

Positive effect of magnetism on cerebral malaria (A hypothesis)

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ABSTRAK

Sugeng Juwono Mardihusodo - *Pengaruh positif magnetisme pada malaria serebral (Suatu hipotesis)*

Malaria serebral (MS) adalah salah satu komplikasi yang berat dari malaria falsiparum yang dapat menyebabkan angka kematian tinggi di suatu daerah endemik tempat *Plasmodium falciparum* paling dominan. Didasarkan atas banyak penemuan histopatologis, patogenesis MS dipercaya disebabkan oleh sumbatan-sumbatan dalam vasa darah serebral oleh sel-sel darah merah yang terinfeksi parasit malaria, yang dapat diperberat oleh faktor-faktor lain yang terjadi bersamaan, misalnya deposisi kompleks imun dalam vasa darah serebral, penurunan imunitas humoral atau selular, kerja endotoksin dan kerja faktor nekrosis tumor. Pengaruh-pengaruh biologis dari magnetisme telah dipelajari secara luas dan mendalam dalam kurun waktu limapuluh tahun terakhir termasuk penerapannya untuk penyembuhan penyakit-penyakit umum. Di antara banyak kesimpulan yang diambil oleh para ilmuwan setelah percobaan-percobaan yang tidak terhitung jumlahnya dalam bidang biomagnetisme adalah : (1) sistem biologis sangat peka terhadap medan magnetik dan pengaruh magnetik mencapai setiap sel dalam tubuh karena daya tembus yang tinggi dari magnetisme; (2) karena tenaga listrik masuk ke seluruh bagian tubuh dan medan magnetik ada dalam tiap bagian tubuh itu, magnet jika diaplikasikan secara benar akan berpengaruh positif; (3) medan magnet permanen berpengaruh terhadap perubahan biokimiawi meliputi gambaran darah dan laju enap darah; (4) suatu medan magnetik dapat berpengaruh langsung terhadap otak bagian tengah dan depan. Hasil-hasil penelitian tentang pengaruh magnetisme terhadap darah mengungkapkan adanya pengglatan kandungan besi dalam darah yang kemudian membangkitkan arus listrik yang lemah, proses ionisasi dipercepat yang mencegah penjendalan darah, serta meningkatkan kelancaran aliran darah lewat vasa dan kapiler-kapiler darah. Atas dasar banyak kenyataan tersebut ditarik suatu hipotesis, bahwa magnetisme jika diaplikasikan secara benar berpengaruh positif terhadap perjalanan MS.

Key words : magnetotherapy - biomagnetism - biomagnetics - malaria - biomagnetology

ABSTRACT

Cerebral malaria (CM) is one of serious complications of falciparum malaria that may cause high mortality rate in a malaria endemic area where *Plasmodium falciparum* is predominant. Based on a lot of histopathological findings, pathogenesis of CM is thought to be mainly caused by the blockade of cerebral vessels by parasitized red blood cells (PRBC), that could be aggravated by secondary factors such as depositions of immune complexes in brain capillaries, reduced humoral or cell-mediated immune responses, action of endotoxin, and the action of tumor necrosis factor (TNF). Biological effects of magnetism have been extensively and intensively studied in the past five decades including their applications to the treatment of common diseases. Among other conclusions reached by scientists after innumerable experimentations in the field of biomagnetism are (1) living systems are very sensitive to magnetic fields and magnetic effect reaches every cells in the body on account of the highly pervasive character of magnetism; (2) as the entire body is infused with electrical energy and magnetic fields exist in every part of it, magnets, if properly applied exercise a positive effect on the electrical response behaviour pattern; (3) effects on the blood picture and on erythrocyte sedimentation rate result from exposure of the organism to a constant magnetic field which initiate biochemical changes; (4) a magnetic field can exert direct influence on the diencephalon and the forebrain. Studies on the effect of magnetism on blood revealed the activation of the iron content in the blood and a weak current was discerned to have been generated, the process of ionisation was hastened which freed the blood from danger of clotting and stimulated easier and more spontaneous flow of blood through the blood vessels and capillaries. It is hypothesized, therefore, that magnetism exerts a positive effect on CM.

