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Vol. 10(10), pp. 329-334, 30 May, 2015
DOI: 10.5897/IJPS2014.4205
Article Number: 83973DE53641
ISSN 1992 - 1950
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International Journal of Physical Sciences

Full Length Research Paper

Oscilating magnetic field an anti malaria therapy

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Received 3 September, 2014; Accepted 13 January, 2015

The effect of oscillating magnetic fields (OSMF) on malaria infected albino rats of about three weeks old was investigated. Ten malaria parasite - infected rats were obtained from the Department of Parasitology, University College Hospital Ibadan. The rats were randomly divided into an experimental and a control groups, of five animals each. The rats in the experimental group were exposed to OSMF of 41mT for fourteen consecutive days after fourteen days of acclimatization. Results obtained from the experimental group showed that the level of the pack cell volume (PCV) gradually increased during exposure whereas the parasitamial level (PD) decreased. Results from the control group showed that the level of the PCV decreased significantly and that of the parasitamial level (PD) increased significantly over time. The results suggest that malaria could be cured with the use of OSMF,

Key words: Oscillating magnetic field, *Plasmodium falciparium*, *Plasmodium vivax*, *Plasmodium ovale*.

INTRODUCTION

In recent years, there has been an increase in reported cases of ineffectiveness of anti-malaria drugs, which is traced to the resistance of malaria parasite (Plasmodium) to the drugs (Jean et al., 1999). In Nigeria, this has been traced to persistent use of adulterated anti-malaria drugs, (Akuyili, 2005). The ineffectiveness of the available anti-malaria drugs has led to the use of combination therapy, which is the spontaneous administration of two to three malaria drugs at a time (Feng et al., 2003). The increase in reported emergence of multiple resistances of the malaria parasites to this mode of therapy has increased the urgency of need of an alternative strategy for destroying malaria parasites. This is in essence the main aim of this study.

Malaria is a vector borne infectious disease caused by protozoan parasite of the genus plasmodium. Only four types of the parasite can affect humans. These are the *Plasmodium falciparium, Plasmodium vivax,* and *Plasmodium ovale,* and *Plasmodium malariae* (Alex, 2001). *P. falciparum* is the most common cause of infection and responsible for about 80% of all the severe malaria cases. It is also responsible for about 90% of the death from malaria. *P. vivax* and *P. ovale* are responsible for chronic malaria infection. These Plasmodia reside and develop to a full stage within the liver and stream into the blood system. Thus the immediate malaria diseases associated with the *P. vivax* and *P. ovale* in any other organ of the body is not yet known.

P. falciparium in full development within the blood has been observed to feed on the globin part of the hemoglobin, the pigment found in red blood cells. The iron-containing heme portion of hemoglobin is left intact within the parasite. Heme is very toxic to the *P. falciparium*. In order to eliminate the toxic effects of the free heme, *P. falciparium* binds the heme together into a polymer called hemozoin whichacts essentially like a tiny

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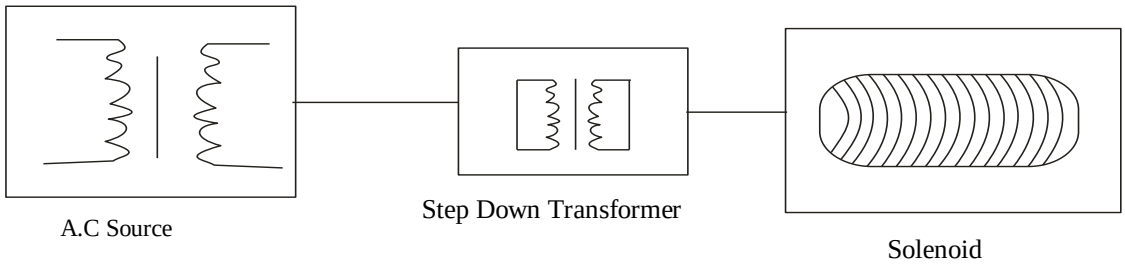

Figure 1. Schematic diagram showing the block diagram of the connection of the AC power source, the step down transformer and the solenoid.

bar magnet, (Henry, 2000). Hemozoin is not toxic, thus aids the existence of the plasmodium parasite in the blood.

