is considered as a principal public health problem in India and in other parts of the world. It is one of the major causes of mortality and morbidity around the globe, and the number of cases is increasing continuously which is estimated to be 21 million by 2030. In 2017, it was estimated that the US has approximately 1,688,780 new cancer diagnoses cases and 600,920 cancer deaths [1,2]. As per World Health Organization (WHO) data, above 14.1 million new cancer cases and 8.2 million deaths were reported globally in the year 2012 and over 70% of new cancer cases have been estimated during the next 20 years [3]. Cancer is characterized by uncontrolled growth of abnormal cells and that finally leads to metastasis. The uncontrolled proliferation of a normal cell leads to genetic instabilities and alterations within the cells and tissues that transform normal cells into malignant cells [4].

There are three stages involved in the development of cancer including initiation, promotion/progression and metastasis. In cancer development, the first step is initiation in which there is a change in the genetic materials of the cells called mutation that makes the normal cells into cancerous cells. The change in the genetic materials of cells may arise spontaneously or induced by exposure to carcinogens (cancer-causing agents). The genetic alterations can result in dysregulation of biochemical signaling pathways associated with cellular proliferation, survival and differentiation that can be influenced by several factors such as rate and type of carcinogenic metabolism and the response of the DNA repair function. Whereas the promotion step is a lengthy and reversible process in which the actively proliferating preneoplastic cells accumulate. Similarly, progression is the phase between a preneoplastic lesion and the development of invasive cancer. It is the stage of neoplastic transformation in which the genetic and phenotypic changes and cell proliferation occur. It involves the increase in tumor size where the cells may undergo mutations with invasive and metastatic potential. Finally, metastasis involves the spread of cancer cells from the primary site to other parts of the body through the blood stream or the lymphatic system (Figure 6.1) [5].



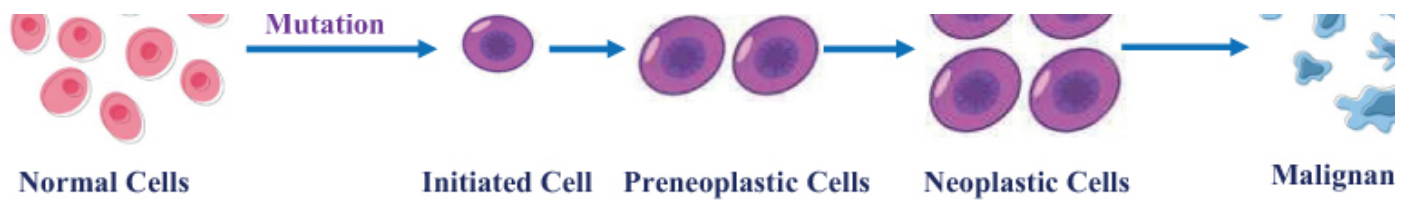


FIGURE 6.1 Development of cancer cells.

Several factors involved to cause cancer include external factors and internal factors. Various external factors are radiation, smoking, chewing tobacco, pollutants in drinking water, food, air, chemicals, certain metals and infectious agents. Similarly, internal factors include genetic mutations, body immune system and hormonal disorders [6].

Hallmarks of cancer consist of an organizing principle for rationalizing the complexities of this disease. Hallmarks include sustaining proliferative signaling, evading growth suppressors, resisting cell death, enabling replicative immortality, inducing angiogenesis and activating invasion and metastasis. Hanahan and Weinberg reported that activating invasion and metastasis is the hallmark of cancer (Figure 6.2) [7].

