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Study the effect of chlorine gas in some blood criteria among the workers in the water purification plants in Babylon governorate

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Abstract
This study goal is to mark the impact of chlorine gas in some physiological and biochemical criteria among the workers in the water purification plants in the Babylon city. The study was conducted in the general education Hilla hospital as were examined blood samples from the workers in water purification plants and divided them for four groups depending on the periods of works in these plants into (1-5);(6-10); (11-15) and (16-20) years in comparison with the control group. The results of this study revealed an elevation significantly ($p<0.05$) in the numbers of total white blood cells as well as in the concentration of urea and creatinine in the workers for the various periods of work in matching with the group of control. The above criteria become more height with the increasing duration of exposure to chlorine.
Keywords: Chlorine , Water , Blood ,Urea, Creatinine

Introduction

Water Pollution problem is eternal where between 1920s and 1930s millions of peoples dies from cholera, typhoid and dysentery which transported via polluted drinking water .Sterilization of drinking water using chlorine represent the ideal step for water treatment in the Twentieth century. Chlorination of water begins in 1890 to eliminate pathogens. Chlorine is used to sterilize water in broadband for the first time in 1908 in Chicago. This discovery lead to eliminate different diseases and humanity reached to the amazing development in the type of drinking water and the preserving the environment, till now 98% of drinking water sterilized by chlorine.(Enger, 1960). Although the importance of chlorine in the sterilization of drinking water , Sewage and Industrial waste, but the drinking of Chlorinated water and the direct exposure to chlorine gas led to harmful effects where several studies indicated that chlorine has related directly with cancer of liver, urinary bladder and large intestine , in addition to its role in atherosclerosis ,hypertension and sensitivity. (Shusterman *et al.*,2008 ; Duncan et al.,2011).The current study aimed to highlight on the harmful effect that results from direct exposure to chlorine in some physiological and biochemical blood criteria among the workers in the water purification plants in the Babylon city .

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Materials and Methods

The subjects in this study included 50 samples selected from workers in the water purification plants in the Babylon city with different working period form (1-20 years), 30 healthy people represent group of control which is compared with study group. All subjects in this study were taken consent before participation in this study. blood were drawn from all samples to detect the following :

Determination White blood cells count (WBC) and hematocrit (HCT)

The BC-2800 Auto Hematology Blood Analyzer was used to determine the numbers of WBCs and percentage of HCT.

Determination of Urea and creatinine levels

Urea and creatinine levels using Reflotron plus device assayed by enzymatic methods in serum (Heil,2000;Young,2001).

Statistical Analysis

Statistical analysis was accomplished by SPSS 17 using T-test and ANOVA test to mark the significant difference among the study groups.

Results and Discussion Results in table (1) detect the presence of elevation significantly ($p<0.05$) in WBCs counts, creatinine and urea levels among the workers when matched with control group while, hematocrit (HCT) percentage decreased significantly ($p<0.05$) among the workers when compared with control group.

Table (1) Chlorine effects in blood and biochemical criteria in the workers and control group's

Criteria	Control group Mean ±SD	Workers group Mean ±SD
WBC (mm3)	**4750 ± 34.52**	**9200 ± 52.3***
HCT (%)	**48.5 ± 1.29**	**39.6 ± 1.83 ***
Creatinine (µmol/L)	**67.9 ± 3.92**	**105 ± 4.62***
Urea (mg/dl)	**3.73 ± 0.33**	**6.24 ± 0.95***

***significant at (0.05) level**

The elevated levels of WBCs may result due to inflammation of respiratory system as a result of chlorine inhalation , where the study of (Uyan et al.,,2009) found that the exposure to chlorine lead to acute inflammation in the nose , pharynx , trachea and Cornea where it lead to Congestion with fluids, in addition, one of the main characteristics of inflammation is increase in the numbers WBCs .Other researches indicated the increment in the numbers of WBCs may result from the elevation of interleukin -1 (IL-1) which is secreted by phagocytes in the state of inflammation where IL-1 stimulate filtration of WBCs to the inflammation zone.(Gao et al.,2007, Mills et al.,2009).

