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Measurement and Analysis of the Half-Life of Some Viable Anti-Malaria and Analgesic Drugs

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ABSTRACT

This paper is experimental research which focuses on the determination of the pharmaceutical half-life of some analgesic and anti-malaria drugs using the volume of distribution and clearance of the pharmacokinetic processes. Some analgesic and anti-malaria drugs were collected and administered to six healthy young men. Blood and urine samples were collected from each of them after one hour from the time of administration. All the samples for each drug were separated using a Gas chromatography machine to obtain the amount of drug remaining in the blood and the amount eliminated. The obtained values for the volume of distribution (Vd) from the blood samples and clearance (Cl) from the urine samples where mathematically evaluated with the elimination rate constant k=0.693 approximated to 0.7 to give a result with little or no error. The half-life for all samples were obtained and the pharmacokinetic properties and interactions of the drugs analysed. The various half-life obtained from this research certifies and correspond to the manufacturer's published half-life for the analysed drug samples. The high volume of distribution of Tramadol hydrochloride 70l/kg-painkiller, paracetamol 65l/kg-painkiller and artesunate 50l/kg-anti-malarial shows that they are highly absorbed into the body system and are very strong medications. They do not leave the system quickly and affects the physiological state for a long period while the low volume of distribution processes of diclofenac 1.4l/kg-painkiller, arthemeter 11.5l/kg-anti-malaria and quinine 28l/kg-anti-malaria shows a low distribution rate of these drugs, and implies they are less strong medications and does not last long in the body with their relative rates of elimination; Diclofenac 0.895l/kg/hr., arthemeter 2.6l/kg/hr. and quinine 2.4l/kg/hr.

Keywords: *Half-life, Anti-malaria, Analgesic, Drugs, Painkillers, Volume of distribution, Clearance of the pharmacokinetic processes.*

1. Introduction

1.1. Background of the study

All over the world, drugs play a very vital role in human health. It is thought to originate from an old French word "drogue", possibly deriving later into "droge-vate" from Middle Dutch meaning "dry barrels", referring to medicinal plants preserved in them [1]. The use of drugs has been around since time immemorial. People have used drugs for various purposes depending on culture and activities at hand. At most drugs have been known to bring euphoric feelings that change moods of people to pleasurable feelings especially in social celebrations and when people are operating under tension [2]. Because of their ability to relief tension many people use drugs and with the stressful life associated with challenges in contemporary society the number has been on the increase. Hence initiating the use of drugs is always associated with the benefits that it brings to the users.

According to the World Drug Report [3] and Sacks [4], the total number of drug users in the world is now estimated at some 200 million people, equivalent to about 5% of the global population. The UNODC estimates that between 155 and 250 million people (3.5% - 5.7% of the population aged 15-64) use drugs at least once. Consequently it is estimated that there are between 16 and 38 million 'problem drug users' every year.

A drug can is defined as a chemical substance, which has known and observable effects on the body. Food is not included in this classification in spite of its health benefits. A drug is a chemical substance used in the diagnosis and treatment, cure and prevention of health disorders and other medical/biological situations of the human life/body [5]. Drugs otherwise enhance the psychological and physical well-being of humans and animals. Drugs may be taken orally, through injections, intravenously, rubbing, and fixing into the body as directed by the physician. The

use of drugs may be for a limited/short period for casual disorders or on a regular or longer period for chronic disorders [6]. A drug is said to be viable if it still has its chemical compositions or strength active and has not reached expiration from the period of manufacture and is safe or fit for use. Drugs are used in treatment of various diseases such as malaria, pain, etc [7].

On the other hand, malaria is a disease of the blood that is caused by the plasmodium parasites, which is transmittable by a particular type of mosquito. The female Anopheles mosquito primarily bites between the hours of 9pm and 5am, so it is advised to prevent it from biting by the use of mosquito nets and other preventive measure such as anti-malaria drugs [8].

Malaria is a vector-borne infectious disease caused by protozoan parasites of the genus *Plasmodium* and is presently endemic in a broad band around the equator, in areas of the Americas, many parts of Asia and much of Africa, however, it is in sub-Saharan Africa that 85– 90% of malaria fatalities occur [9]. Anti-malaria drugs are medications designed to prevent or cure malaria. Analgesics on the other hand are medications designed mainly to prevent and treat pain disorders in the body.

