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Effect on Biochemical and Lipid Profile Parameters on Koradi Thermal Power Plant Workers

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Abstract

Access to electricity has a positive effect on the health and well-being of people worldwide. However, the use of coal to generate the energy has negative health consequences. It pollutes the atmosphere due to production of large amount of smoke and fumes and is exceedingly dangerous to human health and induces severe impacts including bone deformities, cardiovascular problems, and kidney dysfunction, particularly with exposure of radionuclide's. Reactive oxygen species (ROS) have been implicated in the pathogenesis of coal dust-induced toxicity in coal-fired power plants. The aim of the present study was to measure the changes in biochemical parameters and lipid profile estimation in the workers working in Koradi thermal power plant, Nagpur when they are exposed to coal.

Keywords

Biochemical parameters, coal– dust induced toxicity, cardiovascular diseases, kidney dysfunction, lipid profile, thermal power plant, ROS.

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INTRODUCTION:

Power plants are industrial facilities where electrical power is generated for distribution. Coal is the only natural resource and fossil fuel available in abundance in India and is consequently used widely as a thermal energy fuel for thermal power plants producing electricity. India has about 90,000 MW installed capacity for electricity generation, of which more than 70% is produced by coal-based thermal power plants. Coal mining has a number of adverse effects on the environment.

Air pollution from coal-fired power plants includes sulfur dioxide, nitrogen oxides, particulate matter (PM) and heavy metals, leading to smog, acid rain, toxins in the environment and numerous respiratory, cardiovascular and cerebro-vascular effects. The release of carbon monoxide (CO) from explosives, which pollutes the air and poses a health risk for mine workers Drastic alteration of the landscape,

which can render an area unfit for other purposes, even after coal mine reclamation. The clearing of trees, plants, and top soil from mining areas destroys forests and natural wildlife habitats. It also promotes soil erosion and flooding, and stirs up dust pollution that can lead to respiratory problems in nearby communities (Sierrra Club, 2007).

Reactive oxygen species (ROS), such as free radicals and oxygen ions, appear to be central to this process has been implicated in the pathogenesis of diseases caused or made worse by coal pollutants, such as cardiovascular and pulmonary diseases. The continuous production of ROS may damage antioxidant defenses and result in an oxidative stress leading to cellular injury in the lung (London S., 1985).This damage causes denaturation of proteins, destruction of carbohydrates and peroxidation of lipids (Cantin A., Crystal R. G., 1985). The detrimental effects on the exposed subjects depend both on the physical characteristics of PM, their chemical composition, and the exposure time and on the health state of the people exposed. The purpose of the present study is to understand the effect of occupational coal dust exposure on thermal power plant workers by measuring oxidative stress. Some people who are having physical contact with coal might have insufficient accoutrements to combat the ROS that occur after exposure to coal dust. The aim of the present study was to measure the changes in biochemical parameters and lipid profile estimation in the workers working in Koradi thermal power plant, Nagpur when they are exposed to coal.

MATERIAL AND METHODS:

Area of study:

The study was done on the workers of Koradi thermal power plant (KTPS) located at Koradi near Nagpur, Maharashtra. The power plant is one of the four major power plants in Vidarbha – a power surplus region of India. The plant operates 8 units and has a total power generation capacity of 1700 MW. A proposed 440 kilovolt high power transmission line from Koradi to Bhusawal would join Nagpur with Mumbai. KTPS is located on the northern side of Nagpur and is spread across an area of 30,337 km^2.

Subjects:

The study was conducted from August- October, 2019 to Oct., 2019 during autumn season. The study was conducted on the samples collected of different age groups workers (30-60yrs) from the Koradi hospital for the Health checkup conducted regularly in a year. The size of each age groups (n=10) was decided for the measurement of various biochemical investigations on the study of workers. The mean age group was between 50± 5years.A written consent to participate in the study was obtained from the subjects after they were thoroughly informed about the research details.

Methods:

A detailed history including the history of diet and lifestyle was taken and general physical and systemic examination was done. Haemoglobin was estimated by using Sahli's method. For assessment of other parameters, 10ml fasting venous blood was taken from each worker with dry disposable syringe and needle under all aseptic conditions by venipuncture in the anticubital Samples were kept in a cool box at −4°C until they were transferred immediately to the laboratory, where they were centrifuged. Malondialdehyde (MDA) levels in serum were estimated by the method of Satoh (Satoh K., 1978).

A blood sugar test is a procedure that measures the amount of sugar, or glucose, in your blood. This test measures your blood sugar levels, or a glycosylated hemoglobin, also called a hemoglobin A1C test. A hemoglobin A1C (HbA1c) test measures the amount of blood sugar (glucose) attached to hemoglobin. A blood pressure test measures the pressure in your arteries as your heart pumps. A device called a sphygmomanometer has been used to measure blood pressure of the workers.

A complete cholesterol test is also called a lipid panel or lipid profile. This test may be measured any time of the day without fasting. However, if the test is drawn as part of a total lipid profile, it requires a 12-hour fast (no food or drink, except water).

Statistical analysis

Statistical analysis was carried out by unpaired t-test. The data were expressed as mean ±SD and P ≤0.001 was taken as highly significant.

RESULTS:

The study population consisted of workers in Koradi thermal power plant, Nagpur. The samples of different age groups worker (from 30-60 years) were taken for various experimental parameter analyses along with the control samples. The mentioned investigations were determined such as; blood pressure, Hb content, blood sugar level, triglycerides and lipid peroxidation.

