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Prospects for Improving the Effectiveness of Chemotherapy in Patients with Tumors

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Abbreviations: DNA: Deoxyribonucleic Acid; XV: XenogeneicVaccines; HC: Heterocyclic Compounds

Introduction

Despite the intensive efforts of researchers, the area of anti-tumor therapy still contains number of unsolved problems. Among the most general ones are: late diagnosis, poor efficiency of available therapies, multiple side effects [1-3]. In this article we briefly review some modern therapeutic methods used in oncology and describe recent attempts to neutralize the side effects of anti-cancer therapy.

Classical Methods of Therapy for Patients with Oncological Diseases

There are three general ways in tumor therapy: surgical intervention, radiotherapy and chemotherapy [4]. The combined application of these methods is often used. In addition, new specific treatments are being developed each year. Recently developed techniques allow selective detection and suppression of the tumor cells. The number of identified tumor cell markers grows in logarithmic progression. However, the percentage of successful outcomes for many types of malignant tumors is still far from ideal [1,2].

Immunotherapy represents another approach to cancer treatment. It is based on the mobilization of the immune potential of the organism [5,6]. Vaccines activating immunocompetent cells are rather perspective as they improve the ability of these cells to identify and destroy tumor loci [7,8]. Family of cancer vaccines includes autologic and allogenic cell-based vaccines, Deoxyribonucleic acid (DNA) vaccines, vaccines based on dendritic cells and some others [8]. Utilization of cancer vaccines, however, meets some problems. Among them are variability of antigenic spectrum and expression level of the particular antigen; ability of tumor cells to escape from the immune response due to immunological editing; low immunogenicity level of tumor-associated antigens. Due to this specialist distinguish a particular subclass of cancer vaccines - xenogenic vaccines (XV) - as especially perspective. In contrast to the other cancer vaccines, XV ones contain antigens from non-human species. Structural difference from the human analogs makes them highly immunogenic and highly effective against some forms of malignant tumors [7-9]. Moreover, XV are able to stimulate antitumor reactions in the weakened organism with suppressed immune system. This is especially important for the cases of late diagnostic. We have to emphasize, however, that effectiveness of XV was demonstrated only in certain forms of cancer [7-9].

Some promising approaches in the diagnosis and treatment of tumors appeared due to the development of cell technologies. Some of the antigens expressed by the tumor cells at various stages of their life are associated with stem cell antigens [4,10]. A peculiar phenomenon of identical "fingerprints" was revealed in the study when spectra of rat C6 glioma cells and mesenchymal stem cells were compared using Raman spectroscopy [10]. The observed similarity might explain the difficulties faced by the immunocompetent cells when they need to discriminate among undifferentiated elements of tumor and non-tumor origin [10]. This might lead to the failures in the detection of tumor agents by the immune cells favoring further development of the pathological process.

Nanotechnology in Modern Oncology

Development of nanotechnology opened another innovative way in the diagnosis and treatment of cancer. Wide-known

nanomaterials, such as nanoparticles (fullerenes, dendrimers) and heterocyclic compounds (HC), appear to have an antitumor effect. Nanoparticles were shown to act on different levels – from intracellular to systemic. For example, selective accumulation and clustering of gold nanoparticles froming plasmon nanopubes in tumor cell allows using short laser pulses to destroy the tumor nidus without significant damage to the surrounding healthy tissue [11]. Dendrimers maintaining the stability of medicinal substances and promoting their penetration into the cell represent another example of application of the nanoparticles in the clinical practice [12,13]. Due to their positive additive effect nanomaterials can be used in combination with antitumor drugs allowing to decrease the dose of the cytostatics known for their adverse side effects [12-14].

Prospects for Improving the Efficiency of Therapy of Tumors Patients

We would like to unfold the idea expressed in the last sentence of the previous section. Each pharmaceutical company seeks to develop medications with minimal side effects preserving their therapeutic efficacy. However, in spite of some selectivity of the action achieved in the modern chemotherapeutic agents, each chemotherapy course provokes a massive damage of healthy cells in the patient's organism. Such side effects of cytostatic significantly reduce the life expectancy of the patients. One of the strategies able to improve this situation is a combination of standard chemotherapy drugs with a kind of adjuvants [14,15]. These adjuvants might lack an antitumor effect by themselves. Instead, their main action would be catalyzation, or amplification of the cytostatics' action. The good candidates for this role are the above-mentioned nanoparticles and HC. In experimental conditions their combination with chemotherapeutic medications provided a cumulative effect increasing the antitumor action of the treatment. Introduction of such technology will allow reducing the effective dose of cytostatics, which in turn should decrease the adverse effects of the therapy [14,15].

Conclusion

In conclusion, the two principal goals of any medical treatment are: increase of its effectiveness, and reduction of the costs. Combination of the chemotherapy with adjuvants (nanoparticles, HC) will allow reducing the doses of cytostatics while preserving or even improving the efficacy of treatment. This approach should also minimize the adverse effects of the chemotherapy and let on the cost savings [16-18].

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