Pain is an unpleasant sensation that can range from mild, localised discomfort to agony. Pain has both physical and emotional components. The physical part of pain results from nerve stimulation. Pain may be limited to a discrete area, as in an injury or spread over other parts of the body. Pain is mediated by specific nerve fibres that carry the pain impulses to the brain [10].

All drugs produced by a pharmaceutical company have half-life. The half-life is an important parameter that can be used to monitor the rate of deterioration of a drug if the half-life of both viable and non-viable samples of the same drugs is monitored concurrently [11]. Any change in the half life may imply that undesired chemical changes have occurred and that can be used as a pointer to the expiration of the drug. A drug's half-life of elimination from plasma or serum has long been considered a familiar and important pharmacologic property. Elimination half-life is a dependent variable, related directly to volume of distribution and inversely to clearance [12].

1.2. Aim of the study

The various half-life data of the drugs collected for this research have already been published. The question is, why measure half-life again? Data generated from the measurement and analysis of the half-life can be used as a guide to establish the expiration date of a drug. This experiment will be carried out with a Gas Chromatograph, in which, the whole pharmacokinetic of the drugs will be estimated which will give the study and analysis of the processes from which and how the half-life are obtained using the elimination rate constant, the measurement of volume of distribution Vd (L/kg of the body) and clearance Cl (L/kg/hr.). When this half-life data are obtained, they will also give rise to the certification of the manufacturer's published half-life as to whether accurate or not.

1.3. Objectives of the study

The specific objectives for achieving the above aim are;

(1) To measure the volume of distribution of each drug collected for the research,

(2) To measure the rate of elimination of all drugs collected for the research,

(3) To use the measured parameters to compute and analyse the half-life of each medication collected, and

(4) To study the pharmacokinetic processes of an administered drug.

1.4. Statement of problem

When a drug is manufactured and distributed, deterioration sets in due to improper handling, environmental/ atmospheric conditions and age. It begins to lose its potency, strength, and efficiency and incapable of affecting the physiological state of the body for the purpose it is designed.

The half-life is an important parameter that can be used to monitor the rate of deterioration, if the half-life of both viable and non-viable samples of the same drugs is monitored concurrently. Any change in the half -life may imply that undesired chemical changes have occurred and that can be used as a pointer to the expiration of the drug.

1.5. Scope of the work

The scope of this research is limited to the measurement and analyses of the half-life of some Analgesics and Anti-malaria drugs, the study of the pharmacokinetic processes and interactions, effects of action of this drugs in the human body.

2. Literature Review

2.1. Introduction

In reference to the study on the measurement and analysis of the half-life of some viable antimalarial and analgesic drugs, this section presents an up to date review of related literature. The literature was sourced from relevant professional education journals, and published papers.

2.2. Uses of Pharmaceutical Drugs

Since drugs are xenobiotic compounds that are foreign to the body, they have the potentials to cause harm rather than healing, especially when they are used inappropriately or in the wrong dose for the individual patient being treated. As stated by the medieval physician the dose of a drug is enough but not too much [12].

2.3. Pharmacokinetics

Pharmacokinetics is the Study of the absorption, distribution metabolism and excretion (ADME) of drugs (i.e. what the body does to the drug). Pharmacokinetics deals with the processes of absorption, distribution, metabolism and excretion of drugs in the body when administered [13].

2.4. Drug Absorption

Absorption is the process by which the drug enters the systemic circulation from the site of administration through biological barrier. In case of intravenous or intra-arterial administration the drug bypasses absorption processes and it enters into the circulation directly [14].

2.5. Routes of Drug Administration

From the Alimentary Tract:

- ✓ Buccal cavity: e.g. nitrates
- ✓ Stomach: e.g. aspirin, alcohol

- ✓ Intestine: e.g. most of non-ionized and ionized drugs
- ✓ Rectum: e.g. rectal suppositories, bisacodyl laxatives

From the Parenteral Route:

- ✓ Intradermal: This is given into the layers of the skin e.g., Bacillus Calmette-Guerin (BCG) vaccine
- ✓ Subcutaneous: Non-irritant substances are given into subcutaneous tissue e.g. insulin
- ✓ Intramuscular: Soluble substances, mild irritants, suspensions and colloids can be injected by this route. These injections can be given to deltoid or gluteal muscle. This route is one of the more common routes e.g. multivitamins, streptomycin, etc
- ✓ Intravenous: Drugs directly given into a vein, produce rapid action, no need of absorption as they enter directly into blood, can be given as bolus e.g. furosemide, morphine, dopamine or as continuous infusion e.g. fluids during shock or dehydration.
- ✓ Intrathecal: Injected into subarachnoid space of spinal cord e.g. spinal anesthetics.

