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ORIGINAL ARTICLE

Some haematological parameters of welders exposed to oxyacetylene in Calabar, Nigeria.

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Abstract

Introduction: The welder's flame contains toxic and mutagenic compounds that pose a potential health hazard associated with the occupation. This study assessed some haematological parameters in a population of welders in Calabar, Southern Nigeria.

Methods: This was a cross-sectional study involving 50 welders exposed to oxyacetylene as test subjects and 50 non-welders as controls. The haematological parameters were analyzed using the Sysmex XE- 2100 haematology autoanalyser. Data was analyzed using SPSS version 21.0 with Student's t-test and Pearson's correlation. $P < 0.05$ was considered statistically significant.

Results: The platelets count was significantly lower ($p=0.041$) in the welders compared to the controls while neutrophils count was significantly higher ($p=0.0001$) in the welders than in the controls. The neutrophils count was significantly lower ($p=0.0001$) in welders exposed for 1-5 years compared to those exposed for over 5 years. Red blood cell count correlated negatively with platelets count ($r= -0.415$, $p =0.003$) while MCHC and MCV correlated negatively ($r= -0.428$, $p =0.002$)

Conclusions: The study revealed a significant reduction and increase in platelets and neutrophils counts respectively in the welders exposed to oxyacetylene gas

Keywords: *Oxyacetylene gas, welders, platelets count, neutrophils count.*

INTRODUCTION

Oxyacetylene is a mixture of acetylene and oxygen gas used for making hot flame that welds and cuts metals. It is the reaction of acetylene with oxygen in the welding process that produces oxyacetylene gas (1). Welders are semi-skilled or skilled workers who join and cut metal parts using flame, electric arc or other heat sources. There are over 80 different types of welding and associated processes but the commonest types in Nigeria are gas and electric arc welding (2). Gas welding uses oxyacetylene flame while electric welding uses electricity (3). However, welders who use gas welding process in Nigeria are commonly referred to as panel beaters (4). There are over 5 million people estimated to be either part-time or full-time welders globally. In the United States, almost 500,000 full-time workers are engaged in welding operations (5) and 5.5 million welding related jobs exist in Europe (6). In Nigeria, welding is an ancient profession and serves as a means of livelihood for many Nigerians; however, an incidence rate of 2.5% of welders affected by oxyacetylene was reported in Ile-Ife, Osun State, Nigeria (7). Gaseous pollutants are also generated during the welding process including nitrogen dioxide, phosphine, arsine, carbon monoxide, ozone, carbon dioxide, nitrogen oxide (8). The observed effects of prolonged exposure to this flame are attributable to the combined effects of its constituent gases that cause oxidation of haemoglobin, red blood cells membrane fragility and ultimately haemolytic anaemia. Carbon monoxide acts as haemoglobin poison leading to reduced oxygen carrying capacity, hypoxia and secondary polycythaemia (1). Considering the potential health hazards associated with the welding occupation, coupled with the fact that information on this subject is scare in our location, this study therefore aimed at investigating the possible effects of occupational oxyacetylene gas exposure on some haematological parameters of welders in Calabar, Nigeria.

Materials and Methods

Study area

This research study was carried out within Calabar metropolis consisting of Calabar Municipal and Calabar south Local Government Areas of Cross River State, Nigeria.

Study design/Subject selection

A cross-sectional study design was used for this study. A total of one hundred (100) subjects (males) aged between 18-60 years were recruited for the study. This comprised of 50 welders (test subjects) and 50 non-welders (control subjects). The subjects were randomly selected within Calabar metropolis. A well-structured questionnaire was administered to obtain demographic data and their informed consent to participate in the study was obtained.

Inclusion criteria

Welders exposed to oxyacetylene gas for a year and above with average exposure time of between 8 and 10 hours of each working day, who gave their consent were enrolled as test subjects. Non-welders not exposed to oxyacetylene gas who gave their consent were included as control subjects.

