

CASE SERIES

Potential Effects of Electrotherapy on Acquiring of Malaria Infection in Khartoum State

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ABSTRACT

OBJECTIVE

Electrotherapy is the electrical stimulation of tissues for therapeutic purposes which uses a specific wavelength and frequency from the electromagnetic spectrum to produce the desired physiological and chemical changes in the body. Insusceptibility to get malaria infection among patients treated with electrotherapy was locally observed, therefore the study was aimed to detect the potential effect of electrotherapy on acquiring of malaria infection to assess the management of the disease endemic in Khartoum state.

METHODS

This is descriptive cross-sectional study, all patients (101) attending and submitting to electrotherapy unit in the hospitals were enrolled, and their clinical reports were collected. Among these patients 55 were male and 46 were female and were divided into three categories according to the number of sessions, age and gender. The data were analyzed using SPSS software.

RESULTS

The study involved both sexes (55 males and 46 females), and the percentage of males not infected with malaria after electrotherapy sessions (84%) was higher than that of females (67%) out of the total number. Interestingly one of the patients undergoing electrotherapy sessions had been diagnosed with severe malaria with mental disturbance, the symptoms of the severe malaria decreased from him, and his condition improved after submitting to electrotherapy sessions. The exposing percentage of patients who did not acquire malaria after electrotherapy

sessions was approximately 80% with P-value (<0.001) compared to those infected with malaria after electrotherapy sessions.

CONCLUSION

The study results suggest the potential hypothesis of existence of effect of electrotherapy on acquiring malaria infection, the study recommended to carry out further experimental in-vitro and in-vivo studies to prove and explain the mechanism of effect in order to assist in treatment and management of the disease.

KEYWORDS

Electrotherapy; Malaria infection; Malaria in Sudan; Khartoum state

INTRODUCTION

Electrotherapy is the electrical stimulation of tissues for therapeutic purposes the therapy uses specific wavelength and frequency from the electromagnetic spectrum to produced desired physiological and chemical changes in the body, the term electrotherapy can apply to a variety of treatments, including the use of electrical devices such as deep brain stimulators for neurological disease. The term has also been applied specifically to the use of electric current to speed wound healing. Additionally, the term "electrotherapy" or "electromagnetic therapy" has also been applied to a range of alternative medical devices and treatments [1].

Electric shock used in muscle stimulation to prevent atrophy and restore muscle mass and strength employed what was termed galvanic exercise on the atrophied hands of patients who had an ulnar nerve lesion from surgery upon a wound [2] ,it's also used in cancer treatment according to study that report 98% shrinkage of tumor in animal subjects on being treated with DC electrotherapy for only five hours over five days [1].

Modern uses of electrotherapy:

The American Physical Therapy Association acknowledges the use of electrotherapy for:

Pain management by Improves range of joint movement [3].

Treatment of neuromuscular dysfunction by improvement of strength, Improvement of motor control, Retards atrophy, Improvement of local blood flow [4].

Improves range of joint mobility by Induces repeated stretching of contracted, shortened soft tissues [5].

Tissue repair by Enhances microcirculation and protein synthesis to heal wounds, increased blood flow to the injured tissues increases macrophages to clean up debris and restores integrity of connective and dermal [6].

Acute and chronic edema by Accelerates absorption rate, affects blood vessel permeability and increases mobility of proteins, blood cells and lymphatic flow [7].

Promotion of peripheral blood flow by induces arterial, venous and lymphatic flow [5].

Iontophoresis by delivery of pharmacological agents and transports ions through skin (Dexamethasone, Acetic acid, Lidocaine), [8].

Management of urine and fecal incontinence by affects pelvic floor musculature to reduce pelvic pain and strengthen musculature [5].

Lymphatic drainage by stimulate lymphatic system to reduce edema and other medical uses [9].

Malaria parasites:

Malaria disease is caused by Plasmodium parasites. The parasites are spread to people through the bites of infected female Anopheles mosquitoes, called "malaria vectors." There are 5 parasite species that cause malaria in humans, and 2 of these species - *P. falciparum* and *P. vivax* - pose the greatest threat.

In 2018, *P. falciparum* accounted for 99.7% of estimated malaria cases in the WHO African Region 50% of cases in the WHO South-East Asia Region, 71% of cases in the Eastern Mediterranean and 65% in the Western Pacific.

P. vivax is the predominant parasite in the WHO Region of the Americas, representing 75% of malaria cases [10].

Resistance to antimalarial medicines is a recurring problem. Resistance of *P. falciparum* malaria parasites to previous generations of medicines, such as chloroquine and sulfadoxine-pyrimethamine (SP), became widespread in the 1950 and 1960, undermining malaria control efforts and reversing gains in child survival.

Protecting the efficacy of antimalarial medicines is critical to malaria control and elimination. Regular monitoring of drug efficacy is needed to inform treatment policies in malaria-endemic countries, and to ensure early detection of, and response to, drug resistance [10].

MATERIALS AND METHODS

Study Design and Ethics Statement

This study was a descriptive cross-sectional study, carried out in Khartoum clinical hospitals with electrotherapy units which were Taha Baasher psychiatric teaching hospital and Eltigani Elmahi Psychiatric teaching Hospital during the period from January to June 2021.

Ethical clearance was obtained from Al Neelain University, Khartoum state ministry of health research department and the affiliated hospitals. Informed consent of the participant's patient and/or co patient was signed.