2.6. Factors Affecting Drug Absorption and Bioavailability

(A) Physico-Chemical Properties of Drug:

(i) Physical state: Liquids are absorbed better than solids and crystalloids absorbed better than colloids.

(ii) Lipid or water solubility: Drugs in aqueous solution mix more readily than those in oily solution. However at the cell surface, the lipid soluble drugs penetrate into the cell more rapidly than the water soluble drugs.

(iii) Ionization: Most of the drugs are organic compounds. Unlike inorganic compounds, the organic drugs are not completely ionized in the fluid. Unionized component is predominantly lipid soluble and is absorbed rapidly and is often water soluble component which is absorbed poorly. Most of the drugs are weak acids or weak bases. It may be assumed for all practical purposes, that the mucosal lining of is impermeable to the ionized form of a weak organic acid or a weak organic base.

2.7. Distribution of Drugs

The penetration of a drug to the sites of action through the walls of blood vessels from the administered site after absorption is called drug distribution. Drugs distribute through various body fluid compartments such as

(a) Plasma

(b) Interstitial fluid compartment

(c) Trans-cellular compartment

2.8. Apparent Volume of Distribution (Vd)

The volume into which the total amount of a drug in the body would have to be uniformly distributed to provide the concentration of the drug actually measured in the plasma. It is an apparent rather than real volume.

2.9. Factors Determining the Rate of Distribution of Drugs

✓Protein binding of drug: A variable and other significant portion of absorbed drug may become reversibly bound to plasma proteins. The active concentration of the drug is that part which is not bound, because it is only this fraction which is free to leave the plasma and site of action.

✓Plasma concentration of drug (PC): It represents the drug that is bound to the plasma proteins (albumins and globulins) and the drug in free form. It is the free form of drug that is distributed to the tissues and fluids and takes part in producing pharmacological effects.

✓Clearance: Volume of plasma cleared off the drug by metabolism and excretion per unit time. Protein binding reduces the amount of drug available for filtration at the glomeruli and hence delays the excretion, thus the protein binding reduces the clearance.

✓Physiological barriers to distribution: There are some specialized barriers in the body due to which the drug will not be distributed uniformly in all the tissues. These barriers are: affinity of drugs to certain organs etc.

2.10. Metabolism of Drugs

Drugs are chemical substances, which interact with living organisms and produce some pharmacological effects and then, they are eliminated from the body unchanged or by changing to some easily execrable molecules. The process by which the body brings about changes in drug molecule is referred as drug metabolism or biotransformation [15].

2.11. Excretion of Drugs

Excretion of drugs means the transportation of unaltered or altered form of drug out of the body. The major processes of excretion include renal excretion, hepatobiliary excretion and pulmonary excretion. The minor routes of excretion are saliva, sweat, tears, breast milk, vaginal fluid, nails and hair. The rate of excretion influences the duration of action of drug [16].

2.12. Routes of Drug Excretion

✓Renal excretion: A major part of excretion of chemicals is metabolically unchanged or changed. The excretion of drug by the kidney involves.

✓Hepatobiliary excretion: the conjugated drugs are excreted by hepatocytes in the bile. Molecular weight more than 300 Daltons and polar drugs are excreted in the bile. Excretion of drugs through bile provides a backup pathway when renal function is impaired. After excretion of drug through bile into intestine, certain amount of drug is reabsorbed into portal vein leading to an enter hepatic cycling which can prolong the action of drug e.g. chloramphenicol, oral estrogen are secreted into bile and largely reabsorbed and have long duration of action. Tetracycline is excreted by biliary tract can be used for treatment of biliary tract infection.

2.13. Clearance of a Drug

It is the volume of drug cleared from the plasma by metabolism (hepatic) and excretion (renal) and other organs.

Total clearance will be calculated by,

$$Ct = Ch + Cr + C\ others \quad (1)$$

$$Ct = total\ clearance \quad (2)$$

Where,

Ch = hepatic clearance

Cr = Renal clearance

2.14. Half-Life

The period of time required for the concentration or amount of drug in the body to be reduced to exactly one-half of a given concentration or amount. The given concentration or amount need not be the maximum observed during the course of the experiment, or the concentration or amount present at the beginning of an experiment, since the half-life is completely independent of the concentration or amount chosen as the "starting point [17]. Half-lives can be computed and interpreted legitimately only when concentration or amount varies with time according to the law appropriate to the kinetics of a first order reaction: the common logarithm of the concentration or amount is related linearly to time, e.g.:

$$\text{Log } C = a + b \quad (3)$$

Where C is concentration at time t, a (in logarithmic units) is the intercept of the line with the ordinate, and b (which has a negative sign) is the slope of the line.

