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Impact Of Anesthetic Gases On Blood Components In Mosul City

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Abstract

Occupational exposure to anesthetic gases remains a significant yet often underestimated health hazard for hospital staff, particularly those working in operating rooms. Despite advances in ventilation systems and safety protocols, chronic exposure may still lead to subtle but clinically relevant alterations in various blood biomarkers. This study aimed to evaluate the impact of inhalational anesthetic gas exposure on selected blood biochemical parameters among healthcare personnel in Mosul hospitals. comparative cross-sectional study was conducted involving 80 healthcare workers from operating rooms in several Mosul hospitals. Participants were divided into two exposed groups (based on years of exposure and type of gas) and one control group comprising administrative staff with no exposure. Blood samples were collected to assess key biochemical markers, comparative cross-sectional study was conducted involving 80 healthcare workers from operating rooms in several Mosul hospitals. Participants were divided into two exposed groups (based on years of exposure and type of gas) and one control group comprising administrative staff with no exposure. Blood samples were collected to measure red blood cell (RBC) count, hemoglobin concentration (Hb), packed cell volume (PCV), white blood cell (WBC) count, and platelet count. Statistical analysis was performed using ANOVA and Duncan's multiple range test to determine significant differences among groups. The results revealed significant increases in RBC count, Hb concentration, PCV, WBC count, and platelet count in the exposed groups compared to the control group ($p < 0.05$). These elevations may indicate a physiological compensatory response to chronic low-level exposure or reflect underlying inflammatory or stress-related mechanisms induced by anesthetic gases. The findings suggest that chronic occupational exposure to inhalational anesthetic gases may lead to notable increases in various hematological parameters among operating room personnel. Strengthening preventive measures, improving environmental monitoring, and conducting routine hematological assessments are recommended to protect healthcare workers. Further longitudinal studies are needed to clarify the underlying mechanisms and long-term health implications.

Keywords: *anesthetic gas, Isoflurane , Sevoflurane, haemoglobin.*

INTRODUCTION

Inhalational anesthetic is the use of chemical compounds that provide general anesthetic properties through inhalation. The anesthesia team, consisting of an anesthesiologist, a nurse, and an assistant, administers these substances to the patient using an anesthesia mask, a laryngeal air mask, or a tracheal tube connected to an anesthesia vaporizer and an anesthesia system. The most widely used substances for inhalation anesthesia are isoflurane, sevoflurane, and desflurane, in addition to some anesthetic gases such as nitrous oxide and xenon. There are several types of anesthesia that vary in their effect on the body, but the main goal of anesthesia is the same: to make the patient relaxed by numbing their sense of pain and controlling the body's involuntary response by relaxing the muscles [1,2]. General anesthesia usually includes medications that put the patient into a coma and make them forget any events that occurred during the anesthesia period. Side effects of general anesthesia include nausea, vomiting, sore and painful throat, muscle pain, confusion, and disorientation. Anesthesia workers are exposed to anesthetic gases, which are believed to affect blood components, the nervous system, kidney and liver function, as well as oxidative stress, in addition to the accumulation of heavy metals, which leads to serious problems. Anesthetic gases are one of the most important discoveries of modern medicine. Anesthetic gases can leak during operations in emergency and recovery rooms, delivery rooms, and other areas. It is estimated that approximately 200,000 healthcare workers are exposed to these waste gases, most of whom are anesthesiologists, anesthesia technicians, and anesthesia

nurses. Studies indicate that long-term exposure to anesthetic gases can lead to serious health problems among anesthesia workers, including negative effects on the central nervous system, the respiratory system, and sometimes the mental health of workers. The most important organs affected by anesthetic gases are the kidneys and liver [2,3]as they are responsible for ridding the body of waste, which includes anesthetic gases. These gases also cause significant changes in blood parameters such as hemoglobin and red blood cells [4,5].

MATERIALS AND METHODS

Sample Collection

A total of 80 blood samples were collected from anesthesia workers, The samples were divided based on the type of anesthetic used in the samples under study:

1- Isoflurane
2- Sevoflurane
3- Total exposure
4-control

These samples were compared with 30 samples from healthy, non-smoking individuals, serving as a control group, in the same age range. 2ml of blood samples were drawn from no smokers, with hemolyzed blood samples excluded to eliminate false positives. An automated hematology analyzer from the Chinese company Rayto was used to analyze the samples. Two milliliters of venous blood were placed in glass anticoagulant tubes containing ethylene diamine tetra acetic acid (EDTA). Blood tests included the packed cell volume (PCV), platelet count, red blood cell (RBC) count, hemoglobin (Hb) concentration, and white blood cell (WBC) count.

