



ASSESSMENT OF HAEMATOLOGICAL AND BIOCHEMICAL PARAMETERS IN PETROL PUMP WORKERS IN AMRITSAR, PUNJAB- A COMPARATIVE STUDY

Pathology

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ABSTRACT

Petrochemical workers are exposed to many noxious substances present in their work places. The most dangerous effects are due to benzene which is mostly found in petrochemical vapours. The study was carried out in the Pathology department, Govt Medical College, Amritsar. 100 Petrol pump workers from different areas of the city were included as study group and 50 individuals from various departments in Government Medical College, Amritsar, were included as control group. Whole blood samples of the subjects were taken and analysed for complete blood count, liver function tests and renal function tests. The results showed statistically significant increase in values of hematocrit, MCV, RDW, MPV, AST, ALT, ALP, GGT, Blood Urea, S. Creatinine, S. Uric Acid, Random blood sugar and statistically significant decrease in values of MCH, MCHC, Platelet count, TSP, DSP with increased duration of exposure and in comparison to controls. However, there is seen statistically significant increase in Hb, red blood cell count in initial years of exposure with subsequent decrease in their value after increased duration of exposure. There is seen neutropenia and lymphocytosis with PBF examination showing macrocytic RBC picture with no significant difference in values of TLC, mid cell counts, PDW, PCT, S. Bilirubin (total and direct), S. Na⁺, PT, PTI with increased duration of exposure. The results of above parameters indicates that exposure to gasoline compounds over a long period of time may be the causative factor of hematotoxicity, hepatotoxicity and nephrotoxicity.

KEYWORDS

Petrol station workers, benzene, blood tests

INTRODUCTION

Gasoline stations filling attendants spend a full work-day exposed to gasoline vapours from different sources, including losses from underground tanks, displacement vapor, losses from filler pipes during refuelling, fuel spillage, and evaporative and exhaust pipe emissions from motor vehicles.¹ Gasoline is a volatile liquid with a complex mixture of aliphatic and aromatic hydrocarbons along with additives, including short-chain organic compounds, light chain volatile compounds, and heavy-chain hydrocarbons. Gasoline is commonly used as fuel for internal combustion engines.² Benzene is used as additive in petrol to increase the octane rating and to reduce engine knocking. As a consequence, petrol often contains several percentages of benzene. As petrol is evaporated during refilling, atmosphere of petrol filling station contains more benzene than any other place.³ Some of the constituents of gasoline are known to be highly toxic or carcinogenic to humans with many of the toxicological effects on exposure to gasoline attributed to specific components of gasoline, such as benzene, toluene, ethylene and xylene (BTEX), which are also known as volatile organic compounds (VOCs). They constitute the volatile fractions of gasoline that are gradually released into the air and may exist in both the vapor phase and the water-soluble fraction, due to their high vapor pressure and water solubility.⁴ Benzene has been recognized as a carcinogen primarily affecting the hematopoietic system. The effects of systemic benzene exposure can cause acute and chronic clinical disorders, of the cardiovascular, respiratory, neurological, gastrointestinal, liver, renal, immunological, metabolic and allergic reactions. Chronic exposure to benzene is believed to be associated with many of bone marrow failure and haematological malignancies.⁵

OBJECTIVES

- To study the impact of petroleum products in the study group.
- To evaluate the haematological and biochemical parameters of petrol pump workers in comparison to individuals working in various departments of Government Medical College, Amritsar.

MATERIAL AND METHODS

The study was carried out in the Pathology department of Govt Medical College, Amritsar. 100 Petrol pump workers from different areas of the city were included as study group and 50 individuals working in various departments in Government Medical College, Amritsar, comparable to petrol station attendants in most of the variables except for the risk of exposure to petroleum products were included as control group. Demographic data, including age, working time (hours/day) of petrol pump workers was recorded and job duration was divided into three groups <1 years, 1-5 years, >5 years. After approval from Institutional Ethical Committee, written and informed consent was taken. The consenting petrol pump workers and department workers were included in the study whereas subjects having chronic illnesses and metabolic disorders of liver, kidney and respiratory system were excluded from the study. EDTA containing blood samples were analysed by fully automated haematology analyser of Trans Asia Biomedical Limited H360 for estimation of complete blood counts. Liver function tests and kidney function tests were done by fully automated biochemistry analyser Trans Asia ERBA EM360. Easylyte Plus Na/K/Cl analyzer was used for estimation of Serum Na⁺, Serum K⁺. Estimation of Prothrombin Time was done manually. Random blood sugar was done by glucometer. Data was entered into Microsoft excel sheet and statistical analysis were performed using SPSS (Statistical Packages for Social Sciences, version 21.0. Armonk, NY: IBM corp.). The P value <0.05 was considered significant.

