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Awareness On Medicinal Applications Of Silver Nanoparticles Among Dental Students

Research Article

Dhanraj Ganapathy[1*], Martina Catherine[2], Ashok Velayudhan[3]

[1] Professor & Head of Department, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
[2] Tutor, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
[3] Professor, Department of Prosthodontics, Saveetha Dental college and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, 162, Poonamallee High Road, Velappanchavadi, Chennai - 600077.

Abstract

Introduction: Silver nanoparticles are of interest due to the exclusive properties with respect to size and shape depending optical, electrical and magnetic properties) which can be incorporated into antimicrobial applications, biosensor materials, composite fibers, cryogenic superconducting materials, cosmetic products and electronic components. Silver bio-nanoparticles (AgNPs) have been known to have inhibitory and bactericidal effects.
Aim: This survey was conducted for assessing the awareness about medicinal application of Silver nanoparticles amongst dental students.
Materials and Method: A cross-section research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 dental students. The questionnaire assessed the awareness about Silver nanoparticles therapy in medical applications, antibacterial properties, anti-cancer activities, antioxidant properties, anti-diabetic properties and their toxicity, the responses were recorded and analysed.
Results: 12% of the respondents were aware of the medicinal applications of Silver Nanoparticles. 9% were aware of antibacterial properties of Silver Nanoparticles. 9% were aware of antioxidant properties of Silver Nanoparticles, 9% were aware of anti-cancer properties of Silver Nanoparticles, 6% were aware of anti-diabetic properties of Silver Nanoparticles and 4% were aware of their toxicity
Conclusion: There is limited awareness amongst dental students about use of Silver nanoparticles therapy in medical applications. Enhanced awareness initiatives and dental educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Silver nanoparticles therapy.

Keywords: Awareness; Silver; Nanoparticles; Students; Medicinal.

Introduction

Nanoscience has been established recently as a new interdisciplinary science. It is considered as a whole knowledge on fundamental properties of nano-size objects [1]. Synthesis of noble metal nanoparticles for applications such as catalysis, electronics, optics, environmental and biotechnology is an area of constant interest Gold, silver and copper have been used mostly for the synthesis of stable dispersions of nanoparticles, which are useful in areas such as photography, catalysis, biological labeling, photonics, optoelectronics and surface-enhanced Raman scattering (SERS) detection [2]. Silver nanoparticles are of interest due to the exclusive properties (e.g. size and shape depending optical, electrical and magnetic properties) which can be incorporated into antimicrobial applications, biosensor materials, composite fibers, cryogenic superconducting materials, cosmetic products and electronic components. Silver bio-nanoparticles (AgNPs) have been known to have inhibitory and bactericidal effects. Resistance to antimicrobial agents by pathogenic bacteria has emerged in recent years and is a major health problem [3].

However, recent developments include means of protecting ef-

***Corresponding Author**:
Dhanraj Ganapathy,
Professor & Head of Department, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
Tel: 9841504523
E-mail: dhanrajmganapathy@yahoo.co.in

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ficiently silver nanoparticles that offer far improved chemical stabilities. As a result, silver nanoparticles are rapidly gaining in popularity and several research groups have begun to explore alternative strategies for the development of optical sensors and imaging labels based on the unexpected optical properties of these metal nanoparticles [4].

Silver nanoparticles are of interest due to the unique properties (e.g. size and shape depend on optical, electrical and magnetic properties) which can be incorporated into antimicrobial applications, biosensor materials, composite fibers, cryogenic superconducting materials, cosmetic products and electronic components [5]. These particles also have many applications in different fields such as medical imaging, nano-composites, filters, drug delivery and hyperthermia of tumors. Silver nanoparticles have drawn the attention of researchers due to their extensive applications in areas such as integrated circuits sensors, biolabeling, filters, antimicrobial deodorant fibers, cell electrodes, low-cost paper batteries and antimicrobials [6, 7]. Silver nanoparticles have been used extensively as antimicrobial agents in health industry, food storage, textile coatings and a number of environmental applications. Our research experience has prompted us in pursuing this research [8-19]. This survey was conducted for assessing the awareness about medicinal application of Silver nanoparticles amongst dental students.

Materials and Methods

A cross-section research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 dental students. The questionnaire assessed the awareness about Silver nanoparticles therapy in medical applications, antibacterial properties, anti-cancer activities, antioxidant properties, anti-diabetic properties and their toxicity, the responses were recorded and analysed.

Results

12% of the respondents were aware of the medicinal applications of Silver Nanoparticles (Fig 1). 9% were aware of antibacterial properties of Silver Nanoparticles (Fig 2). 9 %were aware of antioxidant properties of Silver Nanoparticles (Fig 3), 9% were aware of anti-cancer properties of Silver Nanoparticles (Fig 4), 6% were aware of anti-diabetic properties of Silver Nanoparticles (Fig 5) and 4% were aware of their toxicity (Fig 6).

