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Nano silver effects on developing airway: a histological evaluation

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Abstract:

Introduction: Nano silver is widely used for its antibacterial effect. Nanoparticles have toxicity effects in the environment. People who are at risk of nanomaterials may have the effect of nanoparticles on the environment and also they will be discharged due to toxic environmental contamination. The nanoparticles may have altered the immune system and blood cells and improper use of them is harmful to the body. Silver nanoparticles can enter the bloodstream and then spread in the placenta, therefore also affecting the development of organs.

Methods: Pregnant Wister rats were administrated with concentrations of 125, 750, and 1500 mg/kg/day silver colloid nanoparticles via gavage in and histologically evaluated the airway development at the nineteenth day of gestation.

Result: Our finding reveals that a noted delay in lung embryonic development occurred in all three concentrations 125,750 and 1500 mg/kg/day.

Conclusion: In this study, possible teratogenic effects of silver nanoparticles appear in different stages of rat lung embryogenesis.

Introduction

Nanomaterial is quickly manifestation in to our everyday life. Using nanotechnology, like other technologies can bring many disadvantages [1]. Silver is one of the most common elements used in nanotechnology. Nano silver (AgNPs) is widely used for its antibacterial effect. Nanoparticles have toxicity effects in environment. People who are at risk of nanomaterials may have the effect of nanoparticles on the environment and also they will be discharge due to toxic environmental contamination.

Nanoscale particles due to its antiseptic properties provide more participants. Bactericidal effects of silver are known for many years[2]. These days, silver typically used in antibacterial salves. Products of Nano-silver include food, textiles, storage containers, antiseptic sprays, catheters, and bandages. The most common combinations used of silver in medical devices and industrial contains: nitrate, chloride, bromide, acetate, oxide, sulfate and cyanide. Silver is also used in the form of colloidal (Colloid silver or silver mineral water) and Nanoparticle [3]. To determine the toxicity of nanoparticles in ecosystems is very complex and specifically due to the frequent use of silver nanoparticles on the toxicity of these nanoparticles on human health is a concern. Despite such widespread presence of silver nanoparticles for human health safety in daily life is still not fully understood[4].

The influence of nanoparticles on cell membranes has been reported in several studies. In general, it seems that silver nanoparticles to attract major organs including the liver, lung, kidney, spleen, heart, skin and testicular Imaging [5].

The nanoparticles may have altered the immune system and blood cells and improper use of them is harmful to the body [6].

The respiratory system is the latest system of the fetus is completed. The incorrect development of lung can cause birth the babies with defects surfactant[7]. The development of Lung is start with the formation of a groove in the ventral part of throat. After that lung buds are formed and is divided into two main bronchi. In fact, perhaps the first step to the formation of lung is migrate to the endodermal cells of anterior gut, which trachea is formation [8]. Inappropriate development of the lungs caused by congenital diseases, including lung hernia and pulmonary hyperplasia [9]. The effects of nanoparticles on the stages of lung developmental have been reported in studies as inflammation. Silver nanoparticles can enter the bloodstream and then spread in the placenta, therefore also affects the development of organ[10].In this study, we tried to examine the possible teratogenic effects of silver nanoparticles on different stages of rat lung embryogenesis.

Materials and Methods

Preparation of Silver Nano Colloid

Silver colloid nanoparticles can be purchased (Nano Saw Company-Iran). Particle size is determined by transmission electron microscope. Nanoparticles are prepared at concentrations of 125, 750, 1500 mg / kg / day.

Keeping animals

In this study, male and female Wistar rats aged 10 weeks. All of the rats were free of any illness and injuries. These animals are quarantined for a week until they completely compatible with the environment. For mating two females and one male were placed in a cage overnight. Vaginal smears prepared to confirm a successful mating and appearance of sperm.

Test Groups

Thirty-nine rats were selected and randomly assigned to four groups: three experimental groups that administrated with silver nanoparticle in concentrations of 125, 750, 1500 mg / kg / day. Each treatment groups include ten rats and a control group that include nine rats.

Treatment of animals

The Mixture daily administered by gavage to pregnant rats during gestation day (GD) six to nineteen. At the same time control rats received an equivalent volume of water, by gavage.

Histological analysis

A caesarean section was done on nineteenth GD. All pregnant females are anesthetized by inhalation of chloroform. Half of the live fetuses were fixed in formaldehyde solution 10%. Cut lung tissue in 10-micron slices and then staining them by H & E staining method. The number of respiratory ducts and conductive ducts were counted in treatment (n=5) and control (n=5) groups for examining and studying them after staining.

Statistical Analyses

The significance of the results in histological analysis was tested by a one-way ANOVA or Post Hoc tests using the commercially available software. A P value <0.05 was considered significant.

Results

Histological Finding

For histological examination Conductive and Respiratory ducts were counted after H & E staining. In this study, histological studies limited to the lung tissue. The number of Conductive ducts and Respiratory ducts are represente of the embryonic lung tissue development. The number of conductive ducts were decreased in the control group comparing with the treatment groups. On the other hand, the respiratory ducts were increased in control group comparing with the treatment groups) Fig1 and 2).

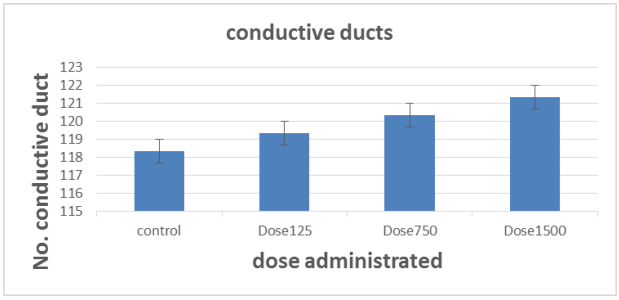

Fig1: Number of conductive ducts.

