



Magic or Morgellons: How their Microbiome might make Morgellons Patients 'Magic'

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Although there is no scientifically reported evidence of a link between Morgellons Disease (MD) and electromagnetism, this article investigates the possible causes if different bacterial organisms were to be implicated in the etiology of MD. Spirochetes, for example, the suggested main pathogen linked to MD, are electroactive and, if indeed are the underlying pathology, could cause chemical precipitation of calcium carbonate crystals, resulting in increased electrical conductivity. Microbiotas such as E.coli, Shewanella, and Listeria have previously been related to electroactive characteristics. Furthermore, the bacteria-induced deposition of pyrite, calcium carbonate, calcium alginate, and magnetite in the epidermis could explain some MD patients' inexplicable symptoms. While only some of these microorganisms are proved in MD patients, the exact etiology of the disease is yet to be determined. It's possible that we'll never find a link at all, but that doesn't rule out the possibility that one exists in the first place. In this review, we attempt to suspend disbelief that MD patients could exhibit such symptoms, and instead investigate how researchers could support their claims with science and compassion, instead of repudiating them.

INTRODUCTION

Surrounded by mystery and controversy, Morgellons Disease (MD) history dates to the early 15th century [1]. The term 'Morgellons' was first used by Sir Thomas Browne, an English physician, who described an illness with harsh hair erupting on the back in children [1]. Fast forward to the early 2000s, doctors concluded that MD was 'Delusion of Parasitosis (DOP),' and researchers did not recognize it as an organic illness [2].

In 2006, the Center for Disease Control and Prevention (CDC) formulated a task force to look into the etiology of MD. However, the CDC report published in 2012 disregarded MD as an organic illness and labeled it as Delusional Infestations [DI] [3]. Currently, there is a stark divide in the scientific literature and community regarding the etiology of MD. One point of view still

characterizes MD as a delusional mental illness. The other point of view regards MD as an organic illness with an underlying spirochetal infection-causing Lyme Disease (LD)-like multisystem involvement and characteristic filamentous dermopathy [4].

Based on the available literature, Middelveen et al. have proposed a definition for MD. MD is defined as "a somatic LD-like illness associated with spontaneously appearing, slowly healing, filamentous, ulcerative skin lesions, with the key diagnostic criterion being: colored, white, or black filaments protruding from or embedded in the skin" [4].

Middelveen et al. have further proposed the classification of MD. This classification helps determine the severity of the condition [4, 5].

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- **Early localized:** Lesions/fibers appear on one localized part (arms, trunk, and legs) of the body for less than three months.
- **Early disseminated:** Lesions/fibers appear on more than one part of the body for less than three months.
- **Late localized:** Lesions/fibers persist on one area of the body for more than six months.
- **Late disseminated:** Lesions/fibers persist on more than one body part for more than six months.

Savely et al. studied a cohort of 122 patients presenting with microscopic skin fibers of unknown etiology. In addition to skin lesions and skin fibers, the most common symptoms expressed by the cohort included crawling sensation under the skin, fatigue, insomnia, skin pigmentation, pruritus, mood changes, arthralgia, myalgia, and symptoms of neuropathy (paresthesia/hyperesthesia) [6]. Most of these symptoms are seen in LD and other spirochetal infections as well.

CAUSATIVE ORGANISMS

Borrelia spirochetes, the causative organism for LD, have been repeatedly isolated from MD patients' tissues and skin samples. The most commonly isolated *Borrelia* species include *Borrelia burgdorferi* sensu stricto (Bb ss) and *B. garinii*. Other isolated *Borrelia* species include *Borrelia miyamotoi* and *Borrelia hermsii* [7-10]. Other bacteria occasionally isolated from the skin and tissue samples of MD patients have *Helicobacter pylori*, *E. coli*, *Treponema denticola*, *Bartonella henselae*, and *Rickettsia* spp [8, 11-12].

EXPLORING THE LINK BETWEEN MD AND ELECTROMAGNETISM

In addition to the aforementioned clinical manifestations of MD, there have been anecdotes where the MD sufferers have reported rather strange symptoms. For instance, there have been reports of individuals experiencing 'electric shocks' when touching metallic objects. Individuals have reported electric and electromagnetic devices not working properly around them. More so, some individuals have reported unlocking electrically or magnetically powered doors or locks just by touching them. Individuals have reported a constant 'electric or magnetic buzz' in their ears or other features of electromagnetic hypersensitivity [19-20].

Are these symptoms linked to MD? Is there any link between MD and electromagnetism?

To search for an answer to this question, a thorough literature review was carried out using two sets of

keywords. The first set of keywords included 'electric', 'magnetic', 'electricity', 'magnet', 'electromagnetic', 'electromagnetism' and the second set include 'Morgellons' and 'MD'. These two sets of keywords were used in different combinations joined by Boolean variables 'and/or.' The databases searched included PubMed, Google Scholar, Scopus, Medline, and Ovid. The database search DID NOT yield ANY results whatsoever.

In other words, there is no scientific evidence to substantiate the claims linking MD to electromagnetism.