Study Subjects and Data Collection

All patients attending and submitting to electrotherapy unit in the affiliated hospitals in malaria endemic area during study period. Total of the 101 of patient's reports were collected, among these patients 55(54.4%) were male and 46(45.5%) were female. Secondary data were collected from patient records through structured ,coded and pretested data sheet .Interview data collected from patients or their co patients through phone call .

Study subjects were categorized according to number of electrotherapy sessions. The effect of electrotherapy was assessed in relation to age group and gender.

Data analysis

Data collected was analyzed by statistical package for social sciences version 20 software (SPSS software, Chicago).

RESULTS

Total of 101patients reports who submitted to electrotherapy sessions in Khartoum hospitals were collected.

In the first category it was noted that the most patient who did not re infect with malaria (43patients) were those who submitted to number of electrotherapy doses range from 4 and less than 6 doses and the least (8 patients) from 1 and less than 3, while for the group that was re infected with malaria it was noted that the group submitted to 4 to 6 doses is the highest category, with 5 patient with re infection period varying among other groups as shown in Table 1.

Table 1: Re-infection with malaria after electrotherapy session (according to dose of sessions).

		Re infection			
		Not re infected	Re infected less than year	Re infected after more than year	Total
Session	1-less than 3	8(66.6%)	3	1	12
	3-less than 5	25(78.1%)	4	3	32
	5-less than 6	43(81.1%)	8	2	53
	6 and more	1(25%)	1	2	4
Total		77	16	8	101
P-value	(0.081)		24		

As for the second category, which was divided according to the age group, it was noted that the most age group that was not re infected with malaria (26) are those whose aged ranged from 31 years to 40 years, while 4 of the same group were re infected with malaria followed by age group more than 40 years (4) with varying in the re infection period as shown in Table 2.

Table 2: Re-infection with malaria after electrotherapy session (according to age group).

		Re infection			
		Not re infected	Re infected less than year	Re infected after more than year	Total
Age	Birth-20	6 (75%)	2	0	8
	21-30	25(75.7%)	4	4	33
	31-40	26(76.4%)	5	3	34
	more than 40	20(76.9%)	5	1	26
Total		77	16	8	101
P-value	(0.303)		24		

As for the third category, which was categorized according to the gender, among the not re infected group it was noted that there were 46(84%) males, and 31(67%) females did not re infect with malaria. And there were 9 males, and 15 females were re infected among re infected group with varying in the re infection period as shown in Table 3.

Table 3: Re-infection with malaria after electrotherapy session (in relation to gender).

		Re infection			
		Not re infected	Re infected less than year	Re infected after more than year	Total
Gender	Male	46(83.6%)	6	3	55
	Female	31(67.3%)	10	5	46
Total		77	16	8	101
P-value	(0.134)		24		

In the effect of electrotherapy on malaria infection, it was noted that 77(80%) does not re infect with malaria and 24(20%) re infect directly with malaria with P-value (<0.001) concluding that the proportion of not re infected is exactly 80% from entire population as shown in Table 4.

Table 4: Effect of electrotherapy on acquiring of malaria infection.

	Category	Frequency	P- value
Reinfection	Re infected	24	<0.001
	Not re infected	77	
Total		101	

DISCUSSION

In this study, it was noted that the majority of the participants did not acquire malaria after undergoing the electrotherapy sessions, despite their presence in a malaria endemic area, and the possibility of a relationship between electrotherapy and malaria infection is potentially exist. Interestingly one of the patients undergoing electrotherapy sessions had been diagnosed with severe malaria with mental disturbance, the symptoms of the severe malaria decreased from him, and his health condition improved after submitting to electrotherapy sessions.

One of the participants in the study also noted that the electrotherapy sessions helped in the regularity of her menstrual cycle.

Although various studies have been reported on effects of electrotherapy on human body tissues and cells, there were no studies on the effect of electrotherapy on malaria infection. To the best of our knowledge this is the first study and observation on the effect of electrotherapy on acquiring of malaria infection, so more studies is needed regarding this concern.

The majority of patients participating in the study did not acquire malaria after undergoing the electrotherapy sessions, this may explain that there may have been an immunological and physiological effect of electrotherapy on the tissues and cells of the body, as it was proven by a study conducted by [11] Who assess the clinical and immunological of micro current electrotherapy effects on palatal wound that conclude occurrence of favorable modulations and inflammatory wound healing markers, and study conducted by [12] that conclude down regulation of serum inflammatory factors and up regulation of anti-inflammatory factors.

CONCLUSION

The results obtained from this study suggest the existence of potential effects of electrotherapy and acquiring of malaria infection which may assist in treat, suppress or prevent malaria infection.

LIMITATIONS

- It's too difficult to obtain ethical approval form Khartoum state ministry of health and the process took long time.
- The research design should be experimental but due to financial ability and lack of facilities in Sudan we conducted a descriptive cross-sectional study.
- Deficiency in the number of research participants due to the scarcity of those who take electrotherapy. No data indicating the actual amount of electrotherapy dose in units that participants exposed to.

DECLARATION

Ethical Approval and Consent to Participate

Ethical approval for study was obtained from Khartoum state ministry of health research department, Sudan and affiliated hospitals. Informed consent of the participant's patient and/or co patient was signed. With commitment to apply all relevant guidelines and regulations.

Consent for Publication

Not applicable

Availability of Data and Materials

All data generated or analyzed during this study will be available for public without restriction and all relevant data within the manuscript.

Competing Interest

Not applicable

Funding

Not applicable

Authors Contributions

MAM provided conceptual framework for the project, guidance for interpretation of the data, performed data analysis, MAM, EAE, MME and HAE perform statistical analysis and guidance for data interpretation. All authors read and approved the final manuscript.

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