RESULTS

Table 1: Significant Haematological Parameters Of Petrol Pump Workers In Comparison To Controls

Haemoglobin (g/dl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	13.98	0.72	13.96	0.97	-0.39	0.42	0.941
1-5 years	14.69	0.93			0.30	1.14	0.001
>5 years	11.36	2.62			-3.41	-1.80	0.000
Neutrophil Percentage							
Duration	Cases		Controls		95% CI		p-value

	Mean	SD	Mean	SD	Lower	Upper	
<1 year	67.64	6.03	68.47	4.43	-3.17	1.50	0.479
1-5 years	66.98	6.15			-3.77	0.79	0.197
>5 years	63.91	8.47			-7.37	-1.76	0.002
Lymphocyte Percentage							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	25.57	5.30	25.29	4.00	-1.798	2.362	0.788
1-5 years	26.20	5.38			-1.11	2.94	0.373
>5 years	29.27	6.26			1.77	6.20	0.001
Red Blood Cell Count (106/ μ l)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	4.64	0.57	4.63	0.65	-0.27	0.29	0.933
1-5 years	5.30	0.53			0.41	0.94	0.000
>5 years	4.09	1.10			-0.92	-0.16	0.006
Mean Corpuscular Volume (MCV) (fl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	89.67	6.31	88.14	5.00	-1.01	4.06	0.235
1-5 years	95.67	7.35			4.87	10.19	0.000
>5 years	97.70	9.99			6.29	12.83	0.000
Platelet Count (103/ μ l)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	204.27	36.71	220.02	49.09	-36.39	4.89	0.133
1-5 years	169.49	33.68			-69.59	-31.49	0.000
>5 years	184.80	79.55			-63.00	-7.45	0.014

Table 2: Significant Biochemical Parameters Of Petrol Pump Workers In Comparison To Controls

Random Blood Sugar (RBS) (mg/dl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	109.76	13.09	101.04	9.60	3.65	13.79	0.001
1-5 years	110.14	14.03			4.01	14.20	0.001
>5 years	115.43	15.78			8.91	19.87	0.000
Aspartate Aminotransferase (AST) (U/L)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	31.13	8.22	30.94	7.63	-3.42	3.80	0.915
1-5 years	30.89	7.78			-3.43	3.32	0.975
>5 years	58.51	29.60			18.88	36.27	0.000
Alanine Aminotransferase (ALT) (U/L)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	30.30	11.11	29.84	9.39	-4.17	5.09	0.844
1-5 years	30.03	10.21			-4.08	4.45	0.930
>5 years	62.46	37.81			21.55	43.69	0.000
Alkaline Phosphatase (ALP) (U/L)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	80.27	29.19	83.86	20.07	-14.57	7.38	0.516
1-5 years	82.20	28.12			-12.05	8.73	0.751
>5 years	126.83	44.27			28.83	57.11	0.000
Total Serum Protein (TSP) (g/dl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	7.33	0.65	7.20	0.68	-0.17	0.44	0.387
1-5 years	7.32	0.63			-0.16	0.41	0.395
>5 years	6.43	1.34			-1.20	-0.33	0.001
B. Urea (mg/dl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	26.10	5.62	25.14	5.56	-1.61	3.53	0.459
1-5 years	26.69	5.42			-0.87	3.96	0.206
>5 years	33.09	10.31			4.50	11.39	0.000
S. Creatinine (mg/dl)							
Duration	Cases		Controls		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
<1 year	0.75	0.17	0.70	0.15	-0.02	0.13	0.130
1-5 years	0.75	0.18			-0.01	0.13	0.110

>5 years	0.95	0.37			0.13	0.36	0.000
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DISCUSSION

Gasoline is a complex mixture of aliphatic and aromatic hydrocarbons consisting of benzene, toluene, ethylbenzene, xylene, considered among the most harmful compounds for human health.¹² Fuel filling station attendants are exposed to hydrocarbons in fuel vapours during dispensing fuel and to the gases from vehicular exhaust. Benzene could be considered to be the most hazardous.¹³ The blood, liver, and kidneys are the major organs affected by gasoline compounds. Studies have shown that in gasoline-exposed individuals, bilirubin, alanine aminotransferase, aspartate aminotransferase, blood urea, and serum creatinine were significantly increased relative to unexposed individuals.^{9,28}

