Formaldehyde Air Levels in some Hospital Mortuaries in Benin City

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ABSTRACT

This study was conducted to measure the air level of formaldehyde in some selected hospital mortuaries in Benin City. The mortuaries included a Teaching hospital mortuary, General hospital mortuary and Private hospital mortuary respectively. The mortuaries served as the test groups while Staff offices who had no connection with the mortuary or formaldehyde served as the control. Measurement of formaldehyde air level was carried out using a formaldehyde gas meter (EXTECH FM 200) which also gave measurement of the room temperature and relative humidity. Statistical analysis was done using Graph pad prism version 5.0. Result was presented as Mean ± SEM. Analysis of Variance was used to compare the means of test and control values while post hoc test was done using Student Newman Keul's test and a p-value of less than 0.05 was considered as statistically significant. Result shows a significantly higher formaldehyde air levels in the Teaching hospital mortuary, General hospital mortuary and Private hospital mortuary when compared with the control. There was a higher room temperature in the General hospital mortuary and Private hospital mortuary when compared with the control while there was a higher relative humidity in the Teaching hospital mortuary. Formaldehyde air levels recorded in all three mortuaries exceeded the acceptable and prescribed limit and it was therefore concluded that measures should be taken to ensure reduction of formaldehyde air levels in our hospital mortuaries in order to protect the Pathologists and Morticians who work in such environment, from the harmful effect of formaldehyde.

Keywords: formaldehyde, mortuaries, limit, air level, morticians

INTRODUCTION

Formaldehyde is a volatile organic compound which has been established as the classical fixative that is commonly used in all hospital pathology laboratories[1]. One of the properties of formaldehyde is delaying the decomposition of cadavers hence it is used in preservation and embalming of human bodies thereby preventing them from undergoing decay. It is also used to fix tissues which are relevant for microscopic as well as histological studies[2]. The concentration or level of formaldehyde vapour in the air is measured in *parts per million* (ppm) and several organizations in the world have established standards which define the limit to which an individual can be exposed to formaldehyde. The American Conference of Governmental Industrial Hygienist[3] suggested a ceiling limit of 0.3ppm as recommended standard while the National Institute for Occupational Safety and Health[4] suggested a ceiling limit of 0.1ppm. The Japanese Society for Occupational Health[5] suggested a ceiling limit of 0.5ppm while the Japan Ministry of Health, Labour and Welfare (MHLW)[6] set limit values for environmental exposure to formaldehyde at 0.08ppm as an average for general workplaces and 0.25ppm for specific workplaces like formaldehyde factories and gross anatomy laboratories. Some published reports have suggested that exposure to formaldehyde could be associated with adverse effects on the respiratory health[7]. Exposure to formaldehyde fumes is almost exclusively occupational, and this exposure occurs mainly in anatomy laboratories, histopathology laboratories and mortuaries where it is utilized continuously for the preservation of tissues and dead bodies. The individuals that are more at risk to formaldehyde exposure include Anatomists, Histologists, Pathologists and morticians[8]. In Benin City there are a number of mortuaries some of which are located in Teaching hospitals, General hospitals as well as private hospitals. There are also a number of private mortuaries in the City. Hospital Staff most especially the Morticians are designated to work in the mortuaries and have their offices next door where formaldehyde is utilized continuously for preserving dead bodies. The air exposure levels of formaldehyde in the mortuaries in Benin City is not known. Hence this study seeks to find out the atmospheric levels of formaldehyde in a Teaching hospital mortuary, General hospital mortuary and Private hospital mortuary and to ascertain if the exposure level is within the acceptable limits prescribed by some known international organizations.

MATERIALS AND METHODS

Study Location: Three mortuaries were selected for this study and they include a Teaching hospital mortuary, General hospital mortuary and a busy Private hospital mortuary while the offices of Staff who had no connection with the mortuaries or formaldehyde were used as the control site. Ethical approval was obtained from the College Research Ethics Committee, University of Benin as well as from the Edo State Hospital Management Board before commencement of this work.

