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A New bone nano-hemostatic agent with antibacterial activity

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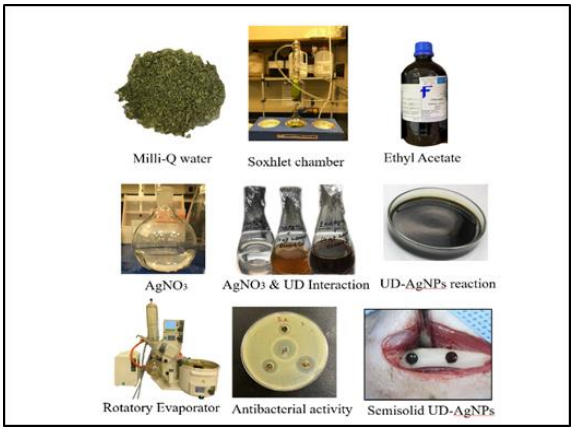
Abstract

Introduction:

Bleeding may easily cause death during surgery. Most recent topical hemostatic agents demonstrated to control bone bleeding ineffectively and increase the rate of surgical site infection. Searching among biosynthesized nanoparticles (NPs) has promising result. The aim of this study is to investigate the physicochemical and biological properties of prepared silver nanoparticles from Urtica dioica (UD-AgNPs) and to test their potential effect as a bone hemostatic agent. Silver nanoparticles (AgNPs) were synthesized using ethyl acetate extract from Urtica dioica (UD) leaves. UD-AgNPs were characterized using ultraviolet-visible spectroscopy, energy-dispersive X-ray analysis, fourier transform infrared spectroscopy, X-ray diffraction, dynamic light scattering, transmission electron microscopy, and scanning electron microscopy. UD-AgNPs were assessed against Gram-positive and Gram-negative bacteria. The active components of the ethyl acetate extract were identified by gas chromatography–mass spectrometry (GC-MS). MTT assay performed to evaluate UD-AgNPs cytotoxicity against normal and cancerous cells. Under general anesthesia, two circular defects 3 mm in diameter were created on the right femur of each rat. In group I: defect left unfilled (negative control); in groups II, III, and IV: defects were filled with bone wax, Surgicel® and UD-AgNPs, respectively. Bleeding time and blood loss was evaluated in each group. Further, coagulation profile and complete blood count were tested at baseline, one week and four weeks postoperatively. The NPs were 19.401 nm in size, spherical and negatively charged the UD-AgNPs surface. The zone of inhibition for 75 µL of UD-AgNPs against Pseudomonas aeruginosa was 21 ± 0.4 mm more than control drug Ciprofloxacin (16 ± 10 mm). The minimum inhibitory concentration was the lowest against Escherichia coli (36 ± 3 µg/mL) and Staphylococcus epidermidis (38 ± 3 µg/mL). The minimum bactericidal concentration was the lowest against Escherichia coli (75 ± 00 µg/mL) and Enterococcus faecalis (83 ± 16 µg/mL). GC-MS shows active components used in bleeding control and antibacterial activities like Phytol, Neophytadiene and Carboxylic acid. MTT assay showed cell viability higher than 75% in all UD-AgNPs concentrations against normal cells but cytotoxic in cancer cells. UD-AgNPs revealed immediate hemostasis (7.7 second) almost like bone wax (7.3 second) with similar amount of blood loss (0.05 gm). UD-AgNPs increased PLT (1347.5×103 /uL), reduced aPTT (12.6 second) and keep normal WBC comparing to bone wax (19.2 ×103 /uL) at first week. These observations suggested UD-AgNPs as an effective hemostatic agent with antibacterial activity.



Biography

Mohammed Awadh Salah is using nanotechnology to improve the practice of medicine through biomolecular and biomaterial researches. He has his expertise in bone hemostasis and bone regeneration. He is working in Nanotechnology field after years of experience in research and teaching both in hospital and education institution.

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