Effectiveness Half-Life

The time it will take a substance to lose its effectiveness on the biological system by half is referred to as the effectiveness half-life.

Potency Half-Life

When a chemical substance loses its potency by half-life the original potency, the time it takes for the process to occur is known as the potency half-life.

Efficacy of Half-Life

Efficacy of half-life is a measure of the maximum biological effect that a drug can produce as a result of receptor binding. Therefore, the amount of time it will take for a drug to lose or reduce the maximum biological effect by 50% of whatever amount it has is the efficacy half-life of that drug.

Half-Life ($T_{1/2}$) Measurement

First Order Elimination

This is a circumstance where the half-life varies with the concentration of the drug. Half-life under this circumstance is proportional to the initial concentration of the drug A_0 and inversely proportional to the Zero-order rate constant K_0.

$T_{1/2} = 0.5\ A_0 / K_0$ (4)

This process is a logarithmic process that is a constant proportion of the agent is eliminated per unit time.

A fall in plasma concentration after the administration of a single dose is described by the following equation

$C_t = C_o e^{-kt}$ (5)

Where;

C_t = Concentration after time t

C_o = Initial concentration (t=o)

k= Elimination rate constant

The relationship between the elimination rate constant and half-life is given by the following equation.

$K = \ln 2 / t_{1/2}$ (6)

Half-life is determined generally by clearance (Cl) and volume of distribution (Vd) and the relationship is described by the following equation.

$T_{1/2} = \ln 2 * Vd / Cl$ (7)

2.15. The Physics of Gas Chromatography

The Gas chromatograph functions with the supply of electrical power ranging from 0-450 volts. It has sections such as the injector, detector, separation columns and the gas flow section. The injector receives the samples to be analyzed, the detector does the work of detecting the components of the samples, the separation columns do the work of separating the substances in to different columns and very high voltage up to 450 volts depending on the model of the Gas Chromatography, the gas flow section contains the gasses used to flush the samples to the separation columns through to the excretion point [18]. The analyzing section gives an output for a personal computer to enhance data analysis on the PC.

3. Materials and Methods

This chapter enumerates and explains the materials, methods and procedures used in carrying out the experiments and measurement of the physical parameters (Vd and Cl) for the analysis of the half-life of drugs.

3.1. Equipment/Materials Used For the Research Analysis

- ✓ Gas chromatograph (GC-2010 Plus)
- ✓ Needle and syringe
- ✓ Small bottle containers
- ✓ Distilled water
- ✓ Tissue paper
- ✓ Filter paper

- ✓ Nitrogen gas
- ✓ Personal computer
- ✓ Power supply

3.2. Drug Samples

The samples collected for the research work are; Artesunate, Arthemeter Paracetamol, Diclofenac, Tramadol, and Quinine all viable. The samples were collected from Juruth pharmacy and store, at B-division, high level, Makurdi, Benue state Nigeria.

3.3. Methods

Blood and the urine are the most commonly used biological fluids in the analysis for drugs other than alcohol. Blood, obtained by an invasive procedure, is available only in small quantities and drug concentration level in blood is typically low.

Fig.1. A Gas chromatograph

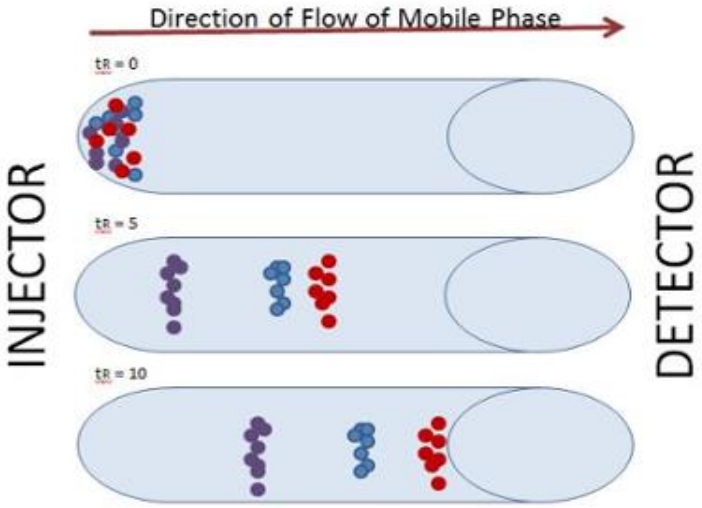

Fig.2. Starting and finished analysis of a sample in a Gas chromatograph

Urine is the preferred sample of choice as it is available in larger volumes, contains the metabolites and requires less invasive procedures in its collection. Both sampling procedures, however are limited in their ability as only determine the absolute amount of drug present in the fluid being examined. This quantity is dependent upon the amount of the drug used, when it was administered, as well as the half-life of the drug.

