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Role of Silver-Nano Particles in Drug Discovery Research

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Short Commentary

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Silver is the only precious metal has been used to fight infection for thousands of years. Hippocrates first described its antimicrobial properties in 400 BC but how it works has been a mystery. It has a long history as an antibiotic in human health care and also used for many purposes. Silver compounds are very effective antibacterial agents against both aerobic and anaerobic bacteria. It has been developed for use in water purification, wound care, bone prostheses, reconstructive orthopaedic surgery, cardiac devices, catheters and surgical appliances. Advancing biotechnology has enabled incorporation of ionizable silver into fabrics for clinical use to reduce the risk of infections and for personal hygiene. The antimicrobial action of silver or silver compounds is proportional to the bioactive silver ion (Ag (+)) released and its availability to interact with bacterial or fungal cell membranes. Silver metal and inorganic silver compounds ionize in the presence of water, body fluids or tissue exudates. The silver ion is biologically active and readily interacts with proteins, amino acid residues, free anions and receptors on mammalian and eukaryotic cell membranes. Bacterial (and probably fungal) sensitivity to silver is genetically determined and relates to the levels of intracellular silver uptake and its ability to interact and irreversibly denature key enzyme systems. Silver exhibits low toxicity in the human body, and minimal risk is expected due to clinical exposure by inhalation, ingestion, dermal application or through the urological or haematogenous route. Chronic ingestion or inhalation of silver preparations (especially colloidal silver) can lead to deposition of silver metal/silver sulphide particles in the skin (argyria), eye (argyrosis) and other organs. These are not life-threatening conditions but cosmetically undesirable. Silver is absorbed into the human body and enters the systemic circulation as a protein complex to be eliminated by the liver and kidneys. Silver metabolism is modulated by induction and binding to metallothioneins. This complex mitigates the cellular toxicity of silver and contributes to tissue repair. Silver allergy is a known contra-indication for using silver in medical devices or antibiotic textiles.

Silver is a locally used antibacterial agent and our targeting technology may make it possible to use silver nanoparticles in treating infections anywhere in the body. Silver nanoparticles as an arch product from the field of nanotechnology, has gained interest because of distinctive properties, such as good conductivity, chemical stability, catalytic, anti-bacterial activity, anti-fungal, anti-viral, anti-inflammatory.

The medical uses of silver include its incorporation into wound dressings, creams, and as an antibiotic coating on medical devices. Wound dressings containing silver sulfadiazine or silver nonmaterial may be used on external infections [1]. It was found that silver-containing hydrocolloid dressings were not better than standard alginate dressings in treating diabetic foot ulcers [2]. One of the review concluded that silver-containing foam resulted in a greater reduction in wound size and more effective control on leakage and odor than non-silver dressings [3].

Urinary tract infection caused by catheterization is one of the leading causes of Nosocomial infection. Silver is an effective broad-spectrum antimicrobial agent at low concentrations [4]. Silver oxide impregnation in Foley's catheters of natural Rubber latex to impart infection resistance. Silver oxide impregnation method of proven antimicrobial efficacy, is non-cytotoxic and has sufficient mechanical properties [5].

Silver sulphadiazine the antimicrobial agent most often used in burn care facilities. Combined topical use of silver sulphadiazine and other antimicrobials may be a possible solution to bacterial resistance in burn wounds. The addition of cerium nitrate appears to enhance bacterial control in large burns, and the addition of other drugs such as chlorhexidine and Norfloxacin seems reduce the emergence of bacterial resistance [6].

Ventilator-associated pneumonia causes substantial morbidity. A silver-coated endotracheal tube has been designed to reduce VAP incidence by preventing bacterial colonization and biofilm formation [7]. The incidence of VAP in patients incubated for at least 24 hours is reduced and delayed with use of silver-coated endotracheal tube vs an uncoated endotracheal tube.

Silver-halide imaging plates used with X-ray imaging were the standard before digital X-rays arrived. Silver remains popular for its extreme accuracy and cost effectiveness, particularly in developing countries, where digital X-ray technology is usually not available [8].

Silver compounds are used in external preparations as antiseptics, including both silver nitrate and silver proteinate, which can be used in dilute solution as eye drops to prevent conjunctivitis in newborn babies. Silver nitrate is also sometimes used in dermatology to treat certain skin conditions such as corns and warts [9]. Silver is also used in bone prostheses, reconstructive orthopedic surgery and cardiac devices.[10]

Chlorhexidine-silver-sulfadiazine central venous catheters significantly reduce the incidence of catheter-related bloodstream infections (CR-BSI) [11]. Silver diamine fluoride is an effective intervention to reduce dental caries (tooth decay) [12,13].

Silver acetate has been used as a potential aid to help stop smoking. A review of the literature in 2012, however, found no effect of silver acetate on smoking cessation at a six-month endpoint and if there is an effect it would be small [14].

Some people are allergic to silver, and the use of treatments and medical devices containing silver is contraindicated for such people. Although medical devices containing silver are widely used in hospitals, no thorough testing and standardization of these products has yet been undertaken. Chronic intake of silver products can result in an accumulation of silver or silver sulfide particles in the skin. These particles in the skin darken with exposure to sunlight, resulting in a blue or gray discoloration of the skin known as argyria [9].

Nano silver acts as a carrier for specifically targeting the cancerous cells. Usually the pores in the cell wall of normal cell are less than 10 nm and the pores in the cell wall of cancerous cells are 10 to 100 nm. The nano carrier prepared by us has a particle size of around 50 nm and has an enhanced permeability to enter into cancerous cells and does not touch the normal cell.

Nanosilver particles affect cell function as it relates to the metabolism and elimination of drugs and other xenobiotics. There are also a variety of nanosilver-containing dermatological preparations and cosmetics available, which are promoted for their antibacterial properties. Solutions containing 5 to 15 nm sized nano silver particles comprising an interior of elemental silver and an exterior of ionic silver oxide are commercially available as mineral supplements and are promoted for immune support. Information on the bio distribution of ingested nanosilver particles and concentrations reached within the human body is not known. Orally ingested nanosilver particles first affect cells in the gastrointestinal tract and if the particles enter the circulation from the intestine the cells affected are of liver.

Therefore we can say that nano sized silver particles are very effective. It has a tremendous quality. Silver is not only use for ornamental purpose but also in the field of drugs. Still work is going on to find its role in other fields.

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