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Awareness On Medicinal Applications Of Selenium Nanoparticles Among Dental Students

Research Article

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Abstract

Introduction: Nanoparticles (NPs) are used to minimise toxicity, increase bioactivity, improve targeting, and modulate the release profile of the encapsulated moiety in a variety of ways. Selenium (Se) NPs hold a special place among NPs due to their distinct bioactivities in nanoforms.
Aim: This survey was conducted for assessing the awareness about medicinal application of Selenium 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 Selenium nanoparticles therapy in medical applications, their pro oxidant properties, anti-cancer activities, anti-diabetic properties and their role in targeted drug therapy, the responses were recorded and analysed.
Results: 12% of the respondents were aware of the medicinal applications of Selenium Nanoparticles. 9% were aware of prooxidant properties of Selenium Nanoparticles, 9% were aware of anti-cancer properties of Selenium Nanoparticles, 6% were aware of anti-diabetic properties of Selenium Nanoparticles and 4% were aware of their role in targeted drug therapy.
Conclusion: There is limited awareness amongst dental students about use of Selenium 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 Selenium nanoparticles therapy.

Keywords: Awareness; Selenium; Nanoparticles; Students; Medicinal; Cancer.

Introduction

In the last three decades, nanotechnology has revolutionised drug discovery and development by unlocking several previously closed doors in disease pathophysiology and therapy choices [1]. Nanotechnology is concerned with submicroscopic particles with a minimum dimension of 100 nanometers. Polymers, dendrimers, liposomes, metal nanoparticles, silicon, and carbon-based nanomaterials have all been successfully employed as therapeutic agents and drug delivery vehicles [2]. Nanoparticles (NPs) are extremely unique due to their small size, large surface area, surface charge, surface chemistry, solubility, and multifunctionality. NPs have demonstrated their efficacy as medication carriers by delivering therapeutic compounds with great success. Nanomedicine is the use of nanotechnology-based techniques and methodologies for the treatment, diagnosis, monitoring, and control of biological systems in medical research and clinical practice [3].

Se is a semi-solid metal that resembles sulphur and tellurium and is commonly observed as a red coloured powder, black in vitreous form, and metallic grey in crystalline form. Immunomodulatory activity and sperm motility orchestration are two important roles played by selenoproteins [4]. The human genome has 25 selenoprotein genes. Various antioxidant enzymes, such as glutathione peroxidase, thioredoxin reductase, and selenoprotein P, incorpo-

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rate se as selenocysteine. All of these enzymes' redox centres are selenium, which is required for their metabolic function. Sodium selenite, selenomethionine, and monomethylated Se are some of the other major Se-containing chemicals that can act as anticancer agents through various pathways.

Glutathione peroxidases and deiodinases are selenoenzymes that are essential for a variety of metabolic activities, including the physiological antioxidant defence system. Depending on the dose, duration, and oxidation state, it exhibits unique antioxidant and pro-oxidant actions [5]. In a mouse model, the application of SeNPs greatly lowers the death caused by acute Se poisoning by up to four times. Furthermore, as evidenced by indicators of hepatotoxicity, the liver damage associated with high doses of Se are significantly reduced when SeNPs are used [6]. When compared to other Se species, SeNPs have excellent anticancer efficacy and lower safety issues. SeNPs have been utilised to treat cancer, diabetes, inflammatory disorders, liver fibrosis, and drug-induced toxicities, among other diseases [7, 8]. SeNPs scavenge the free radicals in vitro in size dependent manner (5 nm–200 nm). Our research experience has prompted us in pursuing this research [9-20]. This survey was conducted for assessing the awareness about medicinal application of Selenium 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 Selenium nanoparticles therapy in medical applications, their pro oxidant properties, anti-cancer activities, anti-diabetic properties and their role in targeted drug therapy, the responses were recorded and analysed.

