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The histopathological changes induced by intra peritoneal administration of cerium oxide on mice brain tissue

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Abstract

The use of nanoparticles (NPs) and nanoparticle- based materials raises many concerns about their impact on health related to its many applications in diverse fields, including petroleum refining, polishing agents, and coatings, as well as the toxicity of these NPs in biological/ physiological environment is a major concern. The study conducted at college of nursing – university of Basrah –Iraq,and it aimed to investigated the effect of cerium oxide nanoparticles on mice brain tissues after 30 days of intra-peritoneal I/P injection of cerium oxide nanoparticles . White laboratory mice of Mus musculus L. strain BALB/C that were supplied from (Drug Control Center - College of Science, Thi -Qar University). The mice were placed under controlled conditions of 20-25 degrees and a 12-hour light cycle. And 12 hours of darkness in plastic cages of standard sizes (30×12×11) cm, the first group injected laboratory mice with 1 ml of normal saline physiological solution as a control group. The second treatment group. Laboratory mice were injected with 1 ml of cerium dioxide at a concentration of 3.75 µl of the raw material to 996.25 µl of physiological solution. By one injection between one day and another for a period of 30 days to investigate the effects of I/P administration of cerium oxide Nano- particles on mice brain tissue after 30 day. Mice were killed and brain isolated to prepare for the histological examination which showed that cerium oxide injected for 30 day induce pathological alteration in brain tissue especially on white matter , neurofibers and glial cells. Brain of mice show degeneration of white matter, ,necrosis of glial cell aggregation of glial cell , The histopathological examination investigate that intra-peritoneal injection in mice for thirty day induce histopathological adverse changes in mice brain tissue.

Keywords: Histopathologica; Intra Peritoneal; Cerium Oxide; Mice Brain Tissue

1. Introduction

The use of nanoparticles (NPs) and nanoparticle- based materials raises many concerns about their impact on health related to it's many applications in diverse fields, including petroleum refining, polishing agents, and coatings [1]. The distinctive property of this material is its reversible conversion to a non-stoichiometric oxide [2]. Cerium oxide nanoparticles (CeO2 NPs) have promising industrial and biomedical applications. In spite of their applications, the toxicity of these NPs in biological/physiological environment is a major concern [3]. Since CeO2 NPs are poorly absorbed by the intestine, inhalation appears to be the major route of exposure. It should also be noted that complete respiratory system acts as repository for deposition of different sizes of NPs. [4,5]. Since CNPs are capable of stimulating the catalytic potency of superoxide dismutase (SOD) [6]. it could be applied as a potent antioxidant. Redox properties of CNPs could also detoxify the existing free radicals for prolonged time intervals by maintaining its bioactivity within the tissues [7]. Cerium oxide can cross the placenta and make its way to the liver, spleen, and lung tissues of adult, neonatal, and fetal mice, inducing tissue destruction and necrosis [8]. CeNPs ameliorated the neurotoxicity induced by FIP by scavenging of ROS involving a decrease of MDA and NO, enhancing antioxidant enzyme activity as SOD and GPx, and normalizing the mRNA expression of brain function genes. Therefore, it could be concluded that cerium nanoparticles have a

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neuroprotective role through antioxidant and anti-apoptotic activity [9,10,11] . focused on the in vivo efficacy of CeONPs in treatment of diseases associated with the brain, including ischemia, traumatic brain injury, Alzheimer's Disease (AD), Parkinson's disease (PD), multiple sclerosis (MS), and other neurodegenerative disorders [10]. also pointed that through their potent and regenerative antioxidant effects, CeONPs extended the lifespan of cortical and spinal neurons in culture, decreased cell dysfunction associated with oxidative stressors, increased neurite outgrowth, increased transcription of genes associated with neuroprotection, and increased dopamine secretion. It is generally assumed that toxicity increases as the NP.

size gets smaller [12,13]. added that this can be explained by the fact that cellular uptake is facilitated for smaller NPs and they are therefore more likely to be distributed in the blood stream or even in the central nervous system. In addition, smaller particles have a larger surface area per mass unit in such a way that they are potentially more active. Long ceria nanorods (greater than or equal to 200 nm) induced inflammatory responses while short ceria nanorods were nontoxic [14]. Teachers are the main caregivers and the first line of protection for school children. Their role complements that of parents. During school hours, school teachers are actually the first-respondent in cases of disasters or emergencies. They must be able to deal properly with health emergencies both in normal children, and those children with special health care needs [22].

