

The role played by the biological absorption of C14 isotope in stimulating neurogenesis and biophoton production

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Abstract

This paper aims to demonstrate that low doses of ionizing radiation, occurring from C 14 isotopes, significantly influence human neurogenesis and produce biopositive effects.

This research may be relevant to social neuroscience, anthropology, psychiatry, nuclear medical technology applications, atomic safety regulations.

Low doses of ionizing irradiation elevate oxidative stress. The shift from a reduced state to an oxidized state acts as a cellular switch mechanism, affecting the stem cells and neurons' modality of action by moving them from proliferation to differentiation. In the first phase, the neurogenesis produces nondifferentiated new neurons, which are open to all possibilities and account for the process of plasticity. Plasticity serves to adapt to various environmental challenges. Later on, by complying with a particular adaptation, the neurons enter the differentiation phase that enlarges the cognition. The proliferation slows down when the differentiation occurs.

A better-oxidized environment favors both cell proliferation and differentiation. The experiments found that proliferation or self-renewing affects the multipotent cell progenitors with a high ROS status. It means that cell proliferation and differentiation are highly responsive to ROS stimulation.

Superoxide dismutase (SOD) is a major antioxidant enzyme that removes superoxide radicals (free radicals).

Keywords: social neuroscience, anthropology, nuclear medical technology applications

Introduction.

Low-dose ionizing radiation is ubiquitous in our environment, and it corresponds to a dose of 100mSv or less. The dose is defined as a rate of radiation exposure of 6mSv or less per hour (Feng Ru Tang, 2016).

It should be noted that from 42,000 years ago to 2,500 years ago, humans have lived with 20-80% higher than normal atmospheric concentration C 14 isotope. Even when it occurred a type of intermittent exposure, the cumulative direct exposure to irradiation is estimated to

total length of over 10,000 years. Some other shorter events (like solar flares, solar minimum, and supernovae bursts) also contributed to ionizing radiation exposure.

Hence, it is of paramount importance to define the possible effect of such prolonged eras of low doses of ionizing radiation on human evolution. It is of particular concern for our brain development into a fundamentally novel intellect.

Let's have first a glimpse into current radiative conjecture being produced by our human-made activities.

In pharmacological and investigative research, C14 (carbon-14) is used in carbonate form for isotopic labeling of molecules. Such activities use a dose greater than 1GBq, which means that the dose is around 0.4% (one in 250) higher than that provided by the natural amount of C14 isotopes in the atmospheric concentration. However, other pharmacological procedures indicate irradiation of 1 to 5 mCi compared to C 14 average irradiation at sea level known to be 2mCi per year in 1950 taken as reference for normality.

Among the medical procedures, CT scanning accounts for 40% of the population's annual irradiation exposure that uses such an approach for medical investigations.

However, C-14 is a low energy beta emitter, and even large amounts of this isotope pose little external dose hazard to persons exposed. The beta radiation barely penetrates the outer protective dead layer of the skin that covers the body. The primary concern refers to the possibility of internal exposure. The critical element for most C14-labelled compounds is the fat of the whole body. Beta radiation has a short-range in the air.

When C14 decays, it emits a beta particle and becomes an N-14 isotope (theoretically reactive) with a half-life of 7.5 seconds. All other isotopes, but not C14, have a half-life of fewer than 20 seconds.

C14 needs 5,730 years (half-life) to decay into a gamma particle and N14. After this decay, the remaining C14 and N14 are preserved within a 1:1 ratio.

Dilution of C 14 isotope concentration in natural pools

There is a tremendous dilution of naturally produced C14 in the various pools of carbon in nature. The C14 is combined with CO₂ making a radioactive compound with an atmospheric half-life of 12-16 years in the northern hemisphere atmosphere. C14 present in the atmosphere is mixed, and it is also mixed in shallow seawaters and freshwaters. In soils, as organically absorbed, it becomes associated with carbonate soil minerals.

According to the literature, the excess carbon 14 produced during nuclear weapons testing reached an 80% high in 1963-1965. From that peak, it has decreased due to the global carbon exchange cycle. By the 1990s, the carbon 14 level was only 20% higher than the theoretical 1950 level of reference. In 2020 that level will be again as in 1950.

As one can see, our exposure to C14 isotopes varied primarily over long and short periods. What was the possible effect of this variation?

Methods, materials, and results

I have searched Pub Med and other sources for English-language articles to acquire the necessary data needed to fulfill my discussion and interpretation.