Statistical analysis:

Statistical analysis of the hormonal study results was performed. Data were collected, reviewed, recorded, and entered into IBM SPSS statistical software, version 26. After ensuring that the quantitative data followed a parametric distribution, we presented means, standard deviations, and ranges. Duncan's multiple-range test revealed significant differences between parameters, which were indicated by different letters at a probability level of $P \leq 0.05$.

RESULTS

The effect of gases and the type of anesthetic used on some blood components.

-The results showed that hemoglobin concentration, showed clear changes in the blood of anesthesia staff as a result of exposure to the effects of the gases emitted and used in the anesthesia process, compared to the control group.

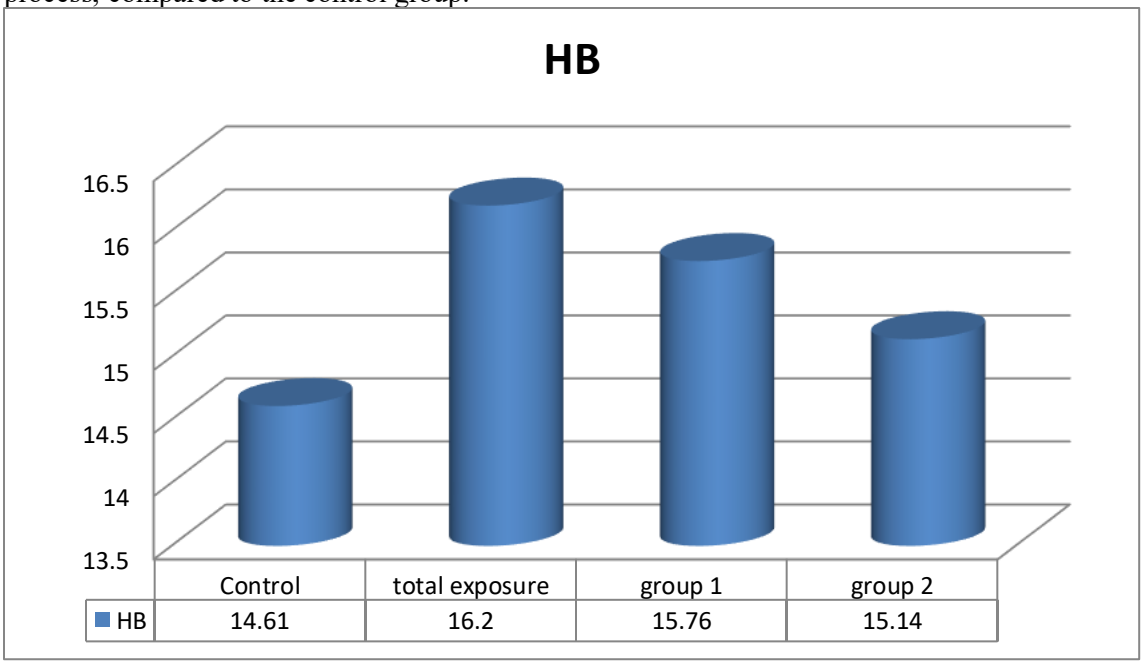

Fig (1): Relationship of hemoglobin with the studied groups

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-The packed cell volume (PCV) showed a significant increase in the blood of employees exposed to gases used in operating rooms compared to the control group, showing the highest increase in the blood of employees exposed to these gases, (45.84), while the increase in the blood of anesthesiologists exposed to the first type of anesthetic was (45.04). The increase in the blood of employees exposed to the second type of anesthetic was (44.04) compared to the control group, as shown in Figure (2).