2. Material and methods

The current study was conducted on white laboratory mice of *Mus musculus* L. strain BALB/C that were supplied from (Drug Control Center - College of Science, Thi -Qar University). The mice were placed under controlled conditions of 20-25 degrees and a 12-hour light cycle. And 12 hours of darkness in plastic cages of standard sizes (30×12×11) cm manufactured by North Kint Plastic Kint UK. Sawdust was used as a bed and changed weekly. The mice were fed freely on a special diet for mice. The injectable solution concentration (750 µl) of cerium oxide was prepared by adding 3.75 µl of cerium oxide in the form of a concentrated liquid solution in a container of 100 ml containing the active substance cerium oxide at a concentration of 20%, produced by SIGMA (USA) to 996.25 µl of the Physiological solution.(NaCl 0.9%).

Experimental animals were divided into two groups, eight mice per experimental group, and injected into the lip area (IP).The first group injected laboratory mice with 1 ml of normal saline physiological solution as a control group. The second treatment group. Laboratory mice were injected with 1 ml of cerium dioxide at a concentration of 3.75 µl of the raw material to 996.25 µl of physiological solution. By one injection between one day and another for a period of 30 days. The animals were killed at the end of experimental period, excised, the brains were separated and placed in 10% formalin solution, which was prepared by diluting concentrated formalin by adding 90 ml of distilled water to 10 ml of 100% concentrated formalin. For the purpose of histological cutting and tissue examination.

3. Results and discussion

Toxicology studies on nanoceria report results that seem contradictory, demonstrating toxic effects in some studies. protective effects in others, and sometimes little or no effect at all. NPs and they are therefore more likely to be distributed in the blood stream or even in the central nervous system [12]. Within the nanotoxicology field, increased findings demonstrate the ability of nanoparticle charge (zeta potential) to influence corresponding cellular responses ranging from particulate endocytosis toxicity [15].

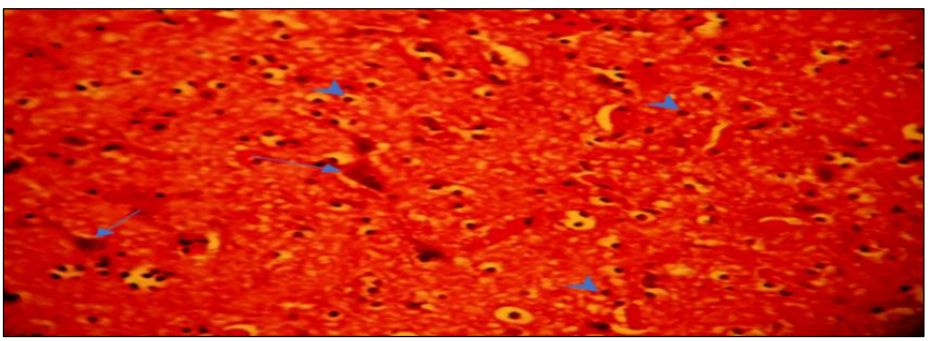

Figure 1 Brain of mice show a normal white matter, neuron(arrows), glial cells (head arrows) H&E, x 40

