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A REVIEW OF HEMATOLOGICAL TOXICITY OF PETROLEUM PRODUCTS

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Abstract

Gasoline or petrol is the generic term for petroleum fuel used for internal combustion of engines. Petroleum fumes are ubiquitous in our environment and the common sources of contact or exposure are petrochemical industries (refineries, oils field, and filling stations) and homes. Also the daily use of petroleum outside the industrial settings is likely to have effect on users. The present review compiles the epidemiological studies done in various parts of world on hematological parameters. The available studies suggest that there is an adverse effect of petroleum products on hematopoetic system.

I. INTRODUCTION

Gasoline is a complex manufactured mixture that does not exist naturally in the environment. Chemicals that are in gasoline are generally present in several physical states (gaseous, liquid or others) in human settlements [1]. Gasoline is produced from petroleum in the refining process. Exposure to automotive gasoline most likely occur from breathing in its vapour at a service station while filling a car's fuel tank, sniffing by activities of mechanics, while refuelling generators at home, by activities of black market gasoline dealers, workers involved in the clean up and maintenance of underground storage tanks, using equipment that runs on gasoline e.g. lawn mower and drinking gasoline contaminated water [2]. Occupational exposures to petroleum fumes have been reported to have toxic effects on various organs and systems and these include respiratory, immune and nervous system. Organs such as the heart, lungs, skin and kidneys are affected by these toxic effects resulting in various diseases [3]. The haematotoxic effects of benzene have been reported to involve both bone marrow depression and leukaemogenesis caused by damage to multiple classes of haematopoietic cells with a variety of functions [4]. Inhalation exposure of rats to gasoline is irritating to the lungs when breathed in and irritating to the lining of the stomach when swallowed [5]. Breathing in high levels of gasoline for short period of time or swallowing large amounts of gasoline may also cause harmful effects on the nervous system [6]. These effects become more serious as the amount of gasoline breathed in or swallowed increases.gFuel attendants also called filling station attendants, gas station attendant, gas tender [7], perform duties at automobile service stations as requested by customers; they fill fuel tank vehicles with gasoline or diesel fuel to level specified by customers;

observes level of oil in crankcase and amount of water in radiator and adds required amount of oil and water; adds necessary amountof water to battery and washes windshield of vehicle. Checks tires for correct air pressure and handling cash payments or preparing charge slips for credit card customers Fuel attendants are exposed by dispensing the fuel into vehicles without any protective device to minimize their exposure. In the process fuel attendants inhale and have skin/eye contact with gasoline [8].

Human exposure to gasoline usually present with adverse effects on health depending on the route of exposure and quantity of gasoline involved. Various degrees of toxicities are also associated with gasoline inhalation and sometimes anaemia and other disease condition may result. The study conducted at Elele, Rivers State, South of Nigeria has shown that auto mechanics and fuel attendants are exposed to gasoline vapour leading to decreased haematological indices.Fuel attendants are more at risk than auto mechanics and could be at risk of developing anaemia there is positive correlation between length of exposure and effect on haematological indices.[9]The studies conducted on rats and rabbits have documented significant changes in RBC, Hb, MCH and MCHC in subjects who are exposed to gasoline [10,11].The toxic components especially those in petroleum fumes, have been reported to change blood chemistry and induce anaemia by causing bone marrow hypoplasia in experimental animals [12]. This study suggests a similar effect on humans. Benzene and lead are toxic constituents of gasoline. They become activated in the bone marrow and the cytotoxic effects observed are mediated through disturbance in DNA function. The resultant bone marrow depression is characterized by inadequate production of red cell and other formed elements [13].Theresultsofthestudyconducted at Mansoura city, Egypt showedthatthemeanhemoglobinlevel and RBCs count of petrol station attendants weresignificantly lower than those of the comparison group whilemean white blood cells (WBCs) and platelets counts werehigher among petrol station attendants with non-significantdifference between both groups.Mean HCT value was significantly lower inpetrol station attendants than comparison group while meancorpuscular volume (MCV), mean corpuscular hemoglobin(MCH), and mean corpuscular hemoglobin concentration(MCHC) were similar in both groups with statistically non-significant difference between them [14].