Exclusion criteria

Welders exposed to oxyacetylene gas for less than a year, those who use personal protective equipment, those who did not give their consent and those with blood related disorders were excluded from the study. Welders and non-welders who were smokers were also excluded from the study.

Ethical consideration

Ethical approval was obtained from the ethical committee of Cross-River State Ministry of Health, Calabar. All experiments were performed in accordance with the ethical standards laid down in the Helsinki Declaration of 1975, as revised in 2000 and all participants gave their consent.

Sample collection

Using aseptic technique, 4mls of blood was collected via venepuncture into a dipotassium ethylene diamine tetra acetic acid (K_2EDTA) container to a final concentration of 2mg/ml. The container was properly mixed, properly labelled and carefully placed in a rack and stored inside a cooler with ice-pack placed at the bottom of the cooler and cotton wool placed in between the ice pack and the rack containing the blood sample to avoid lyses. The anti-coagulated blood samples were used to determine the haematological parameters.

Laboratory analyses

The haematological parameters were analysed using the haematology automated analyser Sysmex XE-2100 (TOA Medical Electronics, Kobe, Japan).

Statistical analysis

Results were presented in tables as mean ± standard deviation (SD). The Statistical Package for Social Sciences (SPSS) version 21.0 was used in the statistics analysis. Student's t-test and Pearson's correlation were used to analyse the data. A P-value less than 0.05 was considered statistically significant.

Results

A comparison of the haematological parameters of the welders and controls show that the platelets count was significantly lower (p=0.041) in the welders compared to the controls while neutrophils count was significantly higher (p=0.0001) in the welders than in the controls. Other parameters were not significant (p>0.05) (Table 1). Table 2 shows a comparison of the haematological parameters of the welders based on duration of exposure to oxyacetylene gas. The neutrophils count was significantly lower (p=0.0001) in welders exposed for 1-5 years compared to those exposed for over 5 years. Other parameters were not significant (p>0.05). Figure 1 shows a significant negative correlation (r= -0.415, p =0.003) between red blood cell and platelets counts while Figure 2 shows a significant negative correlation (r= -0.428, p =0.002) between MCHC and MCV.

Table 1: Age and some haematological parameters of welders and non-welders

Parameter/Group	Welders n = 50	Non-welders n = 50	p – value
Age (years)	29.02±7.07	28.30±8.23	0.307
RBC count ($\times 10^{12}$/l)	5.34±0.62	5.28±0.57	0.627
MCV(fl)	80.25±4.52	80.26±5.64	0.988
MCHC(g/dl)	34.14±1.44	33.84±1.65	0.334
TWBC ($\times 10^{9}$/l)	4.49±1.70	4.56±1.25	0.805
Lymphocyte (%)	32.16±6.94	30.76±5.81	0.277
Neutrophil (%)	76.72±6.34	64.48±8.76	0.000*
Platelet count ($\times 10^{9}$/l)	184.44±69.46	213.54±70.97	0.041*

Values are expressed as mean ± SD, where: * = Significant at $p < 0.05$, RBC = Red Blood Cells, MCV = Mean Cell Volume, MCHC = Mean Cell Haemoglobin Concentration, TWBC = Total White Blood Cell.

Table 2: Age and some haematological parameters of welders based of duration of exposure

Parameter/Group	1-5years n = 19	>5years n = 31	p – value
Age (years)	28.90±8.98	29.12±1.12	0.520
RBC count ($\times 10^{12}$/l)	5.35±0.50	5.21±0.85	0.520
MCV(fl)	79.43±6.60	79.92±4.84	0.763
MCHC(g/dl)	33.84±1.68	34.10±1.71	0.609
TWBC ($\times 10^{9}$/l)	3.98±1.28	4.46±1.29	0.205
Lymphocyte (%)	31.32±6.13	31.02±6.24	0.876
Neutrophil (%)	64.74±7.87	77.06±6.23	0.000*
Platelet count ($\times 10^{9}$/l)	200.53±68.33	184.55±82.63	0.483

Values are expressed as mean ± SD, where: * = Significant at $p < 0.05$, RBC = Red Blood Cells, MCV = Mean Cell Volume, MCHC = Mean Cell Haemoglobin Concentration, TWBC = Total White Blood Cell.