The compilation allowed me to interpolate the introduced results. Such interpolation also provided the opportunity to compare data and bridge the stated effects. It led me to several conclusions, which have been distinct from other authors.

My research intended to evaluate the case of natural occurrences when the atmospheric concentration of C 14 isotopes exceeded normal values recorded before 1950. Such higher values (20-80% higher than usual) were comparable with today's nuclear medicine's clinical doses.

One of the most significant studies of Li-Chun Wei, Yiu-Xiu Ding, Yong-Hong Liu, Li Duan, Ya Bai, Mei Shi, and Liang-Wei Chen is *Low-dose radiation stimulates Wnt/beta-catenin signaling, neural stem proliferation, and neurogenesis in the mouse hippocampus in vitro and vivo* published in the Journal of Radiation Research and in Current Alzheimer Research, January 2012.

Their study indicates that "Wnt/beta-catenin signaling is critical in the control of proliferation and differentiation rate of neural stem cells or progenitors in the hippocampus. In this study, the biological effects of low-dose radiation in stimulating Wnt/beta-catenin signaling, neural stem cell proliferation, and neurogenesis of hippocampus were interestingly identified by in vitro cell cultures and in vivo animal studies."

"First, low-dose radiation (0.3Gy) induced increasing of Wnt3a, Wnt5a, and beta-catenin expression in both neural stem cells and situ hippocampus by immunohistochemical and PCR detection."

"Secondly, low-dose radiation enhanced the neurogenesis of hippocampus indicated by increasing proliferation and neuronal differentiation of neural stem cells, going up of nestin-expressing cells and BrdU-incorporation in the hippocampus."

"Thirdly, it promoted cell survival and reduced apoptotic death of neuronal stem cells by flowcytometry analysis."

"Finally, Morris-water maze test showed behavioral improvement of animal learning in low-dose radiation group."

Another study of a group of Japanese researchers led by Norio Takahashi, Munechika Misumi, and Hideko Murakami, is *Association between low doses of ionizing radiation,*

administrated acutely or chronically, and time to onset of stroke in a rat model, published online 2020 Aug 4.

It came with an interesting definition of the radiation rate for biopositive and bionegative effects.

The authors found that rats acutely irradiated with doses between 0 and 1.9Gy or chronically irradiated with a cumulative dose of 0.5 or 1.0Gy (at a rate of 0.05 or 0.1Gy/day) indicated a threshold around 0.1Gy. Below the threshold of the mentioned low dose-rate, but chronically exposed, no significant increase in stroke symptom was observed. The risk of stroke clearly appeared at high doses.

A study of Feng Ru Tang and Weng Keong Loke is *Molecular Mechanism of low dose ionizing radiation-induced hormesis, adaptive responses, radioresistance, bystander effect, and genomic instability* in Int J Radiat Biol, 2015 Jan, pages 13-27.

They concluded that LDIR-induced hormesis is produced by P53 that directly seems to make the adaptive response, radioresistance, and genomic instability.

Feng Ru Tang and Konstantin Loganovsky wrote *Low dose rate ionizing radiation-induced health effect in the human*, published in Elsevier Epub 2018 Jun 5. They concluded that LDIR or LDRIR exposure to irradiation might induce positive and negative effects.

Some other studies on animals found that a larger group of unregulated genes is not affected by low doses of 2Gy irradiation administered by radiotherapy. They found that some alterations in gene expression are qualitatively different depending on the dose being used. The results indicate a significant opportunity to define the biopositive effect on the human brain that is comparable with similar biopositive effects recorded during animal experiments.

When mice were exposed to low doses but for 20-30 generations, the results show a host of biopositive effects, like increased litter size, more fertile than the control group, increased litter number, increased viability, and faster growth rate.

The mice were exposed to 4.3mGy/day for three weeks. In another experiment, a mice colony was exposed for 21 generations to a 28.8mGy dose at 1.2mGy/h.

The lowest dose used was 31mGy, representing a radiation exposure of 4mCi, which produces an absorption of 0.4mGy/h.

Here, it should be noted that the dose of 4mCi is double compared to C 14 dose recorded in 1950 in the air over the sea level. In the meantime, this same dose equals the peak dose recorded for 10,000 years in our prehistory, and also it equals the peak dose recorded during the atmospheric atomic bomb experiments.

It has been observed that low doses of radiation, as used in the upper range of common nuclear diagnostic, create even more efficient mutations than the much larger doses when reaching the DNA. Also, they produce an increase of 1.5-fold in the gene expression that could affect 6% of total gene loci.

