OPEN ACCESS

Scholars International Journal of Traditional and Complementary Medicine

Abbreviated Key Title: Sch Int J Tradit Complement Med
ISSN 2616-8634 (Print) |ISSN 2617-3891 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Investigating the Effects of Two Types of Anaesthetic Agents on Erythrocyte Sedimentation Rate (ESR) and Osmotic Fragility Rate of Male Wistar Rats

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DOI: https://doi.org/10.36348/sijtcm.2025.v08i10.001 | **Received:** 10.09.2025 | **Accepted:** 04.11.2025 | **Published:** 07.11.2025

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Abstract

Background: Lidocaine and ketamine are anaesthetic agents usually used in clinical practice to manage pain and as preoperative agents. In addition to this, anaesthetic medications can affect other haematological parameters, such as erythrocyte sedimentation rate (ESR) and osmotic fragility. Changes in these parameters may be a sign of the risk of anaemia, inflammation, or oxidative injury after anaesthetic exposure. The literature on these effects is however inconsistent and there is limited comparative data on lidocaine and ketamine. Therefore, the aim of this study was to compare and contrast the influence of these two anaesthetic agents on ESR and erythrocyte osmotic fragility in male Wistar rats. ***Methodology:*** A total of 35 male wistar rats were used for this study after undergoing acclimatization for one week. The animals' blood samples were collected and analysed using appropriate techniques. One way ANOVA was adopted as the statistical analysis method for this study and data were reported as mean ± SEM, where the level of significance was set at $p < 0.05$. ***Results and Discussion:*** There were no statistically significant differences in both the treatment and control groups when it came to ESR and osmotic fragility and the same meaning that lidocaine and ketamine did not impact the erythrocyte membrane stability or the inflammatory condition. ***Conclusion:*** The results concluded that the lidocaine and ketamine are safe in Hb parameters, and can be further used in the anaesthetic practice without causing any erythrocyte injury or inflammation.

Keywords: Lidocaine, ketamine, erythrocyte sedimentation rate, osmotic fragility, Wistar rats.

1. INTRODUCTION

Erythrocyte Sedimentation Rate (ESR) otherwise called Westergren ESR, is the rate at which red blood cells sediments in a period of one hour. It is a common haematological test and is a non-specific measure of inflammation (Diamanti *et al.*,2025). To perform this test, an anticoagulated blood is placed in a upright tube known as westergren tube and rate at which the red blood cells fall is measured and reported in mm/hr. The erythrocyte sedimentation rate is governed by the balance between pro sedimentation factors, mainly fibrinogen and these factors resisting blood sedimentation, namely the negative charge of erythrocytes (Simeon *et al.*,2024).

Erythrocyte sedimentation rate increases in conditions such as inflammation, pregnancy, anaemia or rheumatold arthritis and decreases in polycethaemia,

hereditary spherocytosis and congestive heart failure (Mack *et al.*,2017).

Osmotic fragility refers to the degree or proportion of haemolysis that occurs when a sample of red blood cell is subjected to osmotic stress by being placed in a hypotonic solution. Osmotic fragility is affected by various factors including membrane composition and integrity as well as the cell's sizes or surface area to volume ratio (Rodak, 2017).

The osmotic fragility test is common in haematology, and is often performed to aid with diagnosis of diseases associated with erythrocyte membrane abnormalities (Neli, 2014).

Some diseases linked to increased osmotic fragility include hereditary spherocytosis and hypernatremia, while some are linked to decreased osmotic fragility including chronic liver disease, iron deficiency anaemia, thalassemia, hyponatremia, polycythemiavera and sickle cell anaemia (Neli, 2014).

Verma *et al.* (2018) reported non-significant changes in erythrocyte sedimentation rate (ESR), osmotic fragility, packed cell volume following ketamine administration in dogs while Igbokwe (2018) reported significant increase in PCV, RBC and significant decrease osmotic fragility, fibrinogen and erythrocyte sedimentation rate. These conflicting reports as well as little or no reports on the influence of lidocaine and ketamine on erythrocyte sedimentation rate, osmotic fragility is the reason for this current study.