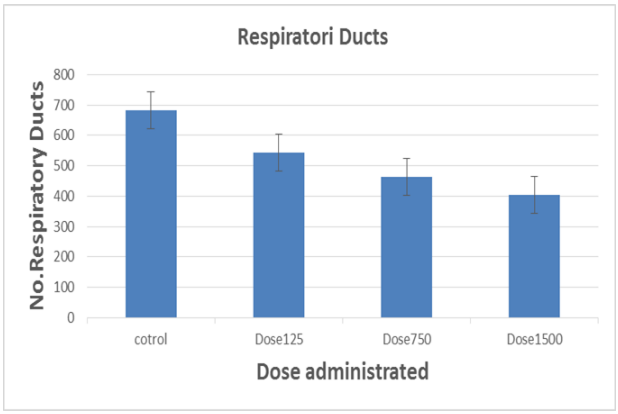

Fig2: Number of conductive ducts.

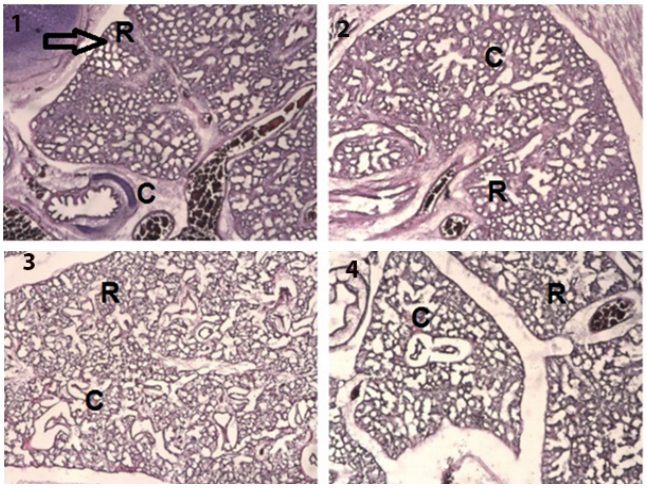

Fig 3: 1- Control group, 2- 125 mg / kg / day,3- 750 mg / kg / day, 4- 1500 mg / kg / day. R: Respiratory ducts, C: conductive channels. X=400

Discussion

AgNPs are widely used for their antibacterial effect. Nanoparticles have toxicity effects in the environment. people who are at risk of nanomaterials may have the effect of nanoparticles on the environment and also they will be discharged due to toxic environmental contamination.

The shape, surface, and size of nanoparticles have important roles in agglomeration and harmful sites.

There is interesting to determine the relationship between the physical and chemical properties of nanomaterials and their potential risk to the environment and human health.

The use of silver in nanoparticle form (as compared to its ionic form) seems to have reduced cellular toxicity [11] but a few in-vitro studies have shown some evidence of nanoparticles being harmful to some cell lines. The toxicity seems to correlate with smaller particle size [12] .

Recent reports have shown that the use of high concentrations of silver as an antimicrobial agent in rat fibroblast cells l-929 AgNPs also accumulate in cytoplasmic granules can cause a small amount of the toxicity effects [13] .

In humans, silver compounds (about 1%) topically were absorbed through the skin. Nanosilver particles were deposited in layers of human skin and also they promoted the skin aging process.

Generally, the toxicity effects of AgNPs are a disruption in cell metabolism which include inflammation, activation of oxidative stress, apoptosis, and necrosis [14] .

Toxicity in the embryonic period is one of the important parts of embryonic biological activity that is related to human health and safety. Experiments have been done on chick embryos and Zebrafish nanoparticles affect that had been identified and also, and these particles can induce toxicity in the differentiation of organs.

AgNPs can induce toxicity in the embryonic period in high concentrations, for example, the deformation of the neural tube and heart muscles. In general, silver nanoparticles could also have a direct effect on tissue development. Many nanoparticles can penetrate the placental barrier such as silver nanoparticles. The penetration is dependent on scale size and the changes that occur on their surface .

This study investigates the developmental toxicity potential of AgNPs administered orally to rats at three

concentrations of 0, 125, 750, and 1500mg/kg/day from GD 6–19.

Histological studies have been conducted on several races and a wide range of. The toxicity of AgNPs was reported in all of these studies.

The purpose of this study is to examine the possible teratogenic effects of silver nanoparticles in three different concentrations in lung rat embryonic development.

Silver nanoparticles can enter the bloodstream and then penetrate the placenta, therefore the toxicity effects of Nanosilver are in the development of tissues. The effects of nanoparticles have been reported as inflammation in the developmental stages of the lung in more studies. The changes in the composition of the Bronchoalveolar cell caused lung inflammation which indicated inhaling nanoparticles. It seems that silver nanoparticles in tissue can be an agent for activities of ROS that ultimately can cause cell toxicity. Small AgNPs are cytotoxicity for human lung cells. Our study is confined to the lung tissue. Results showed the number of conductive ducts was reduced in the control group compared with the treated groups and on the other side, the respiratory ducts had increased in the control group compared with the treated groups which That represents a delay in the development of lung tissue in the treated groups comparing with the control group. Lung Epithelial tissue remains in cuboidal tissue.

Disclosure statement

The authors declare that they have no conflict of interest.

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