Original Article

Hematological assessment of gasoline exposure among petrol filling workers in Baghdad

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Summary:

Background: Petrol station attendants are workers chronically exposed to petroleum derivatives primarily through inhalation of the volatile fraction of petrol during vehicle refueling.The adverse health effects of gasoline exposure may be primarily related to impairment of the haemopoietic system with bone marrow depression.

Objective: The evaluation of hematopoietic changes among petrol filling workers

Methods: a cross sectional survey was carried out with 292individuals, 146 petrol filling workers who spent their working hours in the stations of petrol filling in Baghdad city-group (1) and 146 individuals from people who already work in station as overseers - group (2), were investigated for the effect of gasoline polluted air which arise from inhalation or absorption of benzene through skin

Result: Of examined 292individuals, 146 petrol filling workers (all of them) were found with hematopoietic changes. out of 6 potential risk factors, only one (smoking habit)found to be significantly associated with the presence of white blood cell changes($p<0.05$) as compared with petrol filling workers who had no such risk factors. Of examined 146 comparison group,40(27.37%) were found with hematopoietic changes (only white blood cell changes and haemoglobulin level) as compared with individual who had no such risk factor(smoking habit).

Conclusion: Although no cases of blood disorders were detected but blood involvement in petrol stations workers is still possible and should be given full attention in medical surveillance of workers.

Keyword: petrol filling workers, gasoline exposure, hematological changes.

Introduction:

Benzene (C_6H_6) is the prototypical aromatic hydrocarbon. It is a clear, colorless, noncorrosive, volatile, highly flammable liquid with a strong and rather pleasant odor. Its low boiling point and high vapor pressure cause rapid evaporation under ordinary atmospheric conditions (1). The resulting vapors are nearly three times heavier than air. An estimated 272,000 American workers, including 143,000 women, face potential occupational exposure to benzene (2). Benzene is used widely as a solvent in the chemical and pharmaceutical industries, as a starting material and intermediate in the synthesis of numerous organic compounds, and as a constituent of gasoline (2). In 2002, production of benzene in the United States was 7.2 million metric tons, up from 5.4 metric tons a decade earlier (2). Likewise, exposure to benzene is elevated in people who spend significant time driving in heavy traffic (2). Benzene has been identified in at least 1,001 of the 1,662 hazardous waste sites in the United States that have been proposed for inclusion on the U.S. Environmental Protection Agency's (EPA) National Priorities List (2). Benzene is a constituent of both inhaled and environmental tobacco smoke. Inhalation of vapor is the principal route of exposure to benzene (2). Benzene is a proven cause of aplastic anemia, leukemia, lymphoma, and the myelodysplastic syndrome (MDS) (2). Global demand for benzene is strong (33.6 million metric tons in 2002) and growing (6.7%) increase per year) (3).Occupational exposure to benzene occurs in the chemical, printing, rubber, paint, and petroleum industries (4). Particularly heavy exposure occurs in maintenance; clean up, product sampling, and petroleum bulk transfer operations. Data from developing countries suggest that occupational exposures in those nations are widespread, especially in artisan work, shoe manufacture, small chemical industries, and work involving children (5, 6). Exposure to benzene in the general, non workplace environment is extensive. Benzene constitutes approximately 1% of gasoline by weight in the United States and Western Europe and more in other nations (7, 8). Exposure is elevated in areas of heavy motor vehicle traffic and around gasoline filling stations. (7). Experimental studies indicate that approximately 50% of inhaled benzene is absorbed into the body (9). Benzene can be absorbed through the skin (9). Dermal absorption is substantially enhanced when the skin is cracked, blistered, or abraded. Ingested liquid benzene is rapidly absorbed through the gastrointestinal mucosa (3). Exposure to benzene vapors is classified by the International Agency for Research on Cancer (IARC) (Jan., 2008) as possibly carcinogenic to humans, mainly on the basis of the well-established carcinogenicity of some components such as benzene (10). This classification depend upon evaluation over 900 agent according to the following criteria :- group 1 (carcinogen to human),group 2A (probably carcinogen to human),group 2B(possibly carcinogen to human involve exposure to gasoline), group 3(Not

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classifiable), group 4 (probably not carcinogen to human)**.** The association between exposure to benzene or benzene-containing mixtures and certain types of blood disorders has been shown in epidemiological studies in different countries (11, 12). Benzene, an important component of petrol, is a widely distributed environmental contaminant. Today, about 98% of the benzene is derived from the petrochemical and petroleum refining industries. Therefore, occupational exposure to benzene in humans generally takes place in factories, refineries and other industrial settings. Moreover, the general population is exposed to benzene contained in petrol, vehicle exhaust, and diesel fuel and cigarette smoke (13). Occupational exposure to benzene has mainly been associated with increased incidences of blood disorders such as chronic myeloid and acute lymphoid leukemia and non-Hodgkin's lymphomas (14).

