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Evaluation of Effects of Procaine and Propofol on Vascular Blood Flow of Male Wistar Rats

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***Abstract*—Effects of propofol and procaine on vascular blood flow of male wistar rats was studied. A total of Twenty (20) male Wistar rats were acquired for the purpose of the study. The rats were divided into four (4) groups. Group 1 was the control group which received 10ml of distilled water every day for one (1) week; Group 2 received 5mg/kg of procaine every day for one week; Group 3 received 10mg/kg of propofol every day for one (1) week and Group 4 received both 5mg/kg of procaine and 10mg/kg of propofol combined together. At the end of treatment with drugs, the animals were sacrificed and blood samples collected via cervical dislocation into sample bottles. Haematological analysis was done using automated haematology analyzer while evaluation of haemodynamic parameters was using appropriate techniques. Data were analysed using one way ANOVA. Results revealed non-significant change in packed cell volume, blood and plasma viscosity and deformability index in both procaine and propofol groups as well as its combinations. There was also no significant effect on blood pressure (BP) and systemic vascular resistance (SVR). Conclusively, both propofol and procaine does not have the tendency to alter haemodynamic parameters. It enhances vascular blood flow and does not predispose users to thrombosis and thromboembolism.**

***Index Terms*—Propofol, Procaine, Blood Flow, Blood Vessels.**

I. INTRODUCTION

Propofol is an intravenous anaesthetic that causes profound vasodilation by inhibiting sympathetic nervous system (Ihua, 2025). It decreases systemic vascular resistance and Mean Arterial Pressure (MAP) which lowers tissue perfusion and hypotension (Ihua, 2025). It can reduce total microvasculature density and capillary perfusion during active infusion (Manima, 2010).

Procaine is an ester type of local anaesthetic that have vasodilatory properties when absorbed into systemic circulation (Tan, 2012). Systemic circulation induces steady decline in systemic vascular resistance and mean Arterial blood Pressure during continuous intravenous infusion

(Edwinsson, 1982). Procaine effectively blocks hypertensive and tachycardia responses to surgical stimulation without depressing baseline cardiac index or heart rate (Jashi, et al, 2012). It acts as direct relaxant on vascular smooth muscle limiting high dose use primarily due to risk of secondary hypotension rather direct myocardial failure (Joshi et al, 2012).

Propofol and Procaine decreases vascular resistance and blood pressure but they affect specific regional blood flow differently based on their unique pharmacological profiles (Ihau, 2025).

II. METHODOLOGY

Twenty (20) male Wistar rats were purchased from Animal House for the purpose of this study. The animals were fed adequately and allowed for acclimatization for one week before commencement of the experiment. Animals were allowed free access to water and rat feeds (Wheat Offal Enugu) for the duration of the experimentation.

Experimental Design

Group 1: This as the control group. The rats were administered with 10ml/kg of distilled water intraperitoneally every day for one (1) week.

Group 2: Male Wistar rats in this group received 5mg/kg of procaine intraperitoneally every day for one week.

Group 3: Male Wistar rats in this group received 10mg/kg of propofol intraperitoneally every day for one week.

Group 4: Male Wistar rats in this group received both 5mg/kg of Procaine and 10mg/kg of propofol combined together intraperitoneally every day for one week.

Collection of Blood Samples from Experimental Rats

At the end of treatment with drugs, the rats were sacrificed and blood samples collected via cardiac puncture into various sample bottles for haematological and haemorhological investigations using appropriate technique

Determination of Haematological parameters

Blood Samples were collected via Cardiac puncture into EDTA sample bottles and haematological parameters determined using automated haematology analyzer.

Measurement of Red Blood Cell Deformability

Simple filtration method was used to determine red blood cell deformability. It utilizes a membrane filter with pore sizes of 3-5 micrometer. By applying pressure, the whole blood passes through the pores in the membrane filter and deformability determined based on the pressure required to maintain specific flow rate. RBC deformability was calculated from the volume of blood filtered in a certain amount of time as described by Ihua et al; (2005).

Determination of Blood and Plasma Viscosity

Blood and Viscosity were measured using specialized automated viscometers (Brookfield Cone Plate viscometer).