The method for the measurement of these two samples (urine and blood samples) for this research is the Gas Chromatography. Separation of mixtures is the main outcome of the chromatography method. It is a process where a mixture is separated in a stationary medium.

3.4. Calibration of the G.C (GC-2010 plus)

Before starting the calibration procedure, the Gas Chromatography instrument was checked, the column was appropriate to the solution used to the calibration, the flows of gases were checked to okay, the temperatures of injector, column, detector, and possible leaks of gases were also checked and made sure the Gas Chromatography instrument were ready to make analysis.

3.5. Procedure

The half-life of the drug samples collected for this research were determined by the measurement of the volume of distribution (Vd) and clearance (Cl) of the samples obtained from Gas Chromatography. Six (6) healthy young men volunteered to partake in the experiment all in the age group between 20-25 years. They were labelled $V1, V2, V3, V4, V5, and\ V6$ respectively. The six (6) drug samples were administered to each of them at the same time. Then blood and urine samples collected just after 1 hour hence the parameters are measured per hour. The samples were administered as follows; V1-sample1 (Tramadol 200mg), V2-sample2 (Paracetamol 500mg), V3-sample3 (Diclofenac 100mg), V4-sample4 (Artesunate 50mg), V5-sample5 (Arthemeter 80mg) and V6-sample6 (Quinine 600mg). Urine and blood sample where collected as labelled samples 1, 2, 3, 4, 5 and 6 in small bottle containers. The samples separately separated and analysed one after the other where introduced into a narrow bore (capillary) column which sits in an oven through a syringe. The column which typically contains a liquid absorbed onto an inert surface is flushed with nitrogen gas. The samples introduced into the column were volatilized, and then the separation of the drug from the urine and or blood samples occurred as each substance migrated through the column at different speeds. The readings for the amount of drug separated from the urine and blood samples were taken and tabulated as Vd (amount of drug from the blood samples) in litters per kilogram and Cl (amount of drug from the urine sample) in litters per kilogram per hour. Half-life of the samples where then computed from Vd and Cl using the elimination rate constant k.

k= 0.693 approximately 0.7. With the relationship

$$T_{1/2} = vd \times k \div cl \qquad (8)$$

4. Results

This section gives the table and graphical analysis of the measured parameters used for the determination of the half-lives of the samples used in this research. The graphical and chart representations of the analysis of the elimination rate of the drug concentration and the half-life of the various samples. The parameters that were

measured in the experiment to determine the half-lives of the respective drug samples are the volume of distribution (Vd) and the rate of elimination (Cl).

The dose in "mg", sample manufacture date and the sample expiry date were also put to consideration during the experiment and analysis.

Below is the representation of the result and analysis in a table and graphical form to give an insight on how the half-life was obtained with live first order elimination and two equation of half-life and how a sample is eliminated.

$$T\frac{1}{2} = Vd * 0.7/Cl \qquad (9)$$

Where,

Elimination rate constant=0.7

Table 1. Half-life analysis of Analgesics

Samples	Dose (Mg)	Mfg. Date	Expiry Date	Vd (l/kg)	Cl (l/kg/hr)	99% Elimination time (hrs)	No of half life	Half-life $T_{1/2}$
Tramadol	200	7/2018	4/2022	70.0	6.40	49	7	7
Paracetamol	500	2/2017	5/2022	65.0	20.0	15.4	7	2.2
Diclofenac	100	9/2018	9/2023	1.4	0.0895	2.2	2	1.1

Tramadol hydrochloride with a half-life of 7hrs and total elimination time 49hrs, this implies it will be administered once in a day due to the time of total elimination time. Paracetamol with a half-life of 2.2 hrs, total elimination time of 15.4hrs and can be administered about 3-4 times in a day. Diclofenac possess a half-life of 1.1hrs which is small, therefore it has a total elimination time of 2.2hrs and it can be administered about 3-4 times a day.

