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Original Research Paper

A COMPARATIVE STUDY OF PULMONARY FUNCTION AND EOSINOPHIL COUNT IN PETROL PUMP WORKERS IN KAMRUP METRO DISTRICT IN RELATION TO CHRONIC INHALATION OF PETROLEUM DERIVATIVES

Physiology

KEYWORDS: Benzene, Eosinophil count, Petroleum derivatives, Pulmonary function test.

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ABSTRACT

Background: Workers in the petrol pump stations are chronically exposed to petroleum derivatives which has adverse effects on respiratory and haematopoetic system causing bone marrow depression. Aims & Objective: To study the Pulmonary function and Eosinophil count amongst petrol pump workers who are chronically exposed to the hazards of petrol derivatives and to compare with that of controls. Materials & Methods: This cross-sectional study was carried out on 50 healthy non-smoker male petrol pump workers in Kamrup district who were compared with healthy controls. Medspiror digital expirograph was used to measure PFT and Eosinophil count estimation was done using Haemocytometry. Results: The mean values of FVC, FEV1, FEF25-75% , PEFR and Eosinophil count were reduced significantly in the study group ($p<0.001$ & $p<0.05$). Conclusion: This study has suggested that chronic exposure to petroleum derivatives had toxic effects on respiratory and haematopoetic system causing decrease lung function and reduced cell count.

INTRODUCTION

Hazardous exposures in the workplace and elsewhere in the environment continue to contribute to the burden of lung diseases and haematological abnormalities. Most respiratory diseases, including asthma, chronic obstructive pulmonary disease (COPD), interstitial lung disease and lung cancer may be caused or exacerbated by factors in the workplace[14]. According to the International Labor Organization (ILO), between 1.9 and 2.3 million people are killed by their work every year (including 12,000 children) and 25 million people have workplace injuries, causing them to take time off[6].

The rapid urbanization in India has resulted in a tremendous increase in the number of motor vehicles[20]. In Kamrup metro district, number of motor vehicles registered increases from 9945 in the year 2009-10 to 11434 in 2010-11[10]. This has led to an increase in petrol pump stations and petrol pump workers and also exposure of petrol pump workers to vapours of petrol and gases from exhaust of automobiles[1].

Sources of petroleum vapours at the petrol pump include losses from underground tank, displacement vapour losses from filler pipes during refueling, fuel spillage and evaporative emission from motor vehicles.

Petrol is a complex combination of hydrocarbons. About 95% of the components in petrol vapour are aliphatic and acyclic compounds[13]. While diesel fuel is a distillate of petroleum which contains paraffin, alkenes and aromatics[8]. Benzene and toluene are major monocyclic hydrocarbons in petrol with nitropyrene in diesel exhaust emission[23]. Benzene is a highly volatile and the most usual route of exposure is through inhalation of vapour[16]. It is a gasoline additive and increases octane rating and reduces knocking. Benzene also is a toxic air pollutant and a known human carcinogen. It is a notorious cause of bone marrow failure. Substantial quantities of epidemiologic, clinical and laboratory data link benzene to aplastic anaemia, acute myeloid leukemia and bone marrow abnormalities. This can be extremely harmful in workers exposed to levels below the US permissible occupational exposure limit of 1 part per million[5].

A long term exposure to the petrol derived chemical air pollutants like benzenes, lead, CO_2, NO_2, CO etc. play a role in the pathogenesis of allergic reactions, respiratory problems like bronchoconstriction, mucosal irritation and alveolar swelling which leads to obstructive and restrictive patterns of lung disorders and haematological derangements [2,4,21].It has been reported that chronic exposure to benzene causes bone marrow depression thereby causing low cell count[11,12].

Hence the present study was undertaken to assess the extent of damage caused by the chronic inhalation of petrol fumes on the pulmonary and haematopoetic systems of petrol pump workers.