Measurements of formaldehyde air level: Formaldehyde air level was measured using Formaldehyde Gas Meter (EXTECH FM200). The meter is automated, calibrated and has an external probe that traps air and detects the air levels of formaldehyde which are ultimately displayed on the meter screen. Apart from formaldehyde air levels the meter also measures the room temperature as well as the relative humidity of the air in the site being measured. Five measurements were taken on five different occasions in the mortuaries as well as the control site and this was carried out between 10am and 2pm in all the mortuaries and the average was calculated and taken as the air exposure level. Within the mortuaries measurements were taken at the four corners of the room as well as at the centre making up the five measurements and the average was calculated. This measurement was repeated on four other separate occasions in the mortuaries and control site.

Statistical Analysis: Statistical analysis was done using Graph pad prism version 5.0. Results was presented as Mean ± SEM. Analysis of Variance was used to compare the means of test and control values while post hoc test was done using Student Newman Keul's test and a p-value of less than 0.05 was considered as statistically significant.

RESULTS

Formaldehyde air levels in the different mortuaries are shown in Figure I. It was observed that there was a significantly high level of formaldehyde in the air of the Teaching hospital mortuary when compared with the control ($p < 0.05$). This significantly high level was also observed in the General hospital mortuary as well as the Private hospital mortuary. Figure II shows the Room Temperature of the three mortuaries and the control site. It was found that the room temperatures of the General hospital mortuary and Private hospital mortuary were significantly higher than the control ($p < 0.05$) while there was no significant difference in the room temperature of the Teaching hospital mortuary when compared with the control. Figure III shows the Relative Humidity of the three mortuaries and control site. It was found that there was a significantly higher ($p < 0.05$) relative humidity in the Teaching hospital mortuary when compared with the control while there was no significant difference in that of the General hospital mortuary and Private hospital mortuary when compared with the control.
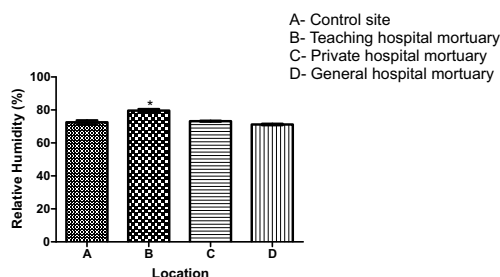

A- Control site
B- Teaching hospital mortuary
C- Private hospital mortuary
D- General hospital mortuary
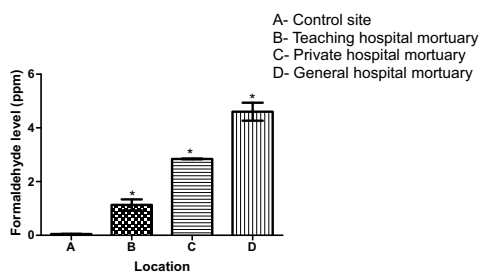
Figure I: Mean formaldehyde air level of control site and mortuaries

Significant values are Mean ±SEM compared to control (* = p<0.05)

A- Control site
B- Teaching hospital mortuary
C- Private hospital mortuary
D- General hospital mortuary
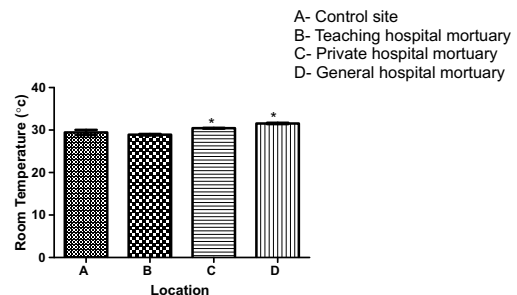
Figure II: Mean room temperature of control site and mortuaries

Significant values are Mean ±SEM compared to control (* = p<0.05)

A- Control site
B- Teaching hospital mortuary
C- Private hospital mortuary
D- General hospital mortuary

Figure III - Mean relative humidity of control site and mortuaries

Significant values are Mean ±SEM compared to control (* = p<0.05)

