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Research Article

Acute Flaccid Myelitis-Possible Link with Electro-Magnetism? A Hypothesis Stimulating Study

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Abstract

"Wonder grows when knowledge fails" (Francis Bacon 1561-1626) A new polio-like condition mainly affecting children (mean 5 years old) is being observed, starting with viral and respiratory symptoms, followed by a demyelination paralysis. Known as Acute Flaccid Myelitis, first identified in 2010 in America, 28% to 95% of cases are associated with Enterovirus EVD68. Yet EVD68 itself was identified decades previously in China and the Netherlands.

Prior to hospitalisation some children had no evidence of neurological symptoms, hinting a possible environmental trigger. Acute hospitals have multiple sources of background Electro-Magnetic-Field (EMF), some above recommended safety levels. Hence the hypothesis "Are critical rises in human background electromagnetism, interacting with other environmental factors, possibly a casual factor, in Acute Flaccid Myelitis? "There is evidence that low frequency EFM creates cellular oxidative stress leading to neurodegeneration. Mechanisms are unclear but could ubiquitous background EMF play a role in children's vulnerability to EVD68?

The context of the hypothesis is the evidence of accelerating rates of neurological morbidity in the 21st Century and whether the range and multiplicity of environmental factors are impacting upon an immune-compromised child's neurology. As health environmental factors were ignored in the past, e.g.

smoking and asbestos, another possible environmental linked anomaly is feared, though we note the recent establishment of the UK Acute Flaccid Paralysis Task Force in 2019. This hypothesis, whilst remaining speculative, needs to be refuted through independent research to ensure that AFM is not another children's neurological condition, which once were rare but now becoming more commonplace.

Keywords: Acute Flaccid Myelitis Environmental Aetiology

1. Introduction

Can background electro-magnetism, like excess Oxygen, become pathological?

1.1 A New paediatric disease

In 2012 the first recorded paper on an apparently new paediatric disorder of children, Acute Flaccid Myelitis (AFM), was identified in America in 2010 [1] The condition begins with simple viral symptoms, increasing respiratory problems and slowly emerging neurological symptoms of weakness in the limbs. MRI demonstrates spinal lesions to confirm the diagnosis [1, 2]. Incidence of AFM has been subsequently confirmed not only in Western countries but across the continents and is mainly associated with Enterovirus D68 infection [1, 3-8].

The condition is reminiscent of poliomyelitis, which ravaged Western countries until the first half of the 20th century when JE Salk's vaccine in 1955 virtually eradicated the condition. Indeed, it is the current surveillance tracking for poliomyelitis in a number of developing countries, that has identified cases of AFM [4, 7, 9, 10]. Although AFM has been associated with Enterovirus D68, this is not exclusively so, as the presence of confirmed EV-D68 cases ranged from 28% to 95% [1, 2, 10, 11], with one relatively large cohort only 50% of cases had confirmed EVD68 [12]. Therefore how to account for the missing variance?

The condition has appeared in two-year cycles, almost doubling in the United States, rising from to 80 cases in 2014, two years later to 153 and by 2018 there were 236 patients, mainly children [1, 2, 10]. In the USA Ayes reported that of all subsequent 336 cases 305 were children, median age 6years [13]. Thus, from an American population of 27.946 million children aged 0-6years, this would yield an AFM rate of just 8 per million (pm) in the peak year 2018. Such a rate, whilst low, is nonetheless more than the highest mortality rate for UK New Variant Creuzfeld-Jacob's Disease in the 1990's , the so-called `mad cow disease' epidemic [14].

With such relatively small numbers there is still much to be learned about AFM but it appears amongst a number of other relatively `new' syndromes related to neurological disorders. For example, autism was once uncommon but is now world-wide, with 700,000 cases in Britain. Similarly, Attention Deficit Hyperactive Disorder (ADHD) and Chronic Fatigue Syndrome (CFS), once both relatively rare but now quite common [14, 15].

