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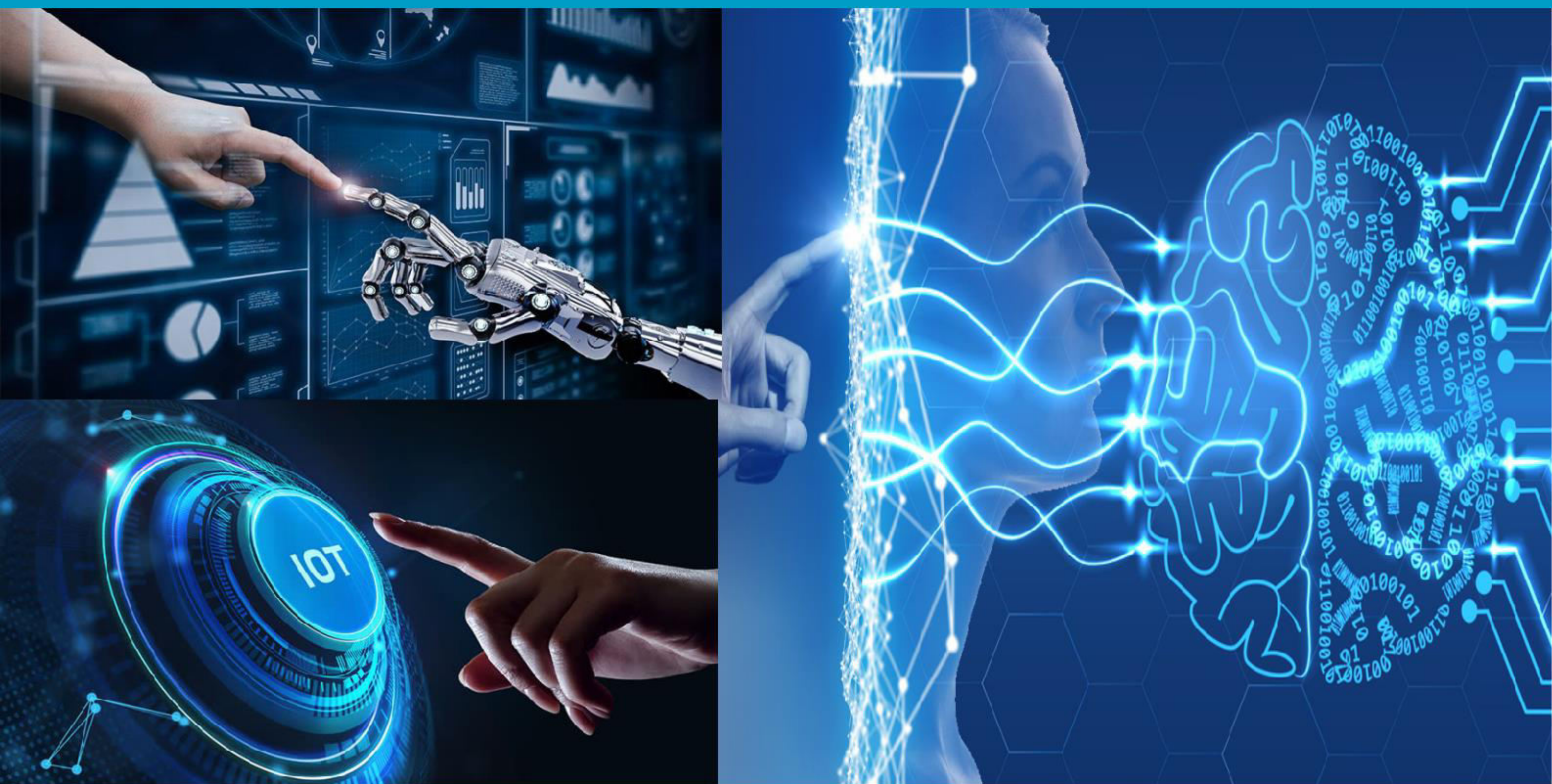

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Mutagenic Effects of Chlorine in Mice at Different Time Periods

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ABSTRACT: Chlorine is a chemical element with the symbol Cl and atomic number 17. The second-lightest of the halogens, it appears between fluorine and bromine in the periodic table and its properties are mostly intermediate between them. Chlorine is a yellow-green gas at room temperature. It is an extremely reactive element and a strong oxidising agent: among the elements, it has the highest electron affinity and the third-highest electronegativity on the revised Pauling scale, behind only oxygen and fluorine.