The discovery of Henry (2000) suggested that a possible cure to malaria infection as caused by *P. falciparium* parasite may be obtained if a toxic environment due to the hemes can be maintained within the blood. This can be achieved if an external device can be put in place to break up the tiny bar magnets (HERMOZOINS) formed by the *P. falciparium* parasite back into heme as they are formed and thus renders the blood environment toxic to the Plasmodium parasites. With this background, this study is set to examine the effects of oscillating magnetic field on the hemozoins formed by the *P. falciparium* parasite.

MATERIALS AND METHODS

Animals

Ten malaria parasite-infected with *P. falciparium* albino rats of about 2 to 3 weeks old and of average weight of about 65 g were used for this study. These rats were obtained from the Department of Parasitology University College Hospital (UCH), Ibadan, Nigeria.

Materials

The materials used for this study are: a solenoid, a wooden cage kept in the animal house of the Adekunle Ajasin University, cereal pellet and 12 V step down transformer. The solenoid is an electrical device generally used to generate magnetic field. It is constructed from a cylindrical wooden frame of length 0.615 m, with a diameter 0.595 m, on which 2950 turns of coil of 0.05 mm diameter copper wire is wound. An alternating current power source (AC) is connected to the solenoid through a 12 V step down transformer, which helps to produce an AC current output of 5.50A, (Figure 1).

Procedures of experiment

Ten albino rats of about 2 to 3 weeks old and of an average weight of 65 g infected with malaria parasite were used for this study. These rats were housed in a wooden cage at room temperature (25 to 27°C) maintained in a normoxic condition for 2 weeks under a 12 h-light-dark cycle. They were fed regularly with a standard cereal pellet and water for two weeks. This two week period was meant to ascertain full maturation of the malaria parasite in the rats. Two of the rats were found to be too weak for the experiment and died on the fifth day. Blood samples from the rats were taken at a day interval for the two weeks. The samples were put in an anticoagulant bottle and taken to Adekunle Ajasin University Health Centre for parasite growth investigation. The weight of each rat was taken every three days. After these first two weeks, the rats were randomly divided into an experimental and a control group, each group contained four rats. The rats in the experimental group were all placed in the solenoid where they were exposed to the OSMF of 41mT, 10 h per day for fourteen consecutive days at the sametime.

Blood samples of rats in the experimental and control groups were again taken every other day and on the last day of the experiment after each exposure. Parasite growth in the blood was investigated.The sampled blood from the rats was observed under a microscope with high resolving power. The observation for the degree of parasitamia (PD) from the microscope was classified as:

(i) 5 to 10% of cells were parasitized and symbolized as +
(ii) 10 to 20% of cells were parasitized and symbolized as ++
(iii) 20 to 30% of cells were parasitized and symbolized as +++.

These (PD) as expressed this way shows the level of the malaria parasite expressed by the number of plus signs. The packed cell volume (PCV) percentage calculation of the blood sample was obtained using the expression:

$$PCV = \frac{W.B.C}{Total\ Packed\ Cell}, \quad (1)$$

Where W.B.C is the white blood cell count.

RESULTS AND DISCUSSION

The average weights of the rats in the experimental and control groups before exposure to OSMF are shown in Figure 2. The curves show that for the first five days of acclimatization, the rats fed well on the pellets provided as a result the average weight of the rats increased and they are very active. From the fifth day the average weight of the rats decreased and there activity level also decreased.

Values of PCV and PD before exposure to OSMF of the rats in the two group are put together in Tables 1 and 2. Table 1 shows the calculated values of PCV of the blood samples of each of the four rats for the rats in the

