

Dissociating Delusional Disorders and Infections from Dermatologic and Neurologic Effects of Morgellons Disease

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Abstract

Morgellons disease (MD) is a multi-system disorder characterized by multi-color filaments extruding out of the skin along with an array of dermatologic and neuropsychiatric symptoms. It was previously termed Delusional parasitosis. However, published scientific data found the association of MD symptoms with the systemic manifestations of Lyme disease, caused by *Borrelia spirochete*. In a retrospective study of 122 MD patients, skin specimens were examined and 96% of them showed *Borrelia spirochete* in their histology sample. Hence, this association suggests that spirochete infection could be a possible cause of chronic illness in MD patients, and this rejected the physician's perception that MD lesions might be self-inflicted. A cohort study reported tick-borne co-infections among MD patients, which could also be an etiological factor for dermopathy in MD patients. Some literature also discussed neuropsychiatric manifestations like cognitive impairment, dementia anxiety, depression, paranoia, and sensory hallucinations in Lyme disease and associated tick-borne infection. The objectives of this review are to identify the differences in the past and current perception regarding the pathogenesis of MD and determine the associations of spirochetal and tick-borne diseases with MD and psychiatric illnesses. More than 50 new research articles and case reports were reviewed and only 31 articles were shortlisted and used as references. This review has a detailed discussion on Morgellons disease and its association with Spirochete infection.

Keywords

Morgellons Disease, Lyme Disease, Spirochete, Tick-Borne Infections,

1. Introduction

Morgellons disease (MD) is a multi-system disease characterized by the spontaneous appearance of slowly healing ulcerating skin lesions and having multicolored filaments embedded in the skin [1] [2] [3]. Many clinicians used to categorize it as delusional parasitosis or delusional infestation previously and considered the filaments to be introduced as textile fibers [3] [4]. Delusional infestation (previously also known as delusional parasitosis or Ekbom's syndrome) is an uncommon disorder, characterized by a patient's fixed belief of having skin infested by a small, living pathogen regardless of any relevant shreds of evidence being found by the medical community [5]. However, it is worth noting that the lack of evidence does not necessarily mean there isn't any pathogen involved, as further studies could prove otherwise.

Patients with Delusional infestation meet the criteria for a persistent delusional disorder (ICD-10 (international classification of diseases, 10th revision) or delusional disorder somatic type (DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, fifth edition)) [6]. Statistics from the Morgellons Research Foundation have shown 50% of patients report disabling fatigue, problems with attention, fibromyalgia, joint pain, and sleep disturbance. Other symptoms include hair loss, vision, and neurologic problems.

While some previous studies done by CDC support the delusional causation for MD, recent research depicts otherwise. Multiple studies published between 2013 and 2015 have shown histological observations and findings from electron microscope imaging that illustrates spirochetes and dermal filaments [7]. This evidence suggests that MD is a completely different entity from Delusional Infestations.

2. Evidence from Gross and Histological Morphology

A retrospective study was conducted on 108 patients diagnosed with Delusional parasitosis of skin at Mayo clinic between 2001 and 2007. All patients who either underwent a biopsy or brought samples for examination to their doctors were included. The results of the study showed that neither of the biopsies that were received had skin infestation. In addition, some of the samples were found to have dermatitis and ulcerations, raising the possibility of underlying pathology. This result was persistent with multiple case reports presented previously [8]. Further results from this study made on the specific specimens found in the patient-provided samples demonstrated that 98% of the sample did not have any pathogens. The most common specimens were skin flakes (34%), Serum crust (25%) and hair (20%). However, there were few samples among the patients who underwent biopsies that tested positive for bacteria (23), fungi (4) and virus (1)

[8]. The virus found in the sample was Herpes Simplex Virus, but the specific bacteria and fungi were not specified in the study. Since some of the patients in the sample group presented with dermatitis (61%), it is possible that an inflammatory skin disorder such as psoriasis was present. Regardless, the study concluded that there was no significant association of skin infestation among patients with delusional parasitosis. This lies in contrast to the spirochetes and dermal filaments observed in biopsy findings from MD patients, which further suggests that MD is not a delusional infestation.

3. CDC Study on Morgellons Disease and Controversies

The CDC and Kaiser Permanente started the study in January 2008. On January 25, 2012, the CDC released the results of the study, and no infectious or environmental relations were found. The study consisted of skin biopsies, blood tests, and interviews of 115 patients in Kaiser Permanente California Hospital. A case was defined as any patient who claimed that certain materials such as fiber, threads, fuzzballs were coming out of their skin AND the presence of a skin lesion or a disturbing skin symptom. Results of this study demonstrated that 75% of the investigated patients had sores on their skin; however, half of them were just due to sunburns, whereas the rest had signs of irritation. Few lesions also had materials embedded inside including cotton from clothing and fragments of skin. Scientists considered Morgellons as a manifestation of other known medical conditions, including delusional parasitosis, in which people imagine bugs invading their bodies [9]. There seem to be sample bias in the study done by CDC as most respondents had delusion of infestations initially.