KEYWORDS: chlorine, mice, mutagenic, effects, time periods, ppm, quantity, health, toxicity, immune system

I.INTRODUCTION

Chlorine played an important role in the experiments conducted by medieval alchemists, which commonly involved the heating of chloride salts like ammonium chloride (sal ammoniac) and sodium chloride (common salt),[1] producing various chemical substances containing chlorine such as hydrogen chloride, mercury(II) chloride (corrosive sublimate), and hydrochloric acid (in the form of aqua regia). However, the nature of free chlorine gas as a separate substance was only recognised around 1630 by Jan Baptist van Helmont. Carl Wilhelm Scheele wrote a description of chlorine gas in 1774,[2] supposing it to be an oxide of a new element. In 1809, chemists suggested that the gas might be a pure element, and this was confirmed by Sir Humphry Davy in 1810, who named it after the Ancient Greek χλωρός (khlōrós, "pale green") because of its colour.Because of its great reactivity, all chlorine in the Earth's crust is in the form of ionic chloride compounds, which includes table salt. It is the second-most abundant halogen (after fluorine) and twenty-first most abundant chemical element in Earth's crust. These crustal deposits are nevertheless dwarfed by the huge reserves of chloride in seawater[3].Elemental chlorine is commercially produced from brine by electrolysis, predominantly in the chlor-alkali process. The high oxidising potential of elemental chlorine led to the development of commercial bleaches and disinfectants, and a reagent for many processes in the chemical industry. [4]Chlorine is used in the manufacture of a wide range of consumer products, about two-thirds of them organic chemicals such as polyvinyl chloride (PVC), many intermediates for the production of plastics, and other end products which do not contain the element. As a common disinfectant, elemental chlorine and chlorine-generating compounds are used more directly in swimming pools to keep them sanitary.[5] Elemental chlorine at high concentration is extremely dangerous, and poisonous to most living organisms. As a chemical warfare agent, chlorine was first used in World War I as a poison gas weapon.In the form of chloride ions, chlorine is necessary to all known species of life.[6] Other types of chlorine compounds are rare in living organisms, and artificially produced chlorinated organics range from inert to toxic. In the upper atmosphere, chlorine-containing organic molecules[7] such as chlorofluorocarbons have been implicated in ozone depletion. Small quantities of elemental chlorine are generated by oxidation of chloride ions in neutrophils as part of an immune system response against bacteria[8].In present investigation the effects of chlorine was observed in mice. Chlorine causes mutation in genes due to which we find different physical, physiological, anatomical and histological changes in mice. Hence these in total can be called mutagenic effects. [9]

II.DISCUSSION

Industrial compound employed in water purification and bleaching operations and in the production of plastics and a variety of other chemicals is Chlorine. Chlorine is highly toxic when inhaled, producing irritation and injury to the respiratory tract.[10] Mice exposure leading to lung injury can occur by drinking chlorinated water .Multiple train derailments leading to chlorine release and human casualties from chlorine drinking water have occurred. Chlorine can be added to water as a gas or in the form of hypochlorite either as liquid or solid.400 ppm of chlorine was mixed in water and supplied to caged mice. The mice were well nourished by provision of feed. These were then given chlorinated water (400 ppm).[11] The effects were recorded after every hour. Physical changes were noted alongwith internal anatomical changes after death of mice. Epithelial hyperplasia, mucus accumulation, and airway hyperreactivity were seen after an

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hour. [12]Mice were seen with shortness of breath after second hour. Eye tearing in third hour. Fourth hour showed their respiratory failure. Vomiting was seen alongwith respiratory failure, in fourth hour. Exposure to chlorine can lead to reactive airways dysfunction syndrome (RADS), [13]a chemical irritant–induced type of asthma in mice during fifth hour. And further provision causes toxicity leading to death. Chlorine is a toxic gas used in a variety of industrial processes and is considered a chemical threat agent. [14]High-level chlorine exposure causes acute lung injury, but the long-term effects of acute chlorine exposure are unclear. Here we characterized chronic pulmonary changes following acute chlorine exposure in mice. Chlorinated water caused oxidative damage to the lung and at high enough levels results in acute lung injury characterized by the death of epithelial cells lining the respiratory tract,[15] epithelial/endothelial barrier disruption, pulmonary edema, hypoxemia, and pneumonitis in mice after 5 hours of drinking 400 ppm chlorinated water (whenever thirsty). All these effects are due to genetic changes in mice cells nucleus and the changes are hence called mutagenic. Chlorine is a mutagen which is highly effective causing varied changes in mice.[16]

III.RESULTS

For histological study, mice lung tissues were collected after 5 hours when dead and fixed by inflation with 10% neutral-buffered formalin at a pressure of 25 cm H_2O. During embedding, the left lung and the inferior lobe of the right lung were oriented to produce cross sections of the main lobar bronchi, and the superior and middle lobes of the right lung were sectioned longitudinally. [17]Sections were cut at a thickness of 5 µm and stained with hematoxylin and eosin.Chronic pneumonitis in chlorine (400 ppm)-drunk mice. Lung tissue sections from A/J mice were stained with hematoxylin and eosin. A: lung tissue from an unexposed mouse. B: lung tissue from1 hour drunk mice C and D: lung tissue from 2 hour drunk mice E and F: lung tissue 3 hour drunk mice (E) and 4 hour (F) after 5 hours G: lung tissue after 5 hours in dead mice showing granulomatous lesion. H: lung tissue in dead mice showing thick alveolar septa and bronchiolization. [18]

Although the immune system is thought to maintain a sterile environment within the lung, we observed numerous bacteria in the lungs of chlorinated mice[19]. Bacteria are small enough that, when they are inhaled, a significant fraction may bypass the upper airways and reach the lung. Healthy host defense mechanisms will effect the rapid clearance of isolated bacteria before extensive proliferation and clinical infection result. [20]Thus, at any given time, inhaled bacteria that have reached the lung but have yet to be cleared may be present, as we observed in both chlorinated and healthy mice.

