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VGCC the main mechanism for all EMF effects? Comment on and addition to Pall's claim

donderdag, 25 juli 2019 - Categorie: Artikelen

In a recent article with the title:
'Cautionary words on Martin Pall's claim that VGCC is the sole target and mechanism for all EMF effects'
a survey is given of comments on this claim by a number of scientists:

betweenrockandhardplace.wordpress.com/2019/06/28/cautionary-words-on-martin-palls-claim-that-vgcc-is-the-sole-target-and-mechanism-for-all-emf-effects/

None of these has a physics background and a physicist's comment is still missing. I give it here below.

In Pall's e-book from 2018:

peaceinspace.blogs.com/files/5g-emf-hazards--dr-martin-l.-pall--eu-emf2018-6-11us3.pdf

voltage-gated calcium channels (VGCC) are claimed to be the main target and mechanism for all EMF effects. VGCC are, however, not claimed to be the sole target and mechanism for all EMF effects as suggested in the title of the survey of comments (the first link above).
Pall actually describes many mechanisms, most of these as a follow up of VGCC activation. Direct activation of voltage-gated sodium, potassium and chloride channels are also mentioned, but with relatively modest roles compared with the VGCC.
The claim that VGCC are the main target and mechanism is partly based on a physics calculation which shows that the forces on the VGCC voltage sensors, caused by the externally applied field, would be extremely large.

The physics in the calculation is, however, not fully correct. Below I make a correction and present an additional calculation which shows that externally applied fields, such as from a cell tower, only give a minor disturbance of the already existing natural fields over and in the cell membranes. The suggestion that VGCC are the main target and mechanism for all EMF effects is therefore not directly supported by physics arguments. There remain the biochemical arguments which are beyond my field of expertise.

The model calculation

On page 18 of the e-book there is the formula:

20 x 120 x 3000 = 7.2 x 10^6, ... (1)

wherein, according to the explanation:
- 20 stands for the 20 positive charges making up the VGCC voltage sensor, which charges are located within the lipid bilayer part of the plasma membrane,
- 120 stands for the 120 times smaller dielectric constant of the cell membrane compared to that of the cell plasma,
- 3000 stands for the estimated ratio of the electrical gradient in the cell membrane compared to that in the cell plasma, caused by the high resistivity of the cell membrane and the high conductivity of the cell plasma, and
- 7.2 x 10^6 (7.2 million) stands for the ratio of the forces on the voltage sensor compared to those on singly charged groups in the cell plasma.

Singly charged groups are meant here to be singly charged atoms or molecules and the 20 charges making up the VGCC voltage sensor are also meant to be singly charged.

The above extremely large ratio is one of Pall's reasons to conclude that the VGCC

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should be the main target of the EMF of wireless communication. This ratio does not give much useful information, however, as long as we don't know by which large number the field gradient (field strength) in the cell plasma is reduced compared to that of the applied field.

Using Pall's input numbers I therefore make a new first order calculation. In:

2 dm Em + dp Ep = (2 dm + dp) Ea ……………………………..……...… (2)

dm and dp stand for the cell membrane thickness and the cell plasma diameter, respectively, and Em, Ep and Ea stand for voltage gradients over the membranes, the cell plasma and of the applied field, all in the direction of electric field component of the applied EMF. Herein dm = 5 nm, dp = 10 μm and Em / Ep = 3000 , taking this as the ratio of the resistivities of the membrane to that of the cell plasma. Inserting these numbers yields:

Ep = 0.25 Ea and Em = 750 Ea ……………………………….………..……… (3)

One thus gets a field gradient reduction over the plasma by a factor 4 and a field gradient enhancement over the membrane by a factor 750. This accounts for the different resistivities but not for the dielectric properties. According to Eqs. (2) and (3) the externally applied field is thus subdivided over the cell plasma and the membranes on both sides of the plasma, a logic assumption.

In order to account also for the dielectric properties of the membrane and plasma to get the field gradient reduction in the plasma and the field gradient enhancement in the membrane one must divide the values 0.25 and 750 by the respective relative permittivities (dielectric constants) εp and εm. Since relative permittivities are always larger than 1, this would reduce the field enhancement in the membrane. In the hypothetical case that Em / Ep = 30,000, a factor 10 larger, one would get Em = 968 Ea. The maximum possible field enhancement over the membrane is determined by the ratio dp / (2 dm) = 1000 in this case.

Compared to the field strength of the applied field, the field strength over the membrane is thus increased by a factor of 750 and the field strength in the membrane is increased by a factor of 750 / εm .

For εp / εm = 120, as in Pall's e-book, Eq. (1) must be replaced by:

20 x 120 x 750 = 1.8 x 10^6, ………………………………………………… (4)

still a very large ratio.

The field of a cell tower on the membrane

For an external field coming from a nearby cell tower, a realistic high-end outdoor field strength for 3G and 4G EMF is 3 V/m, a factor of 20 lower than the 61 V/m ICNIRP and FCC exposure limit for 2 GHz radiation. Multiplying this 3 V/m with the afore mentioned field enhancement of 750 one gets a field strength over the cell membrane of 2,250 V/m. For thicker cell membranes one gets smaller and for larger cell diameters larger field strengths over the membranes.

This field strength of 2,250 V/m can be compared with the natural field strengths over the membranes. These follow directly from the membrane thickness, 5 nm in this example, and from the voltages over the cell membranes which are known to be of the order of 40 to 70 mV. One thus gets field strengths from 8 x 10^6 to 14 x 10^6 V/m. Taking the ratio to the field strength over the membrane caused by the externally applied field one finds that the natural field strengths are 3600 to 6000 times larger.

The externally applied field thus disturbs the natural field over the membrane in a minor way. The additional factor of 20 - introduced to represent the cooperative effect of the 20 positive charges making up the VGCC voltage sensor - may be real, but that amplification factor would also apply to the action of the natural field on the voltage sensor.

From the above one can conclude that the claim that VGCC are the main target and mechanism for all EMF effects is not directly supported by a physics argumentation, but VGCC may still be one of the targets for EMF effects and possibly an important one, not by direct activation, but by interfering with the (initiation of the) naturally occuring activation. The information in the applied EMF is then more important than the energy.

This would be analogous to the possible interference of EMF of a mobile phone with the electrical signals in intensive care apparatus or in airplanes. In these apparatus and in airplanes there are no VGCC, but interference between electrical signals can still lead to a disaster.

Additional remarks

In the above first order calculation the frequency dependent temporal dielectric and conductive properties of the cell plasma and cell membrane are not included. It is in fact a low frequency approximation in which there is no time lag between the applied field and the displacement of ions and polar molecules in membrane and plasma. Apart from severely complicating the calculations, including these dependencies would have an averaging effect, which would probably diminish the relative contribution of the applied field to the natural field.
These complications would not alter the conclusion that the externally applied field only disturbs the natural field over and in the membrane in a minor way. It is not clear in how far these temporal effects would reduce the large ratio between the forces of the external field on the VGCC to those on charged particles in the cell plasma (Eq. 4).

On the other hand, as stated by Pall, it is known that pulsed EMF, such as used for wireless communication, are more harmful than non-pulsed sine-wave EMF. The lower frequency components in the pulsed EMF further lower the threshold for damage and the continous and prolonged exposure have a further deteriorating effect and are in fact most important. All these complications are not accounted for in the above first order calculation.

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