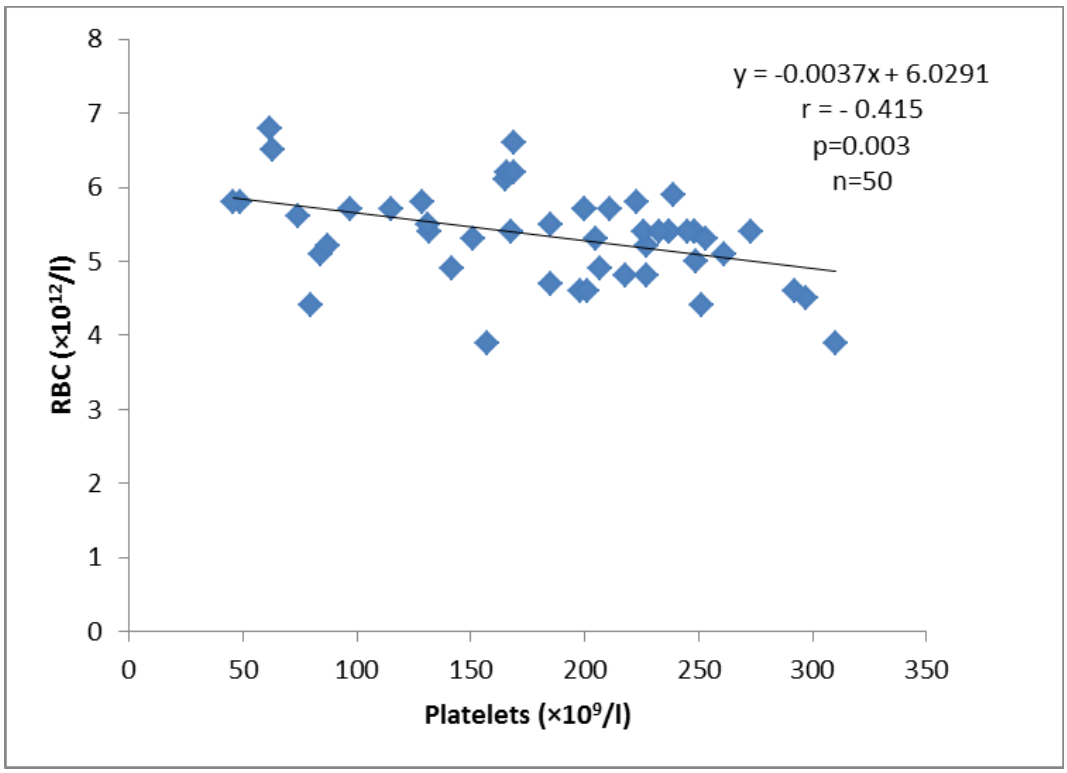

Fig. 1: Correlation plot of RBC count against Platelet count in the welders.

