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The Effects of Polymer-coated Gold Nanoparticles Containing Teriflunomide on Human Glioblastoma Cell-line

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Extended Abstract

Glioblastoma refers to primary brain tumor that is among the highly malignant neoplasm of central nervous system (CNS). It is considered as the most aggressive and common form of brain tumor in adults. No definitive and side-effect-free treatment has yet been found; however, extensive research is currently underway on this topic [1]. Recently, teriflunomide, an MS drug in the pharmaceutical market, has garnered attention as its anti-inflammatory and anti-proliferative effects have indicated anti-tumor properties [2]. With the advancements in nanotechnology and the revolutionary changes it has brought in cancer treatment, along with the ability for targeted drug delivery, reduced toxicity, and increased formulation stability, gold nanoparticles were utilized in this study to enhance the effectiveness of cancer treatment in combination with their photothermal properties. Covering the gold nanoparticles with a biodegradable and biocompatible polymer, poly(lactic-co-glycolic acid) (PLGA), commonly improves the half-life and the physicochemical properties of the drug and leads to more efficient passage of particles through the blood-brain barrier (BBB) [3,4].

Using a pre-studied reductive method with trisodium citrate, gold nanoparticles were fabricated and their concentration was determined by coupled plasma optical emission spectroscopy (ICP-OES) technique [5]. Then, PLGA-coated gold nanoparticles containing teriflunomide were fabricated through double emulsion solvent evaporation method and the obtained nanoparticles were characterized in terms of size, structure and morphology using DLS and SEM. By plotting the calibration curve, the percentage of loading efficiency (LE%) and entrapment efficiency (EE%) were calculated. The drug release test was conducted using dialysis bags in PBS-based medium over various time points within 72 hours. The cytotoxic effects on glioblastoma cells were evaluated using the MTT assay. Moreover, the ability of the prepared nanoparticles to increase the environmental temperature under the 520-nm green-laser radiation was investigated.

According to the results, the spherical nanoparticles with a size range of 100 to 200 nanometers were made. The average polydispersity index (PDI) of 0.11 with a mean value of 60% EE and 25% LE and the average zeta potential of -10 were obtained. The MTT test results revealed an increased cytotoxic effect of our particles on glioblastoma cancer cells, U373, compared with the free drug solution. Furthermore, by significantly increasing the temperature, the prepared nanoparticles showed an appropriate response to green laser light which can potentially cause an irreversible cellular damage.

Consequently, the prepared gold nanoparticles coated with PLGA containing teriflunomide showed improved thermal properties and glioblastoma cell toxicity compared to the free drug. Thus, the designed drug delivery system can be considered as a suitable candidate in future glioblastoma studies and treatments.

References

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