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Original Research Article

Deleterious Effects of Petrol Fumes on Erythrocytes

Deepa Sanjeev Nair[1], Madhura Yogesh Bedekar[2], Meena Jitendra Agrawal[3]

[1]Associate Professor, [2]Asst. Professor, [3]Professor,
Department of Physiology, MIMER Medical College, Talegaon (D), Pune, India.

Corresponding Author: Deepa Sanjeev Nair

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ABSTRACT

Background: Petrol or gasoline is the most commonly used transport fuels. Volatile nature of petrol products make them readily available in the atmosphere any time it is dispersed especially at petrol filling stations. Studies conducted in the animals and human beings suggested that long term exposure to petrol has a deleterious effect on blood cells. The present study is an attempt to establish the deleterious effect of long term exposure to petrol fumes on hemoglobin as well as erythrocytes.
Methods: The study was conducted in petrol pump attendants in Pune, India. Our test group consisted of apparently healthy adult male aged 25-45 years working in the petrol pump for more than 5 years. The control group consisted of adult male aged 25-45 years with no history of exposure to petrol.5 ml of peripheral venous blood samples were collected. Parameters tested were hemoglobin content, R B C count, packed cell volume, Mean Corpuscular Volume and Mean Corpuscular Hemoglobin. Student's 't' test was used for statistical analysis. $p<0.001$ was considered as statistically significant.
Result: Our study showed a statistically significant reduction in the hemoglobin content, PCV and RBC count in the test group compared to control group where as MCV and MCH were significantly higher in the test group.
Conclusion: Observed reduction in the RBC count and PCV are due to toxic effect of components of petrol on hemopoietic cells in the bone marrow as well as increased hemolysis. Decrease in hemoglobin content could be attributed to shortened life span of RBC as well as impairment of heme synthesis and protein synthesis. Increase in MCV and MCH suggests macrocytic anemia in these subjects which could be due to toxic effect of benzene and other components of petrol on DNA function there by interfering with the replication of RBC.

Key words: Petrol pump attendants, Hemoglobin content, RBC count, Packed Cell volume, mean corpuscular Volume, Mean Corpuscular Hemoglobin.

INTRODUCTION

Petrol or gasoline is the most commonly used transport fuels. Petrol has been the main reason for the developments in car engine since last 100 years. With the modernization of world, the uses of petrol cars are also increasing in number. Petrol is a volatile liquid, used as a fuel in internal combustion engines, and is also used as a thinner and industrial solvent. [1] Petroleum consists of aliphatic and aromatic hydrocarbons as well as other organic compounds which include nitrogen, oxygen, and sulfur and trace amounts of metal such

as Iron, Nickel, and Copper & Vanadium. Kerosene and petrol are distilled from crude petroleum. These fractions of crude petroleum contain aliphatic and aromatic and a variety of other branched saturated and unsaturated hydrocarbons. [2] Volatile nature of petrol products make them readily available in the atmosphere any time it is dispersed especially at petrol filling stations. [3]

The International Agency for Research on Cancer (IARC) classifies gasoline vapors and exhaust fumes from gasoline fueled automobiles as potential human carcinogens. [4] Benzene, one of the components of petrol, is a well known carcinogen with relative hematotoxicity. [5] The hematotoxic effect of benzene has been reported to involve both bone marrow depression and leukemogenesis caused by damage to multiple classes of hematopoietic cells with a variety of function. [6] People with higher risk of exposure to petrol vapors include petrol pump attendants, drivers of gasoline trucks and refinery workers. Petrol workers are chronically exposed to petroleum derivatives primarily through inhalation of volatile fraction of petrol during vehicle refueling. Exposure during refueling and driving may affect general population also. The present study is an attempt to establish the possible deleterious effect of petrol fumes on erythrocytes.

AIM: To investigate the possible effect of long term exposure to petrol fumes on

1. Hemoglobin (Hb) content
2. RBC Count
3. Packed Cell Volume (PCV)
4. Blood indices

a. Mean Corpuscular Volume (MCV)
b. Mean Corpuscular (MCH)

MATERIALS AND METHODS

The study was carried out in a petrol pump in Pune. We selected 30 healthy adult male volunteers as test group who had been working in the petrol pump for more than 5 years.

Inclusion Criteria:

1. Adult male of age group 25-45 years
2. History of occupational exposure to petrol for more than 5 years

Exclusion Criteria:

1. Family history of malignancy
2. History of chronic smoking
3. Any systemic illness
4. Individuals on steroids, radiotherapy or chemotherapy
5. Any acute infection.

The control group consisted of adult male of the age group 25-45 years who didn't have the history of occupational exposure to petrol.

For the investigation 5ml of venous blood is collected from peripheral vein (median cubital vein) and immediately transferred to anticoagulant bottle.

The parameters tested were:

1. Hemoglobin content
2. RBC Count
3. Packed Cell Volume
4. MCV
5. MCH

Statistical Analysis: Student's t test is used to compare different parameters between test and control group. P value of < 0.001 was considered as statistically significant

RESULT

Our test group consisted of 30 adult apparently healthy male volunteers aged between 25-45 years with history of exposure to petrol fumes for more than 5 yrs. Control group consisted of adult male aged between 25-45years, but no history of exposure to petrol fumes.

Hemoglobin content

In the test group Hb content were 13.73 $\pm$1.10 (mean $\pm$ SD) where as in the control group it was 15.56$\pm$ 0.63 (mean $\pm$ SD). There was a statistically significant reduction in the Hb content in the test group.