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INTRODUCTION

Human malaria is a serious infection of the blood by haemoglobin-digesting single-celled *Plasmodia* protozoa, transmitted by the bites of *Anopheles* mosquitoes. There are four species of *Plasmodium*, commonly called malaria parasites, infecting man, namely *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale*. The first being the most dangerous one due to many life-threatening complications it causes such as cerebral malaria (CM), heavy anaemia, shock ('algid malaria'), complicating bacterial infections, pulmonary edema, haemostatic disturbances and blackwater fever.¹ Such complications, mainly CM, could be the main direct cause of death of the malaria patients, particularly in Africa where it is believed to be responsible for deaths of some one million children each year.² Although CM could be caused by *P. vivax* as reported by Sachdev and Mohon (cit. Haworth³) in India, rightly, most media attention, and most research, concentrates on the *P. falciparum*-form of disease, particularly on the pathogenesis of CM, one of the most dreadful clinical conditions of falciparum malaria.

Many attempts of CM treatment and management have been done based on the pathogenesis of the disease with some degree of success, ranging from the use of various antimalaria chemotherapy, such as intravenous quinine hydrochloride to the use of various drugs other than antimalarials to overcome cerebral edema, unconsciousness and other severe clinical conditions. Management of severe and complicated malaria, particularly with CM, therefore, still constitutes a major topic of research in the world.

Any studies and practices of alternative medicine or disease management, that scientifically sound, and are supportive to modern medicine, specifically in the treatment or management of severe and complicated malaria, should not be overlooked. Bansal & Bansal⁴ have written their experiences in treating at least 85 kinds of the common diseases of man, and described the scientific basis of magnetism for possible alternative in the treatment of diseases due to infections or non-infections. Thus, whether the application of magnets would exert remedial effect on CM in man is an interesting question to answer.

The present paper discusses some aspects of CM due to *P. falciparum*, and the basic principles of how the magnetism works and exerts biological effects on the human body. The specific objective of this paper is to establish hypothesis that could be the starting point for testing of the value of magnetism in the treatment or management of malaria cases, particularly with CM and other severe complications of falciparum malaria.

DISCUSSION

Cerebral malaria (CM)

Symptomatology. CM is defined by MacPherson *et al.*⁵ and Oo *et al.*⁶ as an acute, diffuse, symmetric encephalopathy in patients with falciparum malaria. It has been estimated that it may occur in about 2% of non-immune subjects.⁷ The symptomatology of CM includes headache and drowsiness succeeded by a comatous state with contracted pupils and abolished or exaggerated deep reflexes. Some CM patients may show different neurological symptoms simulating meningitis, epilepsy, acute delirium, intoxication, heat stroke, etc.⁷ Schmutzhard & Gerstenbrand⁸ described clinical symptoms of 66 cases with CM in Tanzania, all of them were under 15 years old, as follows: hyperthermia (94%), comatous state with signs of midbrain syndrome (72.7%), epileptic fits - local or generalized (63.3%), vomiting (60.6%), headache (47%), focal signs (24.2%), neck stiffness (15.2%) and neurological longterm sequelae including organic psychosyndrome (7.5%), hemiparesis/hemihypaesthesia (4.5%), and residual epileptic fits with residual hemiparesis (1.5%). The mortality of the 66 cases of CM was 18%, all death was due to bulbar brain syndrome. Drowsiness and disorientation are the warning signs heralding the onset of CM.⁹

Sachdev and Mohon (cit. by Haworth³), reported 6 cases of CM due to *P. vivax* in India, all in children under 12 years old, 4 of them died, and the associated symptoms included renal failure, hypoalbuminemia and deep coma.

The clinical variability of symptoms of pernicious attacks of falciparum malaria with cerebral involvement causes some difficulty in

confirming the provisional diagnosis in fatal cases of the infection in infants and children in highly endemic areas. Rangué¹⁰ proposed a simple method for post-mortem confirmation of the brain which was claimed to be rapid and leaving no trace on the body.