Table 2. Half-life analysis of anti-malarias

Samples	Dose (mg)	Mfg. Date	Expiry Date	Vd (l/kg)	Cl (l/kg/hr)	99% elimination time (hr)	No of half life	Half-life $T_{1/2}$
Artesunate	50	9/2018	7/2022	50.0	1.00	4	6	0.58
Arthemeter	80	3/2018	3/2022	11.5	2.60	12	4	3
Quinine	200	6/2018	1/2022	28.0	2.40	40	5	8

4.1. Anti-malaria analysis

Artesunate has a very short half-life of 35mins with a 4hrs total elimination time and the implication that it can be taken 3 times in a day. Arthemeter with a half-life of 3hrs and a total elimination time of 12hrs shows that it can only be taken 2 times in a day. Quinine which has a long half-life of 8hrs and a total elimination time of 40hrs implies that it can only be taken ones in 40 hrs.

Table 3. Results of all samples

Vd against sample		**Cl against sample**		**T1/2 against sample**	
samples	**Vd (ml/kg)**	**samples**	**Cl (ml/kg/hrs.)**	**samples**	**Cl (ml/kg/hrs.)**
Tramadol	70000	Tramadol	6400	Tramadol	7
Paracetamol	65000	Paracetamol	20000	Paracetamol	2.2
Diclofenac	1400	Diclofenac	895	Diclofenac	1.1
Artesunate	50000	Artesunate	1000	Artesunate	0.58
Arthemeter	11500	Arthemeter	2600	Arthemeter	3
Quinine	28000	Quinine	2400	Quinine	8

