Review on Nano Toxic Effects in Living Organisms (Mice & Zebra Fish)

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Abstract

Though nanomaterials have wide applications in various fields, they also have some toxic effects in them known as nanotoxic effects. This paper discusses about the various causes and effects of nanotoxicology in the field of medicine, in female (mice) reproductive system, on fetal organogenesis and morphology and toxicity of nanoparticles in zebrafish embryo.

Keywords: Fetal Organogenesis, Female Reproductive System, Nanomaterials, Nanotoxicology, Zebra Fish Embryos.

I. INTRODUCTION

The study of toxicity of nanomaterials is termed as “Nanotoxicology”. Nano means 10^-9; Toxic means poisonous; and Logy means study. It’s clear from the name itself, the nanomaterial which has toxic effects on its applications are called as nanotoxic materials and the property is called as nanotoxicity and the study that deals with nanotoxicity is called as nanotoxicology. The causes for such nanotoxic effects may be because of their size, their inherent properties, etc. These causes are briefly discussed below [1]. In medical field, the nanoparticles like gold, silver, and carbon nanotubes have many toxic effects which causes many health issues and problems which even leads to cancer. There are several effects of nanotoxic particles in the female reproductive system mainly affecting the uterus, vagina, oviducts and many reproductive organs reported by Jianling Sun et.al. [2]. The fetal development inside the mother’s uterus depends on how healthy the mother is. Many studies results nanoparticles may hit the female reproductive system and fertility. Organogenesis is the process by which ectoderm, endoderm and mesoderm develops into the internal organs of the organism. In this we discuss about the fetal organogenesis in which the three layers of the fetus mentioned above develops into the internal organs of it. Toxic nanomaterials also affect the functions of the reproductive system of the fetus. In zebrafish, metal nanoparticles such as silver (Ag), platinum causes toxic effects on the embryos and this eventually leads to nanotoxicity in zebra fish embryos.

II. CAUSES FOR TOXICITY OF NANOPARTICLE

A. Size

A discount within the size of nano-sized particles ends up in a rise in particle extent. So a lot of chemical molecules could attach to the current surface, which might enhance its reactivity and end up in a rise in its virulent effects. In one study, thirty third of fifty nm, twenty sixth of one hundred nm, and 100% of five hundred nm particles were discovered in tissue layer and bodily fluid tissues of the internal organ [2]. Nanoparticles larger than one µm were feebly discovered and nanoparticles larger than three µm were often seen in bodily fluid tissues. Nanoparticles smaller than one hundred nanometer are consumed by the cells of internal organs.

B. Chemical compounds

Chemical parts of the particle surface have necessary effects on nanoparticles as they will react with metals. Iron is plagued by nanoparticles that will increase the induction of ROS (reactive oxygen species). Researchers have conjointly shown that the toxicity of super magnet iron compound nanoparticles may be reduced by coating them with pollutant.

C. Dosage

Toxicity are defined on the specified dosage used. Research gave the result has high dosage nanoparticle could be harmful to health.
D. Free radical production
Most or all pathogens produce disease causing agents in free system of cell called as cell system and this capacity results asthma, which gives rise to redness of skin, destruction of cells, and defects in genes. The free radicals can trigger the redox cycle and it results in particle toxicity.

III. NANOTOXIC EFFECTS IN HUMAN
Some nanomaterials have worst effect in human beings. These effects may change toxic and cause several problems to health and life of humans [3]. Some of the effects are:
1. It has adverse effects to heart, lungs and skin. It also alters the reproductive performance in humans and contributes to cancer.
2. Because of their tiny size, they enter the human body very easily causing many effects in them.
3. Nanomaterials interact with environmental media and cause health effects in human.

A. Routes for entry of nanotoxic particles into the human body
Generally, nanotoxic particles can enter into the Human body due to lack of knowledge via
- Inhalation;
- Cutaneous;
- Ingestion;
- Others.
As an example, Humans can:
- Inhale the air contaminated with nanotoxic particles;
- Incorporate into their bodies through their skin (via cutaneous respiration);
- Eat food contaminated with nanotoxic particles;
- Drink water and consumes drinks contaminated with nanotoxic particles.

IV. NANOTOXIC EFFECTS IN THE FIELD OF MEDICINE
Nanomedicine is an ever-lasting acreage with abounding developing and predicted improved applications, such as for assorted sclerosis, atherosclerosis and cancer [4]. Carbon nanotubes and graphene nanoribbons are few examples currently accessible to amusement harmful diseases. In accession to biomedical applications, nanoparticles (NPs) are broadly acclimated as cyber banking components, in accomplishment of automotive and automated paints, plastics and aliment blush additives. Research studies on nanotoxicology accomplish assorted in vivo, in vitro, in silico and pharmacokinetic assays to abstraction the interactions of NPs with cellular apparatus and their aftereffect on important cellular functions (mitochondrial activity, candor of corpuscle membranes, apoptosis and necrosis, etc.). Unfortunately, the nanoscale admeasurement of NPs food them with some biophysical backdrop that accomplish them adverse with acceptable assays, abbreviation their acuteness and interfering with their results. Short-term and abiding furnishings of NPs on our bodies, therefore, abide unknown, creating an burning charge in adapted or atypical nanotoxicity assays that are able to affected these abstruse limitations and accommodate us with abundant bare answers to accomplish us accept whether new nanotechnologies are safe for us and our environment or not [5].

A. Nanomaterial toxicity in drug delivery system
Nanostructures could be used to transfer drug as a drug transmitter. Nanotechnology is very much important for the cancer treatment. Essentially, nanostructures are understood for gene transmission, their usage in vaccination [6]. Gene transmission has been done in vitro and vivo with different types of nanoparticles.