So is this just a conspiracy theory and conjectures of someone suffering from a severe case of hysteria, or can there be solid scientific bases behind these reported symptoms? Considering most scientific community is unwilling to accept MD as an actual organic illness, most physicians and scientists would readily label these symptoms as a manifestation of hysteria.

Given the reluctance of the mainstream scientific community to accept MD as an illness, the chances of scientists trying to establish a relationship between MD and electromagnetism are non-existent.

ELECTROMAGNETISM IN DIFFERENT ORGANISMS

Electromagnetism is not a novel concept in nature. Organisms ranging from microscopic bacteria to immense whales interact with electric and magnetic forces in nature.

In 2010, scientists discovered something strange during a lab experiment. They found long 'cable-like structures' in a chemical sludge largely made of H₂S. However, they noticed some electric potential within the liquid as well. Further analysis of the long cables revealed that the cables were connected bacteria, and they used the cables as 'highways' to transfer electrons between two different bacteria. Later, these bacteria were named *Candidatus Electrothrix* and *Candidatus Electronema* [21].

Electric eels can deliver an electric charge of up to 600 V when threatened. They can generate electricity due to cells called 'electrocytes' that make up 80% of the total cells in their bodies. The outside of each cell is slightly more negatively charged than the inside and can produce a current of 100 millivolts. When they act together, these cells act as cells of a battery stacked together to create a current of 600 V [22].

A variety of marine organisms ranging from crustaceans, jellyfish, turtles, fish, dolphins, and even whales have 'electromagnetic sensing organs' that help them detect the slightest shifts in the electromagnetic potential of their surroundings—these shifts in electromagnetic potential drive the annual migration and breeding sessions of these organisms [23].

So the question remains, 'if the world's largest animals can interact with electromagnetic forces, why cannot human beings?'

POTENTIAL MECHANISMS LINKING MD TO ELECTROMAGNETISM

The bottom line is that we do not have clear scientific evidence to link MD to electromagnetism. Nevertheless, for argument's sake, if there were a link between MD and electromagnetism, what could be the plausible explanation?

Perhaps suspending disbelief and practicing compassion when dealing with MD patients might help us learn more about this condition. What if they are not delusional? What if they are right? Suspending disbelief and asking these difficult questions will further science and research in this area instead of stopping it dead in its tracks; labeling such conditions as delusion has done as much.

In this paper, we have tried to explore different potential reasons that could link MD to electromagnetism.

1: Pyrite and its role in electrical conductivity

Pyrite (FeS₂), also called fool's gold, has low electrical resistance and good conductive properties. Not only is it a good conductor of electricity, but it produces electricity when heated [13]. Furthermore, pyrite has magnetic properties due to highly polarized ions (Fe⁺² and S⁻²) [14].

Pyrite is abundant in the ecosystem, but there have been reports about MD sufferers finding 'golden fuzz balls' on their skin. While the exact composition of these fuzz balls has not been studied in detail, these could very well contain FeS₂.

Berg et al. have studied the effects of sulfur/sulfate-reducing bacteria on the production of pyrite. They noticed that a higher concentration of sulfur/sulfate-containing bacteria was associated with higher pyrite deposits. One of the bacteria commonly isolated from high pyrite environments is *Treponema*, a member of

the spirochetes family [15]. Members of the same family are a large part of the skin microbiota in MD.

2: MD Microbiota are electrically charged

As mentioned before, the skin filaments commonly seen in MD contain a high concentration of spirochetes. In addition, the results of skin biopsies and analysis of skin fluids have shown high spirochete concentrations in MD patients [4-6].

Observations have shown that members of the MD skin microbiota have a net electrical charge and an electrical potential at normal body pH. Among the members of MD skin microbiota known to have an electrical charge, *Borrelia* and *Treponema* species are most common. Click and Fairbairn et al. labeled some *Borrelia* variants as 'electrical variants' due to their vast electrical potential. These electrically charged organisms have been found to adhere easily to other body cells and tissues due to the virtue of their electrical charge [16].

Since the skin microbiota in MD is heavily altered and is infested with a variety of 'exotic' organisms, not a part of typical skin flora, it is not unusual for the skin of these patients to behave differently. For example, *Borrelia* and *Treponema* species have been commonly and abundantly isolated from the skin and skin fluids in MD; the sheer abundance of these organisms might represent one of the reasons for the change in electrical potential of the skin in MD.

3: Negatively charged keratin and collagen predominantly comprise MD skin filaments

Keratin and collagen are two integral skin proteins. Both of these proteins are negatively charged [17, 18]. In the skin of an otherwise healthy individual, these proteins exist in a 'soup' of other ingredients such as hyaluronic acid, elastin, water, and other proteins. Some of these substances have a net positive charge, and others have a net negative charge. The sum of these charges gives the skin and underlying tissues a net neutral charge.

However, as proven by the biopsies in MD, the skin filaments are predominantly made of keratin and collagen proteins [4-6]. As a result, it causes an excess of charged proteins on the skin. This charge might be one of the several reasons for the skin of MD sufferers to show more robust interaction with electrical items.