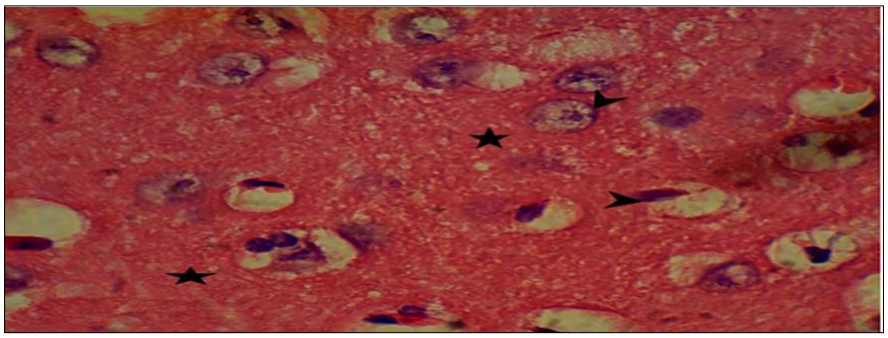

Figure 2 Brain of mice show a normal white matter, neurofibers (stars), glial cells (head arrows) H&E, x 100

The cross section of brain tissue in the present study (figure 3 ,4,5) showed that the dose of cerium oxide for 30dsy induce histopathological changes in brain tissue specially the white mater ,neurofiber as well as glial cells , this may be due to the period of administration and the dose that injected(3.75 ul) of cerum oxide nano-particles.

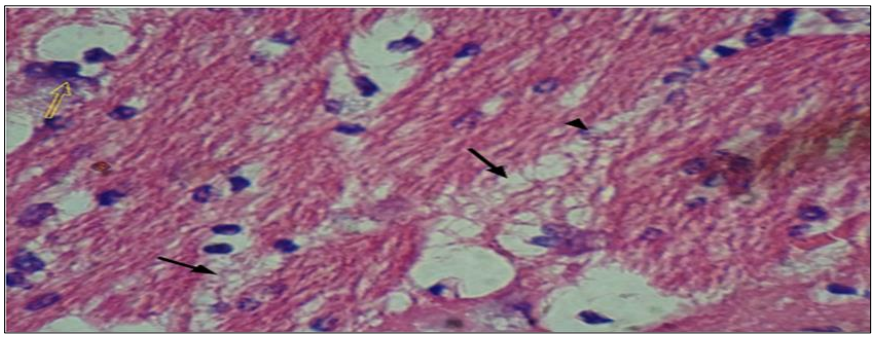

Figure 3 Brain of mice show degeneration of white matter, neurofibers (arrows), necrosis of glial cell (head arrows), aggregation of glial cell (outline arrows), H&E, x 100

Some studies explained by the fact that the chemicals used in the synthesis of the ceria nanomaterials influence the zeta potential, which in turn influences their aggregation behavior, protein adsorption, and cytotoxicity [16,17].

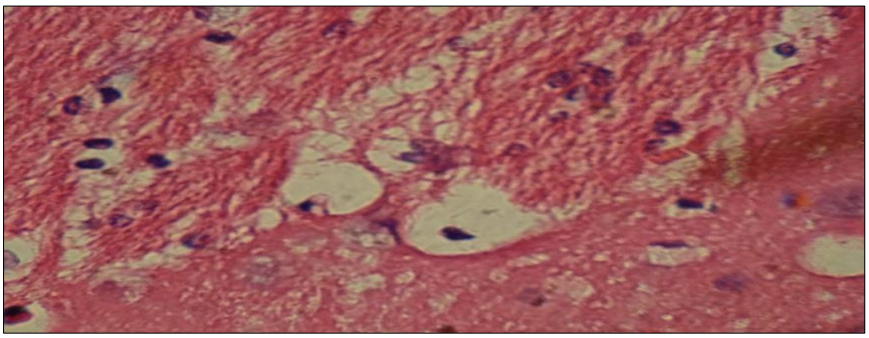

Figure 4 Brain of mice show degeneration of white matter H&E, x 100

The uptake kinetics plays a key role in interpreting the toxicity of materials. Some cells can rapidly internalize ceria nanoparticles. For example, 24 hours after exposure to aerosolized ceria nanoparticles, 80% of the nanoparticles were detected intracellularly in A549 lung cells, and the rate of nanoceria internalization is limited by the particle mass transport [18].