MATERIALS AND METHODS

This cross sectional study was carried out on 50 petrol pump workers who worked for more than 5 years in petrol filling stations across the Kamrup district (Study group) and 50 healthy individuals(Control group) from nearby areas who are not directly exposed to petroleum derivatives.

Inclusion criteria common to both the groups
1. Age group of 20-40 years.
2. Healthy nonsmoking male with no previous history of any major respiratory or other significant illness.
3. No anatomical deformity of chest or spine.

Exclusion criteria common to both the groups
1. Subjects with known respiratory diseases like bronchial asthma, bronchitis, pulmonary tuberculosis, emphysema etc.
2. Subjects with known cardiovascular diseases
3. Subjects with skeletal deformity of chest and thoracic vertebra
4. Subjects who are chronic smoker
5. Subjects where Pulmonary Function Test is contraindicated

Scheme of study : A proforma consisting of the necessary queries regarding the subject and the study concerned was given to each individual under the study to be filled up. Ethical clearance has been obtained from the authority and written informed consent was taken from the subjects. The study was conducted between 10AM – 4PM of the day due to heavy traffic during that period.

Recording of Lung Function was carried out by using an expirograph (Medspiror- Med systems Pvt. Ltd, Chandigarh, India). Parameters recorded are FVC, FEV_1, FEV_1/FVC%, $FEF_{25-75\%}$, PEFR.

Absolute Eosinophil Count was done by using haemocytometry (Direct Method) with Improved Neubauer's counting chamber.

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Statistical analysis: The data collected were presented as the Mean ± Standard Deviation for each of the parameter. The two groups were compared by using unpaired 't'test and p value of less than 0.05 is be considered significant.

RESULTS AND DISCUSSION

The results obtained were tabulated and means of the recorded parameters were calculated, which are presented in the tables.

TABLE 1: COMPARISON OF DIFFERENT PARAMETERS OF PFT BETWEEN STUDY AND CONTROL GROUP

PARAMETERS	SUBJECTS (MEAN±SD)	CONTROLS (MEAN±SD)	P-value
FVC(ltrs)	3.15±0.32	3.43±0.32	p<0.001,VHS
FEV_1(ltrs)	2.65±0.30	2.80±0.25	P<0.001,VHS
FEV_1/FVC(%)	84.39±7.90	82.05±6.45	p>0.05,NS
FEF_{25-75}(ltrs/s)	3.71±0.29	3.91±0.39	P<0.01,HS
PEFR(ltrs/m)	459.80±15.45	467.38±17.93	P<0.001,VHS

VHSVery Highly Significant; NSNon Significant; HSHighly Significant

TABLE 2: COMPARISON OF EOSINOPHIL COUNT BETWEEN THE TWO GROUPS

PARAMETER	STUDY GROUP (MEAN±SD)	CONTROL GROUP (MEAN±SD)	P-Value
AEC(/cumm)	238.33±60.62	262.50±52.81	P<0.05,Significant