The mean MDA levels coal workers were more than the control group. The increase was maximum in coal workers as compared to control group in all thermal plant **(Table a and b).**

The lipid peroxidation measured by MDA levels in contrast showed significant increase all age range *i.e.,* from 30 years to 60 years of all the thermal plant workers as compared control. On comparison of MDA levels in Koradi thermal power plant workers

between age grp 50-60 years found to have been found highest as compared to age grp of 30-40 yrs and 40- 50 yrs grp.

The mean serum Total Cholesterol and LDL-Cholesterol levels were significantly higher in coalfield workers of middle aged groups *i.e.,* 40-50 years gp. and 50-60 years gp. compared to those of 30-40 yrs age workers. Again mean of the serum Triglyceride and HDL-Cholesterol levels did not differ significantly between different age groups of the Koradi Thermal power plant worker. These changes may be related to internal desynchronization due to disruption of circadian rhythm. The changes in serum lipid and lipoprotein levels with the exception of HDL-Cholesterol and Triglyceride in the subjects engaged in shift work may put them at increased risk for cardiovascular and coronary artery disease.

Table a: Biochemical study on the workers (age gp- 30-60 yrs) working in thermal power plant, Koradi, Nagpur

Biochemical parameters of thermal power plant workers	Normal range	Age group (30-40yrs) (n=30)	Age group (40-50yrs) (n=30)	Age group (50-60yrs) (n=30)
Blood Pressure	90/60mmHg and 120/80mmHg	130/80	140/80	187/70
Blood Sugar	less than 140 mg/dL	101	126	138
HbA1c	5	11.0	12.1	10.0

Table b: Lipid Profile study of workers (Age gp- 30-60 yrs) working in thermal power plant, Koradi, Nagpur

Lipid parameters	Control (n=30)	Age gp. 30-40yrs (n=30)	Age gp. 40-50yrs (n=30)	Age gp. 50-60yrs (n=30)	P value
Total Cholesterol (mg/dl)	172.4 ±17.6	222.3±22.1	225.0±25.5	239±44.5	P<0.01
HDL-Cholesterol (mg/dl)	67.55±4.97	57.0±18.4	60.0±15.1	62.6±7.98	P<0.01
VLDL- Cholesterol (mg/dl)	59.97±9.91	74.65±27.9	80.24±35.3	62.9±17.1	P<0.01
LDL- Cholesterol (mg/dl)	47.83±14.8	90.65±25.8	83.76±32.5	112.38±36.5	P<0.01
Tryglyceride (mg/dl)	129.7±23.6	162.3±60.7	165.01±41.0	162.8±40.5	P<0.01
MDA (nmol ml^{-1})	3.49 ± 0.014	3.51±0.011	3.64± 0.014	3.71±0.016	P<0.01

DISCUSSION:

The findings were considered as a result of exposition to respirable coal dust, which leading to production of ROS may be predictive of the inflammation and cell injury. Increase of lipid peroxidation in plasma in blood of subjects has been seen with both acute and long-term coal dust exposure [**Altin *et al.,* 2004** and **Janssen *et. al.*, 1994**]. Oxidative stress which results from alteration in oxidant-antioxidant ratio has been observed in coal miners and other workers in dusty jobs (**Singh *et al.*, 2010**).

It has been established from various studies that parameters like age and sex account for the variations in MDA, total cholesterol, tryglcerides and changes in VLDL, LDL, HDL and various biochemical parameters (like Hb, blood sugar and blood pressure) (**Singh *et al.*, 2010**). These factors were taken into considerations and study was done in males of different age groups.

The levels of lipid profile study were recorded to be significantly higher in the thermal plant workers of different aged groups of workers as the coal particles and causes damages by their metal constituents [**Schins *et al.,* 1999** and **Bowden *et al.,* 1987**]. The rising levels of MDA and cholesterol levels in thermal plant workers are related to oxidation of lipid and protein by ROS in cells. Lipid peroxidation is a chain reaction initiated by the attack on the membrane lipids by free radicals. The carbon radical so formed

is stabilized by molecular rearrangement to produce conjugated diene which reacts with oxygen molecule to form peroxyl radical. Peroxyl radicals form peroxides and endoperoxides the fragmentation of which results in formation of MDA [**Pritchard *et al.*, 1996**]. Plasma MDA level has been used in many diseases as an indirect indicator of tissue lipid peroxidation and general oxidant stress.

The test tool assaying blood parameters we have used in our study is rapid methodology and can be useful for identifying early occupational health hazard for monitoring of individuals occupationally exposed to particulate coal pollutants in power plants.

The workers in thermal power plants are more susceptible to health problems. The data may provide information for the development of preventive measures to minimize the adverse effects of the exposures and offer the opportunity to improve worker health and reduces health-related costs. Use of personal protective equipment and good hygiene practices can be encouraged while at work. Washing hands before eating and drinking at work place should be advised. Antioxidant supplements should be strongly recommended in thermal plant workers and change in shift of duties in various units must be done frequently.

CONCLUSION:

From the results in the present study and their comparison with those of published reports, it may be concluded that, changes in serum lipid and lipoprotein levels, with the exception of HDL-Cholesterol and triglyceride, may occur in shift workers which may put them at increased risk to coronary artery diseases in different age group of coal workers. The levels of lipid profile study were recorded to be significantly higher in the thermal plant workers of different aged groups of workers as the coal particles and causes damages by their metal constituents.

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