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Magnetite Nanoparticles for Biomedical Use

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Introduction

Nanotechnology combines several fields of science. Nanomaterials have unique chemical, physical and biological properties due to their small size. Many nanomaterial types have been described to date and many more will be developed for a variety of applications. Due to their ferrimagnetism, iron oxide nanoparticles (MNPs) are one of the most promising magnetic nanoparticles in biochemistry, nanomedicine and bio-inspired material areas. In particular, Fe_3O_4 magnetite nanoparticles (MNPs) have demonstrated a promising effect in numerous applications [1].

Description

The manipulation of MNPs by an external magnetic field is critical for bioseparation and biosensing applications. Furthermore, magnetic transport of MNPs to tissue allows for targeted therapy and diagnostic applications. Many papers on the synthesis, coating and applications of MNPs have been reported. The number of articles with the key term "magnetic nanoparticles" increases every year. The actual number of papers in the area is much higher, which can be calculated using other keywords. However, prior to 1996, the Scopus database published fewer than 100 articles per year. Following the first successful clinical trial in 1996, the number of papers published skyrocketed [2].

Nano-emulsion research began in 1943. However, Richard Feynman first proposed the concept of nanotechnology in 1959 in his lecture titled "Plenty of Room at the Bottom." This was a watershed moment in nanoscience. In 1981, the first iron nanoparticles were synthesised using gas condensation. Magnetic forces have been used to improve therapeutic and imaging performance for many years. MNPs for imaging purposes were developed in 1990 and silica-coated MNPs were developed in 1995. Numerous studies have been conducted since 2000 to investigate the potential applications of MNPs and nanocomposites with magnetic cores. Another significant advancement was the completion of magnetic hyperthermia clinical trials in 2010. Magnetic hyperthermia generates heat by exposing MNPs to an alternating magnetic field [3].

Co-precipitation is a widely used, simple and cost-effective chemical synthesis that proceeds in an aqueous solution with a high yield and purity. However, the procedure frequently requires surfactant and clear reaction parameters concentration, temperature, tube size and mixing. The presence of inert gas flow is recommended to prevent Feoxidation in base conditions. Changes in such simple reaction conditions result in nanoparticles that are not the same size and shape, so reproducing the synthesis method usually fails to produce MNPs with the same physicochemical and biological properties. Furthermore, "in one person's hands," the size of MNPs varies from one synthesis to the next.

Idiopathic pulmonary fibrosis is a deadly fibrotic interstitial lung disease with a dismal prognosis. It primarily affects older adults and is distinguished by progressive worsening of dyspnea and lung function. Although the exact cause of IPF is unknown, it is thought to be caused by an abnormal wound-healing response. Recurrent lung epithelial injury causes an abnormal repair process in which various pro-fibrotic cytokines are released, resulting in persistent activation of fibroblasts and other mesenchymal cells and disrupting extracellular matrix homeostasis. Excessive ECM deposition disrupts the normal architecture of the lung, resulting in organ dysfunction, failure and death. Aging, genetics, infection, gastroesophageal reflux and environmental factors are all potential etiologic factors for IPF (e.g., cigarette smoke and air pollution). Pirfenidone and nintedanib are currently in use [4,5].

Conclusion

The mouse pulmonary fibrosis model was established by single-dose bleomycin administered intratracheally to investigate the effect of FBZ on fibrogenesis in vivo. During the experiment, no mice died in the experimental groups. The bleomycin (BLM) group's endpoint weight gain was significantly lower than the saline group's; the FBZ-treated group's body weight recovery was significantly higher than the bleomycin model group's. The daily intake dose of each group was calculated based on chow consumption and the average daily intake of FBZ in each group ranged, with no significant difference observed between groups. The FBZ-treated groups had significantly lower lung hydroxyproline content, which is a surrogate for collagen.

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