DISCUSSION

Dead bodies are usually preserved and kept in the mortuary and the location of mortuaries in most health facilities are usually at the outskirt of the hospital environment. The choice of this location may have arisen from the fact that formaldehyde which is used as preservative produces an odour that could be unpleasant. Bodies brought into the mortuary could either be refrigerated or embalmed. If they are refrigerated, they are usually kept at a temperature of 34^0F-39^0F $(1.1^0C-3.9^0C)$ which helps to preserve the body and keep them from decomposing. A dead body without any form of preservation can only last a maximum of 72 hours before it starts decomposing and decaying. Embalming is done with formalin which is the aqueous solution of formaldehyde and it contains about 37% of formaldehyde and about 10-15% methanol which has an inhibitory effect and helps to prevent polymerization[9]. Embalming comprises arterial embalming and cavity embalming. For arterial embalming, formalin is usually infused through the femoral artery. Infusion of intact bodies last for 2 hours while that of autopsied bodies last for about 3 hours[9,10]. After embalming, the bodies are usually stored in a designated room or hall in the mortuary until they are retrieved by their owners for burial. Morticians are employed to work in the mortuaries where they are regularly exposed to formaldehyde.

Pathologists are also exposed to formaldehyde, although to a lesser extent, when they periodically come into the mortuary to carry out autopsies. From this study it was observed that the air exposure level of formaldehyde in the Teaching hospital mortuary was 1.13±0.20 while that for General hospital mortuary was 4.60±0.33 and that for Private hospital mortuary was 2.84±0.01 and when these values are compared with the recommended ceiling it is way above every value prescribed by the different organizations.

These suggest that the health of the Pathologists and Morticians who work in these mortuaries may be at risk. The air exposure level of formaldehyde in the Teaching hospital mortuary was observed to be lower than what obtains in the General hospital mortuary and Private hospital mortuary. The reason for the lower value in the Teaching hospital mortuary can be attributed to the fact that the mortuary was well ventilated and it had air extractors that were functional whereas in the General hospital mortuary the ventilation was poor and they had no air extractors. The Private hospital mortuary had moderate ventilation but there were no air extractors. From the differences in the design and functionality of the mortuaries it can be seen that the health of the workers in the General hospital mortuary is more at risk owing to poor working environment. The exposure level in the Teaching hospital mortuary although lower than the other two mortuaries is still above the recommended standard prescribed by international organizations as stated earlier hence a lot still need to be done to bring it to the desired level. One of the ways to achieve this is to introduce formaldehyde adsorbers. Another possibility may be to use alternative chemicals which are less volatile than formalin for embalming. The mortuary workers on their own part should adopt measures to reduce their personal exposure by wearing personal protective equipment like plastic gown, facemasks and face shields. They can also reduce the number of hours they spend in the mortuary. The high level of exposure to formaldehyde above the recommended limit is not perculiar to this study alone as some other studies carried out in places where formaldehyde is utilized equally reported high levels of formaldehyde that were above the recommended ceiling limits. These can be seen in the work of Hafiz[11] who equally reported higher levels of formaldehyde in the Anatomy laboratory when compared with other laboratories of Sharjah University in the United Arab Emirate. In the study of Akbar-Khanzadah et al.[12] formaldehyde exposure in the Anatomy laboratory were reported to exceed the prescribed ceiling. Similar observations were also reported in some other related studies[13,14].

CONCLUSION

We therefore conclude that following the observations from this study in Nigeria and considering the high level of exposure to formaldehyde that Pathologists and Morticians may be exposed to in the mortuaries, there is a need to find ways of reducing formaldehyde air levels by introducing proper ventilation system, air extractors and formalin adsorbers in the mortuaries as these measures could help to reduce the air exposure levels and possibly bring it close to or below the recommended limit. The use of an alternative chemical to formaldehyde is also another possibility. Pathologists and Morticians should also be encouraged to use personal protective equipment like facemasks and face shields as this may also help to reduce their inhalation of formaldehyde.

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