Pathological figures. The main causes of pathology in malaria are considered to be tissue anoxia, which is due to impaired oxygen-carrying capacity of the blood vessels, and general and local changes in blood flow.⁷

Bruce-Chwatt⁷ noted that the involvement of central nervous system was considered to be the main cause of 20-50% of deaths of patients with falciparum malaria. He further concluded that there were three main types of pathological changes in the brain tissues due to CM as seen on autopsy, namely: (a) gross congestion of meninges and the brain itself with the small vessels of the grey matter packed with erythrocytes containing pigmented parasites in all stages of development, (b) occlusion of the capillaries and precapillaries of the cortex, ring haemorrhage around the 'blocked' arterioles and numerous petechial haemorrhages in the subcortical white matter of the cerebrum, brain stem and cerebellum, and (c) necrotic lesions in midzonal brain tissue with a peripheral reaction of small glial cells ('malarial granuloma') around an occluded capillary.

An electron microscopic study of human brain in CM was presented by Pongponratn *et al.*¹¹ using Thai patient, a boy of 13 years old, who died of CM, pulmonary edema and pneumonia. They concluded that there was a morphological evidence of adhesion of parasitized red blood cell (PRBC) to the endothelium of cerebral vessels via knobs, and of platelets sticking to the injured endothelium. It was found that the endothelial vesicular membrane was in close adhesion to the PRBCs, and to the platelets involved in the mechanism, and no evidence of inflammation, fibrin or thrombin formation were observed in their study.

Aikawa¹² has studied in detail the pathological changes of brain tissues in human patients who died of CM using light and electron microscopy and an immunoperoxidase technique. He summarised the light microscopic results that blockage of cerebral capillaries by *P. falciparum*

infected erythrocytes appeared to be the principle cause of CM. From electron microscopic results, it was concluded that knobs on PRBCs acted as focal junctions which mediated adhesion to endothelial cells. The knobs were again believed to be important contributors to the blockade of the capillary lumen and ensuing pathological changes in cerebral tissues. Further studies by the author using peroxidase technique revealed host cell molecules such as OKM5 and thrombospondin functioned as endothelial cell surface receptors for the attachment of knobs of *P. falciparum* infected erythrocyte. Recent study on the immunohistopathology of CM by Aikawa *et al.*¹³ in *P. coatney*-rhesus monkey model infection showing much similarity to the pathological condition of CM in man indicated the presence of CD36, thrombospondin (TSP) and intercellular adhesion molecule-1 (ICAM-1), that appeared to serve as endothelial cell surface receptors for the attachment of PRBCs.

Pathogenesis. Most authors relate the symptomatology of CM to the blockade of cerebral vessels by the PRBCs, but some investigators indicate that CM is a form of disseminated vasculomyelopathy, a hyperergic response of the central nervous system to the antigenic challenge of *P. falciparum*.⁷ Pathological changes begin with an alteration of the endothelial permeability of the capillaries of the brain followed by perivascular infiltrates and demyelination.

Clark¹⁴ reviewing the cell-mediated immunity in protection and pathology of malaria proposed five possible factors contributing to the development of CM which include: (a) the blockade of cerebral vessels by the PRBCs, (b) deposition of immune complexes in brain capillaries, (c) reduced humoral or cell-mediated immune responses, (d) action of endotoxin, and (e) action of tumor necrosis factor (TNF). Among these, the blockade of cerebral vessels was considered to be the major factor in the pathogenesis of CM. This opinion was supported by histopathological findings as described by Pongponratn *et al.*¹¹ and Aikawa.¹² The blockades of cerebral vessels due to the adhesion of the PRBCs via their surface knobs to the endothelium of cerebral vessels lead to vascular obstruction and disturbances of microcirculation in the brain and consequently result in tissue

hypoxia. In addition, attachment of the platelets to the injured vascular endothelial cell may play a role in obstruction of cerebrospinal fluid, that may lead further to cerebral edema, and also responsible to low circulating platelets.

Das *et al.*,¹⁵ studying pathological features of CM through brain necropsy of falciparum malaria patients, showed the presence of edema, fibrin deposits, mononuclear cells infiltration, and increased cerebrospinal fluid protein and lipid peroxidation products. The authors proposed that CM might be caused by increased permeability of vascular endothelium resulting from increased lipid peroxidation in the endothelial cell membrane.