These changes have occurred within the context of major rises of neurological conditions, controlled for age and population, which have increased in the twenty-one Western countries [14], with significant rises in earlier morbidity and early-onset-dementia [16-20] . For example, in 1989-91 America was fourteenth highest for neurological deaths, with an

Age-Standardised-Death-Rate (ASDR) at 182 per million (pm), rising to 539pm by 2015, becoming second highest, even though every other country had substantial increases over the period [14].

1.2 Possible EMF links?

We became interested in AFM when approached by a non-medical scientist whose child had entered hospital with a typical enterovirus respiratory illness. After a short period in intensive care, the child developed neurological symptoms later diagnosed as AFM. The mother noted that there was extensive electrical equipment in the ward and noted that close to hospital were three other large sources of Electro-Magnetic-Field (EMF) transmissions. Because of earlier work on electromagnetism and neurological disease [15], she asked whether background electro-magnetism could be a factor in her child's AFM? This led to this study hypothesis.

Considering the interactive multiple-environmental pollutants, plus the relatively recent upsurges in background electro-magnetism, we hypothesised that increased `background electro-magnetism MAY be a contributory trigger in immune-compromised children in the development of Acute Flaccid Myelitis (AFM).

1.3 Evaluation of the hypothesis

We do not know of any research linking AFM and electro-magnetism. Nonetheless, over recent years a number of studies have noted the `boom' in electrical appliances in hospitals, which sometimes interferes with other electrical equipment and questions have been raised whether EMF safety levels exceeded acceptable levels, especially for children [21-27]. Kohani's study exemplified the problem in their title `electrostatic charging of the human body caused by activities and material combinations in hospitals' [27]. Besset and colleagues also argued for greater caution in intensive children's and neonatal units, especially with EMF spikes, with some miniscule surges at different times of the day [21]. Afterall, the brain is an electro-biochemical organ and the spinal column a natural antenna [28, 29] and recent military research showed that the brain is the organ most affected by electro-magnetism [30]. Whilst low level but prolonged exposure to micro radiation can affect the dendritic spines [30-38], the spinal cord acts as a monopole antenna with resonance between 10-100MHz(peak) – 2400MHz Height x 2 in metres = wavelength. The possible mechanism of the problematic link between EMF exposure, oxidative stress and neuro-degeneration may be unpaired electrons from magnetic fields which generate 'spin' known in physics as the Magnetic Moment with Reactive Oxygen Species (ROS). Increased ROS means greater magnetic susceptibility that stores charge and energy [28-38].

As a natural antenna, a supine body will undergo maximum effect parallel to the long axis of the body, which can be problematic [24-28]. Indeed, the Kohani study noted that using anti-static slide protection to counter-act the electrical discharges, more than halved the level of charge to which the average patient was exposed [27]. Whilst others cautioned that levels of non-ionizing radiation on children exceeded safety levels recommended for normal adults [23-25] and there is increasing concern about background electro-magnetism upon children [21-23].

Furthermore, background EMF can lead to oxidative stress associated with neuro-degeneration. A series of meta analyses on motor neurone disease –

(amyotrophic lateral sclerosis in the USA) have been conducted, one concluded there is no convincing evidence of occupational link [37], another only mild association, possibly 10% contribution [38] but three other studies had little doubts about negative impacts upon health [39-41]. Furthermore, Belyaev's report on the European Union's EMF guidelines, unequivocally acknowledged there was growing evidence of health related problems, arguing that manufactories were proceeding ahead without considering possible health side effects, which included neurological outcomes [42].