Determination of mean Arterial pressure and Systemic Vascular Resistance
Blood pressure was determined using digital blood pressure apparatus.
Clinically, Systemic Vascular Resistance (SVR) was calculated using the formula:

$$SVR = \frac{MAP - CVP}{CO} X80$$

III. RESULTS

Table 1: Estimation of Some Haematological parameters for control and anaesthetic groups

Groups	RBC	PCV	ESR	HB	MCV	MCH	MCHC
Control	4.8±0.18	39±1.9	3.08±1.1	10+0.8	40±1.2	30±1.5	50.18±0.10
Procaine	4.77±0.18	40±1.8	3.08±1.0	9.9±1.8	41±1.8	31±1.5	51.1±1.0
Propofol	4.76±0.18	3.91±1.8	3.11±1.1	9.88±1.7	40±1.3	30±1.4	50.12±0.10
procaine + propofol	4.69±0.18	38.9±1.8	3.12±1.1	10.1±1.8	40±1.4	31±1.4	49.9±0.10

No Significant Change

Table 2: Estimation of Whole Blood Viscosity, plasma Viscosity and Deformability Index for both Control and anaesthetic groups

Groups	WBV	PV	DI
Control	10±0.1	8.0±0.2	20.20±0.18
Procaine	9.38±0.1	8.1±0.3	19.9±0.18
Propofol	10.1±0.1	8.4±0.2	20.84±0.18
Procaine + Propofol	10.3±0.1	8.0±1.2	19.9±0.17

No significant change

Table 3: Estimation of mean Arterial pressure (MAP), Cardiac output (CO) and systemic Vascular Resistance (SVR) for Control and anaesthetic groups.

Groups	MAP	CO	SVR
Control	60.81 ± 0. 9	25 ± 1.8	18.03 ± 1.0
Procaine	59.85 ± 0.9	24.7 ± 1.8	19.0 ± 1.0
Propofol	61.00 ± 0.8	23.49 ± 1.8	18.04 ± 1.1
Procaine + Propofol	60.9 ± 1.0	25 ± 2.0	19 ± 0.1

No significant effect

IV. DISCUSSION

This study investigated the comparative effects of procaine and propofol on vascular blood flow of male Wistar rats. This study revealed non-significant change in packed cell volume (PCV), blood and plasma viscosity of male Wistar rats when compared to control group. Packed cell volume is a primary determinant of blood viscosity which exerts a direct and profound effect on vascular blood flow, vascular resistance and tissue perfusion. High packed cell volume leads to hyperviscosity. When PCV rises significantly above normal ranges due to dehydration, chronic hypoxia or polycythemia vera, the concentration of Red Blood Cells (RBCs) increases blood thickness and makes it impossible for flow through blood vessels.

Low packed cell volume leads to hemodilution. When PCV drops below normal levels due to anaemia, haemorrhage or intravenous fluid overload, the blood becomes thinner and less viscous. A normal packed cell volume signifies good oxygen transport from the lungs to the tissues. Normal viscosity is essential for maintaining proper function, efficiency and stability in blood flow through blood vessels as it allows blood to flow smoothly through vessels without obstruction.

This study also revealed non-significant change in RBC, Haemoglobin, MCV, MCH and MCHC of male wistar rats. PCV, MCV and MCHC determines how easily blood can flow through blood vessels such as large arteries and microscopic capillaries. These modulate blood flow by directly altering blood viscosity and vascular resistance.

This study also revealed non-significant effect on mean arterial pressure (MAP), cardiac output (CO) and systemic vascular resistance (SVR).

MAP represents the average pressure in the arteries pushing blood flow through tissue beds. If MAP drops below roughly 60mmHg, there will be reduced tissue and organ perfusion.

Due to the interdependence, a change in cardiac output or peripheral systemic vascular resistance directly alters blood pressure.

V. CONCLUSION

Procaine (local anaesthetic), propofol (general anaesthetic) and combinations of both at moderate doses of 5mg (Procaine) and 10mg (propofol) does not have the capacity to alter vascular blood flow. Procaine and propofol anaesthesia enhances normal blood flow in the heart and blood vessels to deliver oxygen and nutrients to the body.

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