Clinical management. The first principle in the management of CM is the intravenous administration of an effective antimalaria schizonticide.⁹ In areas where chloroquine resistant strain of *P. falciparum* has emerged, quinine hydrochloride is the drug of choice. In such situation, clinical CM cases that are confirmed positive for *P. falciparum* in their blood are commonly treated with quinine hydrochloride intravenous injection at the dosage of 10 mg/kg body weight.⁷ Special attentions should also be directed to the improvement of clinical conditions of the CM patients who are invariably shocked and often dehydrated, and suffering from acute haemolytic anaemia. Therefore, transfusion with blood or with packed red cells may be necessary as soon as parasitological treatment and treatment for dehydration and shock have been instituted.

One thing that is overlooked in the management of severe falciparum malaria, particularly with CM complication, is that, a method or methods to prevent or minimize the PRBCs in the capillary blood vessels, from producing blockade of the blood capillaries, particularly in the cerebrum and other vital organs. Supposed, the blockade of the cerebral blood vessels that are the major factor of CM could be hindered to minimal, and thus the microcirculation in the affected cerebral tissues could be well maintained, the fatal outcome of CM could be prevented and the mortality rate due to the cerebral involvement could be reduced to minimum.

Magnetism : Its effect on the human body

Magnetism is one of the natural phenomenon in which pieces of iron or certain metal alloys (serving as permanent magnets) show strong attraction or repulsion for one another. The phenomenon is most familiar through the compass, indicating the direction of the Earth's magnetic poles, and through small permanent magnets used in household fixtures and as children's toys. Most of the importance of magnetism, however, is connected to the relation between magnetism and current electricity.¹⁶

It was Dr. William Gilbert (1540-1600 A.D.) of England, the court physician to Queen Elizabeth I, who pioneered in the scientific study of electricity and magnetism and was the first to declare that the earth itself was a huge magnet.⁴ The earth possesses a magnetic moment, ascribed to the planet about its own axis.¹⁶ The magnetic field of the Earth affects the motions of the electrons in the electrified region of the atmosphere known as the ionosphere and of charged particles approaching from the outside¹⁶, and in turn, also affects the motions of the electrons in the living beings as described by Markel¹⁷, Bansal & Bansal⁴ and Suryadipura.¹⁸

With the existing background the bio-magnetists in America, Russia, Japan, France, India and others, carried out extensive research works and practices of healing during the last 50 years on the nature and scope of the magnetic field and its biological effects on living organisms.⁴ As examples, two volumes of textbooks entitled 'Biological Effects of Electric and Magnetic Fields' have been published and edited by Carpenter and Ayrapetyan¹⁹, results of many studies on the effects of geomagnetic field on various organisms, such as magnetic bacteria, migratory bird, bees, and elasmobranch fishes, have been compiled by Markel¹⁷, electro-magnetism and its relation to the foundation of life, particularly to the process of regeneration in living organisms has been described in great detail by Becker and Selden²⁰, and a book on magnetotherapy for common diseases has been written by Bansal and Bansal.⁴ In this book the two authors mentioned some of the enormous numbers of extensive experimentations on magnetism, for examples : the use of magnets

plant growth and fertility could be increased, their tissues rejuvenated and they could be protected from frost and other dangers, the lifespan of houseflies could be doubled by feeding them on magnetised sugar, life of a mouse was extended to nearly half of its normal lifespan and a mouse under experimentation astonishingly gave birth at the advanced age of four, the maximum span being three years. Quite recently Beason *et al.*²¹ provided evidence for the use of a magnetic material (perhaps magnetite) by a migratory bird, bobolink (*Dolichonyx oryzivorus*), to detect the earth's magnetic field for orientation of the place where it is going to.

Magnetotherapy is a clinical system in which human ailments are treated and cured through the application of magnets to the body of the patients.⁴ Magnet, actually is not new to mankind, but the knowledge of its healing properties has been very sparse and rare, right up to the modern era, but therapeutic system around the healing properties of magnet started evolving only in the 19th century. It was Paracelsus (1493-1541), a Swiss alchemist and physician, who pioneered work on the magnet and brought the light to its healing powers.⁴ He made the revolutionary observation that the magnet could cure all inflammation, influxes, ulceration and many diseases of bowels and uterus, that it could be useful both in internal as well as external ailments, and had an opinion that any disease part of the human body, when exposed to the magnetic force, will be cured better and more rapidly than by any medicines. Then, perhaps Father Hall as cited by Bansal and Bansal⁴, an Austrian Professor of Astronomy in the 18th century, took cue from Paracelsus and treated nervous men and women by applying magnets, as remedial tools, to their bodies; this remedial action was closely watched by Dr. Mesmer (1734-1815).