Discussion

Silver nanoparticles have important applications in the field of biology such as antibacterial agents and DNA sequencing. Silver has been known to exhibit strong toxicity to a wide range of microorganisms (antibacterial applications). Scientists have long known that silver ions, which flow from nanoparticles when oxidized, are deadly to bacteria. Silver nanoparticles are used just about everywhere, including in cosmetics, socks, food containers, detergents, sprays and a wide range of other products to stop the spread of germs. One use of silver ion or metallic silver as well as silver nanoparticles can be exploited in medicine for burn treatment, dental materials, coating stainless steel materials, water treatment, sunscreen lotions, etc. [20].

Figure 1. Awareness of the medicinal applications of Silver Nanoparticles.

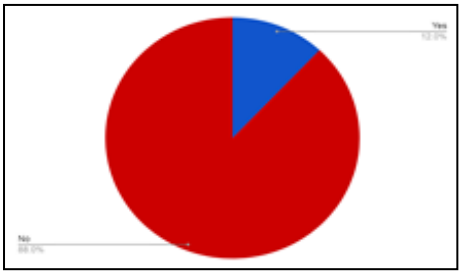


Figure 2. Awareness of the antibacterial properties of Silver Nanoparticles.

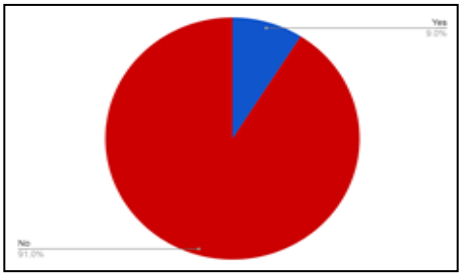


Figure 3. Awareness of the antioxidant properties of Silver Nanoparticles.

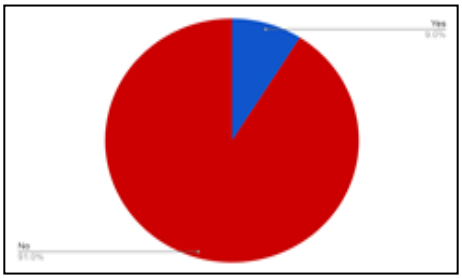


Figure 4. Awareness of the anti-cancer properties of Silver Nanoparticles.

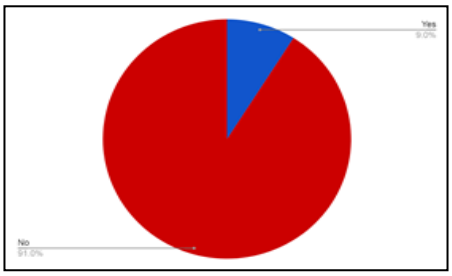


Figure 5. Awareness of the anti-diabetic properties of Silver Nanoparticles.

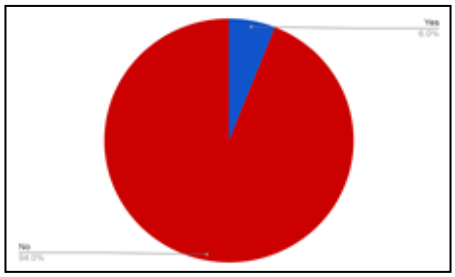
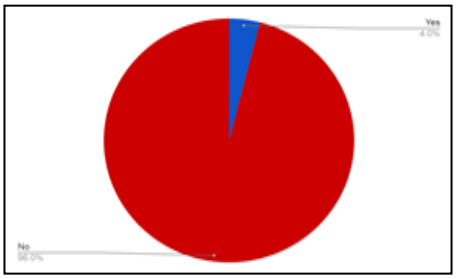


Figure 6. Awareness of the toxicity of Silver Nanoparticles.



Due to unique properties of silver nanoparticles, such as size and shape which depend on optical, electrical and magnetic properties, they are of immense interest and can be subsumed into antimicrobial applications, biosensor materials, composite fibres, cryogenic superconducting materials, cosmetic products and electronic components. Nanoparticles have numerous applications in different fields, such as medical imaging, nano-composites, filters, drug delivery and hyperthermia of tumours [21].