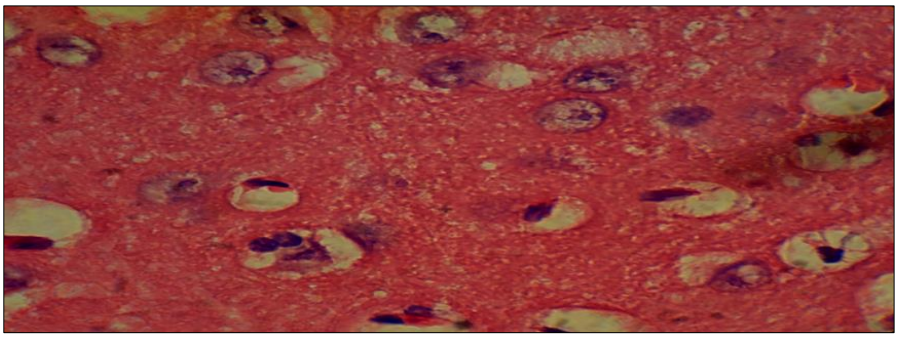

Figure 5 Brian tissue of mise show necrosis of glial cells H&E, x 100

A study on mice injected with cerium oxide for 15 and 30 days concluded that cerium oxide induce histopathological changes in liver, kidney and lung tissue [19] in addition cerium oxide showed elevation in AST and AlT indicated a negative histological change in liver tissue [20].

Found in their study that at the 5.0 mg/kg dose, showed a little change in brain and liver cerium content, but large increases in kidney and spleen concentrations (although there was high variability between animals as evidenced by the large SE). Again, this may be due to redistribution or removal by the reticuloendothelial system. Nonetheless, the bio distribution appears to be dose-dependent [21].

4. Conclusion

The study concluded that intra-peritoneal injection in mice for thirty day induce histopathological adverse changes in mice brain tissue.

Compliance with ethical standards

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Disclosure of conflict of interest

There are no conflicts of interest and all researchers are compatible.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

References

[1] M Melchionna, P Fornasiero. The role of ceria-based nanostructured materials in energy applications*Mater. Today.* 2014; *17*: 349–357.

[2] Klaus, Reinhardt; Herwig, Winkler (2000). Cerium Mischmetal, Cerium Alloys, and Cerium Compounds. Ullmann's Encyclopedia of Industrial Chemistry. Weinheim: Wiley-VCH.

[3] Sandeep,Mittal ; Alok ,K ; Pandey.Cerium .Oxide Nanoparticles Induced Toxicity in Human Lung Cells: Role of ROS Mediated DNA Damage and Apoptosis. Toxicity of Nanomaterials, Volume 2014.

[4] Singh S, A Kumar, A Karakoti, S Seal, WT Self. Unveiling the mechanism of uptake and sub-cellular distribution of cerium oxide nanoparticles, *Molecular BioSystems*. 6(10): 1813–1820, 2010. 5- Chen 5- Chen S., Y. Hou, G. Cheng, C. Zhang, S. Wang, and J. Zhang, Cerium oxide nanoparticles protect endothelial cells from apoptosis induced by oxidative stress, *Biological Trace Element Research*. 2013; 154(1): 156–166.

[5] Pagano G. Rare Earth Elements in Human and Environmental Health: At the Crossroads between Toxicity and Safety. Pan Stanford. 2016.

[6] Pourkhalili N, Hosseini A, Nili-Ahmadabadi A, et al. Biochemical and cellular evidence of the benefit of a combination of cerium oxide nanoparticles and selenium to diabetic rats. World J Diabetes. 2011; 2(11): 204–210.