The experiments recorded in the literature indicated that all bionegative aspects started to occur at doses much higher than 30mGy.

However, exploiting the opportunity to compare the results mentioned above from various studies and experiments could change our understanding and interpretation of exogenous irradiation's role (like C 14 isotopes) in ROS processes.

The materials used in this research refer to a collection of data obtained from other researchers' review work. As I showed in this section of the paper, an increase of 2mCi in the irradiation has produced significant biopositive effects in animal experiments.

It should be noted that human neurogenesis evolved differently than in the rest of animals because, in humans, the neuronal proliferation is directed from the Dentate Gyrus of the hippocampus to help neuronal plasticity (with undifferentiated neurons) and cognition (by differentiating the neurons). By contrast, in the rest of the animals, the neuronal proliferation comes to support the olfactory function. One may say that much of the animal reasoning is connected with olfaction.

The same process identically worked for humans until a fundamental turn took place. We do not know what prompted such a radical neuronal change or when and how in time this process took place.

Was it sudden or gradual?

Therefore, one can estimate much larger effects of the same low dose in human neurogenesis, which are preponderantly driven toward plasticity and cognition.

Discussion

The fluctuation of atmospheric C 14 concentration

Various research estimates that, even on a time scale of a few decades, the atmospheric radiocarbon activity may not have been constant.

"The atmospheric radiocarbon concentration fluctuated due to natural causes by 2% during the Little Ice Age from the 16th to 19th centuries". "The abundance of atmospheric radiocarbon (C14) from 1500 to 1800 AD was 2% above average level, with a maximum that occurred for the years AD 1500 and AD 1700, and a minimum for AD 1600 and AD 1800". "Between AD 1500 and 1850, two maxima, two minima, and other minor variations are known as de Vries effect have been observed. The C14 maxima correspond to the Maunder and Sporer minima of solar activity". "This effect modulates the galactic cosmic rays' activity in antiphase with solar activity." (I quoted from *Temporal fluctuation of atmospheric C14: causal factors and implications* by Paul E. Damon, Juan Carlos Lerman, and Austin Long with the University of Arizona, Tucson, published in Annual Reviews, Inc., 1978).

The global carbon cycle refers to the exchanges of carbon within and between four major reservoirs: the atmosphere, the oceans, land (lithosphere), and fossil fuels. Carbon may be transferred from one pool to another in seconds (by fixating atmospheric CO₂ into sugar

through photosynthesis) or over millennia (the accumulation of fossil carbon through deposition and diagenesis of organic matter).

It is estimated (Nydal-1968) that the residence time in the stratosphere before transfer to the troposphere is 2.0 years. The transfer between Earth's hemispheres takes one year. The C14 atmospheric residence before transferring to the biosphere and aquatics is four years. Here, the residence in oceans is seven years, and from the ocean surface to the deep, the transfer takes 24 years.

Lingenfelter and Ramaty (1970) calculated that the solar flare of February 23, 1956, may have increased the atmosphere's radiocarbon concentration by 7.5%.

Paul A. LaViolette estimated in 2011, based on observations in the Cariaco Basin out of Venezuela coast, that a giant cycle of solar flares occurred in phases around 12,973 years ago, 12,837, and 12,639 years ago. It extended on a length of about 300 years. The radiocarbon concentration rose by more than 50%.

A much smaller occurrence was the Carrington event of 1859, but which was still 20 times greater than the 1956 event.

Another estimate indicates that Global Warming would cause a decrease in atmospheric C14 concentration.

"Because the industrial CO₂ injected into the atmosphere has no C14, the effect decreased the C14 atmospheric concentration. This effect corresponds to the Industrial Era. It is estimated that C14 concentration before the industrial era was 2% higher than in 1950."

Konstantinov and Kocharov (1967) estimated a 0.5 to 40% increase of radiocarbon due to the gamma-ray burst from the supernova Tycho Brahe, seen in AD 1572.

Most such measurements were made on tree rings. The oldest bristlecone pine chronologies extend to 8,400 years ago.

The exchange time between the mentioned three reservoirs is ten years.

While the absolute sum of carbon found in the active reservoirs is maintained in a near steady-state by slow geological processes, more rapid biochemical processes drive carbon redistribution among the active reservoirs.

Dr. Zalasiewicz explains: "As a result of the detonations of hundreds of such weapons (atomic) around the globe, there will be plenty of these isotopes still around far into the future." (He refers to inorganic matter).