Conversely, there are studiers which show that there are therapeutic benefits from low level EMF exposure, some in improvements in energy and memory of Alzheimer patients, others related to beneficial treatments for wound and stroke patients [43-46]. Whilst a number of researchers have reported that their studies found NO statistically confirmed adverse effects from background exposure to non-ionising radiation [37, 47-49]. Nonetheless, given the relative newness of the digital world and its near ubiquitous presence in the last decade, we wonder if this may be a trigger or crucial additional factor in the development of AFM in already immune-compromised children? Or conversely, might levels of prolonged EMF exposure enhance the virus? AFM's initial symptoms are not dissimilar to early Multiple Sclerosis (MS), which are often linked to viral infection, with MS cases recently doubling in the USA and increases have been reported around the Western world [50-55]. Interestingly there are studies beginning to associate multiple sclerosis with electromagnetic damage created by oxidative stress [36, 54-55], might there be a parallel here with AFM in children?.

The findings of the early AFM cases by American researchers assumed that EV-D68 was a new virus, whereas it was noted in China as early 1962 [7], whilst Karelehtop and colleagues reported the presence of EV-D68 in the Netherlands in the late 20th century [56]. Moreover, Uprety reported that they had found a wide-spread EV-D68 in circulation in Philadelphia in 2009 before the first case of AFM was reported. However, one authority asked had possible AFM cases gone un-noticed in Australia [57]. Moreover, a recent study of EVD68 infections in a Northern province of China but found no AFM and another AFM study only had 50% associated with EVBD68 or other viral infections [12].

1.4 AMF: Greater than reported?

Of possible significance is a very similar respiratory-neurological syndrome to AFM which is described as Acute Flaccid Paralysis (AFP), indeed one of the leading researchers on (AFM) the American Massacar, has also reported rises in AFP [58] and some believe that AFM is a variation of AFP and not a distinct disorder [59, 60]. This suggests that there might be more cases of respiratory onsets followed by neurological disorders before AFM was first `discovered'. The worry being that the incidence of Acute Flaccid Paralysis (AFP) is increasing around the world [60-71]. Indeed, of singular importance is that in the UK, in addition to small increases in cases of AFM, since 2019 a new `Acute Flaccid Paralysis Task' force has been established [67]. Whilst in Italy, in response to AFM , there is a call for a National Surveillance system in response to rising cases of post-viral infection and emerging neurological pathology [69] This really poses the question of whether AFM and AFP are really different diseases

but more importantly, what is accounting for these changes?

1.5 Increased neurological morbidity

What needs to be grasped is that a range of para-neurological conditions are more prevalent and there have been substantial rises in earlier onset and neurological deaths in every Western country, [14]. Other unusual conditions, which had been assumed to be functional of `hysterical' nature, such as electro-sensitivity, chemo-sensitivity, are now attracting the attention of serious neurological researchers [72, 73]. Then there are the undoubted increases in the major neurological disorders such as Motor Neurone Disease, Parkinson's Disease, Alzheimer's, which are starting earlier, and conditions that were barely recognised thirty years ago such as Progressive Supranuclear Palsy, Multiple System Atrophy etc [14, 74]. As if to emphasise the changes in brain disease, are the marked increase of Early-Onset-Dementia across all continents [17-20].

Whilst from Wuhan the origin of covid-19, a small proportion of patients in intensive care are showing serious neurological symptoms and not just amongst the elderly [75]. Moreover, despite earlier denials there is now no dispute that over exposure to organophosphates are related to neurodegenerative disease [76, 77]. Most disease processes have many inter-related background factors, with increases in agricultural, domestic, industrial; chemicals, air, plastics, heavy metals in water and breast milk, all containing neurological affecting particulates [78-83] to mention just a few other possible over-lapping factors. Thus, to what extent might these be linked to the increasing rates of brain pathology? Adding emphasis to our assertion that the EMF element is but one of a group of coincident but increasing environmental factors linked to the aetiology of neurological disease.

