DOI: 10.7860/JCDR/2015/15344.6711

Original Article

Physiology Section

Effect of Occupational Exposure on Blood Cell Counts, Electrocardiogram and Blood Pressure in Rice Mill Workers

PRAVEEN S. PATIL[1], MANJUNATHA AITHALA[2], KUSAL KANTI DAS[3]

ABSTRACT

Introduction: Under normal conditions, parasympathetic and sympathetic nervous systems interact to regulate the heart rate of about 70 beats per minute. Activation of sympathetic nervous system by emotional or physical stress increases heart rate and the force of heart beat. There are many factors which alter the heart rate. The chemical and mechanical stimulation of receptors can also cause change in blood pressure through autonomic nervous system. Exposure to dust also causes alteration in blood cell counts. This can be due to allergic reactions and inflammation which in turn evoked by dust entering the lungs.

Objectives: Aim of the study was to evaluate the effect of occupational exposure on haematological and cardiovascular parameters of rice mill workers by analysing Blood Cell Counts, ECG and Blood Pressure.

Materials and Methods: This cross-sectional study was carried on 134 rice mill workers and an equal number of age and sex matched healthy individual. The blood cell counts were determined by automated cell counter machine, ECG was recorded by using ECG machine and Blood Pressure was measured by using mercurial sphygmomanometer.

Results: Neurtrophil, Eosinophil and Lymphocyte count among haematological parameters were significantly increased in exposed individuals. Marked variation was seen in ECG and Blood pressure among cardiovascular parameters of exposed individuals compared with control group.

Conclusion: The findings of our study clearly indicate that the rice mill workers are under high level of dust exposure which has deleterious effects on their blood and tissues. It is due to high oxidative stress. There are abnormalities seen in cardiovascular system.

Keywords: Cardiovascular, ECG, Oxidative Stress

INTRODUCTION

Under normal conditions, parasympathetic and sympathetic nervous systems interact to regulate the heart rate of about 70 beats per minute. Activation of sympathetic nervous system by emotional or physical stress increases heart rate and the force of heart beat.

Abnormal rhythm of heart beat is called as arrhythmia. There are many factors which alter the heart rate. Clinically, the heart rate can be recorded by ECG machine. Brook RD [1] and Bhatnagar A [2] have proved that due to air pollution there is change in electrical activity and its regulation. Pope CA III et al., [3] and Brook RD [1] have also shown death can occur due to cardiopulmonary diseases which are consequences of increased levels of air pollution.

The chemical and mechanical stimulation of receptors can also cause change in blood pressure through autonomic nervous system. The studies were conducted to know the blood pressure changes in carpenters and non carpenters [4]. Similar studies were also carried out on sand stone mine workers [5]. These studies have shown statistically significant variation in blood pressure due to dust exposure.

There are evidences which show that exposure to dust causes alteration in blood cell counts. This can be due to allergic reactions and inflammation which in turn is evoked by dust entering the lungs. There are several studies which have been carried out to show the effect of exposure to cement dust on haematological parameters [6,7]. The exposure to dust and allergic reactions may also cause dermatitis and other hypersensitivity reactions.

MATERIALS AND METHODS

The study group comprised of rice mill workers of urban area in and around Raichur. Prior permission from owners of rice mills was sought. Consent was taken from rice mill workers.

A total of 134 rice dust exposed individuals were included in the study. The subjects who had been exposed to dust in rice mills more than 5 years were included in the study group where as another 134 unexposed individuals constituted control group. Both groups consisted of individuals who were matched with age and socio-economic status.

During collection of data, interviewer administered structured questionnaire was used. It helped to determine information in regard of duration of exposure, general health, disease history, details of habits like smoking and alcohol consumption.

For haematological parameters, 2ml of intravenous blood was drawn and collected in EDTA tubes and processed in CBC Counter Machine. For the determination of heart rate and electrical activity, ECG machine was used. Blood pressure was recorded by mercurial sphygmomanometer.

The anthropometric parameters of subjects were expressed as Mean±SEM. The haematological parameters, blood pressure and ECG recordings were also expressed as Mean ±SEM.

STATISTICAL ANALYSIS

The statistical analysis of the 2 groups was carried out by using unpaired t-test and differences among means were calculated at a level of $p<0.05$.

RESULTS

In [Table/Fig-1], the anthropometric parameters of the exposed and unexposed individuals were presented. There was no significant difference between exposed and unexposed individuals. Mean age of control is slightly higher than those of exposed individuals. Mean duration of exposure of rice mill workers is 9.8±0.6 years.

[Table/Fig-2] shows comparison of mean SEM of Haematological parameters of study and Control groups.

Neutrophil count (p<0.05) of Rice mill workers was significantly lower than the control, where as Lymphocyte (P<0.05) and Eosinophil (p<0.0001) counts were significantly higher in Rice mill workers as compared to control. There was no significant difference in Haemoglobin concentration, RBC count, TLC, PCV, MCV and MCHC of exposed and non exposed individuals.