Materials and methods:

Setting: petrol filling stations in nine different areas in Baghdad city. Study design and sampling procedure: the research approach adopted cross sectional study and laboratory assessment was carried out by researchers in Al Amen Primary Health Center in Baghdad the interview was carried out for 2 working hours\day and for 2 days\week, for the period from May2009to April 2010. , a total sample of 292 individual between age20-55 years , 146 petrol filling workers and 146 individuals from people who already work in these stations as overseers , were included in the study and interviewed to collect information . The laboratory tests included a hemoglobin level, RBC count and WBC count. Their age ranged between 25-55 years (mean40 ±15) for petrol filling workers and 20-50(mean40± 10) for comparison group. Alcohol drinkers considered in this study were those who drank more than 40 gram alcohol \day, while cigarette smokers were those smoked more than 10 cigarettes\day and more than 10 years. Specimens of blood were obtained by researchers by vein puncture using heparinized disposable syringes. Normal white cell count($4.0\text{-}11.0\times10^{9}$), normal red blood cell count for male($4.5\text{-}6.5\times10^{12}$) and normal red blood cell count for female($3.8\text{-}5.8\times10^{12}$)[15] **.** The purpose of the study is to calculate the prevalence of hematopoietic changes related to gasoline exposure, and to see whether complete blood counts could be used as monitors for early detection of gasoline blood disorders among the workers exposed to gasoline and to compare them to group not exposed to gasoline vapors as based on data gathered by interview, blood counts (white blood cells ,haemoglobulin level and red blood cells) . The study also considered certain factors, which are known to have an effect on the parameters of benzene absorption as cigarette smoking and alcohol consumption. Frequencies of white blood cells, haemoglobulin level and red blood cells abnormalities were compared in both smokers and non-smokers in order to examine the possible effects of smoking. Regarding ethical issues all participants supplied sufficient accurate information about the aim of research to enable them to participate in the study with interests and acceptance.

inclusion criteria include :- workers and overseers male of petrol filling station. and residency of them had lived in Baghdad city for at least five years also none of the 292 subjects included in this study had known exposure in any industry directly involved with gasoline as well as duration of employment for each individual not less than 5 years. Exclusion criteria for selection of cases includes: Some workers who were not cooperated to the interview and The laboratory tests.

Construction of questionnaire form: An English language questionnaire form was prepared by researchers, translated to Arabic. the information was obtained by direct interview with workers after taking their consent. The questionnaire form contain information as follow:

-Demographic characteristics of workers includes : (age, smoking status, drinking status, type of work , duration of employment, previous job and duration of residency in Baghdad city).

Pilot study:Before starting to collect information, a pilot study was carried out for two weeks to find out what difficulties were likely to be met. the pilot study done in different areas in Baghdad city for two weeks in march 2009 aims at:

a-Testing the reliability of questionnaire form to reveal any modifications needed.

b-estimate the time needed to collect the required data. The pilot sample consisted of 100 workers and were excluded from the study sample. On average, the interview took about 10 minutes to be completed.

Statistical analysis (minitab version 13) ,was done by using:

1-Descriptive statistic: tables (frequency and percentage)

2-Inferential statistic: t-test, Chi-square were used to test the statistical differences between group means.

Analysis of variance (ANOVA) was used for multiple group comparisons. **P**-value of less than or equal to 0.05 was considered statistically significant.

Result: - Of the examined 292 individual 146(all of them) out door petrol filling workers were found with mean hemoglobin level was less than that of comparison group. It was highly significant statistically ($p<0.0001$) and mean White blood cell count also was lower than that of comparison group. It was highly significant statistically ($p<0.0001$) and also there was significant difference between mean values of red blood cell count for petrol filling workers and comparison group ($p<0.01$) (table1).There was no significant difference between mean values of the mean hemoglobin, red blood cell count and White blood cell count for outdoors petrol filling workers from different areas of Baghdad city ($p>0.05$)(table 2). In outdoor petrol filling workers, no significant difference of Hb level and R.B.C. count between smokers and non smokers ($p >0.05$) while W.B.C. count showed highly significant difference($P<0.0001$)(table4).In comparison Group, the smokers showed highly significant differences in means of Hb level and white blood cell count than non smokers ($p<0.0002$, $p<0.005$) while red blood cell count showed no significant difference between smokers and non smokers of comparison group. (table4).

Table (1) shows Hb, RBC count, WBC count levels in petrol filling station workers and control subjects.