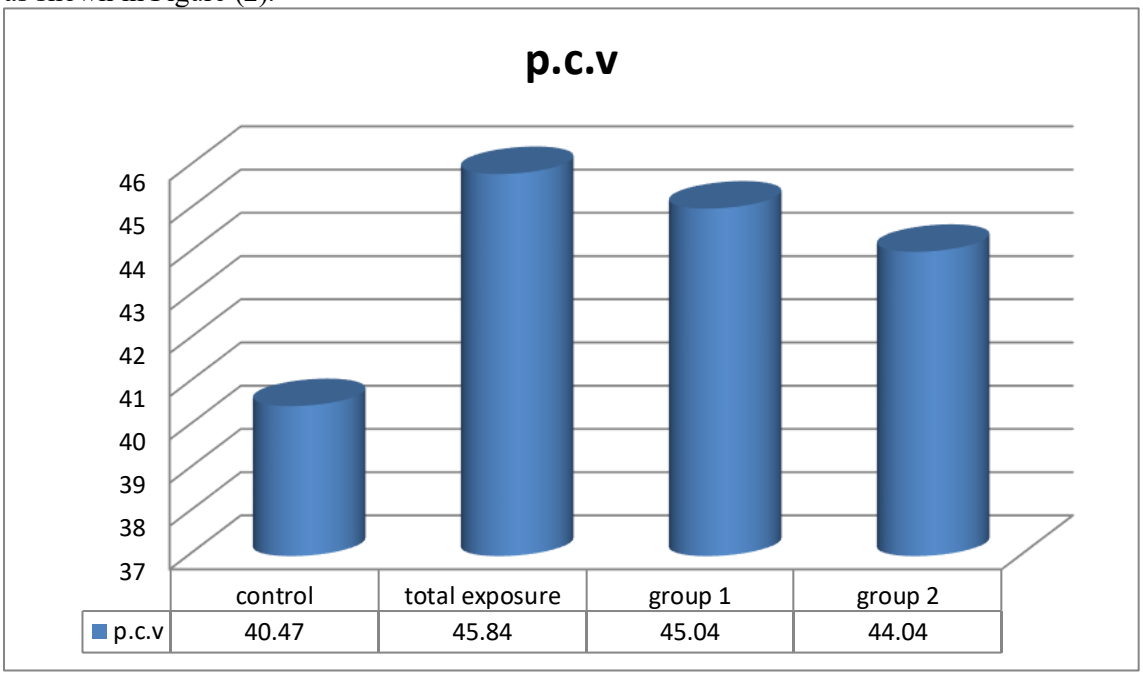


Fig. (2): Relationship of pack cell volume with the studied groups

Red blood cell counts in the blood of users showed a significant increase compared to the control group, reaching a maximum of 5.49 in the blood of employees who are constantly exposed to inhaling these gases, compared to the control group. The rate of increase, depending on the type of drug used, reached 5.36 in the blood of employees who are naturally exposed to the first type of drug, and 5.32 in the blood of employees exposed to the second type of drug, compared to the control group, as shown in Figure (3).