[Table/Fig-3] Mean SEM of Blood Pressure and ECG parameters of Exposed and non exposed individuals were compared.

QRS wave (p<0.0001) and T wave (p<0.0001) amplitudes of Rice mill workers were significantly higher than control, where as T wave duration (p<0.05), PR interval (p<0.0001) and ST segment duration (p<0.05) of Rice mill workers were significantly longer than control. There was no significant difference between P wave amplitude, P wave duration, QRS duration and QT interval of Rice mill workers and control. Systolic blood pressure (p<0.05), diastolic blood pressure (P<0.05) and mean arterial blood pressure (P<0.05) of rice mill workers were significantly higher than control. There was no significant difference in heart rate and pulse pressure of rice mill workers.

DISCUSSION

Present work was carried out to show the effect of occupational exposure on blood cell counts, blood pressure and ECG parameters. We found a significant increase in Absolute Lymphocyte count (P<0.05) and Absolute Eosinophil Count (P<0.0001). Eosinophil count of exposed individuals was markedly increased. It indicates allergic response. This abnormal variation of Eosinophils and Lymphocytes can lead to chronic inflammation. Though, there was an abnormal variation in Differential Leucocyte Count, Total Leucocyte Count did not show any significant variation. It might be due to adaptation of body immune response for long term exposure to the irritant substances. This data shows that there is an

Parameters	Mean SEM of Exposed	Standard Deviation	Mean SEM of Controls	Standard Deviation	p-value
Age (years)	29.24 ± 0.5096	5.8991	32.81 ± 0.7521	8.7058	-
Height (cm)	165.0 ± 0.4145	4.7985	164.6 ± 0.5329	6.1684	-
Weight (kg)	59.21 ± 0.7582	8.7771	60.87 ± 0.5900	6.8302	-
BMI (kg/m^2)	21.75 ± 0.2608	3.0190	22.43 ± 0.1331	1.5407	-
Years of Exposure (years)	9.776 ± 0.5594	6.4756	-		-

[Table/Fig-1]: The anthropometric parameters of the exposed and unexposed individuals were presented

Parameters	Mean SEM of Exposed	Standard Deviation	Mean SEM of Control	Standard Deviation	p value
Haematological Parameters					
RBC count (millions/cumm)	4.826 ± 0.04408 N=134	0.5103	4.792 ± 0.04736 N=134	0.5482	0.6026
TLC (cells×10^3/cumm)	7.765 ± 0.1853 N=134	2.1453	7.771 ± 0.1874 N=134	2.1692	0.9808
Hb(gms/dl) concentration	13.66 ± 0.1581 N=134	1.8303	13.85 ± 0.1304 N=134	1.5098	0.3447
PCV (%)	40.94 ± 0.4418 N=134	5.1142	40.99 ± 0.3492 N=134	4.0426	0.9399
MCV (fl)	85.09 ± 0.7670 N=134	8.8785	85.88 ± 0.5632 N=134	6.5197	0.4043
MCH (pg)	28.40 ± 0.3014 N=134	3.4885	29.05 ± 0.2297 N=134	2.6595	0.0878
MCHC (%)	33.36 ± 0.1983 N=134	2.2955	33.80 ± 0.1365 N=134	1.5806	0.0695
Neutrophils (cells/cumm)	4034 ± 149.2 N=134	1726.603	4560 ± 163.2 N=134	1889.319	0.0181*
Lymphocytes (cells/cumm)	2713 ± 76.59 N=134	886.6106	2464 ± 72.95 N=134	844.4318	0.0195*
Eosinophils (cells/cumm)	467.0 ± 36.24 N=134	419.4698	261.4 ± 20.82 N=134	240.9915	p<0.0001*

[Table/Fig-2]: Shows comparison of mean sem of haematological parameters of study and control groups
(*-Significant difference) Hb-Haemoglobin concentration, RBC-Red Blood Cell count, TLC-Total Leucocyte Count, PCV-Packed Cell Volume, MCV-Mean Corpuscular Volume, MCH-Mean Corpuscular Haemoglobin, MCHC-Mean Corpuscular Haemoglobin Concentration