Results

12% of the respondents were aware of the medicinal applications of Selenium Nanoparticles (Fig 1). 9 % were aware of prooxidant properties of Selenium Nanoparticles (Fig 2), 9 % were aware of anti-cancer properties of Selenium Nanoparticles (Fig 3), 6 % were aware of anti-diabetic properties of Selenium Nanoparticles (Fig 4) and 4% were aware of their role in targeted drug therapy (Fig 5).

Discussion

SeNPs have been studied in a variety of illness conditions due to their superior characteristics over Se. SeNPs provide increased bioavailability with the added benefit of reduced toxicity. In a number of pathological diseases, the prooxidant and antioxidant actions give distinct routes for investigation. The use of SeNPs for various therapeutic applications, including antibacterial, anti-cancer, anti-diabetic, and anti-inflammatory action, is discussed in this section.

Chemically produced SeNPs were observed to alter oestrogen receptor-alpha signalling in MCF-7 breast cancer cells and lead

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

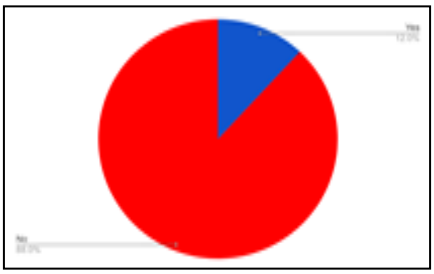


Figure 2. Awareness of the prooxidant properties of Selenium Nanoparticles.

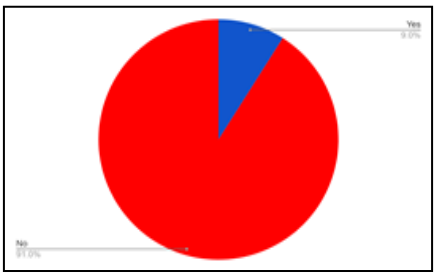


Figure 3. Awareness of the anti-cancer properties of Selenium Nanoparticles

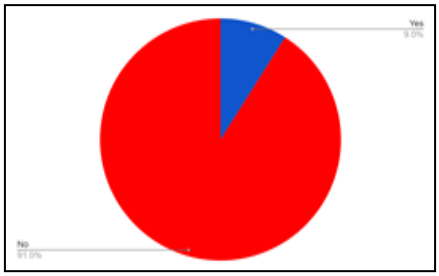


Figure 4. Awareness of the anti-diabetic properties of Selenium Nanoparticles.

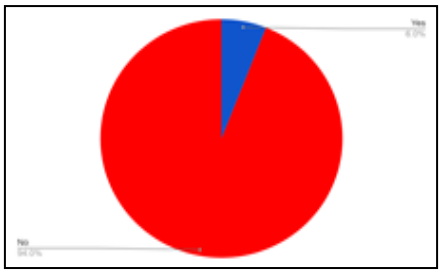
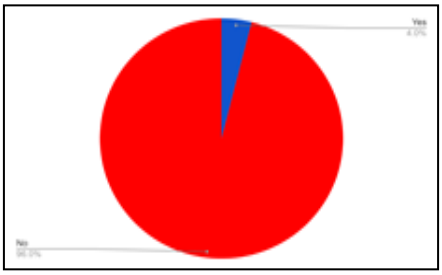


Figure 5. Awareness of the role of Selenium Nanoparticles in targeted drug therapy.



to enhanced expression of cytochrome C, Bax, and P-p38 compared to MDA-MB 231 cells, according to Vekariya *et al.,* [9]. In a separate study, SeNPs were found to significantly reduce adhesion force, induce apoptosis and necrosis in MCF-7 cells, and decrease CD44 expression; caused disorganisation and dysregulation of intracellular cytoskeleton F-actin in MCF-7 cells; and caused disorganisation and dysregulation of intracellular cytoskeleton F-actin in MCF-7 cells [21]. SeNPs inhibit the matrix metalloprotein-2 expression which is mainly involved in tumor invasion, metastasis and angiogenesis in fibro-sarcoma cell lines [22]. SeNPs showed promising anti-proliferation activity and inhibition of HeLa cells during S phase [23]. SeNPs were produced intracellularly from the haloarchaeon Halococcus salifodinae BK18 with the help of the enzyme NADH-dependent nitrate reductase in another work. SeNPs demonstrated exceptional antiproliferative action in HeLa cells while causing no harm in normal HaCat cell lines [24].