The result of the current study show a significant decrease ($p<0.05$) in hematocrit (HCT) among the workers in water purification plants when compared with control group, this may result from the distortion of erythrocytes (RBCs) when exposure to

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chlorine gas where the study of (Heffernan et al.,1979) found that the chickens which exposed to chlorine led to oxidation of thiol group that lead to deposition of hemoglobin and hemolysis of erythrocytes. (Woollard et al.,2009).

In other studies, they were found that the incubation of erythrocytes *invitro* with chlorine gas led to empty them from glutathione and increase hydrogen peroxide levels in addition to hemoglobin oxidation and all this would lead to change the shape of erythrocytes; from these results ,it's clear that the effect of chlorine gas is hemolytic and oxidative to erythrocytes, and this would lead to decrease percentage of hematocrit and this agreed with results of the current study .(Kapralov et al.,2009 ; Pal et al.,2011) .

The results also, showed a significant increasing in creatinine and urea levels among the workers in water purification plants and this may be due to disorders of the kidney that result from chlorine effects and this was referred in the study (Lacey and Randle,1990), where the kidney represent important organ in the body which is act on the excretion of wastes from the body and the elevated levels of creatinine and urea indicate the presence of disorders in the kidney like chronic kidney failure . The study of (Kum et al.,2010; Mohsen et al.,2018) found the poisonous effects of chlorine on liver and kidneys, the study found that the exposure of mice to different concentrations of chlorine lead to proteinosis and enlargement in the renal tubules ,in addition to lesion in the kidney and these conditions are associated with acute kidney diseases that increasing the intensity of renal inflammation ,glomerulisederosis, hyperplasia and mineralization all these factors may lead to elevation of creatinine and urea and this agreed with the results of current study.

The results of exposure time to chlorine that shown in figure (1) indicated the presence of significance elevation in the numbers of WBCs among the workers in water purification plants in different duration of works when compared with control group .

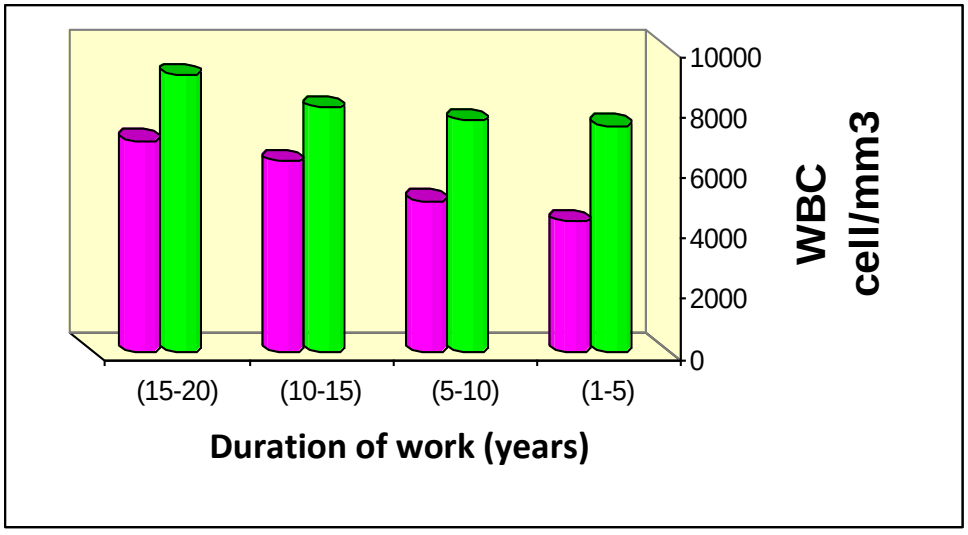

Figure (1): Correlation of the duration of works in the water purification plants with the total number of WBCs.