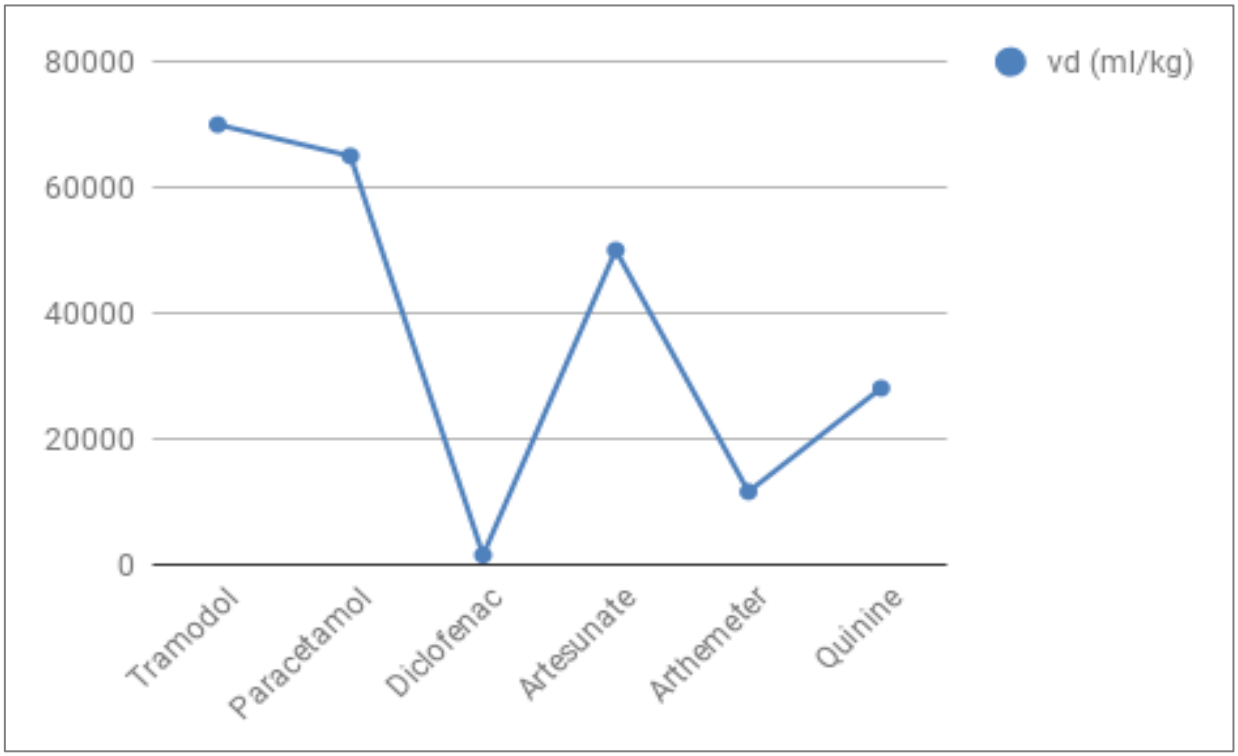

Fig.3. An Analysis of the Volume of Distribution of the all the Drugs

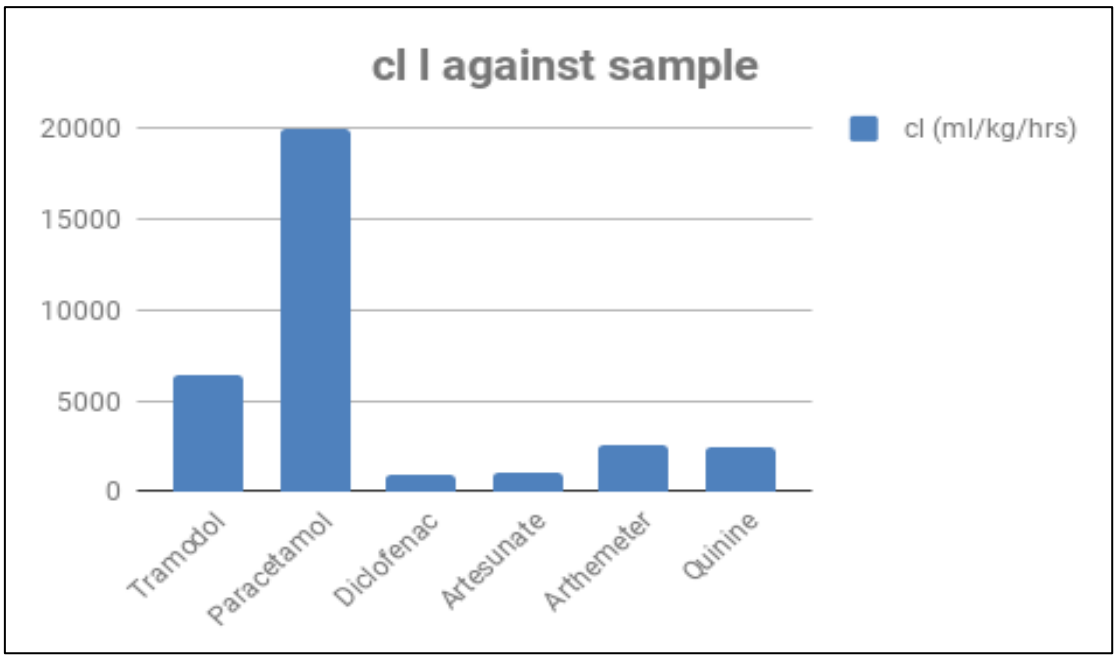

Fig.4. A Sample Chart with Quinine showing the longest half-life and artesunate with shortest half-life

5. Discussions

The results obtained from this experimental research gives an analysis of the half-life of the respective anti-malaria drugs and analgesics used for the research. The drug samples are; Tramadol hydrochloride, paracetamol, diclofenac, artesunate, arthemeter and quinine. The parameters measured are the volume of distribution (Vd) and rate of elimination (Cl) from which the drug's half-life were computed and the elimination rate constant 0.7. The most important parameter of a drug metabolism is the Vd. Cl is as well important, it is a parameter which enhances the determination of the half-life of a drug.

In this experimental paper, the Vd of tramadol was measured to be 70l/kg/, this shows that the drug is rapidly absorbed and distributed into the body after administration. It also shows the drug has high efficacy, potency and strength and it will take long periods of half-life to totally eliminate the drug from the body system. With its clearance obtained to be 6.40l/kg/hr., it shows that tramadol hydrochloride has a long elimination half-life periods of about 7 half-life. Vd of paracetamol was measured to be 65.0l/kg, Cl of 20l/kg/hr. and half-life of 2.2hrs. This shows that it will take long half-lives to totally eliminate it from the body system and has high efficacy, potency and strength. It is rapidly distributed in to the system as well. Diclofenac on the other hand has very low Vd of 1.4l/kg which means it is poorly distributed and would take very short periods of half-life to totally eliminate it from the system as it shows clearance of 0.895l/kg/hr. and half-life of 1.1hr. It will take only about 1-2 periods of half-life to reach steady state (eliminated totally from the body). The Vd of artesunate was obtained to be 50l/kg, Cl of 1.0l/kg/hr. and half-life of 0.58hrs (35mins). This implies a long period of half-life to totally eliminate it from the body but it shows a very short half-life based on the low Cl. It as well shows high efficacy, potency and strength of physiological effectiveness and a rapid distribution concentration. Vd of arthemeter was measured to be 11.5l/kg, Cl of 2.6l/kg/hr. and a half-life of 3hrs. This shows that arthemeter has an average distribution rate, low Cl and average half-life. This means its efficacy, potency, and strength will be on an average level. Quinine had a

