Clinics in Oncology

Opinion
Published: 09 Aug, 2021

Molecular Profiling and Progression of Malignant Melanoma: Nanomedicine and Immunotherapeutic Remedies for Diagnosis, Treatment, and Therapy

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Opinion

The phenomenon of molecular mechanisms of malignant melanoma progression

The interpretation of molecular profiling and progression of malignant melanoma explores the hidden routes and pinpoints unrecognized subtypes of cutaneous melanoma [1]. The elucidation of phenotypic characteristics foretells the progression of malignant melanoma and later on authenticates them experimentally. Many molecular underlying mechanisms and types of the subset of malignant melanoma have different profiling and progression patterns in invasive melanoma (Figure 1). It is crucial to notify accurately and highlight the multi scale mechanobiology, the origin of metastatic disease, the theories, and the phenomenon of molecular mechanisms of malignant tumor progression [2]. It was earlier notified that the progression of malignant melanoma is a consequence of a diverse phenomenon that materialized among malignantly distorted cells and host essentials. The interpretation strategies of these biological events and specified tumor progression routes are ready to lend a hand in the discovery of novel and effective treatment remedies and therapy [3]. Besides, this outlook on the dysregulated molecular mechanisms of altered melanocytes was highlighted in the key topographies of current findings [4]. In this opinion, the author summarizes many critical molecular mechanisms underlying and molecular phases in progression (metastasis, dysregulated proliferation, invasion, and angiogenesis). Moreover, several other necessities are there, which can conduct accurate analysis, foresee a melanoma and distinguish it from genetic abnormalities.

All in all, it is a considerably thought-provoking task to innovate promising theranostics strategies that can fulfill the aforementioned deeds. Despite these challenges, the molecular profiling of malignant melanoma is gaining resistance to available therapeutic and therapies [5]. However, the accurate assessment of melanoma progression is a tough assignment [6]. Therefore, the innovation of nanotools and nanodevices is urgently desirable and can be done for accurate

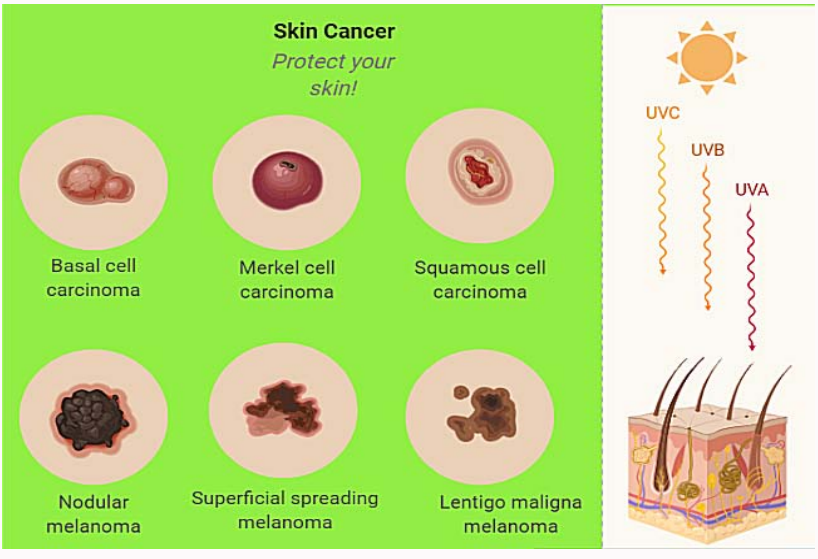

Figure 1: Diagram to illustrate the phenomenon of molecular mechanisms of malignant melanoma.

OPEN ACCESS

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Received Date: *15 Jul 2021*
Accepted Date: *05 Aug 2021*
Published Date: *09 Aug 2021*

Citation:
Kumar R. Molecular Profiling and Progression of Malignant Melanoma: Nanomedicine and Immunotherapeutic Remedies for Diagnosis, Treatment, and Therapy. Clin Oncol. 2021; 6: 1846.