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The researcher Aslan et al., (2006) that exposure to chlorine for a long time and inhalation will lead to interaction with water in the tissues, which result in to the genesis of hydrochloric acid in addition to the formation of free oxygen and one of the damage of hydrochloric acid is that it causes acute inflammation in the epithelial tissues of respiratory tract and eyes and one manifestation Inflammation is high numbers of WBCs.

In an experiment included the exposure of rats to different concentrations of chlorine for 90 days and 120 days respectively showed that the rats that killed in day 120 have hyperplasia in the goblet cells of the nasal cavity as well as metaplasia in the epithelial tissue , in addition to an inflammatory response represented by increasing in the numbers of white blood cells especially neutrophil (Chen et al.,2012).

In figure, (2) the results show the presence of a significance decrease in the levels of in the hematocrit (HCT) among the workers in water purification plants in different duration of works when compared with control group

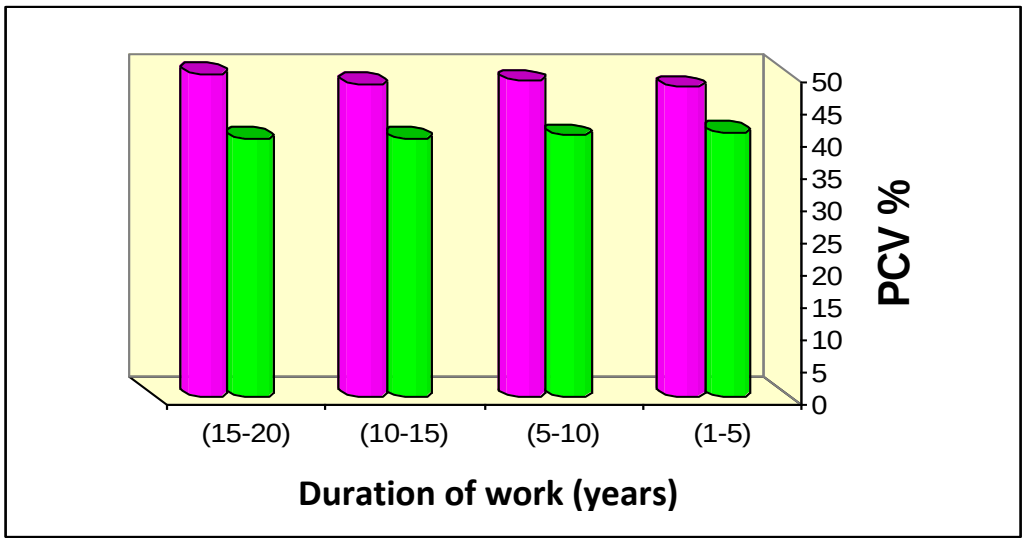

Figure (2): The Correlation of the duration of works in the water purification plants with HCT levels.

Exposure to chlorine for a long time lead to the reduction in glutathione levels and formation of free radicals which are act on the oxidation of hemoglobin and this may reflected on the decrease of HCT levels and this similar to our results (Moor,1999). The study of (Rother et al.,2005) find that the exposure to chlorine for long time lead to hemolysis of blood. In the other study included exposure of rats to chlorine gas for the duration (2 and 6 months respectively) showed that the rats stay exposed to chlorine for 6 months have acute anemia associated with changes in the figure of red blood cells (White and Martin,2010)

The results showed significant elevation in creatinine and urea levels among the workers in water purification plants in different duration of works when compared with control group, as shown in figure (3) and figure (4) .

