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Connections in

Sizing up Electromagnetic Fields

BY MARTHA R. HERBERT, PH.D., M.D.

If someone had asked me nearly 20 years ago, when I first started working in autism research and seeing patients with autism, whether electromagnetic fields (EMF) or radiofrequency radiation (RFR) had anything to do with it, I would have had no idea what they were talking about. At that point I was already hooked on computers and email, but the web was new and we weren't using cell phones, so there were no cell towers. I had a microwave oven and used it to "nuke" my food with only the vaguest inchoate concerns.

So not so much Wi-Fi, and not so much autism either – a coincidence? Lots of other things have changed since then too,[1] and there was plenty of electricity,[2] but in any case I had hardly seen any autistic patients during my training in the early 1990s, and back then, the teaching was that autism and other childhood neurodevelopmental or neuropsychiatric disorders were caused by genetically based early disturbances of brain development.[3]

Many things have transpired to bring me to the point where I would co-author a 40,000 word paper with 560 scientific footnotes supporting the plausibility of a connection between autism and EMF. [Editor's note: This paper may be may be downloaded from http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf, and a revised version has been published in the journal Pathophysiology.[4]]

Over the years, I have learned a lot from watching and listening very carefully to my patients. I found large discrepancies between what I had been taught to look for in my brain research and what I was actually finding in the data. I started learning about more and more ways the environment and diet could affect brain and body. And I watched the numbers of autistic kids skyrocket when it was supposed to be purely genetic and inherited.[5-7]

Listening to my patients was a huge impetus in changing my thinking. My pediatric neurology training did not really prepare me for the problems my patients presented. My first clinic was in 1996, in a neuropsychiatric practice. As my clinical practice filled with children with autism, ADHD, obsessive-compulsive disorder, trouble in school, and seizures, I sometimes put them through elaborate hunts for genetic and metabolic underpinnings that I had been trained to do, but I rarely found anything wrong. As I listened to their stories I found myself intrigued by the commonplace problems that were shared by so many patients who were in other ways different from each other. These children were just plain not healthy! They had diarrhea, or constipation, or rashes. They had headaches. They could not sleep. They wiggled a lot in their chairs. They had food allergies. They ate a few foods and refused many others. They hated certain textures, or sensations. I had to work really hard and rephrase and repeat a lot to get them to follow my instructions when I examined them. All these challenges happened with most of my patients, not just the ones with autism. And my practice was filling up with these unhealthy, unstable kids.

As I straddled the worlds of brain research, environmental neurotoxicology, and in-the-trenches medical care I found I could no longer be satisfied with the questions people were asking in any one corner. It wasn't enough to ask how the brains of people who had autism or other neuropsychiatric conditions might differ from the brains of people who are "normal," or what toxins in the environment might cause autism. I didn't see those questions as directly helping me get my patients better. And in fact, some of my patients, and patients of friends of mine, WERE getting better – but HOW were we changing the brain's "autism" if it wasn't supposed to be changeable?

Over time I gathered more and more evidence to support the idea that autism is not about having a "broken brain," but about having a brain that is having a hard time regulating itself. This set me on a hunt not for "what causes autism," but HOW autism is caused, and how you might un-cause it.[8,9 10,11]

So what kind of things can dys-regulate a brain? Well, lots of things.[12] Like disrupted sleep or insomnia. Like exposure to pesticides and fumes from automobiles or household chemicals and glues, and other chemicals. Like having a diet that is short on zinc or magnesium or other vital nutrients or has too much sugar or additives or other junk. Like having a gut so irritated or inflamed that you don't absorb your nutrients well. Like having allergies.

A dys-regulated brain may or may not show changes in its anatomy – on what you see if you look at an MRI picture of what the brain looks like. It may not show brainwaves that are sufficiently abnormal to be seizures if you do an EEG brainwave study. But on more subtle examination, brain researchers who study brain FUNCTION in ASD find that the different parts of the brain aren't as well coordinated with each other as in kids with more typical development.[13-15]

Now we're starting to get close to where EMF/RFR came into the picture for me. These brain waves that the brain uses to communicate inside of itself are electrical, or electromagnetic. So is EMF/RFR. Given the proliferation of devices that emit RFR (such as cell phone towers, cell phones, DECT cordless phones, Wi-Fi routers etc.) we are walking around in an invisible soup of electromagnetic signals without really knowing whether we might be complicating or confusing the communication processes in our brains.

That might seem a little far-fetched, but there is more here. First of all, it's not just the brain that uses electromagnetic signaling. The more sensitive our scientific measurement instruments become, the more we learn that every cell in our body uses electromagnetic signaling – many cellular processes, and even DNA, involve electromagnetic properties that change in meaningful ways. The main thing different about the brain is that it takes this electromagnetic activity to a dazzlingly high and complex level of organization.[16]

When we go to school we study biology, chemistry and physics (including electromagnetism) as separate subjects, but in reality our biological bodies and brains operate through processes that are simultaneously chemical and electrical. Chemical ions set up electrical voltage differences across cellular membranes, for example, that keep us alive. Recently it was found that people with lower voltage difference between the inside and outside of a membrane are more vulnerable to cancer, and if you increase the voltage difference between the inside and the outside of the cell, the vulnerability goes down and the cancer may improve.[17] So even cancer may be simultaneously electrical and chemical.