Figure 1: Diagram showing Mean and SD values of FVC, FEV_1 and $FEF_{25-75\%}$

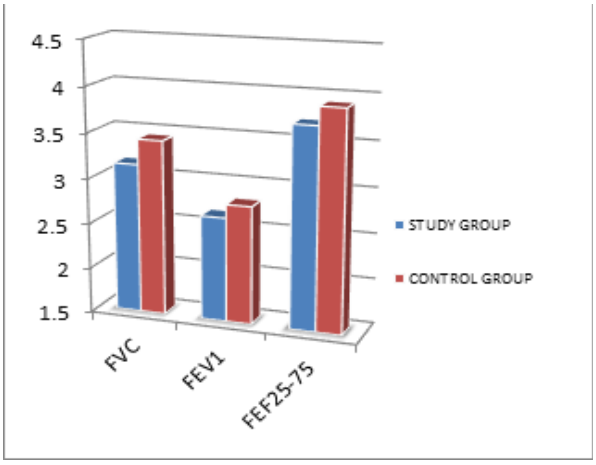

Figure 2:Diagram showing Mean and SD values of FEV1/FVC and PEFR

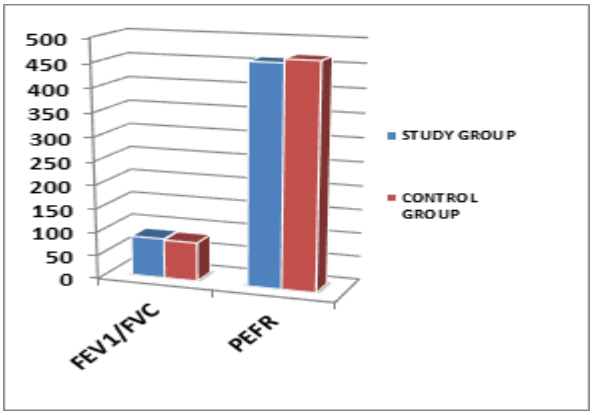

Figure 3:Diagram showing Mean and SD AEC

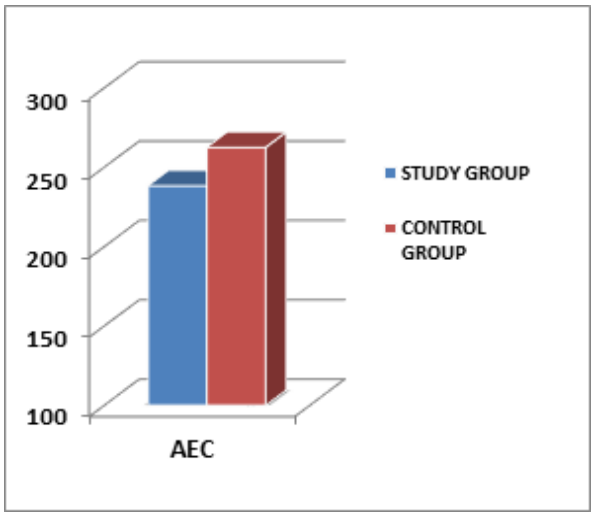

Table1 shows the Mean and SD values of FVC, FEV1, FEV1/FVC, FEF25-75% and PEFR between the Study and Control group in relation to chronic exposure. By applying Student's unpaired t-test we observed that Mean values of FVC, FEV1 and FEF25-75%, PEFR were significantly reduced (p<0.001) in Study Group (duration > 5 years) in comparison to Control group. No significant difference (p>0.05) were observed in mean values of FEV1/FVC between the two Groups.

Table 2 shows the values of AEC in both the groups where AEC is significantlylower(p<0.05)inStudygroup.

DISCUSSION

In the present study we found that all the lung volumes and Eosinophil count were decreased in petrol pump workers when compared to controlgroup.

The significant reduction of FVC and FEV1 in the study group as compared to the control group with no significant change in the ratio of FEV1/FVC between the study and control groups suggest restrictive patternoflunginvolvement.

On the other hand significant reduction of AEC in the petrol pump workerswithmorethan5yearsdurationcanbeattributedtothechronic exposure of benzene, which is used as an anti knocking agent in petrol, causesbonemarrowsuppressionandhaematotoxicity.

Theresultsofthisstudyareconsistentwiththeearlierstudiesrelatedto pulmonary function test and Eosinophil count with occupational exposuretopetrolderivatives.

RittikaSingh[19]in2013inherresearchpaper"Effectofpetrolanddiesel fumesonpulmonaryfunctionsinfuelpumpworkers"conductedastudy on 50 non-smoker petrol pump workers of Mangalore with duration of servicemorethan1yearand50agematchedhealthyindividual.Shealso found statistically significant reduction in the values of FVC (L), FEV1 (L),andFEF25-75%amongpetrolpumpworkersascomparedtocontrol and also exposure-wise denotes prevalence of restrictive type of lung diseases.