4: 'Electroactive' Bacteria

Researchers have identified a variety of 'electroactive' bacteria that are capable of producing electricity. More

interestingly, these bacteria are part of human microbiota identified in a variety of conditions.

One such candidate is *E. coli*. *E. coli* is part of a typical flora of the gut. An excess of *E. coli* is the critical pathological process in various infections involving the respiratory tract, urogenital system, gut, and skin. An imbalance of skin microbiota and excess of *E. coli* on the skin has also been reported in patients with MD. Researchers at the Massachusetts Institute of Technology (MIT) have unlocked the 'electroactive' potential of *E. coli*. They identified that *E. coli* could generate electrons within their cells and generate an electrical charge [24].

Listeria monocytogenes is a bacterium that is commonly not a part of the human microbiota. However, bacterial dysbiosis can lead to an increase in the levels of bacteria such as *L. monocytogenes*. For example, an increase in the skin levels of *L. monocytogenes* is reported in some cases of MD [25]. *L. monocytogenes* is an organism with a positive charge on the outside of its cell membranes. These bacteria can transfer negatively charged electrons from the inside of the cells to the positively charged outside in order to generate electricity [26].

Shewanella sp. such as *Shewanella oneidensis* and *Shewanella putrefaciens* are gram-negative bacteria commonly found in marine ecosystems. However, members of *Shewanella sp.* have been found to cause various illnesses in human beings as well. Like *E. coli* and *L. monocytogenes*, *S. putrefaciens* is an electroactive bacteria capable of producing electricity. More so, *E. coli* can interact with *S. putrefaciens* to generate higher electric potentials [27].

Pseudomonas aeruginosa is a bacterium responsible for causing a variety of illnesses of the respiratory and genitourinary tract. *P. aeruginosa* is found in the skin biofilms of MD patients. The concentration of *P. aeruginosa* is 102-fold higher than healthy controls in MD [28]. *P. aeruginosa* is an Anode-Respiring Bacteria (ARB) that can transfer electrons from an organic substrate to a solid electrode. Researchers have found that *P. aeruginosa* could generate electricity in an organic broth containing glucose, fructose, and sucrose [29].

Certain *Staphylococcus* species such as *S. epidermidis* ATCC 12228 have electroactive properties. For example, in a study, *S. epidermidis* produced an electrical voltage of ~4.4 mV that peaked in 60 minutes when the media containing this bacteria was treated with 2% polyethylene glycol (PEG)-8 Laurate [33].

4: Spirochetes could cause calcium carbonate precipitation

Spirochetes are the critical organisms implicated in the pathogenesis of MD. Spirochetes can cause calcium carbonate precipitation in in-vitro studies [30]. In ionic form, calcium carbonate leads to highly charged ions (Ca⁺² and Carbonate⁻²). These ions are capable of conduction of electricity [31]. Moreover, calcium alginate crystals have been found in *Borrelia* biofilms as well. *Borrelia* is an organism found in skin biofilms in MD patients [32]. Calcium alginate is a collagenous water-insoluble substance that forms when calcium compounds interact with sodium alginate. The alginate in calcium alginate compounds is an acid of alginic acid. The calcium alginate contains conjugated chemical bonds between carbon compounds leading to unpaired electrons per carbon atom. The unpaired electrons create the mobility of charge along the calcium alginate chain. In addition, the compounds also contain ions such as Ca⁺² and -COO⁻ that aid in the movement of electrons along the polymer chains [36].

5: MD might alter magnetite levels in the body and brain

Although there is no direct evidence, some indirect evidence suggests that environmental factors and different infections can alter magnetite levels in the human body and mind, which might alter electromagnetic responses of the body [34]. Magnetite is one of the main minerals found in iron ores. It is an oxidized form of iron with a formula of Fe₃O₄. It is attracted to magnetic fields, and it can become a permanent magnet even when exposed to a small amount of electrical current. For example, common magnetotactic bacteria isolated in nature include *Magnetospirillum magneticum* and *Magnetobacterium bavaricum* [35].

CONCLUSION

Morgellons is a mysterious condition with its roots in disbelief. As far as MD and electromagnetism go, we do not have concrete evidence to prove that such a link exists. More research is needed to explore this area in great depth.

In this review, we have explored the potential links between MD and electromagnetism. If electromagnetism were to occur in MD patients, it would have deep links with the alterations in the microbiome. For example, spirochetes, the proposed key pathogen associated with MD, are electroactive and could lead to precipitation of substances leading to increased electrical conductivity. Other microbiotas

associated with electroactive properties include *E.coli*, *Shewanella*, and *Listeria*. All of these bacteria are often seen in MD patients. In addition, pyrite, calcium carbonate, calcium alginate, and magnetite deposition in the skin triggered by bacteria could explain the mysterious symptoms that some MD patients experience.

Eventually, we might not find a link at all, but it does not mean that we shrug the idea of this possibility existing altogether. Everyone, including the skeptic scientific community, needs to understand that MD patients are real people suffering from real problems. Paying attention to the complaints of the patients might be the first step towards healing from this condition.

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