4TH National Conference of Iran Chmistry, Chemical Enginereeng And Nano

FORMATION OF BIOCOMPATIBLE BONE CEMENT (NANO HYDROXYAPATITE BASE) AT 37˚C AT VARIOUS REMINDING TIMES IN SIMULATED BODY FLUID (SBF)

Dastafkan Poriya [1],Krimi Faizallah[2]

Department of chemistry,Ialamic Azad University,lahijan,Iran[1],(poriya0395@gmail.com)

Department of chemistry ,Farhangian university,rasool akram factuly Ahwaz,Iran[2],(karimi.faizallah@yahoo.com)

Abstract: Biocompatible bone cements (nano hyroxyapatite base) are applicable in repairing of bones and teeth because of their superior biocompatibility and bioactivity. In this work, we report the synthesis and characterization of bone cement nanoparticles in synthetic body fluid (SBF) solutions at 37˚C, using calcium phosphate and sodium silicate as precursors. The mixture was reminded in the SBF solutions for 24 hrs, 36 hrs, 48 hrs and 72hrs in an incubator at 37˚C. Formation of HA nanoparticles was surprisingly observed after 24hrs. Characterization and chemical analysis of the synthesized powders were performed by Fourier transform, infrared spectroscopy (FT-IR), X-ray powder diffraction (XRD), scanning electron microscopy (SEM), Dispersive x-ray analaysis (EDAX) and transmission electron microscopy (TEM).

Keywords: Biocompatible; Nano hydroxyapatite; Bone cements; Simulated body fluid

1. INTRODUCTION

Every year, millions of patients, particularly among the aged, are suffering from bone defects arising from trauma, tumor or bone diseases and of course several are dying due to the insufficient ideal bone substitute. Thus, the requirement for new bone to replace or restore the function of traumatized, damaged or lose of bone is a major clinical and socioeconomic need. To date, much attention has been paid to hydroxyapatite (HA) because of its chemical and crystallographic characteristics are similar to the inorganic component found in natural bone and it has been extensively investigated due to its excellent biocompatibility, bioactivity and osteoconductivity [4]. Therefore, the development of the synthesized bone materials by mimicking the structure and composition of human tissue, namely the biomimtic approach, has long been a major goal in the filed of bone tissue engineering. In fact, bone tissue engineering strategies, as the alternative strategy to regenerate bone [3] have yet to yield functional and mechanical competent bone.

In contrast to the hydroxyapatite (HA), $Ca_{10}(PO_4)_6(OH)_2$ which is one of the most bioactive material [1, 2], HA NPs, chemically similar to bone mineral, should not assumed to be innocuous. It has been shown that exposure to HA retrieved from atherosclerotic lesions causes death of smooth muscle cells [6]. The toxicity of NPs frequently differs from that of the bulk materials that they are derived from. In most cases the reason for such toxicity is unknown [7,8]. It may be a result of specific characteristics such as the high surface area to volume ratio of NPs or their surface In this work, we attempted to synthesis and characterization of bone cement nanoparticles, in synthetic body fluid (SBF) solutions at 37˚C, using calcium phosphate and sodium silicate as precursors.Their cytotoxicity to human monocytes'-derived macrophages (HMMs) was assessed in vitro using a range of techniquesThese included the MTT assay, LDH leakage and a confocal based live–dead cell assay. Cytotoxicity differed significantly between preparations, with the suspended gel preparation being the most toxic (31–500 mg/ml). Other preparations were also toxic but only at higher concentrations (>250 mg/ml).Transmission electron microscopy (TEM) and stereology showed variable cellular uptake and subsequent dissolution of the various forms of HA. We have demonstrated that HA particle toxicity varied considerably and that it was related to their physico-chemical properties. Cell death correlated strongly with particle load. The intracellular