Parameters	Mean SEM of Exposed	Standard Deviation	Mean SEM of Control	Standard Deviation	p value
Electrocardiograph Parameters					
P Wave amplitude(mV)	0.1552 ± 0.005562	0.0644	0.1449 ± 0.004889	0.0565	0.1655
P Wave duration (sec)	0.09134 ± 0.001778	0.0206	0.08896 ± 0.001507	0.0174	0.3065
QRS amplitude (mV)	1.230 ± 0.03585	0.4149	0.9619 ± 0.02856	0.3306	p<0.0001*
QRS duration (sec)	0.08567 ± 0.001350	0.0156	0.08478 ± 0.001274	0.0147	0.6300
T Wave amplitude (mV)	0.3187 ± 0.01122	0.1298	0.2530 ± 0.009863	0.1141	p<0.0001*
T Wave duration (sec)	0.1758 ± 0.003171	0.0367	0.1615 ± 0.002626	0.0303	0.0006*
PR Interval (sec)	0.1439 ± 0.002815	0.0325	0.1012 ± 0.004188	0.0484	p<0.0001*
QT Interval (sec)	0.3654 ± 0.002772	0.0320	0.3640 ± 0.002872	0.0332	0.7367
ST Segment (sec)	0.1000 ± 0.002638	0.0305	0.1143 ± 0.003118	0.0360	0.0005*
Heart Rate (bpm)	75.62 ± 0.8333	9.6462	76.42 ± 0.7901	9.1465	0.4874
Blood Pressure (mmHg)					
Systolic BP (mmHg)	123.9 ± 0.9893	11.4516	121.4 ± 0.7207	8.3424	0.0452*
Diastolic BP (mmHg)	80.19 ± 0.8284	9.5896	77.99 ± 0.5441	6.2983	0.0267*
Pulse Pressure (mmHg)	43.60 ± 0.9486	10.9812	43.42 ± 0.6412	7.4220	0.8758
Mean Arterial BP (mmHg)	94.83 ± 0.7631	8.8330	92.53 ± 0.5302	6.1371	0.0140*

[Table/Fig-3]: Mean SEM of blood pressure and ecg parameters of exposed and non exposed individuals were compared
(* -Significant difference), BP-Blood Pressure

immune response which is provoked due to dust exposure. Similar observations were made by various other researchers also.

Tripathi A et al., have shown there was a significant abnormal variation in haematological parameters of rice mill workers of Lucknow district [8]. HH Lim et al., have shown in their study, a significant increase in Eosinophil count of rice mill workers, which indicates allergic reactions and inflammation [9]. Kayaba et al., Weller PF et al., have found the exposure to rice husk dust causes increase in Eosinophil count as well as Eosinophil-Lymphocyte interaction in immune response [10,11].

In our study, we also observed statistically significant difference in Systolic ($p<0.05$), Diastolic ($p<0.05$) and Mean Arterial Blood Pressures ($p<0.05$) in subjects of study group as compared to subjects of control group. This indicates the change of vascular response to stress. These observations were in the agreement of observations of studies conducted by other researchers. Ibald Mulli A et al., Chaung KJ et al., and Liu L et al., suggested that there is an increased systolic blood pressure when density of particulate matter increases [12-14]. Bellavi A et al., in their experimental study on controlled exposure of dust on human beings have shown that there was an increased blood pressure on short term exposure to fine particulate matter [15]. Brook RD et al., have shown in their study there were an increased morbidity and mortality and also reduced life expectancy on long term exposure to increased density of particulate matter [16]. Urch B et al., observed a significant increase in Diastolic Blood Pressure and Mean Arterial Blood Pressure of carpenters as compared to control [17].

A very few studies have emphasized on effect of occupational exposure to dust on ECG parameters. In this regard of ECG parameters it was noticed a significant difference in PR interval ($p<0.0001$), QRS amplitude ($p<0.0001$), T wave amplitude ($p<0.0001$) and duration of T wave ($p<0.05$), in study group. They are indicators of abnormal variation in the electrical activity of cardiac muscle of Rice mill workers.

CONCLUSION

The rice mill workers were exposed to high concentration of particulate matter. It can be inorganic or organic chemical substance or can be toxins produced by bacteria or can be gases. The deleterious effect also depends upon the sizes of the particles that are inhaled by the individual. There was a significant increase in Neutrophil, Eosinophil and Lymphocyte counts. There was no significant difference in Haemoglobin concentration, PCV, RBC Count, TLC and MCHC.

There was a significant abnormal variation in PR interval, QRS amplitude, ST segment and T wave. There were no significant differences in other components of ECG. There were significant differences in the Mean values of systolic blood pressure, diastolic blood pressure and mean arterial blood pressure of Rice mill workers as compared to control. The findings of our study clearly indicate that the Rice mill workers are under high level of dust exposure which has dangerous effects on their blood and tissues. It is due to high oxidative stress. There are abnormalities seen in cardiovascular system also. The rice mill workers should be educated regarding health hazards of dust exposure. They should be provided with masks and gloves which can reduce the consequences of dust exposure.

ACKNOWLEDGEMENT

I am very much thankful to employers and volunteers of Rice mill workers for their assistance in carrying out my research work. I acknowledge my sincere thanks to non teaching staff, Department of Pathology, Government Medical College, Raichur for their technical assistance.

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PARTICULARS OF CONTRIBUTORS:
1. Tutor, Department of Physiology, BLDE University, Vijayapur, Karnataka, India.
2. Professor and HOD, Department of Physiology, BLDE University, Vijayapur, Karnataka, India.
3. Professor, Department of Physiology, BLDE University, Vijayapur, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Praveen S. Patil,
Tutor, Department of Physiology, Raichur Institute of Medical Sciences,
Hyderabad Road, Raichur, Karnataka-584102, India.
E-mail: praveenkmc@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jun 24, 2015**
Date of Peer Review: **Sep 14, 2015**
Date of Acceptance: **Sep 21, 2015**
Date of Publishing: **Nov 01, 2015**