Groups(G)	Subject No.	hemoglobin g\dl	White blood cell count($\times 1o^9$)	Red blood cell count($\times 10^{12}$)
G1 petrol filling workers	146	12.5±1.5	5.5±1.7	4.3±1.9
G2 Comparison subjects.	146	13.8 ±0.3	6.4±1.0	4.7±0.3
Significant of t-test p-value		10.2686 0.0001	5.5137 0.0001	2.5127 0.0125

Table (2)measurements of Hb, RBC count ,WBC count levels in petrol filling station workers from different areas of Baghdad city.

areas	No.	Hb g\dl Mean ±SD	W.B.C.$\times 10^9$ Mean ±SD	R.B.C.$\times 10^{12}$ Mean ±SD
1	15	11.9± 1.7	5.5±0.3	3.95±0.1
2	16	13±1.2	5.65±0.1	4.2±0.2
3	13	13±1.1	5.55±0.1	4.35±0.1
4	20	12.8±1	5.35±0.2	2.9±0.6
5	12	12.2±1.4	5.50±0.3	3.95±0.1
6	16	12.4±1.9	5. 35± 0.1	3.9±0.2
7	18	13.1±0.5	5.20±0.2	4.2±0.3
8	19	12±2.4	5.55±0.1	4.25±0.1
9	17	12.1±2.3	5.85±0.3	4.1±0.2
Total	146	12.5±1.5	5.5±1.7	4.3±1.9
p-value = 0.245 0.371 0.751				

Table(3)measurements of Hb, RBC count ,WBC count levels in cigarette smokers and non smokers petrol filling workers.

Petrol filling workers	number	Hb\dl blood Mean ±SD	W.B.C. count$\times 10^9$ Mean ±SD	R.B.C$\times 10^{12}$ Mean ±SD
smokers	66	13±1	5.3±0.4	4.2±1.2
Non smokers	80	12.9±0.6	5.8±0.1	4.3±0.9
Significant t-test		0.7465	10.7864	0.5749
p-value		0.4566	0.0001	0.5663

Table(4)measurements of Hb, RBC count ,WBC count levels in cigarette and non cigarette smokers among comparison group.

Comparison group	number	Hb \dl blood Mean ±SD	W.B.C. count$\times 10^9$ Mean ±SD	R.B..C$\times 10^{12}$ Mean ±SD
smokers	40	14.7 ±1	6.0 ±1.1	4.3±0.8
Non smokers	106	13.6±1.7	6.5±0.9	4.7±0.7
Significant t-test		3.8440	2.8117	0.0036
p- value		0.0002	0.0056	2.9592

Discussion:

The principal screening tool for clinical assessment of benzene toxicity is the complete blood count, including red blood cell count, hemoglobin, and red blood cell indices (16). By WHO criteria, anemia is defined as a hemoglobin concentration lower than 13 g/dL in men. (17)Clinicians have long believed that these hematologic markers were not sufficiently sensitive to detect toxic changes in workers whose exposures are within current exposure standards. However, a recent report from China found that white blood cell counts were significantly depressed in workers exposed to benzene at levels below 1 ppm (part per million, a unit to measure levels of benzene vapor in air and this level considered as exposure standard) compared with unexposed controls (18). This study also found evidence for individual variation in genetic susceptibility to benzene toxicity that may be due to a series of polymorphisms in genes that control cell adhesion as well as DNA stability and repair (19). In Iraq, no study similar to our study had been done before and the need for it has arisen by an increasing number of cars using gasoline.Changes in the mean values of Hb level, W.B.C count and R.B.C. count have been routinely used to detect minimal changes in hematopoietic system (20,) .The result of Hb level, W.B.C. and R.B.C. obtained from this study confirm that different level of Hb, W.B.C., and R.B.C. exist between petrol filling workers and comparison group in Baghdad city which could be attributed to the gasoline exposure at workplace , a result being in agreement with other reports (22). In this study we found no significant difference between mean values of the hemoglobin, red blood cell count and White blood cell count among outdoors petrol filling workers from different areas of Baghdad city this may be attributed to the same level of environmental pollution with benzene, which is inconsistent with other foreign study (23). Also our result showed cigarette smoking out door petrol filling workers had relatively no difference in Hb level and R.B.C.count than non smokers petrol filling workers while W.B.C. count showed significant difference which could be attributed to the agonist action of smoking with benzene exposure , a result being in agreement with the finding of other studies(24). This finding, significant difference in W.B.C. count, may be attributed to the fact that the cigarette smoking is the main source of exposure to benzene and estimates are 7900 µg of benzene in air per day equal to smoking 20 cigarettes per day (25).Group of control subjects of smokers and non smokers showed significant differences in means of Hg level and White blood cell count while red blood cell count Showed no significant differences. In other study, Duarte- Davidson et al. found significant association with differences in means of Hb level and White blood cell count (26). Our study showed high hemoglobin level in smokers than non smokers among comparison group, indicating an additive effect of smoking to produce change in hematopoietic system this is consistent with results of a population-based case-control study in Germany (27). In general, the finding of our study lead us to conclude that the hematological indices may be useful in detection early hematological changes among workers exposed to benzene vapor.

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