Similarly, in hematologicalassessmentofgasolineexposureamongpetrolfillingworkersin Baghdad, their mean hemoglobin level, WBCs, and RBCscounts were significantly lower than those of comparison group [15].Liquefied petroleum gas- (LPG-) exposed workers ofGaza governorates were found to have significantly highervalues of RBC, hemoglobin, HCT, MCH, MCHC, andplateletsthancomparisongroupwhilethemeanWBCscountwas significantly lower. This study showed a significant effectof LPG exposure on the haematological parameters of LPGworkers compared to comparison group [16].This shows that mean values of haemoglobin %, RBC count and TLC were significantly decreased in the test group when compared with the control group. The results obtained were statistically significant, p-value being less than 0.05 in case of Red and White cell counts and less than 0.01 in case of haemoglobin values [17]. Decrease in haemoglobin content could be due to decrease in red blood cells or impaired biosynthesis of heme in bone marrow Decreased haemoglobin and red blood cell could also be attributed to insufficiency of protein synthesis that mainly induces decrease of essential amino acids and shortage of the energy source of protein synthesis incorporated in haemoglobin production. The decrease in red blood cell count wasobserved in the exposed population [17].Another study done in Nigeria on fuel attendants showed similar results, with a global reduction in the mean values of total leucocyte count, red blood cell count, Packed Cell Volume and other red blood cell indices in exposed individuals [18]. Naza and Ali (2012) designed a study to evaluate the expected toxic effects of long-term exposure to petrol

products in 48 gasoline filling workers with an age rangebetween 27 to 65 years within Sulaimani city area and found significant differences in means of haemoglobin level on most workers.[19].Similarly, the impact of occupational hazards on erythrocyte and haemoglobin levels and menstrual cycle characteristics in women exposed to aromatic hydrocarbons was studied by Georgieya *et al*. (1998) and found that the mean RBC counts and Haemoglobin levels of the subjects exposed to benzene were statistically significantly lower than those of the control group and the difference was mainly due to the direct influence of aromatic hydrocarbons in the working environment on hematopoiesis.[20]

In a study conducted in Elobid city, Sudan, among Petrol Station workers It was found no significant difference between mean values of the hemoglobin, red blood cell count, White blood cell count and platelets count among exposure workers to benzeneIn conclusions, those exposed to benzene may develop bone marrow depression, as evidenced by drop in reticulocytes, HCT and red cell indices in all workers WBC and platelets count were not sensitive indicators of benzene-induced hematotoxicity. Also this study leads us to conclude that the hematological indices may be useful in detection early hematological changes among workers exposed to benzene. [21].

The haematological findings showed a significant increase ($p \leq 0.05$) in the white blood cells and decrease ($p \leq 0.05$) in lymphocytes of the tanker driver compared with the controls. These observations may reveal ongoing infection which could have led to skin rashes and infection experienced by the tanker drivers as a result of altered immunity.[22]

Although mean values were still within parametric reference ranges, some variations were observedin the oil workers when compared to the controls: while granulocytes consistently decreased significantly ($P<0.01$),consistent significant increases in lymphocytes ($P<0.01$) and ESR ($P<0.05$) were observed, indicating a possibility offunctional aberration following haematopoietic toxicity in the oil workers. Findings suggest petroleum refining anddistribution industrial environments as being furnished with potentially haematotoxic substances, andhaematopoietic toxicity as part of potential health effects of exposures in this industry in Nigeria. Though genderclassification showed no appreciable impact, age grouping suggests that the health effects indicated by theobserved variations are likely to rear up from age 40 yr. Changes observed for exposure groupings and statisticallysignificant correlations between age, exposure (service) period and most of the parameters suggest that both ageand exposure period have strong impacts in defining the patterns of variations observed in the haematologicalindices among the oil workers. Findings indicate a need for frequent environmental and biological monitoring for asafer and healthier workplace and workforce respectively.

Therefore there is need to periodically evaluate the individuals at risk and prevent further damage either by changing the work type if possible, or provision of protective gear like specialized gowns to protect from transdermal absorption, and gas masks for effective prevention against inhalation the petroleum fumes.

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