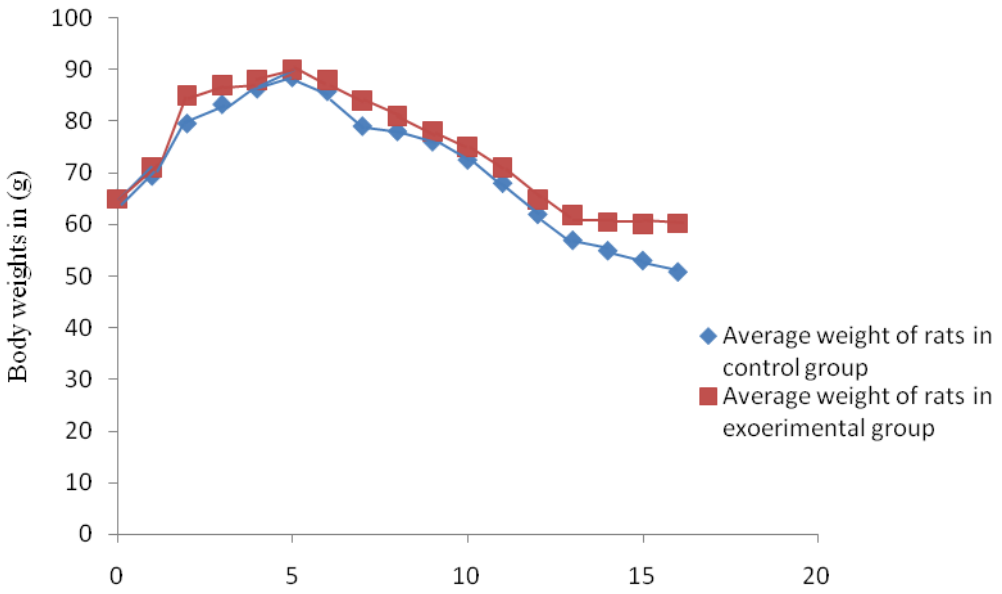

Figure 2. Variation of average body weight of the rats in the both control and the experimental groups exposure to OSMF.

Table 1. Calculated values of the PVC and PD for each of the rats in the control group for the first fourteen days.

Animal	1st Blood Sample		2nd Blood Sample		3rd Blood Sample		4th Blood Sample		5th Blood Sample	
	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)
1st Rat	++	42	+++	36	+	31	+	27		21
2nd Rat	++	38	++	30	+	27	+	21		12
3rd Rat	++	32	+	27	+	22	+	18	+++	12
4th Rat	++	41	+	32	-	23	+	15		13

control group. They changed from 42 to 21%, 38 to12%, 32 to 12% and 41 to 13%, during the period, all in downward trend. Since these values were computed from Equation (1), this downward trend in the values of the PCV was attributed to the decrease in white blood cells. Evidently the red blood cells have greatly reduced by the attack of the hemoglobin by malaria parasite. This we believe has adversely affected the eating habit of the rats, and thus the appreciable decrease in the weight of the rats. The graphical variation of the PCV of the control rats with days of acclimatization is shown in Figure 3.

In Table 2, the calculated value of PCV of the blood samples of each of the four rats in the experimental group,showed changes vary from 48 to 18%, 35 to 17%, 40 to 14% and 36 to 13%, all again in the downward trends. The graphical variation of the PCV of the rats in the experimental group with number of days is shown in Figure 4.

Table 3 contains the calculated values of PCV from the blood samples obtained after a 10 h exposure to OSMF of the rats in the experimental group during exposure. The variation of the PCV with number of days for each rat is shown in Figure 5.

The first column in Table 3 contains the calculated values of PCV and PD of the blood samples collected from each rat in the experimental group on the first day of treatment (exposure). This coincides with the day when the last values of the PCV and PD for the rats before they were exposed to OSMF. There was no marked difference in PCV and PD between these values in first column of Table 3 and those in column four in Table 2. The first rat of the experimental group showed an increase PD after the fourth day of exposure, with PCV rising to 37%. The PCV of the second, third and fourth rats remarkably increased to 29, 30 and 22% respectively. This is an indication that the number of the malaria parasites has decreased in these rats. The trend changed as from the eight day as the values of the PCV for all the four rats respectively assumed constant average values of 40, 37, 31 and 41%. Consequently, there was a rapid decrease in the PD reported for all the experimental rats within this period, (8th to 14th days).