While previous research and case reports believed that it is a delusional disorder with no infectious agent and the origin of fibers was inorganic material, new studies demonstrate immunohistological, chemical, and light microscopic evidence of keratinocyte origin of these fibers. A study based on three patients diagnosed with MD was conducted, and all of them were found to have painful skin lesions, systemic illness, and multicolor fibers coming out from their skin. Keratin immunostaining, microscopic examination, and chemical agents were used to determine their cells of origin. It was demonstrated that Morgellons filaments were originated from keratinocytes which are found in pavement epithelial cells [7]. These findings further conclude that these fibers are not self-implanted textile fibers [9] [10] [11] [12].

4. Association of Morgellons with Spirochete Infection

Recent peer-reviewed publications have found out that MD is a true somatic illness at least partly caused by *Borrelia* infection (although other spirochetes possibly involved are not ruled out), the causative agent of Lyme disease [1] [13] [14]. Lyme disease is estimated to affect approximately 300,000 people a year in the United States and 65,000 people a year in Europe [15]. Lyme disease is caused by the bacterium *Borrelia burgdorferi* and rarely, *Borrelia mayonii*. It is a multi-systemic disease transmitted to humans through the bite of Ixodes ticks.

Typical symptoms of Lyme disease include fever, headache, fatigue, joint pain, and a characteristic skin rash after a bite called erythema migrans (EM). If left untreated, the infection can lead to Lyme carditis and neuroborreliosis.

A retrospective study was conducted using medical records of 122 patients who were seen at the clinic and had microscopic subcutaneous fibers. The symptoms of the fiber group were compared with patients of Lyme disease with no fibers. This study found that the PCR test of 97% of MD patients had positive *B. burgdorferi*, confirming the clinical association between MD and spirochete infection [4]. In another study, all MD patients were seroreactive to *Borrelia burgdorferi* antigens [16]. But these results were in contrast to the cohort study done on North American MD patients, in which only 6% of patients were seropositive for *Borrelia burgdorferi* infection, the causative agent of LD [17]. It is observed that the etiology of MD is multifactorial [16].

As mentioned before, MD is a multisystem disease-causing different symptoms in the body. Since MD is associated with Lyme disease, these patients could present with gastrointestinal symptoms as well. A study involving 15 patients diagnosed with Lyme disease, found that 10 patients had evidence of inflammation at a biopsy site with detection of *B. burgdorferi* DNA. Two of those patients had blood in their stool and presented with clinical features of Crohn's disease and ulcerative colitis [18].

Factors like being female, Caucasian ethnicity, middle age, hypothyroidism and substance abuse were observed in MD patients although a causative relation has not been established [4] [16] [17]. One study concluded that most MD cases were found in California and Texas (18). Very little literature is found on the epidemiology of MD. In addition to dermatopathy, MD patients may also exhibit debilitating musculoskeletal and neurological manifestations resembling the symptoms of Lyme disease [1]. The study done in North America also listed the most common non-skin-related symptoms among MD patients including Musculoskeletal symptoms (93%), fatigue (88%), insomnia (80%) and Cognitive Impairment (50%) [17].

5. MD and Psychiatric Diagnosis

More than 250 peer-reviewed articles have found links between Spirochetal diseases and tick-borne diseases to mental illnesses [19] [20]. It may include cognitive impairment, dementia anxiety, depression, paranoia, schizophrenia, bipolar disorder and sensory hallucinations [21]. Two studies concluded that the aforementioned list of neuropsychiatric illnesses might be associated with Chronic Lyme disease in MD patients [19] [21]. Although some patients might not show any symptoms after tick bites, others might develop a broad spectrum of psychiatric impairments including suicidal tendencies [22]. But the presence of psychiatric comorbidities does not prove that a patient is delusional.

While reviewing the further literature on *Borrelia* and MD association, we noted patients having MD disease were resistant to antibiotics treatment [23] [24] [25]. Two separate studies observed the presence of *Borrelia spirochete* in

fibroblast and keratinocyte monolayers in patients treated with antibiotics [24] [25]. Therefore, persistent antibiotic resistance can occur due to *Borrelia sequestration* in fibroblast and keratinocytes. In addition, it has been recorded that spirochetes are found in the brain of patients with Alzheimer's disease. Biofilms produced by these bacteria are known to activate the innate immunity which however fails to penetrate the slime layer of the biofilm. The resultant accumulation of inflammatory markers such as Nuclear Factor Kappa B (NF- κ B) and Tumor Necrosis factor (TNF) is detrimental to the neurocircuitry [26]. Some of these spirochetes are persisters, they are resistant to aggressive anti-biotic treatment. L-forms of bacteria and micro-colonies alter the way *Borrelia* species respond to hostile environments. Biofilms have been found to have high concentrations of such resistant *Borrelia* species; therefore tolerance to anti-biotics is more common recently. In addition, atypical cystic forms were also found in the brain parenchyma of patients with chronic Lyme neuroborreliosis under treatment [27]. Another spirochete, *Treponema Pallidum*, the causative agent of syphilis causes cerebral atrophy, personality changes, delirium and psychosis in the very late stage of parenchymal neurosyphilis [28].