According to Bansal and Bansal⁴ there are three basic principles, or the triple action, underlying the action and reactions triggered in a physical system consequent to its getting exposed to a magnetic field, namely :

(1) Any biological system is composed of different chemicals/molecules which in turn are conjunctions of atoms holding within themselves electrons and the nuclei, the

charged particles. When the system is exposed to a magnetic field, these charged particles within the molecules are displaced or their relative placement is disturbed or changed resulting in the increased activity in the ions;

- (2) In addition, this displacement of charged particles or change in their relative placement causes the creation of extra pervasive heat in the system;
- (3) Different chemicals present in all parts of the body are continuously generating a very weak electricity and the associated magnetic field to be used up in all voluntary and involuntary functions within the system. All nervous signals sent by brain and received by it are flashed through these electric impulses in collaboration with surrounding magnetic fields.

Bansal and Bansal⁴ also noted conclusions reached by scientists after innumerable experiment in the field of biomagnetism that could represent the scientific basis in magnetotherapy :

- (1) Living systems, including the human body, are very sensitive to magnetic fields and magnetic effect reaches every cell in the body on account of the highly pervasive character of magnetism;
- (2) As the entire human body is infused with electrical energy and magnetic fields exist in every part of it, magnets if properly applied exercise a positive effect on electrical response behaviour pattern;
- (3) A constant magnetic exposure initiates biochemical changes in the blood. Biomagnetists found that the magnetic contact immediately activated the iron content in the blood hemoglobin, resulting in generation of a weak electric current in a blood, and hastening of process of ionisation in the blood easing the free flow of the blood throughout the body.⁴ Flow of the ionised blood enlivens every organ, wipes out lethargy from all the systems within the body, i.e., digestive, excretory, nervous, respiratory, etc., and gives strength to brain, heart, and all the muscles. Mild heat generated in the blood activates glands

regularising essential secretions. In a similar way, magnets works upon other and chemicals present in the body. Through its working on blood and other liquids the effect of application of magnets reaches the magnetic fields within the body and affects them internally.

- (4) Qualitative and quantitative effects of a magnetic field are visible on tissue and on cellular metabolism.
- (5) It has been confirmed that fibroblast proliferation and fibrosis are reduced in magnetic fields.
- (6) An interaction exists between function of the nervous system and external magnetic fields.
- (7) A magnetic field can exert direct influence on the diencephalon and the forebrain.
- (8) Magnetic treatment has stabilising effect on the genetic code.
- (9) A magnetic field produces predominantly an inhibitory effect.

The experimenting biomagnetists and practising magnetotherapists have demonstrated that magnetic treatment drives out all types of bodily pains, helps in speedy healing of wounds and fractured bones, dissolved any blood clotting in the blood vessels, washes out stones in kidney and gall bladder and cures such diseases as exzema, tumours, stiffness in limbs, arthritis, spondylitis, swellings and inflammations, paralytic and polio effects and to some extent even the dreaded cancer.⁴

CONCLUSIVE HYPOTHESIS

Based on (1) the facts that the pathological evidence of CM is mainly due to tissue anoxia resulting from the blockade of cerebral capillaries by PRBCs and impaired oxygen-carrying capacity of blood, damage to the endothelial cells lining the blood vessels, and general and local changes in blood flow, and on (2) the facts that exposure of magnets to the human body initiates hastening of ionisation process and electricity in the blood which consequently frees the blood from danger of clotting and stimulates easier and more spontaneous flow of blood through canals, and causes an increase in the number of red blood cells and strengthen the inactive and decayed ones, it is hypothesized that magnetism and

magnetic exposure exert positive effects on CM and extend the patient lifespan.