Gene therapy is a robust platform for molecularly inhibiting disease progression. Delivering siRNA/miRNA, on the other hand, has proven difficult, and several nanotechnology-based techniques have been utilised to successfully transport genes. Li *et al.,* placed heat shock protein-70 (Hsp-70) siRNA into polyethyleneimine modified SeNPs to kill HepG2 cells in order to test the survivability of SeNPs for gene delivery. Surprisingly, the NPs had a high transfection efficiency while also causing considerable cancer cell death through the induction of ROS and apoptosis [25].

SeNPs are possible drug carriers, and various studies have demonstrated their viability as a viable carrier. SeNPs treated with polyamidoamine dendrimers administered cisplatin and siRNA at the same time. In A549/DDP cells, it caused cell death via the PI3K/Akt/mTOR and MAPK/ERK pathways. Polyamidoamine modified SeNPs significantly transported siRNA and cisplatin to the tumour in a nude mouse model, with no systemic damage. Crocin delivery through PEG functionalized SeNPs was found to be effective for pH responsive delivery. The new NPs were found to destroy lung cancer cells effectively in vitro and in vivo in nude mice models via synergistic anticancer action . Mesoporous SeNPs have been described as a carrier for doxorubicin administration to breast cancer patients with lower toxicity and improved anticancer activity [26]. Curcumin-loaded SeNPs were discovered to have promise anticancer efficacy in a mouse model of Ehrlich's ascites carcinoma, inducing apoptosis and reducing NF-kB signalling as well as EMT [27]. Curcumin functionalized SeNPs were reported for enhanced chemopreventive activity [28].

SeNPs were found to protect against chromium-induced thyrotoxicity. In treated rats, SeNPs reduced K2Cr2O7-induced oxidative stress in the thyroid gland and restored T3, T4, superoxide dismutase (SOD), catalase, and GSH levels. Additionally, SeNPs protected cellular integrity, avoided cell damage, and blocked thyroid alterations [29]. Melatonin-SeNPs were found to protect mice from immunological liver injury caused by BCG and LPS. BCG/LPS induces oxidative stress, and SeNPs and melatonin produce a new complex with synergistic antioxidant action that reduces it. Melatonin has been shown in previous research to protect the liver from harm through its direct antioxidant and immunoregulatory properties. Melatonin-SeNPs treatment increased the activity of antioxidant enzymes like SOD and GPX, decreased serum ALT, AST, NO, MDA levels, liver pathological abnormalities, proinflammatory cytokines [30].

Kumar *et al.,* investigated the preventive impact of SeNPs on diabetic nephropathy development. SeNPs reduced oxidative stress and increased the activity of cytoprotective protein Hsp-70, longevity protein Sirt1, and regulated the expression of apoptotic protein Bax and anti-apoptotic protein Bcl-2 in apoptotic kidney in streptozotocin-induced diabetic nephropathy. The effects, on the other hand, were unrelated to selenoprotein concentration or a conventional inorganic Se source [31]. Peptide conjugated chitosan modified with vasoactive intestinal peptide receptor 2 agonist SeNPs were discovered to have selective anti-diabetic action. Proliferation, glucose and insulin uptake, as well as intracellular oxidative stress, were all observed to be improved by the NPs. [32]. SeNPs have been postulated as a possible carrier for oral insulin delivery in a recent breakthrough. The NPs were found to exhibit synergistic anti-diabetic effect, enhanced pancreatic islet function, and boosted glucose utilisation [33].

Conclusion

There is limited awareness amongst dental students about use of Selenium 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 Selenium nanoparticles therapy.

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