Our vital biological functions derive from countless chemical-electrical interactions, and for us to be at our best they need to be optimized. I think there is enough strong scientific support to argue that EMF/RFRs are important contributors to degrading the optimal chemical-electrical function of our bodies – thereby detuning our brains and nervous systems.[18]

How would EMF/RFR do this? The problems I list below are parallel to issues that have been documented in people with autism spectrum disorders.[4,18]

- EMF/RFR stresses cells. It leads to cellular stress, such as production of heat shock proteins, even when the EMF/RFR isn't intense enough to cause a measurable heat increase.[19-21]
- EMF/RFR damages cell membranes, and makes them leaky, which makes it hard for them to maintain important chemical and electrical differences between what is inside and outside the membrane. This degrades metabolism in many ways – makes it inefficient.[22-30]

our Environment

• EMF/RFR damages mitochondria. Mitochondria are the energy factories of our cells. Mitochondria conduct their chemical reactions on their membranes. When those membranes get damaged, the mitochondria struggle to do their work and don't do it so well. Mitochondria can also be damaged through direct hits to steps in their chemical assembly line. When mitochondria get inefficient, so do we. This can hit our brains especially hard, since electrical communication and synapses in the brain demand huge amounts of energy.

• EMF/RFR creates "oxidative stress." Oxidative stress is something that occurs when the system can't keep up with the stress caused by utilizing oxygen, because the price we pay for using oxygen is that it generates free radicals. These are generated in the normal course of events, and they are "quenched" by antioxidants like those we get in fresh fruits and vegetables; but when the antioxidants can't keep up or the damage is too great, the free radicals start damaging things.

• EMF/RFR is genotoxic and damage proteins, with a major mechanism being EMF/RFR-created free radicals which damage cell membranes, DNA, proteins, anything they touch. When free radicals damage DNA they can cause mutations. This is one of the main ways that EMF/RFR is genotoxic – toxic to the genes. When they damage proteins they can cause them to fold up in peculiar ways. We are learning that diseases like Alzheimer's are related to the accumulation of mis-folded proteins, and the failure of the brain to clear out this biological trash from its tissues and fluids.

• EMF/RFR depletes glutathione, which is the body's premier antioxidant and detoxification substance. So on the one hand EMF/RFR creates damage that increases the need for antioxidants, and on the other hand they deplete those very antioxidants.[4,18]

• EMF/RFR damages vital barriers in the body, particularly the blood-brain barrier, which protects the brain from things in the blood that might cause it harm. When the blood-brain barrier gets leaky, cells inside the brain suffer, become damaged, and get killed.[4,18,31]

• EMF/RFR can alter the function of calcium channels, which are openings in the cell membranes that play a huge number of vital roles in brain and body.[32-41]

• EMF/RFR degrades the rich, complex integration of brainwaves, and increase the "entropy", or disorganization, of signals in the brain – this means that they can become less synchronized or coordinated; this has been measured in autism.[13-15,42-51]

• EMF/RFR can interfere with sleep and the brain's production of melatonin.[52-54]

• EMF/RFR can contribute to immune problems.[55-61]

• EMF/RFR contribute to increasing stress at the chemical, immune and electrical levels, which we experience psychologically. [31, 62--79]

Please note that:

1 *There are a lot of other things that can create similar damaging effects, such as thousands of "xenobiotic" substances that we call toxicants. Significantly, toxic chemicals (including those that contain naturally occurring toxic elements such as lead and mercury) cause damage through many of the same mechanisms outlined above.*

2 *In many of the experimental studies with EMF/RFR, damage could be diminished by improving nutrient status, particularly by adding antioxidants and melatonin.[80-83]*

We live in a world full of new-to-nature substances and electromagnetic frequency combinations and intensities, many of which damage our cells, tissues and living processes in similar ways. So it is hard for me to believe that EMF/RFR is the ONLY contributor to ASD or other neuropsychiatric and health issues. On the other hand, its impact could be significant – and we can do a lot to reduce exposure and thereby reduce that impact.[84]

We have barely begun to explore the impact of EMF/RFR on fetuses and babies, but it does not look good. A developing fetus or young infant is engaged in an incredible set of dynamic processes that are very vulnerable, where even small shifts can have lifelong consequences. And yet how many people put wireless baby monitors right next to their babies' head, blithely unaware of the potential degradation they may be inflicting on their child's brain?[85] How many pregnant women plug in their laptops and put them on their laps exposing their fetuses?[86] How many men stick their cell phones in their pants pockets when this has been demonstrated to degrade sperm counts and lead to mutations? [87-92]

The more I know about the underlying biology of autism and of many other chronic neuropsychiatric and medical diseases, the less store I hold by the labels we put on specific diseases. From the point of view of protecting people and helping them get better, I don't care so much about whether it's autism or ADHD or OCD or whatever other label you may choose, because under the surface I see more overlap than differences. Where I think we can make a difference is addressing the FUNCTION of our bodies and brains,[8] by:

• reducing noxious exposures as much as we can, to avoid the degradation of our body function and to prevent the detuning of our brains and nervous systems – and

• maximizing the quality of our food through a high nutrient density diet so that our bodies have all the nutrients they need to protect themselves and to function at their best.

Meanwhile, given how much we have already learned about the subtle biological, cellular and electrical impacts of EMF/RFR, we need to update our out-of-date regulations to take into account of how exquisitely vulnerable we now know we are. And we need to aim for safer ways of meeting our needs for communication and other devices that generate EMF/RFR. Just because EMR/RFR is invisible doesn't mean it's harmless. We need to admit that we have a problem, and do something about it.

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The full length of references documented in this article can be found at www.AutismNotebook.com