REFERENCES

1. Warrel DA. Pathophysiology of severe malaria : a clinician's view. In: Thavaraniy S, editor. ABSTRACT Vol. I. XIIIth International Congress for Tropical Medicine & Malaria, Pattaya Thailand, 1992.
2. Godal T. From investigation to eradication. Beyond the first 20 years. Tropical Diseases Progress 1975-94 Highlights 1993-94. Twelfth Programme Report UNDP/World Bank/WHO Special Programme for Research & Training in Tropical Diseases (TDR Geneva 1995; 9-36.
3. Haworth J. Malaria in man: Its epidemiology, clinical aspects & control. A Review of recent abstracts from Tropical Diseases Bulletin and Abstracts on Hygiene and Communicable Diseases, January 1984 - Jun 1986. London: Bureau of Hygiene and Tropical Diseases, 1978.
4. Bansal HL & Bansal RS. Magnetic cure for common diseases. New Delhi : Orient Paperbacks, 1987.
5. MacPherson GG, Warrel MJ, White NJ, Looaresuwa S, Warrel D. Human cerebral malaria. A quantitative ultrastructural analysis of parasitized erythrocyte sequestration. *Am J Trop Path* 1985; 119:385-401.
6. Oo MM, Aikawa M, Than T, Aye Tm, Myint P, Irigashi I, et al. Human cerebral malaria: Aetiological study. *J Neuropath Exp Neurol* 1987; 46:223-31.
7. Bruce - Chwatt LJ. Essential malariology, 2nd ed. London : ELBS Williams Heinemann Medical Book Ltd, 1985.
8. Schmutzhard E, Gerstenbrand F. Cerebral malaria in Tanzania. Its epidemiology, clinical symptoms and neurological longterm sequelae in the light of 66 cases. *Trans Roy Soc Trop Med Hyg* 1984; 78:351-53.
9. World Health Organization. The Clinical management of acute malaria, 2nd edit. New Delhi : WHO SEAR 1986.
10. Rangué P. A simple method for post-mortem confirmation of the diagnosis of cerebral malaria transthemoidal puncture of the brain. *Trans Roy Soc Trop Med Hyg* 1986; 80:663.
11. Pongponratn E, Riganti M, Harinasuta T, Bunnag I. Electron microscopy of the human cerebral malaria. *SEA J Trop Med Pub Hlth* 1985; 16: 219-27.
12. Aikawa M. Human cerebral malaria. *Am J Trop Me Hyg* 1988; 39:3-10.
13. Aikawa M, Brown A, Smith DC, Tegoshi T, Howar RJ, Hasler TH, et al. A primate model for human cerebral malaria: Plasmodium coatney-infected rhesus monkeys. *Am J Trop Med Hyg* 1992; 46:391-7.
14. Clark IA. Cell-mediated immunity in protection and pathology of malaria. *Parasitology Today* 1987; 3: 300-5.
15. Das BS, Mohanty S, Mishra SK, Patnaik JK, Satpathy SK, Mohanty D, et al. Increased cerebrospinal fluid protein lipid peroxidation products in patients with

- cerebral malaria. *Trans Roy Soc Trop Med Hyg* 1991; 85:733-4.
16. Anon. Magnetism. *The New Encyclopaedia Britanica, Macropaedia Vol 11, 15th edit.* Chicago : Encyclopaedia Britanica Inc 1982; 309.
 17. Markel H. Geophysics: The effect of ambient pressure, gravity of the geomagnetic field on organisms. In : Hoppe W, Lohman W, Markel H, Ziegler H, editors. *Biophysics.* New York: Springer, Verlag Berlin 1983; 776-787.
 18. Suryadipura RP. *Manusia dengan atomnya dalam keadaan sehat dan sakit (Antropobiologi berdasarkan metafisika).* Jakarta: Bumi Aksara, 1994.
 19. Carpenter DO, Ayrapetyan, editors. *Biological effects of electric and magnetic fields, Vol 1 & 2.* San Diego : Academic Press Inc, 1994.
 20. Becker RP, Selden G. *The body electric. Electromagnetism and the foundation of life.* New York : Quill William Morrow, 1985; 364.
 21. Beason RC, Dussourd N, Deushlander ME. Behavioural evidence for the use of magnetic material in magnetoreception by a migratory bird. *J Exp Biol* 1995; 198:141-46.