The unavoidable side lobes from high masts are of major significance as reported by industry, as in the current court case between the USA Health Protection Agency and the Federal Communications Commission, that argued the FCC were ignoring research from the last ten years and therefore failing to explain that the American public now live in a permanent state of very low radiation exposure (Environmental Health Trust, 2020). Might this possibly disturb our hitherto `Goldilocks' balanced world? The speed and increasing ability to accumulate sources of background electro-magnetism raises the question is there a cut-off point when EMF impacts on human physiology but in a non-linear way, reflecting individual bio-psycho-social and epigenetic circumstances.

1.6 Possible consequence of hypothesis

Of course, most Western governments have a range of Health and Safety regulations to cover possible negative environmental factors impacting upon human health. For example, the British M.o.D. Leaflet 35 in 2014 outlined the requirements for keeping and using equipment emitting radio frequencies. They note that "at present no statutory UK legislation specially concerns exposure to radiofrequency radiation"- arising from equipment such as transmitter, microwave links, `communication' apparatus etc-" However, almost casually Leaflet 35 stated "EMF can produce both acute and chronic effects…. These generally only occur if exposure is above the permitted levels. However, low level chronic effects have been

postulated … but as yet no conclusive proof". Yet non-ionising radiation is extremely common, with constant low frequency but prolonged exposure, which can easily be tested by taking a compass around one's home or office (EHT, 2020).

Even the ultra-cautious Health Protection Agency report (2012) on health effects of non-ionising Radiofrequency reported that "exposure of the general public to low level RF fields…. Is now almost universal and continuous" (our italics) (p3). They acknowledged the multiple sources, personal, occupational and industrial, yet concluded at the time there was "no convincing evidence that RF fields causes genetic damage… no evidence of health effects… no consistent evidence of the effects on the brain, nervous system or the blood brain barrier… etc." We are cautious in being critical of a report carried out by a very distinguished group but they lacked an accumulative historical focus, as in effect their research had ended by 2010.

However, with more modern results there can be no doubt that EMF does impact on cells creating oxidative stress [30-36]. Indeed, the USA Federal Communications Commission, whose role is to monitor radiation safety has been strongly criticised by a group of independent scientists- the Planetary Health Alliance and sued by another NGO, the Environmental Health Agency, for using old research evidence to reassure the general public. Implicitly inferring the FCC is under-playing legitimate concerns evolving from more current research.

Of special significance is an early European Union report on the potential hazards from low frequency EMF, who had no doubts whatsoever! They strongly urged an investigatory proactive precautionary approach. Their method was to look at cell change invitro and reminded critics that the review needed to be over decades to account for the slow and accumulative change (REFLEX,2004). More recently and significantly the 2016 EUORPAEM EMF Guideline, clearly stated that to some extent EMF does negatively impact on human health, especially for cancers, falling male sperm counts but also neurological disease [42]. They complained that new wireless technologies have been introduced without any certainty about their health effects. They affirmed that there is no longer doubt about electro-magnetism and oxidative stress, though recognised that EMF exposures affects individual's differently [42]. If EMF was water, most of us live is a continual faint mist, some in a light drizzle and others in various occupations, in occasional light showers.

Considering a series of meta analyses on MND, the epitome of neurodegenerative diseases. with varying degree of confidence of EMF association, though Gunnarson notes stronger association with exposure to occupational pesticides [32]. Whereas Riancho 2021 is somewhat uncertain and feels EMF impacts upon the genetically predisposed [43], whereas others have confirmed the EMF link [33-36]. What most of studies of electromagnetism perhaps fail to appreciate, is the considerable increases in background EMF over a little more than two decades but at the same time people, and especially children, all are also exposed to other pollutants at unprecedented levels both air, water, breast milk, possible creating a significant interactive affect.

