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Editorial

Development of Advanced Nanomaterials for Multifunctional Devices: Insights into a Novel Concept of Personalized Medicine

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The application of biocompatible nanomaterials to simultaneously detect and provide treatment of a disease is referred to as nanotheranostics.

In the last decade, this broad discipline has significantly improved diagnosis and finely tuned therapeutic approaches, paving the way for effective personalized medicine. The development of biocompatible multifunctional devices working as platforms for detecting specific biomarkers of the target region, allowing real-time monitoring by imaging acquisitions, and delivering therapeutic agents to their target sites have significantly enriched healthcare methodologies, particularly regarding precision medicine applied to cancer.

This research field has emerged based on the knowledge that every single therapeutic agent has a different effect on patients, even when diagnosed with the same disease. Moreover, it works by predominantly exploiting the properties of nanoparticles, such as photothermal conversion, photoacoustic/ultrasound imaging to achieve biomarker identification, visualization of damaged tissues, and drug delivery treatments [1–3].

Unfortunately, current nanotechnology-based theranostic systems are not yet sufficient; therefore, finding new strategies for diagnosing and monitoring diseases and administering therapies based on patients' specific molecular fingerprints are necessary for reaching the desired efficacy of personalized medicine.

The present Special Issue exists in this context, specifically including two original research papers that make new contributions to this field.

Chavva et al. [4] designed a 3D printable platform that is able to simultaneously monitor surface-enhanced Raman scattering (SERS) and photothermal radiation output and tested it by using morphologically complex gold nanoparticles (such as gold nanostars and nanoplates). This device allows researchers to effectively screen nanoparticle candidates for their photothermic and SERS properties and make informed decisions when choosing the best performing agents for the specific needs.

On the other hand, Gal et al. [5] focalized their efforts in developing an effective strategy for delivering tumor-targeting antibodies to the brain and enhancing the standard of glioblastoma therapy. Conventional treatments include chemotherapy administration and radiotherapy, and despite multiple strategies being implemented and evaluated in clinical trials, very few successfully brought benefits to the patients, with many challenges still remaining [6,7]. Gold nanoparticles are good candidate for glioblastoma detection because they present excellent properties as radiosensitizing agents [8] and great versatility for functionalization with targeting antibodies [9]. Moreover, gold nanoparticles coated with insulin are able to cross the blood–brain barrier (BBB) [10]. In the present work, Gal et al. showed that these nanoparticles can also actively deliver anti-epidermal growth factor receptor (EGFR) antibodies to the brain in an orthotopic mouse model of glioblastoma. Interestingly, the nanovectors targeted and selectively accumulated within the tumor in vivo, demonstrating an effective improvement of the standard of care treatment outcome.

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This study provides a proof of principle of employing these nanomaterials as potential tools for delivering therapeutics for fighting glioblastoma.

In conclusion, nanotheranostics arises with the idea that therapy and diagnosis can work hand in hand to achieve the greatest efficacy in a hugely heterogeneous disease, such as cancer. In the future, therapy will be specifically chosen based on cancer and patients features. How close this future actually is will depend on our ability to develop diagnostic systems and treatment approaches with increasingly improved sensitivity and multiplexibility.

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