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Research Article

Particle Dose Dependent Neurotoxic Effect of Silver Nanoparticles in Fetuses of Swiss Albino Mice

Jyoti Pani

Department of Anatomy, Krishna Mohan Medical College, Pali Dungra, UP, 281123.

ABSTRACT

Nanoparticles exhibits idiosyncratic properties because of that it shows wide range of applications in industries and many biomedical sectors ultimately leads to nanopolution. AgNps effects on embryo-fetus neuro-development are still under research level. To evaluate dose dependant neurotoxic effect of silver nanoparticles in pregnant Swiss albino mice and their fetuses. The present study was undertaken to determine the potential effects of AgNps of different dose on brain of pregnant dams and fetus after repeated maternal exposure on Gestational Days (GD) (5–17) in mice. AgNps colloidal solution, were administered to pregnant mice by repeated oral gavages at concentrations of 0.5, 1, 5, 10, 15 & 20 mg/kg/day respectively. Brain removals were done on all dams and fetuses on GD 18. Samples were exposed to H&E and Golgi staining. The dams and fetuses were evaluated for signs of neurotoxic effects. Maternal and Fetal nervous tissue showed significant histomorphological alterations in the form of Gliosis, vacuolization and honey comb shape deformity of neural cells in H&E 40x view. Whereas Golgi stain of fetus brain in same magnification showed damaged dendritic arborization and weak multipolar neuron. The intensity of such sign and symptoms were observed higher in 5, 10, 15 and 20 mg/kg/day dose group and lower in 0.5 and 1mg/kg/day dose group. The results show that a repeated oral dose of AgNps during pregnancy caused oxidative stress and neuro toxic effects in maternal and fetal brain tissue which is dose dependent.

Keywords: Lugaro cell deformity; Damaged and weak neuronal cell; Nano silver colloidal solution; Neurotoxicity

INTRODUCTION

Silver metal nanoparticles are deliberately used in super specialty medical sector for life threatening diseases diagnosis and drug effect enhancement after application to such diseases as analyst agent in form of drug coater. This metal nanosilver also vastly used in different cumbersome industries of consumer products which dastardly create environmental pollution uninanimously designated as nano pollution. Nano pollution also creates in natural environmental circumstances when millions and trillions of nano material flies in air invisibly and hurts human civilization when come in contact. The major source of nanopollution creates in nano laboratories where various types of nanoparticle are used in experiments. These nano pollution in globe which created by silver nano metals differs in intensity which corresponds to size and dose. The major hazards generated by these nano pollutions are neurotoxic neurotoxicity when entered into brain circulatory channels Therefore, the present study examines the detail chemistry of various doses (0.5, 1, 5, 10, 15 & 20 mg/kg b.w.) of silver nanoparticles (AgNps) with increased concentration in colloidal solution with the brain circulatory channels to investigate different inflammatory agents in the increased blood brain barrier permeability associated with contact and chemical reaction through the circulatory system of rest of the body. To our experience, this research is the first attempt to assess the cell viability mechanism and disintegrity with dysfunction of the blood brain barrier inside brain following exposure to different dose of small size AgNps which corresponds to increased intensity of neurotoxicity in same. The preliminary brain micro capillary endothelial cells (BMEC) which lines the parenchyma of cerebral cortices provide a good experimental brain model .

Correspondence to: Jyoti Pani, Department of Anatomy, Krishna Mohan Medical College, Pali Dungra, UP, 281123 India., E-mail: jyotiprakashimsbhu@gmail.com

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MATERIALS AND METHODS

The present study was undertaken to determine the potential effects of AgNps of different dose on brain of pregnant dams and fetus after repeated maternal exposure on gestational days (GD) 5–17 in mice. AgNps colloidal solution, were administered to pregnant mice by repeated oral gavages at concentrations of 0 (Control), 0.5, 1, 5, 10, 15 & 20 (Small size AgNps colloidal solution repeated oral gavages treated) mg/kg/day respectively. Brain removals were done on all dams and fetuses on GD 18 followed by killing of animals by deep ether and chloroform anesthesia and cervical dislocation. The brains of mother and fetuses were preserved in 10% formalin for 3 to 7 days and further half of samples from all groups were exposed to H&E (Haematoxylin & Eosin) and other half to Golgi staining.

RESULTS

Samples were exposed to H&E and Golgi staining. The dams and fetuses were evaluated for signs of neurotoxic effects. Maternal and Fetal nervous tissue showed significant histomorphological alterations in the form of Gliosis, vacuolization and honey comb shape deformity of neural cells in H&E 40x view. Whereas Golgi stain of fetus brain in same magnification showed damaged and reduced dendritic arborization and weak unipolar & multipolar neuron. The intensity of such sign and symptoms were observed higher in 5, 10, 15 and 20 mg/kg/day dose group and lower in 0.5 and 1mg/kg/day dose group (Figure 2).