The lung functions of 133 subjects (33 controls and 100 petrol pump workers) were studied by Neena Sharma et al [15] (2012) in "Ventilatory impairment in petrol pump workers" . The study showed a significant decline in the values of FVC, FEV1, MVV among petrol filling workers when compared to controls. There was progressive decline in lung functionwithincreaseindurationofexposure.

ArpanaBhideet.al[3]in2014,foundintheirstudyofpulmonaryfunction onpetrolpumpworkers statistically significant decrease in the values

ofTV,FVC,FEV,FEF25-75%,FEF75-85%,FEV/FC,PEFandMVVinpetrol pump workers who have worked for more than 5 years when compared to control group. The result shows statistically significant decrease in value of TV, FVC, FEV1, FEF25-75% and MVV in petrol pump workers whohaveworkedforbelow5yearswhencomparedtoControlGroup.

Deepankar Singh, Syed Hasan et al[7] (2014) studied 54 petrol pump workers between the age of 20-60 years whom they divided into four groups depending on duration of exposure and found significant decrease(<0.05) in eosinophil count on petrol pump workers exposed to benzene more than 15 years. But there was initial rise in eosinophil count in the study group when the duration of exposure was less than 10 years. The count decreases as the duration of exposure increases. T. Tunsaringkarn et al[22] conducted a study in 2013 and reported that exposure to benzene causes bone marrow depression presenting as drop in haemoglobin, haematocrit and eosinophil counts and also reportedthatasthedurationofexposuretobenzeneisshort,eosinophil count increases and as the duration of exposure increases eosinophil count decreases, the lower of eosinophil count in those with duration of exposureareremoremayduetosuppressionofbenzeneonbonemarrow.

Petroleumhydrocarbonsledtoasignificantriseinlungtissuemalon-di-aldehyde (MDA) which increases lipid peroxidation and free radicals[17]. The antioxidant enzymes super oxide dismutase (SOD), catalase(CAT)andglutathioneperoxidase(GPx)serveasaprimaryline of defense in destroying the free radicals produced by oxidative stress. Studies have reported that exposure to petroleum hydrocarbons impairs type II pneumocytes resulting in a decreased production of surfactant and consequent alveolar collapse, ventilation-perfusion mismatch and hypoxemia. This ultimately leads to haemorrhagic alveolitis, interstitial inflammation, intra-alveolar haemorrhage, oedema, hyperemia, bronchovascular necrosis contributing early closure of small airways[9,18]. Benzene exposure was found to induce theexpressionofp21,aninterlockingcounterdeviceforcellcycle,dueto p53 up regulation, thereby inducing the immediate suppression of the kinetics of hemopoietic progenitors followed by the prominent suppressionofhemopoiesis[24].

CONCLUSION

Occupational environment plays a major role on the health of those exposed to pollutants. Petrol pump workers by virtue of their work are exposedtopetrolanddieselfumes,whichmayworsenlungfunctionand thehaemopoieticsystem.

In the present study the dynamic lung volumes and capacities like FVC, FEV1, PEFR, FEF25-75% were significantly lower in petrol pump workers compared to matched controls, but ratio of FEV1/FVC% was non-significant in petrol pump workers. These results point towards restrictive airway pathology probably affecting the smaller airways of petrol pump workers. The significant decline in AEC of petrol pump workers working more than 5 years duration can be attributed to the affectofbenzenewhichcausesbonemarrowsuppression.

Hence, the outcome of the present study would encourage further detailedstudieswithlargersamplesizetoevaluatethelongtermeffects ofpetrolderivativesondifferentsystemsofthebodythoseareexposedby virtueoftheiroccupation.

Control strategies like periodic health check up including screening of lungfunctionandbloodparameters,useofsuitablemask,removaloftheir sensitiveworkersfromtheworkplaceandtocreateawarenessamongst the petrol pump workers should be adopted to prevent long term morbidityarisingoutofworkplace.

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