Yumed Text
OPEN ACCESS JOURNALS

Archives of Clinical & Experimental Dermatology

Editorial | Vol 4 Iss 2

Advances in Melanoma Nanotheranostics: The Light Side of the Moon

Farid Menaa*

Departments of Dermato-Oncology and Nanomedicine, Co-pioneer of the fluoro-imaging platform Spectrofluor™, CIC and Fluorotronics, Inc. San Diego, CA, USA

***Corresponding author:** Menaa F, Departments of Dermato-Oncology and Nanomedicine, Co-pioneer of the fluoro-imaging platform SpectrofluorTM, CIC and Fluorotronics, Inc. San Diego, CA, USA, E-mail: menaateam@gmail.com

Received: June 27, 2022; **Accepted:** July 04, 2022; **Published:** July 11, 2022

Keywords: ***Melanoma; Nanomedicine; Combinatorial therapy; Imaging-Guided surgery; Diagnosis; Translational medicine***

Melanoma (from Greek—melas: "dark") is a tumor originated from malignant transformation of melanocytes (i.e., melanin pigment-producing cells) that can be found in the skin, bowel, and eye [1,2]. According to the American Cancer Society's estimates for melanoma in the United States for 2022 [3] about 100,000 new melanomas will be diagnosed and about 8000 people are expected to die of melanoma (twice more men). The rates of melanoma have been rising rapidly over the past few decades, but this has varied by age.

Melanoma is the most aggressive type of skin cancer [1,2,4,5] which is quite difficult to treat because of its complex pathogenesis, including (i) tumor heterogeneity, (ii) drug resistance treatment with monotherapy, (iii) immune escape capacity of tumor cells (including 'melanoma stem cells'), (iv) genetic (e.g. *BRAFV600E* mutations) and environmental factors (e.g. sun light exposure of white skin). Most melanoma cases develop in the skin rather than in the viscera or mucosa. For early stage or primary cutaneous melanoma (CM), surgical resection is the gold standard therapy. However, when melanoma progresses into an aggressive or metastasized form, chemotherapy (e.g., DTIC), radiotherapy (e.g., *external beam radiation therapy*), immunotherapy (e.g., CTLA-4, PD-1) and/or targeted therapy (e.g., vemurafenib) are needed [1]. Unfortunately, monotherapeutic strategies have shown much limited therapeutic effects (e.g., drug resistance, adverse effects, relatively low efficiency, and disease time relapse) [1].

Currently, nanomedicine is being widely investigated in small animal models and *in vitro* cellular experiments. to afford melanoma theranostics (e.g., targeted/directed, and controlled release of cytotoxic drugs and/or imaging labels in the site of growing tumor) [6]. Importantly, huge progress has been made using multimodal strategies (e.g., combinatorial chemotherapy and fluorescence-guided imaging especially in the near infrared (NIR)) based on nanomedicine (e.g. use of nanoparticles (NP)) to achieve optimized therapeutic output for melanoma treatment. Thereby, nanosized drug delivery systems (NDDSs) showed

advantages over the conventional drug delivery systems [7-9] by (i) enhancing the circulation time of the drug, (ii) enabling tumor site-directed delivery of the drug, through the capacity of NDDS to be tunable and functionalized, (iii) preventing from enzymatic degradation of the drug , (iv) improving the therapeutc index of chemotherapeutic drugs, thereby minimizing the severe systemic toxicity caused by off-target exposure, (v) allowing a synergistic combination of cancer immunotherapy with other therapies such as photothermal therapy (PTT). However, one must consider the possible drawbacks of using unrationally-designed nanopartilces (NPs) to treat melanoma because they could prove unsafe with unknown long-term effects (cytotoxicity, aggregation in the endoplasmic reticulum inducing autoimmunity), and even fatal [6,7].

Interestingly, it has been recently reported that NIR fluorescence imaging, including both 700 nm -1000 nm NIR-I window and 1000 nm - 1700 nm NIR-II region, has several advantages in terms of real-time monitoring, intraoperative navigation ability, and reasonable imaging quality [6,10-12], enabling intraoperative diagnosis of CM with a total depth of less than 1 cm and the distinction of melanoma from adjacent nonmalignant tissue.

Due to the remaining high mortality rate and poor prognosis, early diagnosis and effective therapies for melanoma are urgently required. Eventually, successful treatment shall include synergistic multimodal strategies to be intensively evaluated by multi-centric studies, in both lab-scale small animal models and clinical settings, while ensuring (i) the establishment of an optimal dose that retains the therapeutic benefit while balancing adverse events due to drug reactions, (ii) the development of efficient delivery systems that direct delivery of chemical agents and other therapeutic materials to tumor sites, (iii) the fluorescence-guided detection and excision with clear tumor margins at three-dimensional (3D) angles at the NIR-II window (to improve imaging contrast and penetration depth).

There is a big hope that advanced NDDS of combined drugs for melanoma and NIR-II imaging-guided diagnosis and surgery of melanoma will constitute an asset in the management of patients suffering from melanoma). The multimodal synergistic therapies shall enlighten the dark side of the human skin...

REFERENCES

1. Menaa F. Latest Approved Therapies for Metastatic Melanoma: What Comes Next? J Skin Cancer. 2013;2013:735282.
2. Schadendorf D, Fisher DE, Garbe C, et al. (2015). Melanoma. Nat Rev Dis Primers. 2015;1:15003.
3. https://www.cancer.org/cancer/melanoma-skin-cancer/about/key-statistics.html
4. Menaa F, Houben R, Eyrich M, et al. Stem cells, melanoma and cancer stem cells: the good, the bad and the evil? G Ital Dermatol Venereol. 2009;144(3):287-96.
5. Houben R, Wischhusen J, Menaa F, et al. Melanoma stem cells: targets for successful therapy? J Dtsch Dermatol Ges. 2008;6(7):541-6.
6. Guan M, Zhu S, Li S. Recent Progress in Nanomedicine for Melanoma Theranostics with Emphasis on Combination Therapy. Front Bioeng Biotechnol. 2021;9:661214.
7. Menaa F. When Pharma Meets Nano or The Emerging Era of Nano-Pharmaceuticals. Pharmaceut Anal Acta. 2013;4: 223.

8. Prabhakar U, Maeda H, Jain RK, et al. Challenges and key considerations of the enhanced permeability and retention effect for nanomedicine drug delivery in oncology. Cancer Res. 2013;73(8):2412-7.
9. Ma YF, Huang J, Song SJ, et al. Cancer-targeted nanotheranostics: recent advances and perspectives. Small. 2016;12(36): 4936-54.
10. Zhong YT, Ma ZR, Wang FF, et al. In vivo molecular imaging for immunotherapy using ultra-bright near-infrared-IIb rare-earth nanoparticles. Nat Biotechnol. 2019;37(11):1322-31.
11. Zhang CC, Zhang ZX, Lin KS, et al. Melanoma imaging using F-labeled α-melanocyte-stimulating hormone derivatives with positron emission tomography. Mol Pharm. 2018;15(6):2116-22.
12. Li J, Liu Y, Xu YL, et al. Recent advances in the development of NIR-II organic emitters for biomedicine. Coord. Chem. Rev. 2020;415:213318.