Effects of inhaled anaesthetic agents (Chloroform and Diethyl ether) on fasting blood glucose and haematological parameters in Wistar rats

Moke Emuesiri Goodies¹*, Erhirhie Earnest Oghenesuvwe¹, Ahante Ejiroghene²

¹Department of Pharmacology and Therapeutics, Delta State University, Abraka, Delta State, Nigeria.
²Department of Pharmacology and Toxicology, University of Nigeria, Nsukka, Enugu State, Nigeria.

Accepted 25 July, 2015

The present study compared the effects of short term exposure of Wister rats to diethyl ether and chloroform on blood glucose level and haematological parameters. Fifteen Wistar rats were divided into 3 groups of 5 rats each, which were exposed to either chloroform or diethyl ether with the control group exposed to neither. The result of this study showed that exposure to diethyl ether and chloroform had no effect on fasted blood glucose level (mg/l); 67.80 ± 2.18, 68.60 ± 4.69 and 67.00 ± 3.33, as well as non-significant variations in packed cell volume PCV(%); 46.00 ± 0.95, 43.60 ± 1.40 and 44.00 ± 2.10. Haemoglobin concentration Hbc (g/l); 12.00 ± 0.49, 12.07 ± 0.16 and 12.90 ± 0.27, red blood cells RBC(10¹²/l); 5.44 ± 0.83, 4.02 ± 0.41 and 4.80 ± 0.56 and white blood cells WBC (10⁹/L); 11.02 ± 1.67, 11.29 ± 2.76 and 10.88 ± 0.44 of the Control, Chloroform and Diethyl ether treated rats respectively. The study showed that both chloroform and diethyl ether may not result in hyperglycemia or hypoglycemia when used as sources of anaesthetic agents.

Key words: Anaesthetic, chloroform, diethyl ether, glucose, haematology, hypoglycemia and hyperglycemia.

INTRODUCTION

General anaesthetic agents are used to render patients unaware of, and unresponsive to painful stimulations during surgical procedures (Bertram, 2007; Rang et al., 2007). Chloroform, ether, cyclopropane, amongst others, are inhaled anaesthetics that are been used in the laboratory for experimental animals; in clinical practice, these agents are now been replaced by the enflurane, isoflurane, sevoflurane, and desflurane (Rang et al., 2007). Winder et al. (1983) and Nishiyama et al. (2005) reported that anaesthetic agents could affect plasma corticosterone and/or other metabolic parameters such as glucose and insulin concentrations. In a study carried on rats (Van Herck et al., 1991), short term exposure (2 mins) to diethyl ether produced a slight increase in plasma glucose. A longer exposure (30 min), significantly increased the fasting plasma glucose and insulin (Aynsley-Green et al., 1973). A clinical study on humans revealed a significant increase in plasma glucose but a marked decrease in insulin levels following 25 mins of anaesthesia with isoflurane or sevoflurance (Tanaka et al., 2005). Hence, experimental results can be influenced by exposure to anaesthetic agents, thus the need for this study.

The aim of this research is to evaluate the effect of the inhaled anaesthesia induced by chloroform and diethyl ether on fasting blood glucose level and haematological indices of Wistar rats.

MATERIALS AND METHODS

Animals

Fifteen (15) Wistar rats with an average weight of 125 g were obtained from the animal house of the Department of Pharmacology and Therapeutic, Faculty of Basic and Medical Sciences, Delta State University Abraka. The
Table 1. Effect of chloroform and diethyl ether anaesthesia on fasting blood glucose level of Wistar rats.

<table>
<thead>
<tr>
<th></th>
<th>Fasting blood glucose (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tail vein</td>
</tr>
<tr>
<td></td>
<td>Before</td>
</tr>
<tr>
<td>Control</td>
<td>67.80±2.18</td>
</tr>
<tr>
<td>Chloroform</td>
<td>67.20±4.35</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>70.80±4.73</td>
</tr>
</tbody>
</table>

Values are presented as mean ± standard error of mean (SEM) of sample replicate, n = 5.

Table 2. Comparative effect of chloroform and diethyl ether anaesthesia on haematological parameters of Wistar rats.