Haematological Parameters

- In our study, that there was statistically significant increase in hemoglobin during 1- 5 years duration of exposure, however it decreases with duration of exposure > 5 years, in comparison with controls. These findings are in accordance with the study conducted by Mahapatra et al²¹, Deepali Joshi et al²⁵, Jabbar et al²⁷. However, studies by Firouzkouhi et al⁹, Mohammad Alses et al²⁹ showed statistically significant increase in haemoglobin in comparison to controls.
- No statistically significant difference was seen in total leucocyte count with increasing duration of exposure, in comparison with controls. This finding is in accordance with studies conducted by Nida Qafisheh et al³⁰, Sirwan M Mohammad¹⁰. However, study by M. Lavanya et al¹⁹ showed statistically significant decrease, while study by Awodele et al⁶ showed statistically significant increase in total leucocyte counts as compared to controls.
- Statistically significant neutropenia and lymphocytosis was seen with increasing duration of exposure, in comparison with controls. The findings are in accordance with study of Abozer Y Elderderly et al¹⁰
- No statistically significant difference was seen in mid cell count (basophils, eosinophils, monocytes) values with increasing duration of exposure, in comparison with controls. This finding was not in accordance with the finding by Mahapatra et al²¹ showing statistically significant decrease in eosinophil count with increased duration of exposure.
- Statistically significant increase was seen in red blood cell count during 1- 5 years duration of exposure, however it decreases with duration of exposure > 5 years, in comparison with controls. This is in accordance with studies by Gebre Teklu et al²⁴, Deepali Joshi et al²⁵, Jabbar et al²⁷. However, studies by Firouzkouhi et al⁹, Hardik A Mistry et al¹⁷ showed statistically significant increase, while studies by Shilpi et al²⁰, Al Jothery et al²³ showed no significant difference between petrol pump workers and controls.
- Statistically significant increase was seen in haematocrit during 1- 5 years duration of exposure, in comparison with controls. The finding is in accordance with the studies conducted by Firouzkouhi et al⁹, Sisay Getu et al²⁶ and Hardik A. Mistry et al¹⁷. However, studies by Hala Samir El-wafa et al¹³ and Nair et al¹⁴ showed decrease in haematocrit values, while studies by Mohammad Alses et al²⁹ and Sirwan M Mohammed¹⁰ showed no significant difference in haematocrit in comparison to controls.
- Statistically significant increase was seen in mean corpuscular volume (MCV) with increasing duration of exposure, in comparison with controls. The finding is in accordance with studies by Gebre Teklu et al²⁴ and Nair et al¹⁴. However, studies by Sisay Getu et al²⁶ and Jabbar et al²⁷ showed statistically decrement in MCV values, while Mohammad Alses et al²⁹ and Deepali Joshi et al²⁵ in their studies showed no significant change in MCV between exposed group and non exposed group.
- Statistically significant decrease was seen in mean corpuscular hemoglobin (MCH) with increasing duration of exposure, in comparison with controls. The finding is in accordance with study by Ajugwo et al¹¹. However, the study by Nair et al¹⁴ showed statistically significant increase, while study by Sirwan M Mohammed¹⁰ showed no significant change in values of MCH among exposed and non exposed group.
- Statistically significant decrease was seen in mean corpuscular hemoglobin concentration (MCHC) with increasing duration of exposure, in comparison with controls. The finding is in accordance with studies by Deepali Joshi et al²⁵ and Jabbar et al²⁷, while study by Firouzkouhi et al⁹ showed statistically significant increase in MCHC, the study by Sirwan M Mohammed¹⁰ showed no significant difference in values of

MCHC among exposed and non exposed group.