ISSN: 2474-1663

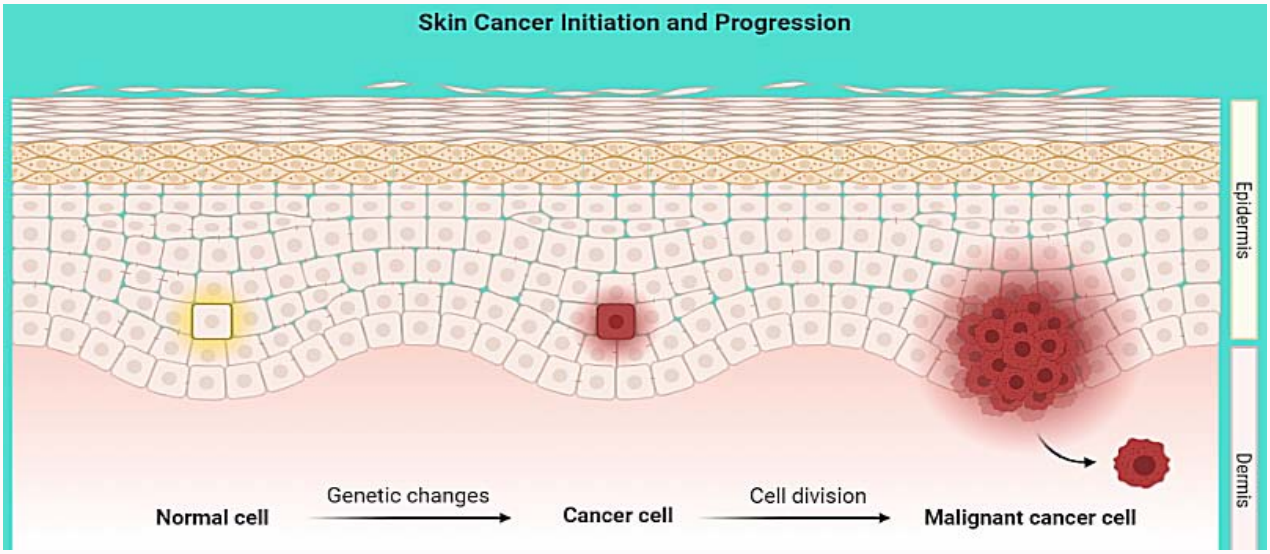

Figure 2: Illustration of progression of malignant melanoma.

treatment and to achieve a perfect therapy. Several pieces of evidence were acquired recently, which evidenced that intense intermittent disclosure to sunlight initiate melanocyte tumorigenesis and these findings highlighted significant mechanisms of intricate pathogenesis of malignant melanoma by inducing immunosuppression. Various other features of metastasis are openly intertwined with the biophysical routes of chemokines, angiogenesis, and metalloproteinase to enhance progression. Besides it, more early events and routes are still undisclosed. In summary, the phenomenon of the pathogenesis of melanoma is complicated as many genetic and epigenetic factors contribute to its progression [7]. To expose the newly originated perturbations at the molecular scale, the diagnosis and scientific interpretations will further bring new hopes to treat these biophysical complications. To deactivate such molecules and physicochemical routes that instigated malignant melanoma and innovate new therapies is seriously needed. Due to certain environmental factors, the skin melanocytes transformed into malignant melanoma and during these alterations, various interfaces between genetic and environmental factors metastasized [8]. These biochemical activities do specific biological changes and change the stage of progression. The progression of malignant melanoma influenced the normal functioning of cellular proliferation and vitality activities and is illustrated in Figure 2. After this event, other irregularities in the natural processing of the cellular pathways and routes were observed and described. These unnatural features of the cellular environment induce molecular genetic alterations in its natural proceedings of it. Therefore, a better insight into these characteristics of molecular alterations will be helpful but not yet well-defined that will expose the correct route of melanoma pathogenesis [9]. These alterations in the normal events of the cells displayed potential tumorigenic and metastatic characteristics and can eventually trigger apoptosis in malignant melanoma cells. Therefore, these events are considered crucial events in the progression of melanoma [10].

Nanotheranostics, nanotherapeutics, and immunotherapeutic remedies for treating melanoma microenvironment

To deal with these unnatural locations of malignant melanoma, various forms and compositions of multifunctional nanomaterials (ZnO: Ag, selenium, polymer-coated cerium oxide, anionic gamma-Fe_2O_3, single-walled carbon nanohorns, and Cu_2O) and their nanoformulations were utilized as effective theranostics (cancer immunotherapy, cytotoxic chemotherapy, targeted therapy, combined therapy, diagnosis, and imaging) as per their physicochemical properties and versatile chemical functionalization to cope with emerged needs [11]. Nanotechnology brings hope for improving diagnosis and provides operative novel theranostic for the treatment-resistant diseases with increase therapeutic efficacy when safely applied in the clinical setting. Nanotechnology developed new molecular contrast agents and nanomaterials to enable prior and more precise early diagnosis as well as infrequent monitoring of effective treatment. Nanotheranostics and nanotherapeutics displayed potential in understanding the role of melanoma tumor microenvironment in the progression of melanoma, performed as drug-delivery vehicles and enhanced drug resistance [12]. For immuno-oncology applications, the nanotheranostics and nanotherapeutics should be actively modulated for enhancing host anticancer immunity. Such fortitudes will open new avenues for developing novel and advanced melanoma remedies and therapy that can perform as a controlled drug delivery agent at the affected site upon injection.

Indeed, natural nanocarriers can be innovated for delivering the above-mentioned drug agents as cutting-edge melanoma therapeutics and can initiate mitigate drug resistance by minimizing toxicity. Proper knowledge of biogenesis, molecular contents, melanoma-related exosomes, and biological events is further supportive in early diagnosis and very helpful in exploring the phenomenon of prognosis in malignant melanoma [13]. These findings will enhance the possibilities of a proper analysis of fortresses of hidden mechanisms of resistance that originated in malignant melanoma during the implementation of various melanoma therapies and nanotechnology-based strategies [14]. These strategies designed *via* nanotechnology can overcome persistent barriers of mechanisms of resistance to various melanoma therapies naturally, engendered by malignant melanoma cells, and could improve the pharmacologic impacts of these theranostics. In summary, the immunotherapeutic agents derived by nanotechnology will have in-built nanotubes, polymeric

micelles, and liposomes with high grade of pharmacokinetic and pharmacodynamics properties which can reduce the invasiveness of malignant melanoma influence of the tumor microenvironment by improving the bioavailability and penetration abilities of the aforementioned theranostics [11]. Several common nanoparticles, including liposomes, dendrimers, various metal nanoparticles, and human albumin, have been used for diagnosis, treatment, remedies preparations and escape from possible mechanisms of resistance in the tumor microenvironment. Indeed, the US Food and drug administration approved several nanotheranostics, nanotherapeutics, and immunotherapeutic remedies for treating melanoma tumor microenvironment safely and can be applied in different clinical locations.

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