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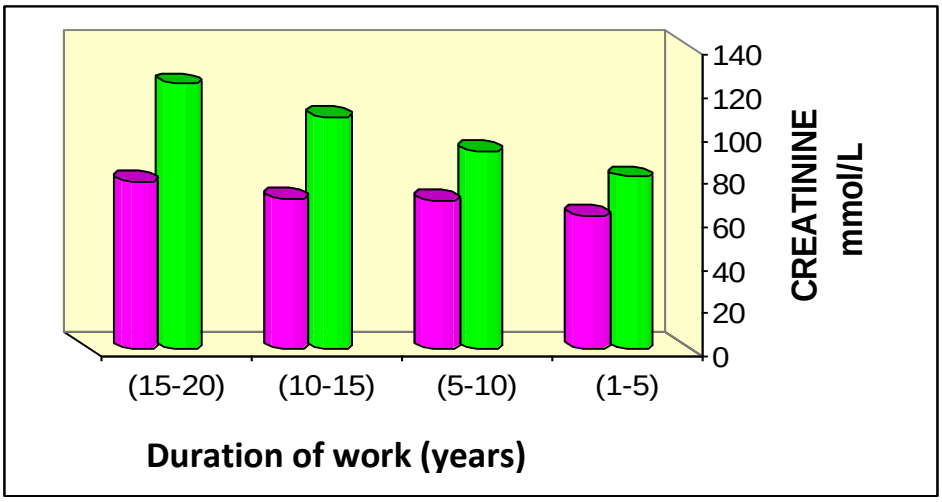

Figure (3): The Correlation of the duration of works in the water purification plants with creatinine levels.

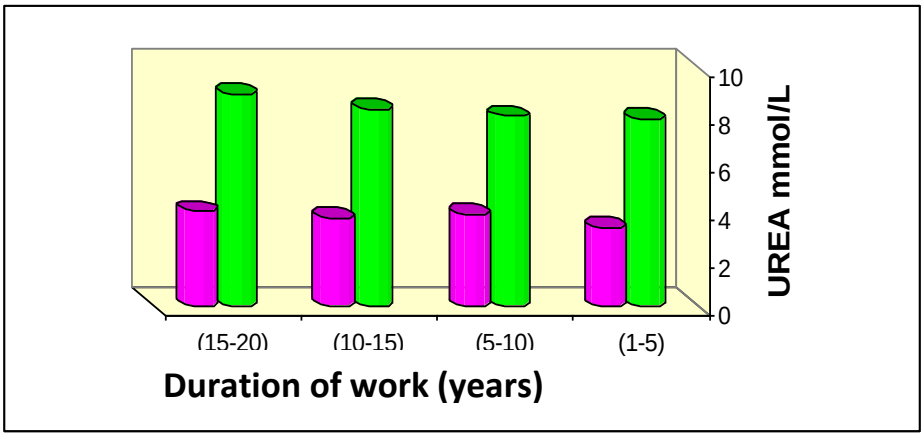

Figure (4): Correlation of the duration of works in the water purification plants with urea levels.

This may be caused by the greater damage in the renal tubules in addition to hyperplasia in the tissues of these tubules as a result of exposure to chlorine and this agreed with the study of (Perigo and Prado,2005).In the other study performed on mice find that the long time exposure of mice to chlorine lead to elevation the levels of N-acetyl-glycosaminidase enzyme, which is associated with renal tubules damaging and thus lead to elevation the creatinine levels ,in addition to elevation of urinary proteins as a result of kidneys damaged and this lead to elevation in the levels of urea in the blood and this agreed with our results (Patrick-Iwuanyanwa et al.,2011).

Conclusions and recommendations

Exposure to chlorine effect in some blood parameters of workers in water purification stations, by decrease the hematocrit levels and a significant increase in the total number of white blood cells, in addition to association of chlorine with the occurrence of diseases in the kidney due to the higher levels of both urea and creatinine levels.

Chlorine is one of the polluting gases and has a great impact on health and must be treated with great caution to prevent its health effects and therefore should educate the

workers in this area and to inform them on the seriousness of this gas and to identify ways to prevent its effects and to find alternative ways to sterilize water be safe for workers and citizens

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