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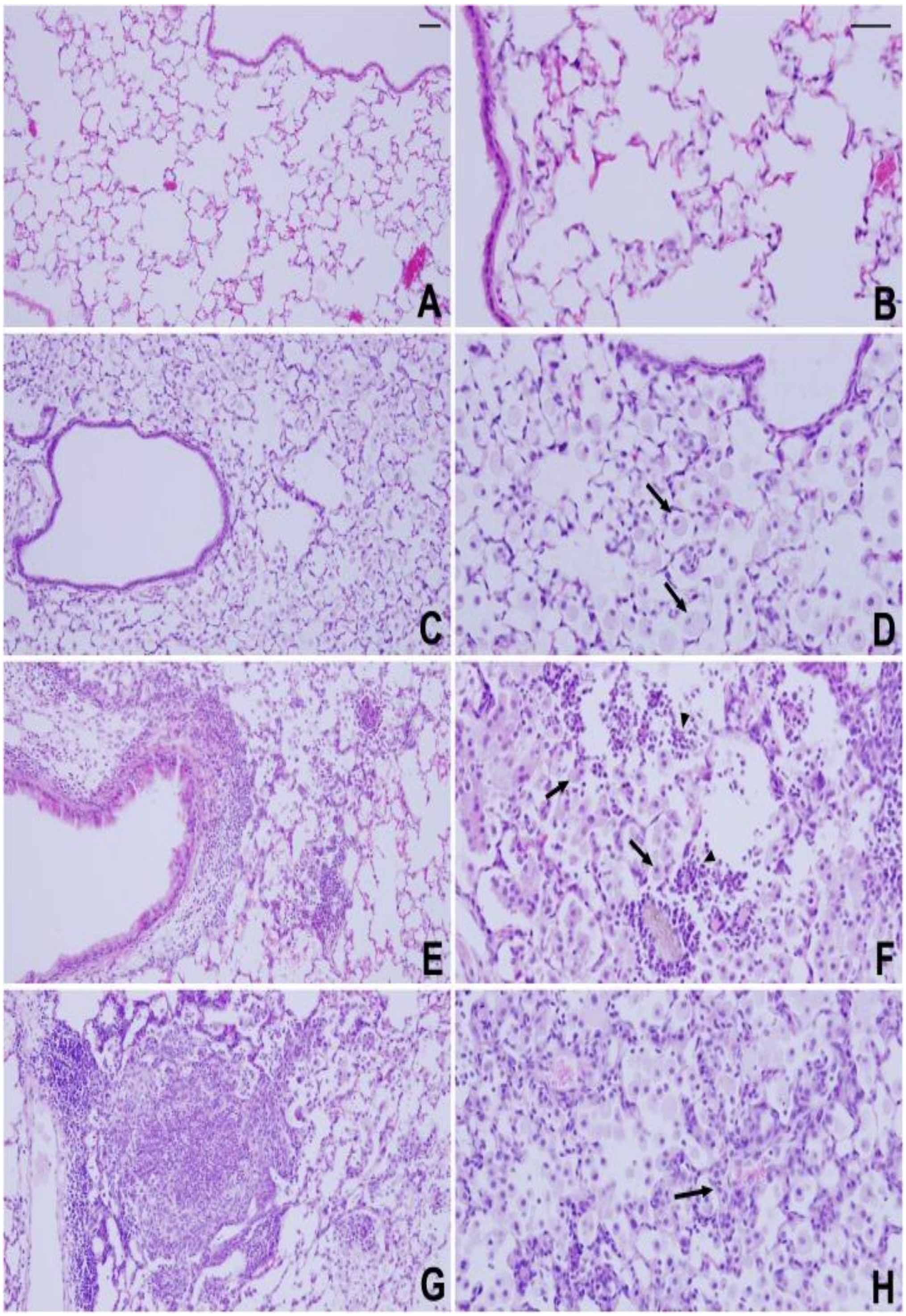

IV.CONCLUSIONS

In general, Chlorine is a mutagen detectable with measuring devices in concentrations as low as 0.2 parts per million (ppm), and by smell at 3 ppm. Coughing and vomiting may occur at 30 ppm and lung damage at 60 ppm.[20] About 400 ppm can be lethal for mice causing toxicity, hence death. The IDLH (immediately dangerous to life and health) concentration is 10 ppm. Breathing lower concentrations can aggravate the respiratory system and exposure to the gas

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can irritate the eyes. When chlorine is inhaled at concentrations greater than 30 ppm, it reacts with water within the lungs, producing hydrochloric acid (HCl) and hypochlorous acid (HClO).Such Physical , physiological, anatomical and histological changes in mice leading to death is all mutagenic and hence chlorine is lethal. [21]

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