AgNPs have been used tremendously as anti-bacterial agents in the health industry, food storage, textile coatings, numerous environmental applications, as an antibacterial agent from fumigating medical devices and home appliances to water treatment cotton fibre [22]. Smaller AgNPs have a greater binding surface and show more bactericidal activity when compared to larger AgNPs. The reason for the sensitivity of Gram positive and Gram negative bacteria towards AgNP is because of variation in thickness and molecular composition of the membrane structures. Bactericidal activity is apparently due to alteration in the bacterial cell wall structure as a result of interactions with embedded AgNPs, leading to enhanced membrane permeability and finally death. AgNPs also react with sulphur and phosphorus-rich biomaterials, such as proteins or DNA, or membrane protein, which affect the respiration, division and ultimately survival of cells. Upon entering the bacterial cell wall, silver ions (as part of AgNPs) can enter into cells, leading to the aggregation of damaged DNA and exert effect on protein synthesis [23].

AgNPs in cancer control since AgNPs can disrupt the mitochondrial respiratory chain, they could be expanded to instigate the reactive oxygen species (ROS) production, ATP synthesis and finally DNA damage; they can perform well in cancer therapeutics. Sesbania grandiflora leaf extract mediated AgNPs exhibited cytotoxicity to MCF-7 cancer cells instigating ROS production resulting in oxidative stress and caspase-mediated synthesis with further changes in morphological attributes including hampering of membrane integrity, cell growth reduction, cytoplasmic condensation, etc. G. mangiferae extracts mediated AgNP synthesis are highly biocompatible with IC50 values of AgNPs were 63.37, 27.54 and 23.84 lg/mL against normal African monkey kidney (Vero), HeLa (cervical), and MCF-7 (breast) cells, respectively, should be probed or examined as promising candidates for a variety of biomedical/pharmaceutical and agricultural applications. The alcoholic flower extract of Nyctanthes arbor-tristis mediated AgNP can be used for molecular imaging and drug delivery and AgNP were slightly toxic to L929 cells even at highest concentration, i.e. 250 mg/mL. MCF-7 cells treated with either AgNPs or cisplatin demonstrated decreased Bcl-2 expression and increased Bax expression, pointing out the embroilment of mitochondria in the mechanism of death induced by AgNPs. Rosa indica mediated AgNP synthesis may be used in vast range of therapeutic anticancer application and act as radical scavenger and induce apoptosis in HCT-15 cells and the ROS generation [24, 25].

Ahn *et al.,* determined antioxidant capacity of thirty plant extracts and AgNPs prepared by using them with the conclusion that the scavenging activity using DPPH assay increased with higher amounts of either extract or AgNPs. In general, the extracts showed better scavenging activity than the AgNPs. Authors explained this phenomenon by the role of phytochemicals. An extract with high scavenging activity leads to the rapid formation of small AgNPs seeds, which grow into larger nanoparticles with

assistance of phytochemicals presented in the matrix [26]. A reduced antioxidant capacity of AgNPs in comparison with extract was also observed by Demirbas . They prepared silver nanoparticles by biological method using extract of red cabbage (*Brassica oleracea var. capitate f. rubra*). The authors proposed that AgNPs were synthesized using antioxidant power of red cabbage extract to reduce Ag+ ions, so AgNPs may promote superoxide radicals which would consume antioxidant capacity of red cabbage [27].

Tephrosia tinctoria stem extracts mediated AgNP synthesis was evaluated for control of blood sugar levels. AgNPs scavenged free radicals, reduced the levels of enzymes that bring about the hydrolysis of complex carbohydrates (a-glucosidase and a-amylase), and as a result of which there is an increase in consumption rate of glucose [28]. The resistance developed by microorganism in silver in less as compared to antibiotics as a broad range of microorganisms is being targeted by silver. The uses of silver nanoparticles are varied and many, but the most utilized and desired aspect is their antimicrobial capacity and anti-inflammatory capacity.

The toxicity induced by silver nanoparticles at various degrees leads to their pitfall. It is suggested that higher concentrations of silver nanoparticles are toxic and can cause various health problems and can induce various ecological problems if released into the environment. However, there are some issues, which need to be addressed, such as, the exact mechanism of interaction of silver nanoparticles with the bacterial cells, how the surface area of nanoparticles influence its killing activity, use of animal models and clinical studies to get a better understanding of the antimicrobial efficiency of silver dressings, the toxicity if any of the silver dressings, etc. Hence, care has to be taken to utilize this marvel well and in a good, effective and efficient way, understanding its shortcoming and taking utmost care that it does not cause any harm to an individual or the environment. On the whole, the silver nanoparticles due to their unique properties of silver and nano size appear to be promising in pharmaceutical, biomedical and allied fields provided safety data is generated to prove their safety and simultaneously ruling out their toxicity.

Conclusion

There is limited awareness amongst dental students about use of Silver nanoparticles therapy in medical applications. Enhanced awareness initiatives and dental educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Silver nanoparticles therapy.

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