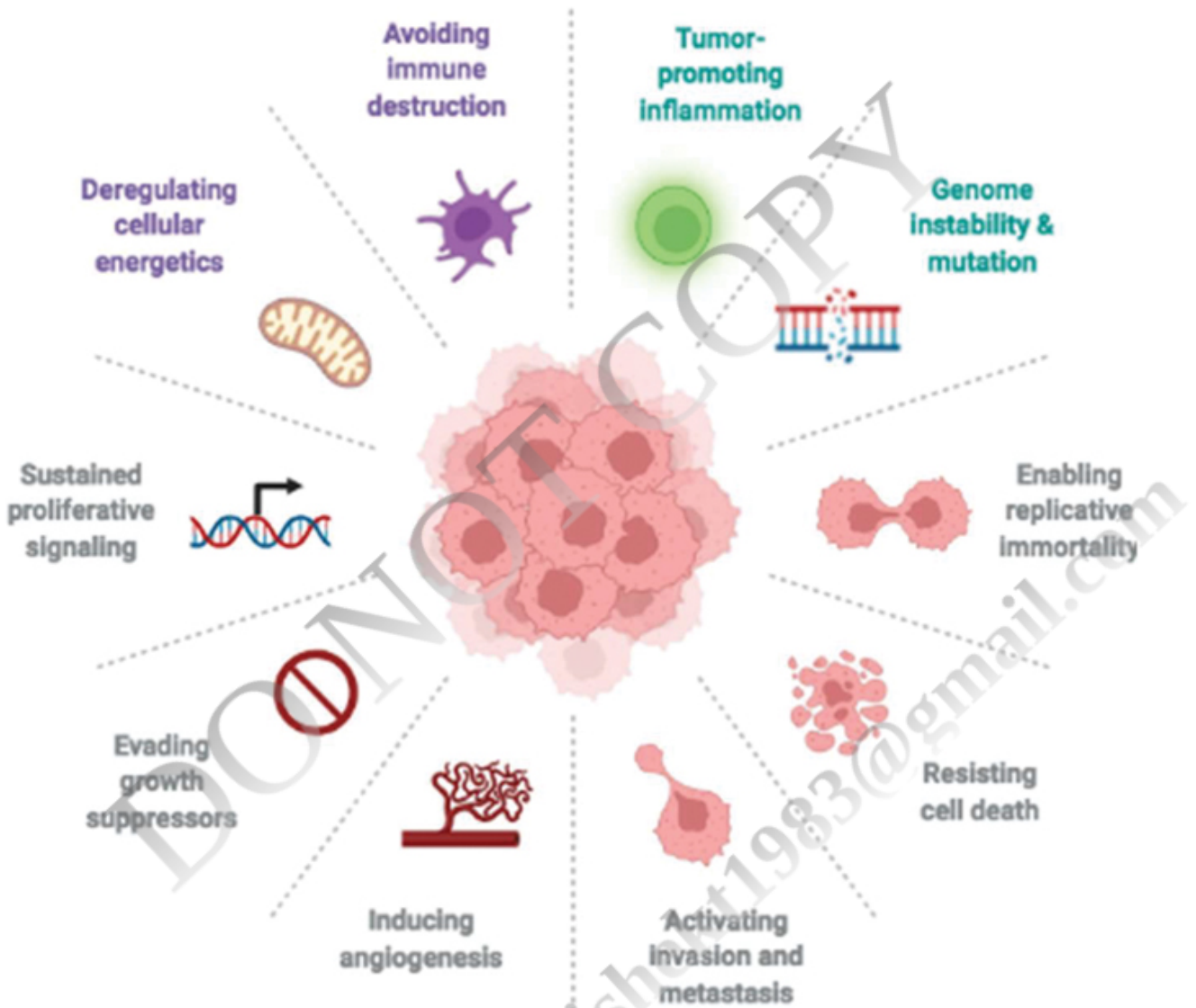


FIGURE 6.2 Hallmarks of cancer.

There are several types of cancer observed in human beings such as lung cancer, liver cancer, ovary cancer, colon and rectum cancer leukemia, prostate cancer, breast cancer, thyroid cancer, pancreas cancer, colon and rectum cancer. Among these, lung cancer is reported as top list in male and breast cancer in the case of females [8]. Approximately, 80% of the world's