Awareness of Silver Nanoparticles and its Biomedical Applications among Undergraduate Dental and Medical Students - A Survey

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Abstract

Silver, which is considered as a noble metal, can be synthesised into nanoparticles which can be widely used in biomedical applications. A questionnaire was prepared and administered to 100 participants through Google forms - an online survey platform. The study population included all the undergraduate dental and medical students. The results were collected, and data were generated using SPSS software. The study surveyed awareness of silver nanoparticles and their biomedical applications among undergraduate medical and dental students.

Keywords:
Silver nanoparticles, biomedical applications, medical students, dental students

INTRODUCTION

Nanotechnology is a booming field in which the emergence of producing inorganic nanoparticles is rising. The unique features and functions of the nanoparticle may be physicochemical properties which differ significantly. Silver nanoparticles are novel to produce as they have a unique physical, chemical and biological properties which makes them seek attention from the researchers especially. (Rajeshkumar, 2013)

Silver nanoparticles, their physical and chemical properties, such as high thermal, electrical conductivity, surface-enhanced Raman scattering, chemical stability, catalytic activity, nonlinear optical behaviour, antimicrobial properties enables these nanoparticles to be widely used in daily commercial usage products (Ariga, 2018). These nanoparticles are getting popular recently due to an increase in advantage in the production of useful products synthesis and characterisation. (Haider and Kang, 2015) Silver is considered as a noble metal which helps to treat burn wound infections, infections, open wounds and cuts. Silver nanoparticles can be widely used for its biomedical applications. They are used as antibacterial agents, Nanogels, Nanosolutions, silver-based dressings and coatings over medical devices. Silver nanoparticles can be synthesised using biological sources which makes it eco-friendly and cost-effective. (Shanmuganathan, 2019) The optical property of surface-modifiable silver nanoparticles was extremely sensitive to their size and surface modification, which helps in carrying biomedical analysis and detection. Silver nanoparticles with an average diameter suppress the proliferation of...
Human Leukemia K562 cells in the dose and duration. These nanoparticles also indicate potential in cancer therapy. (Wu, 2008)

The morphology and size distribution of silver nanoparticles is significant to synthesise these particles for various biomedical applications. (Huang and Yang, 2004) The main aim of the study is to analyse and study the awareness of silver nanoparticles and its biomedical applications among undergraduate dental & medical students.

MATERIALS AND METHODS

A self-structured questionnaire survey (Basha et al., 2018; Ashok and Suvitha, 2016) based on the Silver nanoparticles and their biomedical applications was created. The method of the study included a prospective observational study comprising about 100 people (sample size) belonging to age groups 18 - 20, 20 - 25 and 25 & above in undergraduate dental and medical students were circulated on an online survey link using Google forms and were asked to take up the survey. The sampling method involved non - probability convenience sampling. The questionnaire was checked for validity in Saveetha Dental College, Chennai. The results were collected, and the data was generated using SPSS software, and finally, the statistics were analysed.

RESULTS AND DISCUSSION

The results were collected, and the data was generated using SPSS software, and finally, the statistics were analysed. Majority of the respondents show an optimistic perception regarding the silver nanoparticles and its biomedical applications.

When asked about silver nanoparticles which are used in nanomedicine [Figure 1], 100% respondents - 92% were aware of the silver nanoparticles, and 8% were unaware. According to (cobb and Macoubrie, 2004), when asked people (Americans) about nanotechnology, the initial reaction to nanotechnology was generally positive, which probably rooted in a generally positive view of science overall.

Figure 1, The people who knew about silver nanoparticles, 100% respondents - 92% were aware of silver nanoparticles, and 8% were unaware.

When asked if silver nanoparticles can be used in the treatment of bacterial infection [Figure 2] (Vijayalakshmi and Ganapathy, 2016), 100% respondents - 64% voted yes, and 36% voted no. According to (Prabhu and Poulose, 2012), the antibacterial activity of the silver nanoparticles was investigated by introducing the particles into a media containing Escherichia coli. (Selvan and Ganapathy, 2016) The silver nanoparticles were found to exhibit antibacterial effects.

Figure 2, The people who knew that silver nanoparticles are used to treat bacterial infections, 100% respondents - 64% were aware of it, and 36% were unaware.

When asked about silver nanoparticles which are used in nanomedicine [Figure 1], 100% respondents - 92% were aware of the silver nanoparticles, and 8% were unaware. According to (cobb and Macoubrie, 2004), when asked people (Americans) about nanotechnology, the initial reaction to nanotechnology was generally positive, which probably rooted in a generally positive view of science overall.