The amount of fossil fuel combustion decreases the C14 because fossil fuels have lost, on long geological scales, all C14 because of radioactive decay. In contrast, such fuel emission adds large nonradioactive volumes (CO₂).

The biological implication of changes in the gaseous concentration

It is considered that today C14 concentration is 2% enriched compared to the preindustrial era (from over 200 years ago). The current trend in emissions continues to decrease the C14 concentration that, around 2020, it will reach the level from the preindustrial era.

By 2040, the concentration of atmospheric C14 will diminish by one quart compared to the preindustrial era.

Here, I like to note that such a decrease, from double concentration (around 1963) to 25% less than the concentration assumed to exist in the preindustrial era, may have vast mental implications.

However, such a change in C14 atmospheric concentration is generated by increasing to double the carbon dioxide during the same time interval.

It is well-known that it exists a direct proportionality between these gases concentration in the atmosphere: one component, like the carbon dioxide, rises, the other elements, like nitrogen (N), Oxygen, and C14, would diminish correspondingly.

For example, studies of euthanasia on mice have revealed the influence of such euthanasic gases on mice subjects:

- CO₂ use increased the locomotor activity;
- N₂ decreased such locomotion;
- CO₂ increased the delta, theta rhythm correlation on the EEG, and increased excitation;
- N₂ reduced behavioral activity and central neurological depression while being less aversive.

Both gases act on the brain and nervous system.

Other studies were concentrated on the effects of pollution on our neurological system. I will note several found effects:

- traffic-related air pollution (with mainly the carbon dioxide) exposure was associated with adverse effects, like a reduction in attention, global IQ, memory, and higher prevalence of several mental diseases (ADHD, ASD);
- it was observed a cognitive decline and increased dementia behaviors.

Global atmospheric CO₂ levels passed 400 parts per million in 2016, double compared to the preindustrial era.

As the studies point out, the CO₂ concentration in the atmosphere tends to increase almost to 1,000 parts per million toward the end of the current century.

However, we have frequent cases where the indoor concentration of CO₂ is daily higher than 1,000 ppm and even higher than 2,000 parts per million, especially in the school environment and almost in all office spaces. Even the concentration can reach over 1,000 parts per million

in our houses when they are tightly isolated from the outdoor environments for energetic preservation reasons.

In sum, there are significant changes in the gaseous concentration in our planetary atmosphere, where such changes affect our biology. Most importantly, they affect our brain workings in a very substantial manner. It is hard to imagine that our Late Paleolithic brain would accommodate such functional changes when the previous plasticity source, like C14 high atmospheric concentration, diminishes significantly.

One last aspect is global nitrogen pollution on the rise, but this subject does not enter the issues I like to discuss here.

The role of C 14 in the mechanism of our biology

Let me continue with the role being played by C14 in the evolution of the human brain.

The animal organisms assimilate C14 Glucose when feeding on vegetables. This process stimulates the oxygen species (ROS) and regulates nitric oxide production and inhibition (NO), which have interrelated neurogenesis roles.

Under certain circumstances, experimental animal data suggest that the exposure gives anti-tumor ability, slows the progression of arteriosclerosis, and ameliorates diabetic nephropathy.

However, during experiments, the C14 traces have been 1 to 5mCi, thus entering the low hazard category.

The average concentration of C14 isotopes at sea level is 2mCi per year. During the atomic bomb testing in the atmosphere, such C14 concentration rose to 3.6mCi (as 80% higher than usual) as it was investigated in 1963-1965, and it diminished to 2.4mCi in 1990 (20% higher than average).

Thus, the atmospheric data mentioned above could be correlated with the dose used in pharmaceutical and medical experiments and procedures. The length of the exposure would produce fundamental differences.

The C14 isotopes inside the human body, as part of C14 Glucose, would stimulate the production of oxygen species (ROS), which have specific reactions with nitric oxide, regulating its concentration in various tissues. NO is known to create a nitrite reduction pathway. Within the blood vessels, the Oxygen produces vasoconstriction that causes hyperbaric tension within the vessels. High tension is also found inside the cells, inflicting the level of permeability of the cellular membranes. It increases the amount of available Oxygen in blood vessels and cells and interacts with local nitric oxide, regulating its production.

Nitric oxide is involved in transporting and dispersing Glucose in the entire organism. Glucose also stimulates oxygen species that metabolize any unwanted excess of this substance. When nitric oxide (as an antioxidant) decreases in the brain and nervous system, local oxygen species increases. By contrast, the same vascular tension affects the vascular

peripheries distinctly, making the nitric oxide increase locally (vasodilation) while stimulating muscle fibers and skeletal developments.