Hence our hypothesis that increased background EMF exposure might well be the tipping point into

neurological pathology, interacting with other environmental pathogens, for the increases in both Acute Flaccid Myelitis and Paralysis. Sadly previous `official' responses to possible environmental threats have had a mixed history, for example with asbestosis. This was recognised in the late 1960's as dangerous but it was not until the 1980's it was effectively banned and even then its earlier commercial use was so spasmodic that currently there is an `epidemic' of asbestos related deaths going through current age cohorts [85, 86]. We fear that there may be another environmentally linked disorder that is not being recognised. But it is vitally important to `think outside the box' and recognise the degree of a range of environmental pathogens, which might then be compounded by "unprecedented human exposure to radiofrequency and EMF from conception until death has been occurring in the past two decades" (Planetary Health Alliance, 2019).

2. Discussion

2.1 Need for precautionary approach

Hypotheses without evidence can be dangerous and misleading and it is acknowledged that "*wonder grows when knowledge fails*" (Francis Bacon 1561-1626). Moreover, it is recognised that in the continued expansion of the digital world, there may be possible vested interests that might find precautionary ideas unwelcome and describe them as `conspiracy theories'. Yet we recall the adage "*what's the reason that treason never prospers, for if it prospers, who dares call it treason*" (Pope 1688-1744). Thus, if a hypothesis proves not to be an eccentric `conspiracy' theory, then it might be recognised as a new Public Health environmental health alert.

A key feature in our approach is the understanding of recent historical time. Crucially we are not attributing the recent rises of neurological pathology to just one major cause, background EMF, but rather question its importance in the presence of OTHER potentially pathological stimulating or enhancing interactive environmental factors, from air, water, food to breast milk pollution that can impact on human health. The question remains, can the substantial increase in background EMF over little more than 30 years have contributed to rises in viral affected neurological disease? Possibly in the case of Acute Flaccid Myelitis / Paralysis in the 21st Century, interacting with a virus previously recognised since the 1970's? To us, it is the increases in AFM/ AFP in this century, coinciding with major rises in other neurological conditions, leads us to ask the **precautionary question**. Can new levels of prolonged EMF exposure trigger polio like neurological disease in immune-compromised children experiencing a viral infection? This might be from gentle low but prolong exposure or the sudden exposure of EMF on hospital wards [21-27]. This should be a serious consideration for governments and the appropriate research instituted to ensure we are not entering a new `epidemic' that might be human enhanced, either affecting the immune-vulnerable child or the virulence of the virus.

As more is known about AFM, whilst most studies see the origins of AFM as mainly viral associated, some recent research hints at other possible non-linear interactive features, as with increases in Multiple Sclerosis in this century [50-55]. Moreover, for the first time there now have been reports of adult AFM cases [70, 71]. Bearing in mind the END68 is the virus associated with AFM, in covid-19 patients there appears to be a sub-set with spinal-cord myelitis [58].

A Japanese study examined all cases of respiratory viral disease and cases of AFM, expecting to find a correlation between the two but failed to do so. However, they commented that there was an increased number of cases admitted to ICU and conjected whether this might be a factor [5] not forgetting of course the importance of the individual's genetic predisposition and proclivity for different conditions.

The growing seriousness of AFM is evidenced by a December 2020 paper from the University of Texas that states that Acute Flaccid Myelitis is a subset of Acute Flaccid Paralysis [87], whilst a 2021 Lancet paper from eighteen different American Universities plus contributions from eight other countries, expressed concerns about prevalence of AFM, hence the call for vigilance [88, 89], confirming our fear that AFM might be a bigger problem than was first reported. We appreciate that we have covered a very wide research area but consciously have excluded discussions of increases in heavy metals and plastic particulates in human breast milk, water and endocrine disruptive chemicals and the impact upon children's development, which are further additions to the changing human environment [77-82] hence it is reiterated that any negative impact of electro-magnetism, is but one of many possibly interacting environmental influences.

This remains essentially speculative but with the uncertain aetiology of AFM there needs to be urgent and independent research to disprove our hypothesis. For it is the changing range of factors in the human environment that may be inter-actively impacting upon an immune compromised child's developing neurology. The worry is that can increased background electro-magnetism, like life-essential Oxygen, become pathological?

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