T value was 7.89, d f = 58 (p< 0.001) [Table-1]

RBC Count: There was a statistically significant decrease of RBC Count in the test group compared to control group. In the test group RBC Count was 4.52± 0.58 and in the control group it was 5.53±0.34. Values are expressed in mean± SD. t value= 9.46, d f = 58 (p <0.001) **[Table-1]**

PCV: PCV also showed a statistically significant lower value in test group 42.69±3.86 (mean±SD) compared to control group 48± 1.55 (mean ± SD). t value was 7.46 and d f was 58. (p <0.001) **[Table-1]**

Table-1

Parameters	Study group (n = 30)		Control Group (n = 30)		Statistical significance
	Mean	SD	Mean	SD	
Hb	13.73	1.10	15.56	0.63	t = 7.89; d.f. = 58; p < 0.001, Sig
RBC	4.52	0.58	5.53	0.34	t = 9.46; d.f. = 58; p < 0.001, Sig
PCV	42.69	3.86	48.35	1.55	t = 7.46; d.f. = 58; p < 0.001, Sig

Student's 't' test is applied to test difference between study and control groups for different parameters.
Sig =the difference between study group and control group is statistically significant.

Table-2

Parameters	Study group (n=30)		Control Group (n=30)		Statistical Significance
MCV	95.57	6.85	86.32	2.82	t = 6.84; d.f. = 58; p < 0.001, Sig
MCH	30.73	2.59	30.78	0.78	t = 5.31; d.f. = 58; p < 0.001, Sig

Student's 't' test is applied to test difference between study and control groups for different parameters.
Sig =the difference between study group and control group is statistically significant.

MCV: MCV was significantly higher in the test group, that is 95.57+ 6.85 (mean + SD) where as in the control group it was 86.32 + 2.82 (mean + SD) {t= 6.84, d f = 58 p <0.001} **[Table-2]**

MCH: MCH showed a finding similar to MCV with a statistically significant higher value in test group compared to control group. In the test group it was 30.73± 2.59 and in the control group it was 30.78±0.78. Values are expressed in mean±SD. t value was 5.31 and d f 58, p < 0.001 [**Table-2]**

Test group showed a statistically significant lower value of Hb content, RBC count and PCV where as MCV and MCH were significantly higher in the test group compared to control group.

DISCUSSION

Petrol station workers are chronically exposed to petroleum derivatives primarily through inhalation of volatile fraction of petrol during vehicle re fuelling. Decreased in hemoglobin content and RBC count could be attributed to shortened life span of RBC as well as impairment of heme synthesis. Decreased hemoglobin could also be due to insufficient protein synthesis. [7] Ito SO and Udofia UA observed a decrease in PCV, RBC count and hemoglobin in rats exposed to petrol. [8] Metabolism of aliphatic and aromatic hydrocarbons which are the major components of petroleum and petroleum products result in generation of free radical species in various tissues. In RBC free radicals are known to alter erythrocyte membrane as well as other cell membrane as a consequence of oxidative stress. Observed reduction in the RBC count may be attributed to cytotoxic effect of compound present in the petrol. Oxidative stress induced by petroleum products could possibly have accounted for susceptibility of red cell membrane to oxidative attack giving way to hemolysis. [8] A decrease in RBC count can lead to decrease in PCV. In their

study in the rats exposed to petrol, Ito S A and Udofia UA also observed an increase in MCV and MCH. We also observed an increase in MCV and MCH in petrol pump attendants exposed to petrol for more than 5 years. They associated increase in MCV to the presence of large no. of reticulocytes in circulating blood than mature RBC. Reticulocytes are known to be larger than mature erythrocyte and present larger volume. [8] In their study, Bogadi- Sare A etal observed macroerythrocytosis on occupational exposure to benzene at a level below. [9] The macrocytosis associated with occupational exposure to benzene was also observed by Robert Schnatter A et al. [10]

Mean corpuscular volume (MCV) is the average volume of an RBC. [11] The term 'macrocytosis' refers to a blood condition in which RBCs are larger than normal. It is characterized by an increase in MCV. Macrocytosis with associated anemia includes nutritional deficiencies (Vitamin B12 & folate), drugs, primary bone marrow disorders (myelodysplasia and leukemia) & other chronic illness. A defect in DNA synthesis that interferes with cellular proliferation and maturation can lead to large` erythrocytes. [12] The increase in MCV in our study can be due to macrocytosis induced by benzene because benzene is an ingredient of petrol. It has been established that toxic constituents of petroleum such as benzene and lead are activated in the bone marrow, where the substances exert cytotoxic effect that could be mediated through destruction in DNA function. [8]

The average amount of hemoglobin in an RBC is called mean corpuscular hemoglobin (MCH). [11] In megaloblastic anemia, which is characterized by macrocytes in peripheral blood, along with increased MCV, increased MCH is also seen. [13] Here increased MCV and MCH give the clinical picture of macrocytic anemia which can be due to toxic effect of benzene on DNA function there by interfering with the replication of RBC.

CONCLUSION

Petrol, which is an important contributor for the developments in transportation, has got some deleterious effect on health. Petrol pump attendants are chronically exposed to petroleum derivatives primarily through inhalation of volatile fraction of petrol during vehicle refueling. Long term exposure to petrol can lead to some toxic effect on the hemoglobin synthesis. In addition to that toxic component of petrol can affect erythropoiesis, produce changes in the RBC membrane and make it susceptible to hemolysis, interferes with replication and thereby macrocytic anemia. In our study we were able to establish a correlation between long term exposures to petrol and a decrease in hemoglobin level, decrease in RBC count, decrease in PCV and macrocytic anemia.

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