2. METHODOLOGY

2.1 Ethical Approval

This study was performed with animals treated in accordance with guide for the care and use of laboratory animals after securing ethical statement approval from the Research Ethics Committee (REC) of the Faculty of Basic Medical Sciences (FBMS), Rivers State University with REC approval number: RSU/FBMS/REC/23/160.

2.2 Experimental Animals

Thirty-five (35) Wistar rats were acquired for the purpose of this study. The rats were housed in a well-ventilated room with adequate light source and temperature. The animals were fed adequately and allowed for acclimatization for one week before commencement of the experiment.

2.3 Drugs

The experimental rats were treated with 5mg/kg of ketamine according to Yohannes *et al.* (2018) who used same doses of ketamine in his study while 2% of lignocaine at 2mg/kg according to Yakubu *et al.* (2020) were administered to the experimental rats.

2.4 Experimental Design

Thirty-five (35) male Wistar rats were divided into five (5) groups of six (6) rats each.

Group 1: This is the control group. The rats in this group were administered with 1ml of diluted distilled water orally for 2 days.

Group 2: Male Wistar rats in this group received 2mg/kg of plain lignocaine (lidocaine without adrenaline) for 2 days.

Group 3: Male Wistar rats in this group received 2mg/kg of lidocaine with adrenaline for 2 days.

Group 4: Male Wistar rats in this group received 5mg/kg of ketamine every day for 2 days.

Group 5: Male Wistar rata in this group received 5mg/kg of ketamine and 2mg/kg of lidocaine combined together every day for 2days.

2.5 Collection of Blood samples from Experimental Rats

At the end of treatment with drugs, the rats were sacrificed and blood samples collected by cardiac punctures into various sample bottles for haematological, hemostatic, haemorheological and biochemical investigations using appropriate techniques.

2.6 Estimation of Serum Biochemical Profile

Blood samples were collected and serum separated via centrifugation at 3000rpm for 15 minutes and serum estimated using fully automated serum analyser (Microlab Biochemistry Germany) for determination of serum electrolytes, urea and creatinine.

2.7 Statistical Analysis

Values for the results are pressed as meant SEM. The statistical analyses were done using the analysis of variance (ANOVA). Computer software: Microsoft excel 2013 edition and SPSS 23.0 windows were used. Differences between mean were considered at $p<0.05$.

3. RESULTS

This deals with the presentation and analysis of data obtained from laboratory work with a view of arriving of concrete findings. The data are presented and analysed with appropriate titles for clarity.

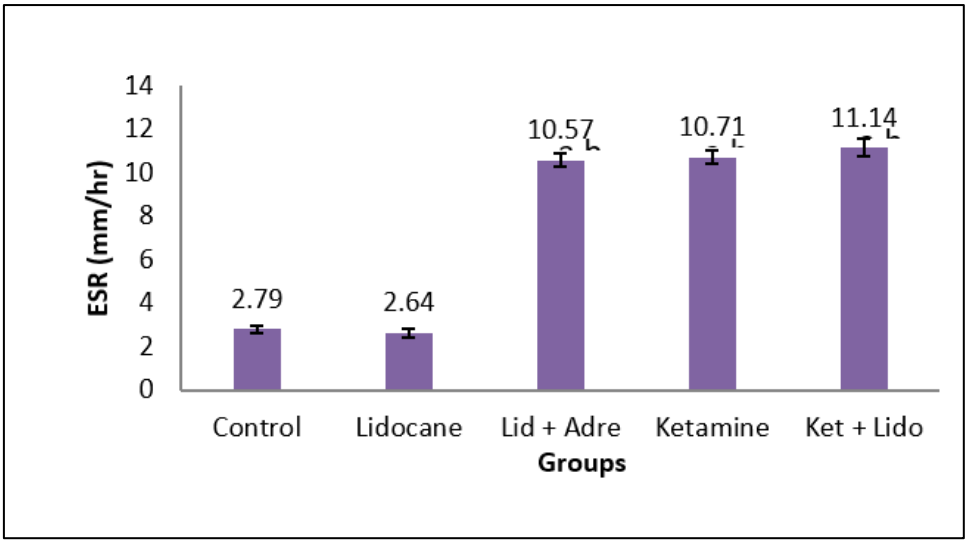

Figure 1: Comparing erytrocyte sedimentation rate in all the experimental groups. Results presented as mean ± SEM. a, b, c, and d = versus control, lidocane, Lid plus adre, and ketamine groups respectively at p<0.05