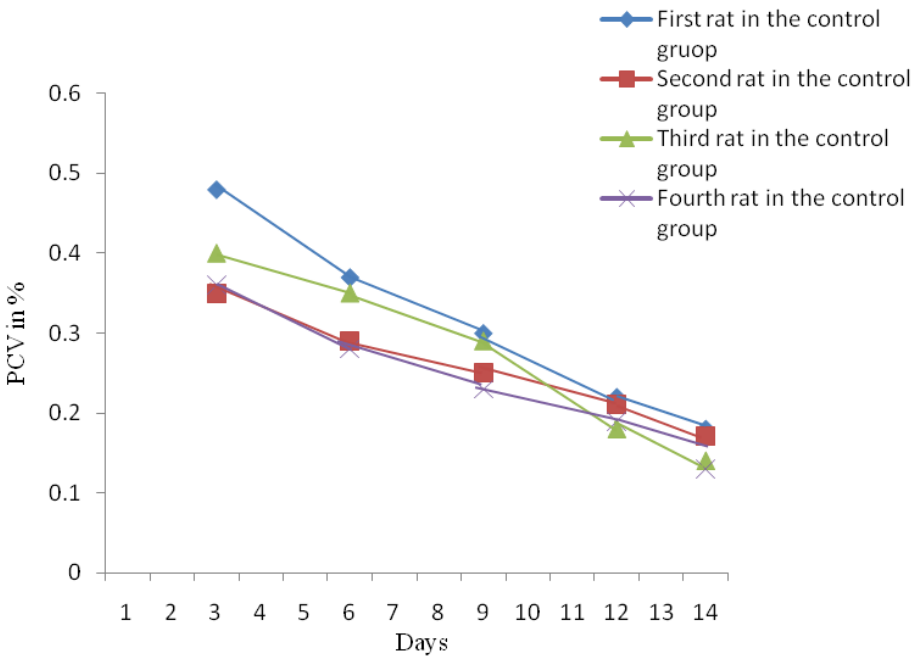

Figure 3. Variation of the PCV of rats in the control group against the number of days.

Table 2. Calculated values of the PVC and PD for each of the rats in the experimental group before exposure to OSMF after two weeks.

Animal	1st Blood sample		2nd Blood sample		3rd Blood sample		4th Blood sample		5th Blood sample	
	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)
Rat 1	+	48	++	37	+++	30	+++	22	++++	18
Rat 2	++	35	++++	29	++++	25	++++	21	++++	17
Rat 3	+	40	++	35	++++	29	++++	18	+++	14
Rat 4	+	36	+++	28	++++	23	++++	19	++++	13

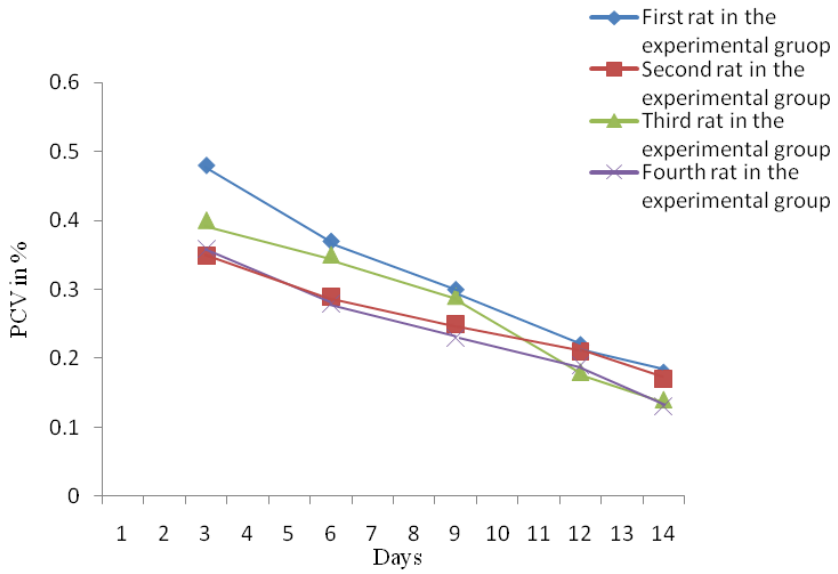

Figure 4. Variation of the PCV of rats in the experimental group against the number of days before exposure to OSMF.

Table 3. Calculated values of the PVC and PD for each of the rats in the experimental group after a 10 h exposure to OSMF for two weeks.