6. Tick-Borne Coinfections in MD Patients

One cohort study reported that all patients with MD were diagnosed with LD and positive tests for tick-borne co-infections noted in the sample were *Babesia microti* or *Babesia duncani* (18%), *Anaplasma phagocytophilum* (10.7%), *Ehrlichia chaffeensis* (9.8%), and *Bartonella henselae* (9.8%) [4]. Likewise, similar findings were found in another study including 60 MD patients [17]. In Lyme disease, co-infections are common because ticks can easily transmit pathogenic microbes. These findings warrant further work on multiple co-infections involvement in dermatopathy of MD.

With recent research on co-infections in MD patients, the co-existence of *Borrelia* and *Helicobacter pylori* with amyloid biofilm formation has also been studied in many MD patients. In one such study, dermatological specimens of 14 MD patients were examined using different techniques and cultures. It was concluded that both BB and Hp co-localize in the skin, with amyloid biofilm formation. These findings show the role of biofilm in the development of chronic skin conditions and jointly contribute to MD progression [29].

Another common co-infection caused by yeast that is associated with LD is candidiasis. Clinically this association is observed when LD patients are treated with anti-biotic that causes a bloom of candida organisms in the gastrointestinal tract [30]. A study published in National Institute of Allergy and Infectious Diseases evaluated the co-infection of the protozoa *Babesia microti* and Tick-borne encephalitis virus. The results showed that 2.5% of the patients with LD had *B. microti* whereas none had the virus [31]. Very little work was found on the role of biofilm in the pathogenesis of MD and further work is needed to be done to find out the clear role of Biofilm formation in the pathology of MD.

7. Clinical Classification of MD

A study conducted on 25 MD patients proposed the following clinical classification scheme, based on duration and location of skin lesions, to validate and standardize the diagnosis of MD [2] [23]:

- Early localized: lesions/fibers present for less than three (3) months and localized to one area of the body (head, trunk, extremities).
- Early disseminated: lesions/fibers present for less than three (3) months and involving more than one area of the body (head, trunk, extremities).
- Late localized: lesions/fibers present for more than six (6) months and localized to one area of the body (head, trunk, extremities).
- Late disseminated: lesions/fibers present for more than six (6) months and involving more than one area of the body (head, trunk, extremities).

Note: So far there isn't a clinical classification which involves neurological symptoms, but it is important for this to be included in the classification.

Each of these classifications is further sub-divided into A-mild, B-moderate, and C-severe based on certain morphological and histological features. Although the classification does not include patients in between 3 to 6 months, it is the only classification published in recent literature.

The same study has also devised diagnostic criteria for MD. They suggested that MD is a systemic disease due to spirochetal infection and the manifestation of the disease can be variable. The criteria are as follows [2] [23]:

1) Primary features (Must include the following):

Multicolored filaments embedded within or protruding from the skin.

2) Secondary features (May include one or more of the following):

Development of calluses, ulcerative lesions, papules, burning, itching, stinging, biting, Hair loss, atypical hair/nail production, Dry appearance with or without flaking skin, Edema, Hyper- or hypopigmentation from scarring, Hypertrophic scarring, excoriations, slowly healing lesions and aging skin.

Most of the secondary features presented here are proven by evidence from previous studies [14]. The primary diagnostic feature of Morgellons disease is theoretically accurate since it is the most distinct manifestations among all Morgellons patients. However, since Morgellons disease is often mistakenly associated with psychiatric conditions such as delusional parasitosis, it will be more precise to diagnose this condition specifically through histology or biopsy samples of the lesion rather than symptoms and signs.

8. Conclusions

The majority of physicians, researchers, and health care providers have always insisted and claimed that this disease is a delusional psychiatric illness and has no association with the infection without presenting any scientific data to support this theory. But recent research and studies have proved that Morgellons disease fibers have keratinocyte origin and these findings have been proved by histology and microscopic findings as well. According to the best-available scien-

tific research, dermatopathy and neuropathy in MD have been associated with Lyme disease, caused by Tick-borne infection *Borrelia* and some other co-infections as well. These facts give solid evidence to disapprove the previous understanding of MD as a self-inflicted psychiatric condition. Furthermore, the CDC study which depicts the most contradicting view to recent findings seems to be illogical now since they reported “most findings to have skin or cellulose” but found 83% of the patients to have proteins in the lesion. This does not make sense since cellulose is a carbohydrate and if most patients had proteins cellulose could not have been a major finding.

In recent years tick-borne infections have increased all around the world and this reflects the growing number of MD patients. Multiple clinical schemes are also proposed to work on their diagnosis and treatment. As of now, treatment of underlying causative infections with antibiotics and usage of engineered enzymatic bacteriophages to disperse biofilms that are resistant to antimicrobial treatment and eradication by host immune system are possible options for management. In summary, MD is an emerging disease associated with *Borrelia* infection which needs further study of genetics, pathogenesis, and treatment. Very little literature was found on epidemiology, transmission, and prevalence of MD which warrants further investigation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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