V. NANOTOXIC EFFECTS IN FEMALE REPRODUCTIVE SYSTEM
The frequently acclimated beastly model for toxicological appraisal is mouse. The beastly reproductive arrangement is consist of the reductive organs and genitalia. The arrest of Xenobiotics with the reproductive arrangement may blemish accustomed gonadal processes, such as oogenesis, ovulation, hormone assembly by granulose cells and the anatomy or action of the accent reproductive structures [7].

In an agreement conducted in non-pregnant reproductive mice, abiding acknowledgment to TiO2 nanoparticles (5–6 nm, intragastric administration) at a absorption of 10 mg/kg was begin to could cause ovarian aberancy and alterations in anatomic gene announcement levels [8]. Changes in the announcement of genes acclimation allowed and anarchic responses, oxidative stress, ion transport, corpuscle proliferation, archetype and oxidoreductase action of the ovary were as well observed [9]. Titanium dioxide (TiO2) were found in the ovary cells of the mice, and the attendant cellular accident led to an alternity in sex hormones and decreased fertility. In addition study, the circadian assimilation of CdO nanoparticles (230 μg/m³) added the uterine weight and adapted the placental weight of abundant mice [10][11]. The bang of SiO2 and TiO2 nanoparticles through
attitude at a dosage of 0.8 mg in abundant mice after-effects in a decreased uterine weight and an added fetal reabsorption rate. These studies authenticate that nanoparticles may abnormally appulse the reproductive arrangement and fertility.

VI. TOXICITY ON FETAL ORGANOGENESIS AND MORPHOLOGY

Exposure to nanoparticles over the gestational period strike organogenesis [12]. With intravenous administration, both aboriginal and breakable single-walled carbon nanotubes (SWCNTs) with concentrations ranging from 10 ng to 30 μg/mouse were empiric to cause morphological abnormalities in the unborn of abundant mice. The fetuses’ apparent deformities in the belly bank or head, backward development of the limbs and snout, bloated abdomens with aberrant bewilderment of the trunks. Furthermore, breakable SWCNTs acquired added abnormalities in the fetuses than aboriginal SWCNTs. The intragastric administering of hydroxyl-modified SWCNTs (10 mg/kg) to abundant mice was approved to cause added ashen defects, such as angled cervical vertebrae, bargain ossification of sternbra and duke and morphological abnormalities [13]. Anyway, toxic results are not empiric if multiwalled carbon nanotubes (MWCNTs) were allocated by material into the stomach by tube to abundant Sprague-Dawley rats. The baby of the activated accumulation showed no differences in morphological, belly or ashen abnormalities compared with the ascendency group. The non empiric adverse aftereffect akin for beginning fetal development is advised to be 1000 mg/kg per day.

VII. TOXICITY OF NANO PARTICLES IN ZEBRAFISH EMBRYOS

Zebra fish embryos have been used to judge experimental toxicity and bio-compatibility in their fast growth aspect. As a predictive model, zebra fish are used estimate the nanotoxicity of metal and metal oxide particles [14].

A. Metal nanoparticles

Both silver (Ag) and platinum (Pt) nanoparticles were apparent to reason attention-dependent hatching holding, a bead in affection amount and added abnormalities. Furthermore, acknowledgment to Ag nanoparticles (5–35 nm) acquired abnormal eyes or dark phenotypes. The analytical absorption of Ag nanoparticles (5–46 nm) that resulted in beginning abnormalities and afterlife was bent to be 1.9 nm. Surface modifications, decreased the toxicity of Ag nanoparticles in zebra fish. It was as well empiric that Ag nanoparticles are added baneful than gold (Au) nanoparticles in zebra fish.

The microinjection of TiO2 nanoparticles (<25 nm, 8.5 ng/g) into zebra fish embryos was empiric to down-regulate the announcement of genes that adapt the circadian rhythm, kinase-related activities, the allowed acknowledgment and vesicular transport. However, beginning evolution with a suspension of TiO2 nanoparticles (≤20 nm) showed no toxic results to the absorption of 500 μg/mL. In accession to the nanotoxicity of TiO2 nanoparticles, photo catalysis of TiO2 beneath beam produces ROS, alms addition key agency for toxicity.

B. Effects due to carbon nanotubes

Carboxyl-functionalized MWCNTs acquired bloodshed and adapt gene announcement in zebra fish embryos. Incubation with MWCNTs (30–40 nm) at a absorption of 60 μg/mL induced hatching delays and an anarchic response. Detrimental furnishings on the cardiovascular system, an added bloodshed rate, and apoptosis in advised embryos were as well observed. The length and distinguishing status of CNTs are the factors that access their toxicity. Fullerene (C60) acknowledgment was empiric to advance malformations and bloodshed in zebra fish embryos and to assist a concentration-dependent access in corpuscle afterlife (both afterlife and apoptosis) in the arch and trunk. Oxidative accent elicited by C60 was articular as an agency for malformation in zebra fish embryos.

VIII. CONCLUSION

Thus the nanotoxic effects in the field of medicine are reviewed in this paper. These include the nanotoxic effects in female reproductive system of mice, on fetal organogenesis and morphology and also the toxicity of nanoparticles in zebra fish embryos. It is obvious that all nondegradable nanoparticles discussed above are virulent and might influence the body cells. Some artificial materials like poly lactic-co-glycolic acid (PLGA), poly caprolactone (PCL), or natural materials like scleroprotein or chitosan will themselves be used as nanoparticles in medicine field. With added abundant studies, a bigger compassion ate of reproductive and developmental toxicity will appear in the near future.

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