The ROS regulates cellular differentiation, proliferation, apoptosis, cell cycle, and migration.

It is known that, during physical activity, the ROS and NO interplay stimulates oxygen production.

The effect of low doses of radiation

The total amount of ROS generated by primary ionizing events (like C14 isotope activity when inserted into C14Glucose) is propagated to the level of intracellular activation. Almost immediately after exposure to ionizing radiation, the detoxifying enzymes activate the antioxidant system's cellular defense mechanism. There is an entire biological mechanism that converges to repair nucleic acid damage and DNA modifications induced by the ionizing radiation, like the one generated by the atmospheric C14 isotopes when inserted into the Glucose produced by plants.

Low-dose Ionizing Radiation (IR) at 15-30mGy induces in biological molecules Reactive Oxygen Species (ROS) because gamma radiation of cellular water rapidly generates ROS like hydroxyl radical (OH) and ionized water.

The literature analyzed experimental cases where the irradiation of A549 cells induced mitochondrial ROS production, increased mitochondrial membrane potential and promoted respiration and ATP production.

The experiments with doses lower than 30mGy represent 4mCi radiation exposure, which produces an absorption of 0.4mGy/hr. They proved to have no statistical significance. On the other hand, it may increase gene expression and trigger higher than regular mutation rates.

Experiments on mice colonies were prolonged to several generations, and the dose used was 4.5mGy/day to 28.8mGy at 1.2mGy/h. These experiments recorded many biopositive effects, like increased litter size, more fertile than the control group, increased litter number, increased viability, and faster growth rates.

Production of biophotons

However, a chemical reaction in cells caused by oxidation produces free radicals, which are the primary source of biophotons. Such biophotons are made during the free radicals deexcitation process.

Brain plasticity refers to an undifferentiated neuronal state. When the entropy occasionally increases in the hippocampus's Dentate Gyrus, a neuronal generation will burst with higher than average plasticity, meaning more undifferentiated neurons. It is known that higher oxidative stress generates a higher entropy.

Scientific literature estimates that biophotons would play a significant role in neuronal transmission and communication. Hence, the ionizing radiation inserted in C14 Glucose

generated oxidative stress that resulted in a high biophoton production. These steps contributed to anatomical and functional changes in the Homo brain, producing a new type of mental activity and a modern intellect. The ultimate result was a revolution in language prompted by a language-ready brain.

Human neurogenesis

It has been experimentally demonstrated that a high concentration of atmospheric C14 has contributed to increased neurogenesis and higher brain plasticity by combining the interpolations.

The current trend of diminishing atmospheric concentration of C14 seems to have implications for the future human generations, making them less adaptable to changes.

This is important because we enter an Artificial Intelligence implementation era, where we will need a significantly augmented capacity of adaptation.

Another issue to pay attention to is the ingestion of inorganic minerals by organisms, including humans.

Dr. Rick Wagner, C.N., explains in his paper Ionic Minerals:

"In nature, our mineral sources have always been the water-based either form of foods we eat or the water we drink. When minerals come from water, they are inorganic. When one ingests sea salt for the mineral content, they are utilizing inorganic forms of the minerals ".

"The important thing is that it does not matter if you consume minerals from plant sources, water-based, or solid pills or even dirt. What matters is how much time it takes the body to break down the minerals into their atomic (ionic) state to be effectively utilized at the cellular level. The body does not need its minerals bonded to carbon (ions are not bounded to carbon) for beneficial absorption and utilization. A mineral is an ionic form that alleviates the need for stomach acid to perform the function of ionization".

There is known that C14 usually bounds with sodium, potassium, and magnesium.

Investigation of C 14 trackers

Returning to the investigative-use of C14 tracers, there is known that the human organism has a safety system that, in less than 48 seconds, eliminates a source that posits biological danger.

Such a trace-use of C14 isotope, as a beta emitter, is low-dose equivalent and has insufficient energy to cause ionization but has enough energy to produce local excitation.

A radiotracer is a radioactive element, like the C14 isotope, added to a nonradioactive part.

Various pharmacological testing and experiments with isotopic C14-labeled products (mostly C14 labeled glucose) resulted in an electrical stimulation that doubles the rate of glucose consumption. They showed a trifold increase in the rate of CO₂ production.