[7] Kawagoe M, Ishikawa K, Wang SC, et al. Acute effects on the lung and the liver of oral administration of cerium chloride on adult, neonatal and fetal mice. *Journal of Trace Elements in Medicine and Biology.* 2008; 22(1): 59–65.

[8] Kawagoe, M; Ishikawa, K; Wang, S, C. Acute effects on the lung and the liver of oral administration of cerium chloride on adult, neonatal and fetal mice. Journal of Trace Elements in Medicine and Biology. 2008;22(1),59–65.

[9] Rzigalinski BA, Meehan C, Davis RM, Miles WC, Cohen CA. Radical nanomedicine. *Nanomedicine.* 2006; 1: 399–412.

[10] He L, Su Y, Lanhong J, Shi S. Recent advances of cerium oxide nanoparticles in synthesis, luminescence, and biomedical studies: a review. *J Rare Earths.* 2015; 33: 791–799.

[11] L, Su, Y; Lanhong , J, Shi ,S. Recent advances of cerium oxide nanoparticles in synthesis, luminescence, and biomedical studies: a review. J Rare Earths. 2015; 33: 791–799.

[12] G Oberdörster, E Oberdörster, J Oberdörster, *Environ. Health Perspect.* 2005; *113*: 823–839.

[13] Z Ji, X Wang, H Zhang, S Lin, H Meng, B Sun, S George, T Xia, AE Nel, JI Zink, *ACS Nano.* 2012; *6*: 5366–5380.

[14] Xia T, Kovochich M, Brant J, Hotze M, Sempf J, Oberley T, Sioutas C, Yeh JI, Wiesner MR, Nel AE. Comparison of the abilities of ambient and manufactured nanoparticles to induce cellular toxicity according to an oxidative stress paradigm. Nano Lett. 2006; 6: 1794–807.

[15] S Patil, A Sandberg, E Heckert, Self S Seal. *Biomaterials.* 2007; *28*: 4600–4607.

[16] JM Berg, A Romoser, N Banerjee, R Zebda, CM Sayes, *Nanotoxicology.* 2009; *3*: 276–283.

[17] DO Raemy, LK Limbach, B Rothen-Rutishauser, RN Grass, P Gehr, K Birbaum, C Brandenberger, D Günther, WJ Stark, *Eur J Pharm. Biopharm.* 2011; *77*: 368–375.

[18] D, O, Raemy; L, K, Limbach; B, Rothen-Rutishauser; R, N, Grass; P, Gehr, K. Birbaum, C. Brandenberger, D. Günther, W. J. Stark, Eur. J. Pharm. Biopharm. 2011, 77, 368–375.

[19] Semahir S, Sami J, Ali A .histological and enzymatic changes in male mice liver induced by CeO_2 nanoparticles.IJPRI. 2021; 13(2).

[20] Semahir, S; Sami , J; Ali, A,histological; enzymatic changes in male mice liver induced by CeO2 nanoparticles . IJPRI.2021.vol13Issue 2.

[21] Beverly, A; Rzigalinski, Charles, S; Carfagna, Marion, Ehrich.Cerium Oxide Nanoparticles in Neuroprotection and Considerations for Efficacy and Safety. Wiley Interdiscip Rev Nanomed Nanobiotechnol. 2017 Jul; 9(4): 10.1002/wnan.1444.

[22] WASFI, DHAHIR, ABID ALI; LUAY, ABDULWAHID, SHIHAB; MARYAM, ABDULKAREEM, ABDULRAZAQ; NOOR, SABAH, DAIF; NABAA, MUSSAB, HASSAN. ASSESSMENT OF TEACHERS' KNOWLEDGE ABOUT FIRST AID SOME BASRAH CITY SCHOOLS, BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS) ISSN (P): 2348–0521, ISSN (E): 2454–4728 Vol. 9, Issue 02, Feb 2021, 7–12.