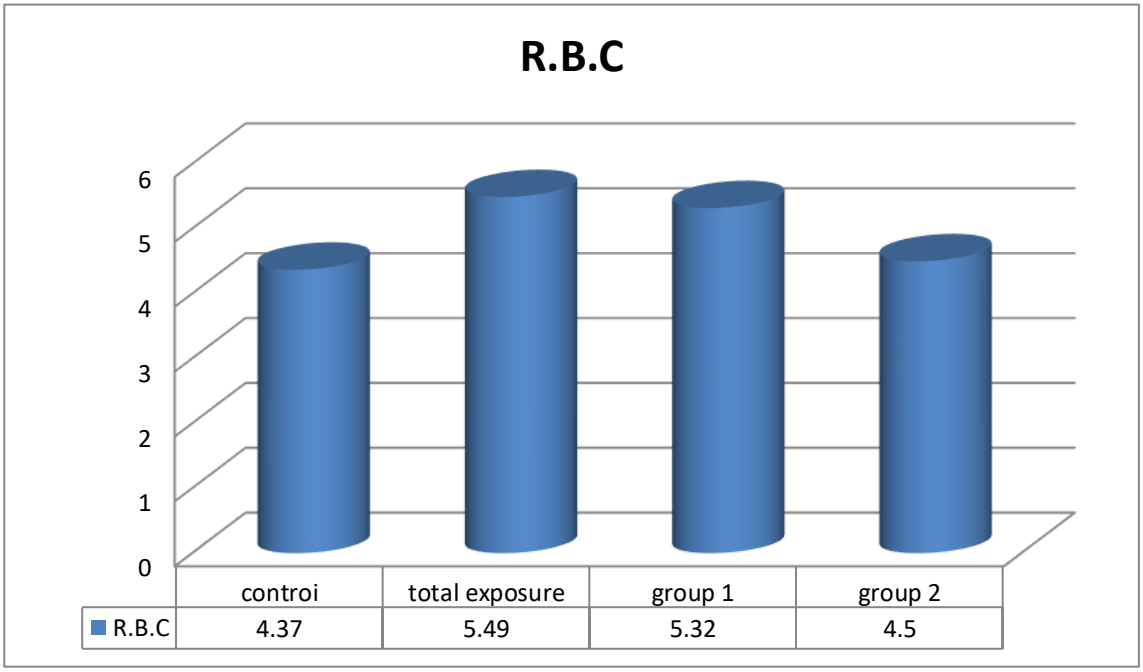
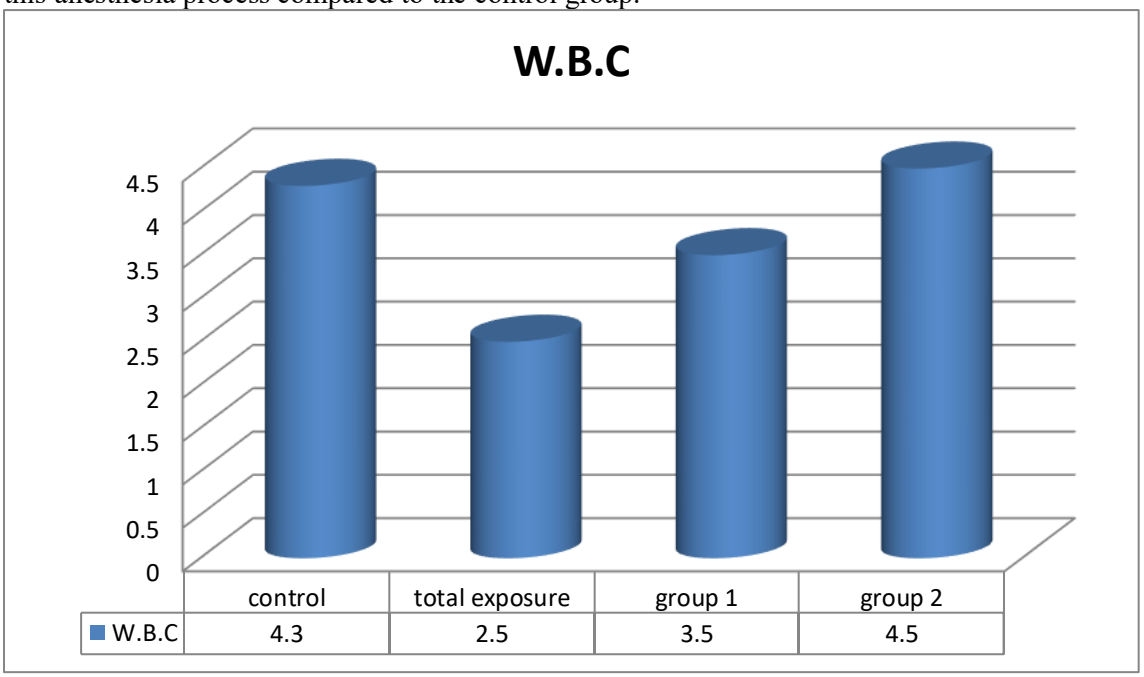


Fig.(3): Relationship of Red Blood Cell volume with the studied groups

White Blood Cell Count (WBCs) and Platelet Count (PLTs)

The results showed that the white blood cell count showed clear changes in the blood of anesthesia employees as a result of exposure to the effects of environmental gases emitted during this anesthesia process compared to the control group.



Fig(4): Relationship of white Blood Cell with the studied groups

Figure (5) also showed a significant increase in the number of PLT during the use of two types of anesthetics compared to the control group. The highest rate of increase in PLT in the blood of individuals using type 1 anesthetics was (287) compared to the control group