- Statistically significant increase was seen in red cell distribution width (RDW) with increasing duration of exposure, in comparison with controls. The finding is in accordance with the study conducted by Sisay Getu et al26. However, Al Jothery et al23, in their study found no significant difference in RDW in comparison to controls.
- Statistically significant decrease was seen in platelet count with increasing duration of exposure, in comparison with controls. The finding is in accordance with studies by Gebre Teklu et al24 and Deepali Joshi et al25. However, Sisay Getu et al26 in their study found statistically significant increase, while studies by M. Lavanya et al19 and Mahapatra et al21 found no statistically significant difference in platelet count in comparison to controls.
- Statistically significant increase was seen in mean platelet volume (MPV) with increasing duration of exposure, in comparison with controls. The finding is in accordance with study by Al Jothery et al23. However, study by Gebre Teklu et al24 found statistically significant decrease, while study by Sirwan M Mohammed10 found no significant difference in MPV in comparison to controls.
- No statistically significant difference was seen in platelet distribution width (PDW), plateletcrit (PCT) with significant increase seen in platelet large cell ratio (P-LCR) with increasing duration of exposure, in comparison with controls. The platelet indices (PDW, PCT, PLCR) were not described in the literature we reviewed.
- Peripheral blood film examination showed normocytic normochromic RBC picture with presence of macrocytes in increasing duration of exposure in comparison with controls. The findings are in accordance with study by Gebre Teklu et al24. However, study by Abozer Y Alderdery et al10 showed half of participants having microcytic picture on peripheral blood film examination.

Biochemical Parameters

- In our study, we found that there was statistically significant increase in random blood sugar with increasing duration of exposure, in comparison with controls. The parameter has not been described in the literature we reviewed.
- No statistically significant difference was seen in serum bilirubin (total and direct) with increasing duration of exposure, in comparison with controls. These findings are not in accordance with study by Masoud Neghab et al18, showing significant increase of serum bilirubin in comparison to controls.
- Statistically significant increase was seen in aspartate aminotransferase (AST) and alanine aminotransferase (ALT) with increasing duration of exposure, in comparison with controls. The findings are in accordance with studies by Marwa Elnabi et al28, Rahul et al12 and Ogunneye et al7. However, studies by Mohammad Alses et al29 and Sirwan M Mohammed10 showed no significant change in AST, ALT in between exposed and non exposed groups.
- Statistically significant increase was seen in alkaline phosphatase (ALP) with increasing duration of exposure, in comparison with controls. The finding is in accordance with studies done by Awodele et6 and Ogunneye et al7. However, studies by Abdelrahman Mohammed16 and Zahra Zamanian22 showed no significant change in ALP values.
- Statistically significant decrease was seen in total and differential serum proteins (TSP, DSP) with increasing duration of exposure, in comparison with controls. The findings are in accordance with studies conducted by Marwa Elnabi et al28 and Masoud Neghab et al18 and Hala Samir El-wafa et al13.
- Statistically significant increase was seen in gamma glutamyl transferase (GGT) with increasing duration of exposure, in comparison with controls. The finding is not in accordance with study by Abdelrahman Mohamed16 showing no change in gamma glutamyl transferase value.
- Statistically significant increase was seen in blood urea and serum creatinine with increasing duration of exposure, in comparison with controls. The findings are in accordance with the studies by Akram H Awadalla et al15, Masoud Neghab et al18, Ogunneye et al7 and Festus O.O et al8.
- No statistically significant difference was seen in serum sodium levels but there is seen statistically significant decrease in serum potassium levels with increasing duration of exposure, in comparison with controls. The findings are not in accordance with the studies by Festus O.O et al8 showing increase in serum

potassium and decrease in serum sodium and the study by Akram H Awadalla et al15 showing increased serum sodium levels.

- Statistically significant increase was seen in uric acid with increasing duration of exposure, in comparison with controls. The finding is in accordance with studies by Hala Samir El-wafa et al13, Akram H Awadalla et al15.
- No statistically significant difference was seen in prothrombin time (PT) and prothrombin time index (PTI) with increasing duration of exposure, in comparison with controls. The parameters were not described in the literature we reviewed.

CONCLUSION

In conclusion, the present study has shown that occupational exposure to gasoline products at petrol pumps have a significant effect on haematological, hepatic and renal parameters. This study has inferred that long term exposure to gasoline vapours might have deleterious effects on hematopoietic system leading to bone marrow depression as observed with significant reduction in RBC count, Hb concentration and platelet count. The exposure also has deleterious effect on liver and kidney functions as observed with derangements in liver enzymes and urea, creatinine levels. Although the findings of the current study are not clinically significant, they indicate significant change in various parameters that requires assessment of the impact of prolonged exposure to gasoline vapours in high risk populations like petrol pump attendants. The petrol pump workers should be subjected to periodic medical examination and blood tests to identify changes that could be attributed to gasoline exposure and protected from exposure to benzene by providing personal protective equipment, such as masks and goggles and also implementing various measures at petrol pumps to minimize the vaporization of fuel into the atmosphere.

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