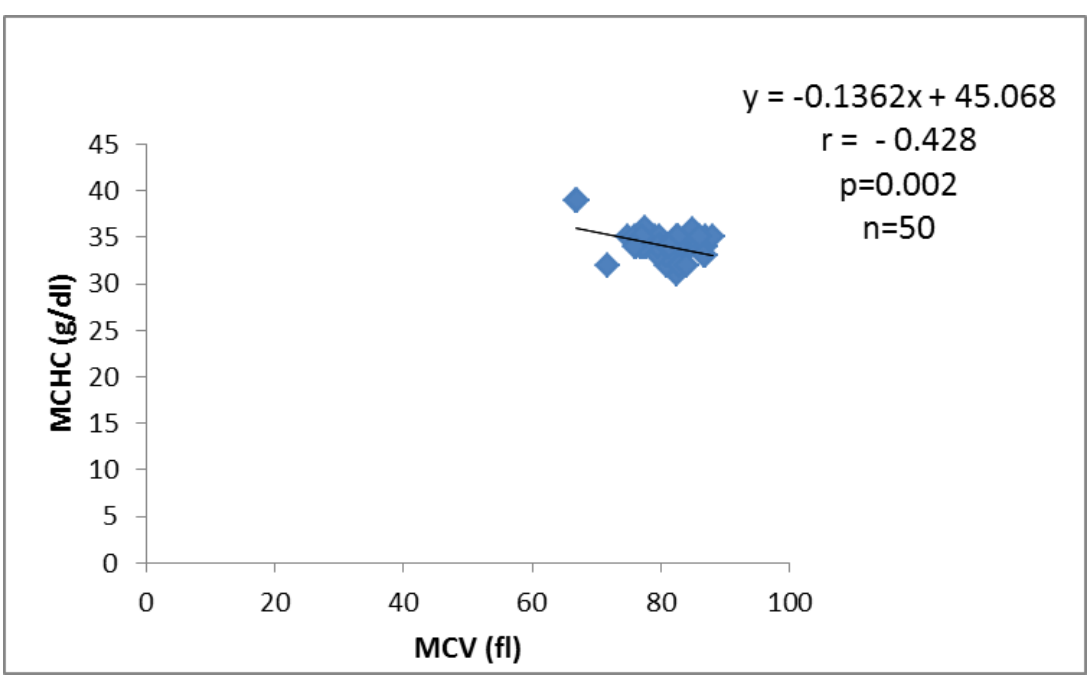

Fig. 2: Correlation plot of MCHC against MCV in the welders.

Discussion

In the study, there was a significant increase in neutrophil count of the welders. This observed elevation may be an initial adaptive response to cope with the toxic effect of oxyacetylene. Similar findings were observed in a study carried out by Kim *et al* (9) who reported a significant increase in neutrophil count of non-smoking welders in Massachusetts, USA. However, this observation disagrees with the findings of a study conducted by Prabhu et al (10) who reported a significant lower neutrophil count of welders in Mangalore, India. Other researchers also reported a non-significant marginal difference in absolute neutrophil count of welders compared to non-welders (11).

This study also observed a significant decrease in platelets count of the welders. This observed decrease may be due to the cytotoxic effect of the chemical constituents of oxyacetylene flame. Similar findings were observed in a work by Prabhu *et al* (10) who reported a significant decrease in platelets count of welders in Mangalore, India compared to non-welders. However, this observation is in contrast to the findings of earlier researchers who reported a statistically significant increase in absolute platelet count of welders compared to non-welders (1).

It is feasible that prolonged exposure to oxyacetylene gas can stimulate some level of inflammatory response in the test subjects; a significant increase in neutrophil count was observed in the welders with higher duration of occupational exposure. This finding is similar to the work of earlier researchers in Nnewi, South eastern Nigeria who reported an increase in absolute neutrophil count of welders with over 5 years of exposure[1]. However, this has been shown to increase in certain conditions as a part of systemic inflammatory response (12).

This study observed a significantly negative correlation between RBC count and platelets count. The effects of RBC interactions with platelets in humans are largely unknown. However, in straight vessels, the presence of red blood cells (RBCs) is known to push platelets toward walls, which may affect platelet aggregation and thrombus formation (13). There was also a significantly negative correlation between MCV and MCHC. The reason for this association is not clearly understood, however similar association was observed in animal studies by Okolie et al (14) who reported a negative correlation between the two parameters. This implies that exposure to oxyacetylene may affect MCV and MCHC.

Conclusion

The study revealed a significant reduction and increase in platelets and neutrophils counts respectively in the welders with a significant increase in neutrophil count associated with prolonged exposure to oxyacetylene gas.

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Conflict of interest: The authors declare no conflict of interest.

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