DISCUSSION

The present study provides the morphological and cellular evidence that exposure to various dose AgNps colloidal solution results in a abnormality in histological presentation, neural cytoskeleton disintegrity and degeneration, neural cell proliferation, deformity and inflammation, abnormal accumulation by making its degenerated and damage changes, hamper mitochondria functionality of neural cells and increases cell viability in a dose-dependent manner. AgNps cause gliosis, cellular blebbing and honey comb cell deformity histologically. The adverse effect on health of human being of these dose sequenced metallic colloidal silver nano particles has not been well explored and proved. These doses sequenced metallic colloidal silver nano particles because of neurotoxicity and neuronal degeneration sequels in pregnant mice and fetuses' brain this research area needs more exploration as more discoveries in this stream are still awaited. Small size silver nanoparticles when injected into blood vessels of brain it turns up in causing blood brain barrier malfunction, astrocyte inflammation & neuronal degeneration in vivo. Sharma and their colleagues further suggested that the increased cerebral microvasculature penetration or rate of permeability involves reactive oxygen species (ROS) generation because the increased permeability was attenuated by nano wire antioxidant therapy following chronic exposure of small size AgNps in vivo.

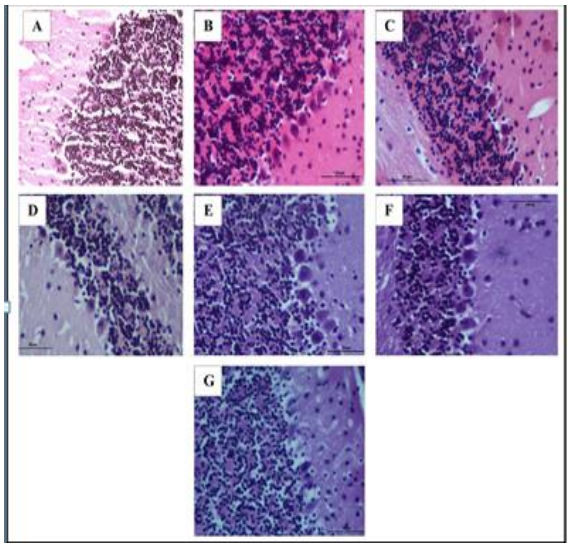

Figure 2: Represent 40× view of cerebellum histology

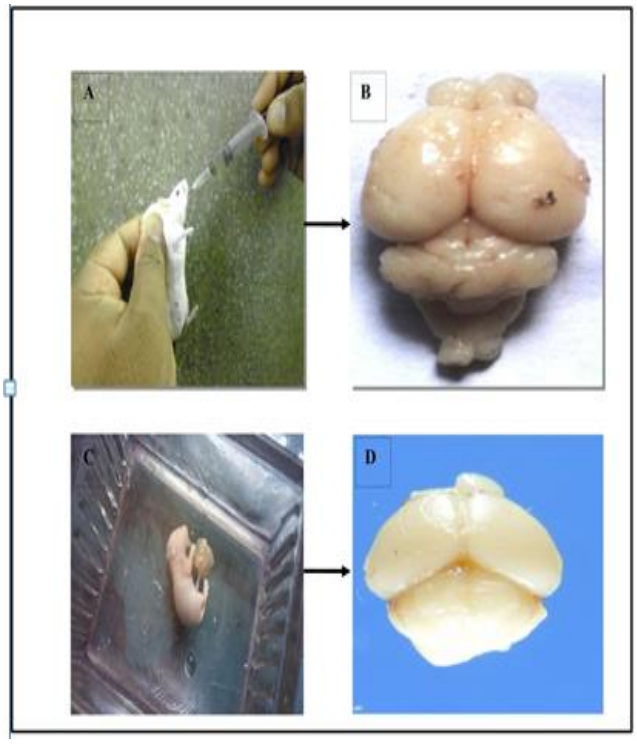

Figure 1: Oral Fresh Colladial

CONCLUSION

Based on fast and productive research is now underway into the structural modification of novel silver nano materials to colloidal form for preview of damages in neuronal cells of brain of animal and humans, it is quite wise and critical analysis performs that attention must be deviated toward their potential neurotoxicity. Much work on this stream has been done with cells in culture as proof of the concept that AgNps interact with brain cells. However, less work has been done testing the possible neurotoxicity of these silver nano particles in vivo by histological staining like Haematoxylin and Eosin and Golgi staining. This review provided strong and proved evidence that AgNps cause the generation of oxidative stress and neurotoxicity in Swiss Albino mice brain. Silver nano particles in form of colloidal solution repeated oral gavages treatment also caused a marked depletion in the levels of neurotransmitters indicating a possible change in the behavior of the treated animals due to neurotoxicity. With addition to histology combination of Golgi staining might also be useful to make understand the pathway and underlying mechanisms of neurotoxicity induced by silver nano particles colloidal solution. Therefore, understanding of the neurotoxic effects of silver NPs would help in the development of safety guidelines by scientists to promote nanotechnology for consumer applications without hazard.

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