<table>
<thead>
<tr>
<th></th>
<th>WBC (x10⁹/l)</th>
<th>RBC (x10¹²/l)</th>
<th>PCV (%)</th>
<th>HbC (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>11.02 ± 1.67</td>
<td>5.44 ± 0.83</td>
<td>46.00 ± 0.95</td>
<td>12.00 ± 0.49</td>
</tr>
<tr>
<td>Chloroform</td>
<td>11.29 ± 2.76</td>
<td>4.02 ± 0.41</td>
<td>43.60 ± 1.40</td>
<td>12.07 ± 0.16</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>10.88 ± 0.44</td>
<td>4.80 ± 0.56</td>
<td>44.00 ± 2.10</td>
<td>12.90 ± 0.27</td>
</tr>
</tbody>
</table>

Values are presented as mean ± standard error of mean (SEM) of sample replicate, n=5.

animals were housed in cages for 14 days for acclimatization prior to commencement of experiment, and were allowed free access to water and feed. The animals received humane care in compliance with the ethical guide for the care and use of Laboratory Animals approved by the College of Health Sciences, Delta State University, Abraka, Nigeria.

Drugs

Chloroform and diethyl ether were used as inhaled anaesthetics (supplied KERMEL).

Experimental design

The animal were divided into three (3) groups of five animals each; Group 1 – No exposure Control, Group 2 – Exposed to Chloroform and Group 3 – Exposed to Diethyl ether.

Induction and collection of samples

A clean and sterile cotton ball was soaked in chloroform and kept inside a desiccator with a tightly closed lid, into which “Group 2” rats were placed and monitored. Another cotton ball was soaked in diethyl ether and kept inside a different desiccator with a tightly closed lid, and “Group 3” rats were placed and monitored. “Group 1” animals were not exposed to either chloroform or diethyl ether. Following loss of righting reflex and reduction in the animal’s respiratory rate (occurring at approximately 2 min. after exposure), the rats were immediately removed from the desiccator and blood samples collected.

The fasting blood glucose (FBG) of each rat from all the groups with blood samples from the tail vein and retro-orbital plexus, was assessed by means of a glucometer (ACCU-CHEK® Active) and compatible blood glucose test strips.

Blood samples from both the tail vein and retro-orbital plexus of each rat were collected into an EDTA container for assaying of haematological indices.

Statistical analysis

The sample result were calculated from triplicate assay and expressed as the mean ± Standard Error Of Mean (SEM) at P<0.05 (P<0.05%).

RESULTS

From Table 1, there was no significant difference (P > 0.05) in FBG of blood samples collected from the tail vein and retro-orbital plexus of animals exposed to chloroform when compared to control group. There was also no significant difference (P > 0.05) in FBG of blood samples collected from tail vein and retro-orbital plexus of animals exposed to diethyl ether when compared to control group. There was no significant difference (P > 0.05) in FBG of animals collected from the different sites before anaesthesia when compared to blood samples of animals collected from different sites after anaesthesia.

Table 2 showed that there was no significant difference (P>0.05) in white blood cells (WBC) and red blood cells...
(RBC) counts, packed cell volume (PCV), and haemoglobin concentration (HbC) of animals exposed to chloroform and diethyl ether when compared to the control group.

Discussion

This present study protocol was designed to investigate the effect of short-term exposure to inhaled anaesthetics (chloroform and diethyl ether) on fasted blood glucose concentration and haematological parameters. Indications from the study imply that brief exposure of both anaesthetics agents to fasting rats resulted in non-significant difference (P > 0.05) in the blood glucose concentration of the rats. This is in stark contrast to the report by Aynsley-Green et al. (1973) that fasted rats (24 h) showed a significant high level of blood glucose. This might be due to the variation in the experimental design such as the time of exposure to the anaesthetics and the level of fasted state.

The effect of the anaesthetics on haematological parameters showed that their short-term exposure caused non-significant variations in all the parameters (RBC, WBC, PCV, HbC) tested when compared with the control group of no exposure. This suggests the unlikelihood of the inhaled anaesthetics to cause toxic effects such as induction of anaemia or disruption of the circulating cells of the immune system on brief exposure (Coles, 1986; Obi et al., 2012).

This present research showed that anesthetizing experimental animal (Wistar rats) with chloroform and diethyl ether produces no significant increase in plasma blood glucose level as well as haematological parameters. It is an indication that both chloroform and diethyl ether will cause neither hyperglycemia nor hypoglycemia, or will not cause anemia or affect circulating cells of the immune system, following their use anaesthesia in experimental animals. However, it is suggested that further work be done following long-term exposure to chloroform and diethyl ether on fasting blood glucose and other parameters.

Acknowledgements

We wish to appreciate Emeje Blessing and Ogwemho Jennifer of the Department of Pharmacology and Therapeutics, Delta State University, Abraka, Nigeria, for their assistance in this study.

REFERENCES