Animal	1st Blood sample		2nd Blood sample		3rd Blood sample		4th Blood sample		5th Blood sample		6th Blood sample		7th Blood sample	
	PD	PVC (%)	PD	PCV (%)	PD	PVC (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)	PD	PCV (%)
Rats 1	++	18	++	37	+	42	+	41	+	40	+	40	+	40
Rats 2	++	17	++	29	++	37	+	38	+	38	+	38	+	37
Rats 3	+	14	++	30	++	32	+	31	+	39	+	31	+	31
Rats 4	+	13	++	22	++	37	+	41	+	40	+	40	+	41

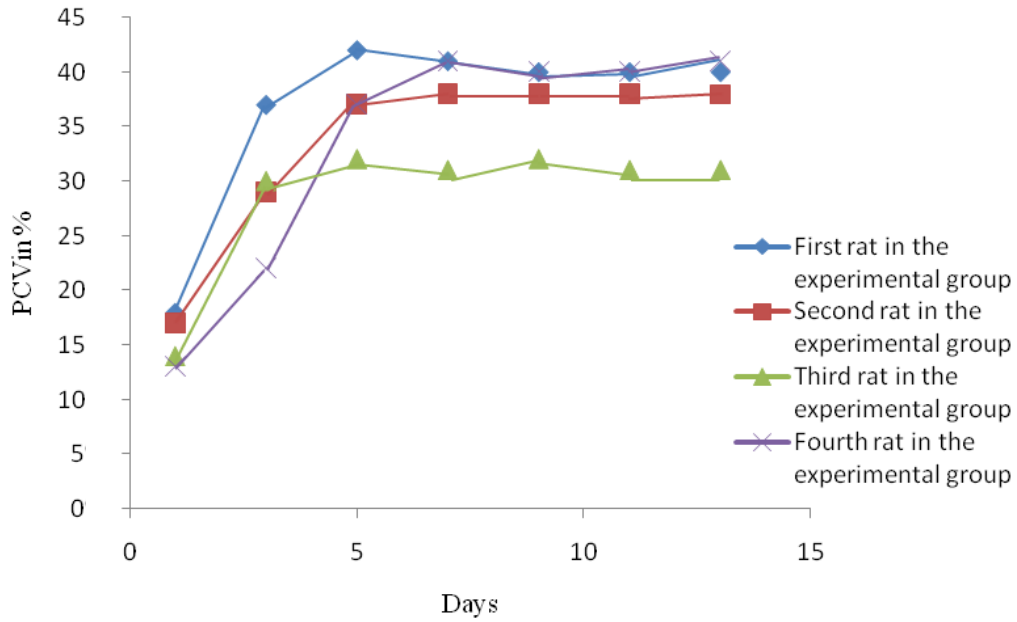

Figure 5. Variation of the PCV of rats in the experimental group after 10 h each day exposure to OSMF.

Table 4. Calculated values of the PCV and PD for each of the rats in the control group after the first two weeks of acclimatization.

Animal	1ST Blood Sample		2nd Blood Sample		3rd Blood Sample		4th Blood Sample		5th Blood Sample		7th Blood Sample	
	PD	PVC (%)	PD	PCV (%)	PD	PVC (%)	PD	PCV	PD	PCV	PD	PCV
1ST Rat	++	21	++	15	+++	09	----	---	-----	---	----	---
2nd Rat	++	12	+++	07	+++	---	----	---	-----	---	----	---
3rd Rat	+	12	+++	06	++	---	----	---	-----	---	----	---
4th Rat	+	13	+++	06	++	---	----	---	----	---	----	---

Table 4 contains the calculated values of PCV and PD for the control group after the first two weeks of acclimatization. The calculated values of the PCV decrease rapidly to a very negligible values when the third blood sample was taken after the first fourteen days of acclimatization for the first rat, while this rapid decrease was observed in the second sample for other rats. The measure PD equally increased. The four rats were very weak at this instance and they eventually died after the third blood samples were taken from them. For this reason, PCV and PD values were not obtained after that time.

Conclusion

The main aim of this study was to investigate an alternative therapy for malaria using an external agent which can successfully be used to separate the hemozoin into the hemes so that a toxic environment is maintained within the blood as long as the malaria parasite are present in the blood stream of the host. The results from this study have shown that an oscillating magnetic field can be used for this purpose. The curative effect obtained through the use of OSMF suggests a parallel or an alternative malaria therapy to the orthodox medical antimalarial therapy. Although a possible cure for malaria issuggested at this stage, this cannot be said to be a conclusive study as a post exposure observation of the rats is required to ascertain that the malaria parasites are not just rendered dormant for a period of time and would become active again when the oscillating magnetic field is removed. Also, it is necessary to find out the extent of damages the OSMF could cause to tissues of the body where the malaria parasite resided.

Conflict of Interest

The authors have not declared any conflict of interest.

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