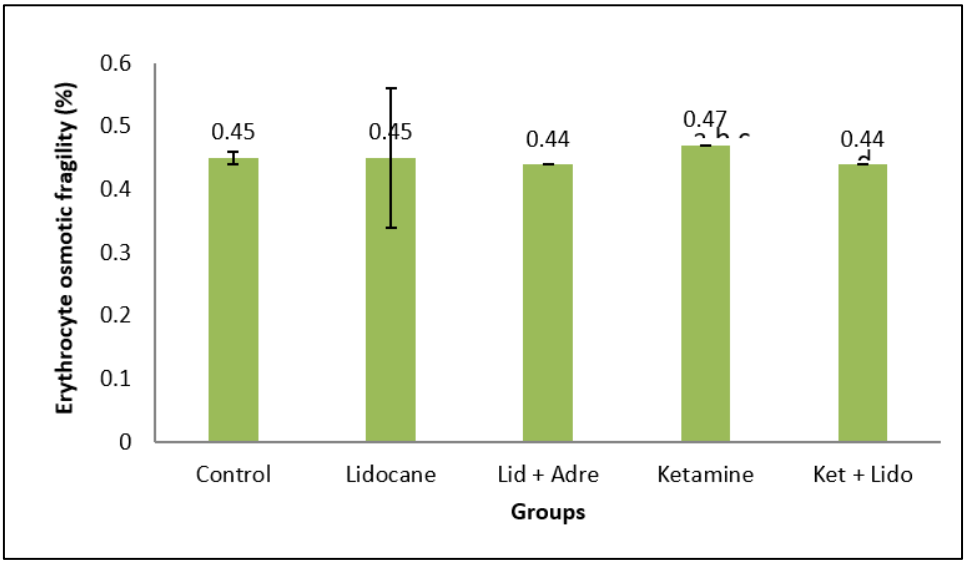

Figure 2: Comparing erythrocyte osmotic fragility in all the experimental groups. Results presented as mean ± SEM. a, b, c, and d = versus control, lidocane, Lid plus adre, and ketamine groups respectively at p<0.05

4. DISCUSSION

The present study has demonstrated that different kinds of anaesthetic agents do not alter the physiology of erythrocyte membrane significantly as indicated in their median corpuscular fragility. The integrity of the erythrocyte membrane envelops and protects the contents of erythrocyte.

Results from this study revealed that anaesthetic agents have no significant effect on the erythrocyte membrane and perhaps may not induce anaemia by haemolysis.

The findings of this present study is in consonance with the reports of some investigators in literatures who reported that anaesthetic agents does not significantly affect osmotic fragility and erythrocyte sedimentation rate (ESR).

Gwebal *et al.* (2012) reported no significant effect of ketamine on erythrocyte sedimentation rate, blood viscosity and osmotic fragility on volunteer human subjects.

Sika (2024) in a different study reported decrease in white blood cell count, red blood cell count, osmotic fragility and erythrocyte sedimentation rate and this report contradicts the reports of the current study.

Although, Sika (2024) study was on goat compared to the wistar rats used in this study. From the findings of the current study, ESR in ketamine use cannot induce inflammation and thus does not predispose users to infection.

5. CONCLUSION

The following conclusions were drawn from the present study:

i. Different kinds of anaesthetic agents does not show the capacity to alter the integrity of erythrocyte membrane, hence cannot induce anaemia.

ii. Anaesthetic agent use does not cause significant change in osmotic fragility and hence cannot predispose user to inflammation and cardiovascular diseases.

6. RECOMMENDATION

i. Erythrocyte sedimentation rate in ketamine use cannot induce inflammation and infection in users

ii. Use of anaesthetics for anaesthesia is encouraged

iii. Anaesthetic use in patient with risk of thrombotic disorders and other cardiovascular diseases is safe

iv. Post-operative inflammation following ketamine use during surgical intervention is rare and minimal,

v. Use of anaesthetic for surgical produce is safe

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