Figure 3, The people who knew about the methods involving in producing silver nanoparticles

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When asked if the synthesis of silver nanoparticles involves methods which are toxic or non-toxic [Figure 3], 100% respondents - 75% voted 'toxic', and 25% voted 'non-toxic'. (Jyothi, 2017) According to (Prabhu and Poulose, 2012), Silver Nanoparticles are widely used in many medical procedures (Duraisamy, 2019) and devices as well as in various other biological fields, and they have their drawbacks due to nanotoxicity.

Figure 4: The pie chart depicts the Knowledge about the production of silver nanoparticles eco-friendly

When asked is there a need to produce silver nanoparticles eco-friendly [Figure 4], among 100% respondents - 78% voted 'yes' and 22% voted 'no'. According to (Logeswari et al., 2015), the biosynthesis of nanoparticles is considered as a green technology, as it does not involve any harmful chemicals. It is important to synthesise silver nanoparticles eco-friendly, for example, using plant materials (Subasree et al., 2016) to reduce toxicity due to widespread use of silver nanoparticles in the field of medicine.

Figure 4, The people who knew about the production of silver nanoparticles ecofriendly, 100% respondents - 78% were aware, and 22% were unaware.

Figure 5: The pie chart depicts the Knowledge about the physical & chemical versatility of silver nanoparticles

When asked about the physical and chemical versatility of silver nanoparticles if adding an advantage [Figure 5], among 100% respondents - 79% of voting 'yes' and 21% of voted 'no'. According to (Rajeshkumar, 2013), physicochemical characteristics help silver nanoparticles to be used in a wide range.

Figure 5, The people who knew about the physical & chemical versatility of silver nanoparticles which adds an advantage, 100% respondents - 79% were aware, and 21% were unaware.

When asked about the silver nanoparticles if it helps in wound healing [Figure 6], among 100% respondents, 69% voted 'yes', and 31% voted 'no'. According to (Shanmuganathan, 2019), the silver nanoparticles are used to treat burn wound infections, open wounds and cuts. (Ganapathy, 2016) When asked if these nanoparticles can be used in diagnosis and treatment [Figure 7] (Ashok, 2014; Venugopalan, 2014), 100% respondents - 72% voted 'yes', 28% voted 'no'.

Figure 6: The pie chart depicts the Knowledge on wound healing properties of silver nanoparticles

Figure 7, The people who knew about the silver nanoparticles on diagnosis and treatment, 100% respondents - 72% were aware, and 28% were unaware.

When asked if silver nanoparticles are used in drug delivery, cancer therapy [Figure 8], among 100% respondents - 63% answered 'cancer therapy', 20% answered 'both', 16% answered 'drug delivery', and 1% answered 'none'. According to (Mohammadzadeh, 2012), the risk of the therapeutic process against the tumours is reduced by a new target, the physical nature of micelles and silver nanoparticles. According to (Zhang et al., 2013), nanomaterials can elevate the drug - delivery and efficiency of
anti-cancer drugs based on nano-drug delivery vectors. Efficient delivery systems have been developed that utilize nanoparticles loaded with high doses of cancer drugs. It has been designed for drug delivery with specific bonding.

**Figure 7: The pie chart depicts the Knowledge of silver nanoparticles on diagnosis and treatment**

When asked if silver nanoparticles can be used in bioimaging, among 100% respondents - 71% voted 'yes', and 29% voted 'no' [Figure 9]. (Jain et al., 2017) According to (Ganapathy et al., 2017; Kannan and Venugopalan, 2018), silver nanoparticles are widely used in the field of medicine to treat the patients. (Ajay, 2017)

**Figure 8: The pie chart depicts the Knowledge about silver nanoparticles used in drug delivery and cancer therapy**

The future scope of the study may enable to create and analyse the awareness of silver nanoparticles and its biomedical applications among the students in larger population. The limitations of the study include minimum articles referred, and the minimal sample size results may vary in larger populations.

**Figure 9: The pie chart depicts the Knowledge about the usage of silver nanoparticles in Bioimaging**

**CONCLUSIONS**

Silver is a noble metal which is used in nanotechnology for its various biomedical applications in the field of medicine and dentistry. It is used to treat various bacterial infections, and its healing properties help it to be used in wound healing. They are also used in silver dressing and coatings over some medical devices. By this survey, we conclude the majority of the students were aware of the silver nanoparticles, which is used in nanomedicine.

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**Conflict of Interest**

The authors declare that they have no conflict of interest for this study.

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