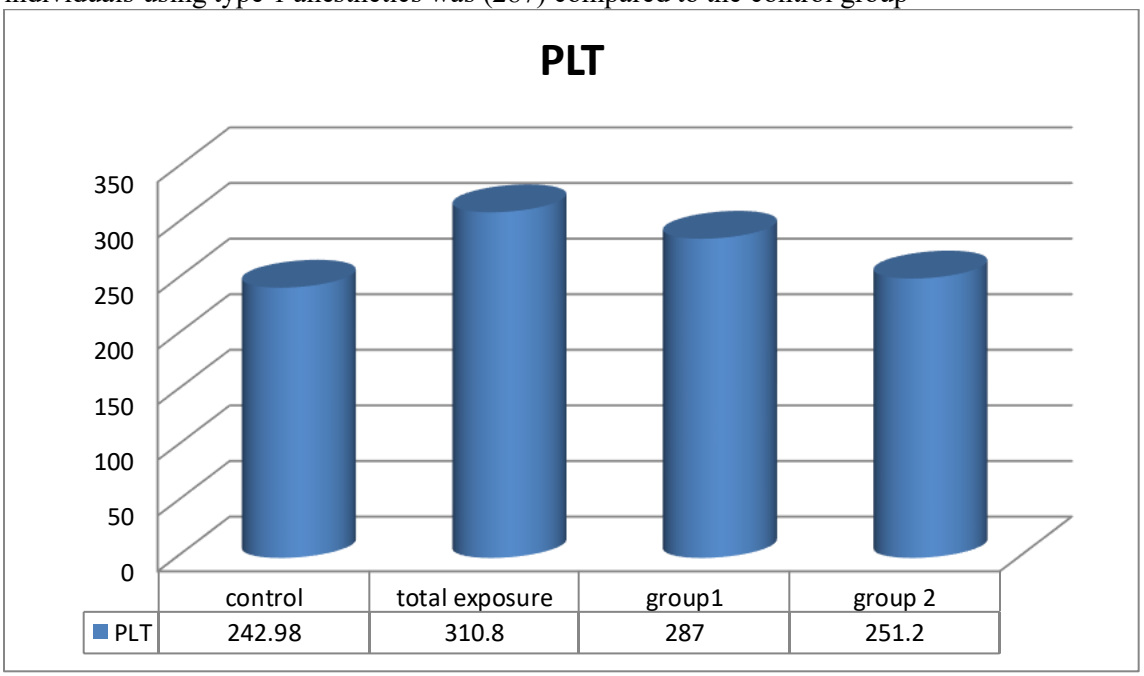


fig (5): Relationship of platelet Cell with the studied groups

DISCUSSION

Exposure to inhalational anesthetic gases such as isoflurane and sevoflurane, in operating room environments has been reported to cause significant alterations in hematological parameters, including elevated levels of hemoglobin, red blood cells (RBCs), white blood cells (WBCs), packed cell volume (PCV), and platelets. The increase in hemoglobin and RBC counts can be primarily attributed to a compensatory mechanism triggered by chronic or intermittent tissue hypoxia. This hypoxia results from impaired pulmonary function and reduced oxygen diffusion capacity due to repeated exposure to anesthetic gases, which subsequently stimulate erythropoietin secretion from the kidneys[6,7,8]. Elevated erythropoietin levels enhance erythropoiesis, leading to higher RBC counts and hemoglobin concentrations to improve oxygen delivery to peripheral tissues [9,10].

The elevation in WBC counts may reflect a subclinical inflammatory response and oxidative stress induced by these gases. Inhaled anesthetics are known to increase the generation of reactive oxygen species (ROS), which can stimulate immune cell activation and systemic inflammatory responses[11,12,13]. Prolonged low-grade inflammation may promote leukocyte proliferation and mobilization [14,15]. An increase in PCV is a direct consequence of the elevated RBC mass, leading to a higher proportion of cellular components in blood relative to plasma volume, thereby reflecting an adaptive erythrocytosis response[16,17]. Additionally, the rise in platelet count may be attributed to the activation of bone marrow megakaryocytes, mediated by inflammatory cytokines and oxidative stress pathways. This enhancement in thrombopoiesis is considered a protective mechanism to maintain hemostatic balance under continuous endothelial stress[18,19,20]. Chronic exposure to anesthetic gases may thus result in significant hematological adaptations aimed at counteracting hypoxia and oxidative damage, yet these changes could potentially increase the risk of hyperviscosity, thrombosis, and other vascular complications over time [21]

CONCLUSIONS

The study results showed clear physiological effects of prolonged exposure to anesthetic gases (isoflurane and sevoflurane) on anesthesia personnel in operating rooms. These effects were manifested by a significant increase in hemoglobin concentrations, packed cell volume, red blood cell and white blood cell counts, and platelets compared to unexposed individuals. The effect of isoflurane on blood components was also more severe than that of sevoflurane. These findings suggest the potential for health risks associated with chronic exposure to these gases, requiring appropriate preventive measures to protect medical personnel.

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