measurement of Vd 28l/kg, Cl of 2.4l/kg/hr. with a computed long half-life of 8hrs. This result shows a long period of half-life will be needed to totally eliminate the drug from the body, it has high efficacy, potency and strength. It is distributed in a low amount and is slowly eliminated. When a drug is still viable, it does not alter its half-life in the body system when administered and as well does not alter the pharmacokinetic processes.

The half-life of the drugs is not altered by the shelf life of that drug. Also, the dose of a drug does not change its half-life. It may alter the Vd and Cl but in a manner that it will still produce the same and accurate half-life of that drug. Other factors that would cause a variation in the Vd and Cl of a drug include: the weight of the person taking it, the drug absorbing fats, state of health, etc. A drug with short period of half-life may be prolonged due to severe health disorder as its pharmacokinetic processes in the body may be slowed down. A healthy person may shorten the half-life periods of a drug due to perfection in the pharmacokinetic processes of the drug.

Figure 1 shows the analysis of the analgesics pointing out their half-life, time of total elimination and number of half-lives. Irrespective of the dosage, tramadol shows a longer half-life of seven hours, seven half-life periods and a long period of elimination with forty nine hours. Paracetamol with a shorter half-life than tramadol two hours plus, elimination time rate of fifteen hours plus and a 7 hours periods of half-life. From the table, diclofenac possess the shortest half-life of one hour, two half-life periods and a total elimination time of two hours. In Figure 2, the analysis of the anti-malarias shows artesunate possesses the shortest half-life of thirty-five, four hours elimination time, it has six number of half-life periods. Arthemeter with three hours half-life, twelve hours total elimination time and possesses four half-life periods. Quinine shows a longer half-life of eight hours, forty hours total elimination time and five half-life periods. Chart 1 shows the analysis of the volume of distribution of the all the drugs used in this work. Tramadol is most rapidly distributed while diclofenac has a lowest rate of distribution. Chart 2 shows that paracetamol is most rapidly cleared from the body system while diclofenac is lower in clearance rate as well. The various half-lives of all the samples are displayed in the chart 3 with Quinine showing the longest half-life and artesunate with shorter half-life. (Michael E.W., 2003).

6. Conclusion

The high Vd of Tramadol hydrochloride 70l/kg-painkiller, that of paracetamol 65l/kg-painkiller and artesunate 50l/kg-anti-malarial shows that they are highly absorbed into the body system and are very strong medications. They do not leave the system quickly and affects the physiological state for a long period. Their respective Cl; tramadol hydrochloride 6.40l/kg/hr.-painkiller, paracetamol 20l/kg/hr.-painkiller and artesunate 1.0l/kg/hr. show that they are slowly eliminated relative to their high Vd and lasts long in the body system. The low Vd of diclofenac 1.4l/kg-painkiller, arthemeter 11.5l/kg-anti-malaria and quinine 28l/kg-anti-malaria shows a low distribution rate of these drugs, and implies they are less strong medications and does not last long in the body with their relative rates of elimination; Diclofenac 0.895l/kg/hr., arthemeter 2.6l/kg/hr. and quinine 2.4l/kg/hr. Analytically, tramadol hydrochloride has 7 half-life periods, 49hrs total drug elimination time and a dose of any amount once in 2days. Paracetamol has 7 half-life periods, 15.4hrs total elimination time and dose of any amount twice in 1day. Diclofenac with 2 half-life periods, 2.2hrs total drug elimination time and a dose of any amount 4 times in 1day. Artesunate has 6hrs half-life periods, 4hrs total elimination time, dose of 3-4 times in 1day of any amount.

Arthemeter has 4 half-life periods, 12hrs total elimination time and does of any amount once in 1-2days. A viable drug would interact almost 100% accurately with the biological body system if administered to healthy and unhealthy persons while non-viable drugs would either be non-effective or hazardous. The various half-life obtained from this research certify and correspond to the manufacturer's published half-life for the analysed drugs samples

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Consent for publication

The authors declare that they consented to the publication of this research work.

Availability of data and material

The authors are willing to share the data and material according to relevant needs.

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