These experiments indicated that the required energy increased as a direct result of increased respiration and glycolysis. Here, a supplementary metabolism was present, generating Oxygen, which was necessary to satisfy the increase in oxygen consumption.

However, the changes in the absorption of C14-labeled products by various cerebral structures resulted from their activation and the isotopic incorporation rate. When one substrate was involved in the mechanochemical reaction, the resultant product had the same isotopic composition as the substrate. It was found that C14 is stably into organic molecules and blood. Of interest to me, there was an increase of C14-glucose in the hypothalamus that generated an acute activation at the beginning of the experiments that was followed by a diminishing activation as a specific adaptation occurred.

Beyond the medical interest in the use of C14 as investigative tracers, it must be considered some other aspects of C14 isotope absorption by biological systems.

Natural and artificial cause of increases in C 14 concentration

I have to specify that cosmic radiation, which produces atmospheric C 14 isotopes, currently generates a level of 0.3mSv per year at sea level.

During the atomic bomb atmospheric experiments, the mentioned above level was almost doubled to 0.5mSv. The same doubling occurred during the geophysical events produced by the geomagnetic excursions.

A person flying at 10,000 meters above the ground for 4 hours is subject to 20microSv. By comparison, a tracer used in medical and pharmaceutical fields can cause exposure of 0.2 to 5.2microSv, which is four times lower than the mentioned flight exposure.

When C14 decays, it emits a beta particle. The beta particle generates free-radicals. The presence of free radicals or reactive oxygen species (ROS) corresponds to ultraweak photon emission (UPE). ROS production plays a crucial role in defense against infections, apoptosis, aging, and cellular communication. The presence of reactive nitrogen species (RNS) that is the second element (as N14) encountered during C14 decaying also busts UPE or biophoton production.

However, one should consider that since a high atmospheric concentration existed for almost 10,000 years, such concentration (20% to 80% higher than usual) was preserved in inorganic systems at the same level for 6,000 years, each time it was produced. The last known high concentration of atmospheric C14 was produced by the Sterno-Etrussia geomagnetic excursion of the geomagnetic field 2,500 years ago. It would remain present at its initial concentration in inorganic forms for 3,500 years from now on. It may continue to be absorbed from inorganic into biological systems.

There is information that neural theta rhythm (central to language production) is correlated with biophoton emissions.

The research has found that the biophotons are sent along the axonal and neuronal ramifications and throughout the nervous system. Such biophoton conduction occurs with greater emphasis on the white matter of the brain representing the communication channels between the gray matter structures that define the neurons. Reactive oxygen and nitrogen species (ROS and RNS) are also part of the cellular metabolism and have beneficial effects. The balance between prooxidants and antioxidants is critical for the survival and function of (aerobic) organisms.

Oxygen and neurogenesis

The following part of this paper is dedicated to what the literature calls the critical role of Oxygen in regulating cell behavior during neurogenesis.

It intends to bridge the natural occurrence of high atmospheric concentration of C14 in our recent prehistory that produced a significant stimulation inflicting human neurogenesis.

Joseph Tafur, M.D., Eduard P.A. Van Wijk, Ph.D., Roeland Van Wijk, Ph. D., and Paul J. Mills, Ph.D. in their paper "*Biophoton Detection and Low-Intensity Light Therapy: A Potential Clinical Partnership*," published in *Photomedicine and Laser Surgery*, Volume 28, Number 1, 2010, Pp. 23-30, made a review of current knowledge on this matter. Some of their conclusions serve very well the purpose of my investigation.

"We know that Low-Intensity Light Therapy (LILT) has the potential to accelerate ATP production and mitigate oxidative stress, which derives from excessive production of reactive oxygen species (ROS) or a lack of antioxidant activity."

"Cellular sensitivity to red and infrared light is influenced by the cellular redox state. The cellular growth phase, which may also correspond to the cellular redox state, appears to be another determinant of this sensitivity. Proliferating cells are, in many cases, more sensitive. In each case, this proliferating phase is associated with elevated ROS production".

Here, the authors indicate that the proliferation of cells, neurons included, depends on the oxygen species' effect or redox. These effects are oxygen-dependent and involve the generation of ROS.

Wulf Droge, in his paper "*Free Radicals in the Physiological Control of Cell Function*," published online on January 1, 2002, indicates:

"At high concentration, free radicals and radical-derived, non-radical reactive species are hazardous for living organisms and damage all major cellular constituents. At moderate concentrations, however, nitric oxide (NO), superoxide anion, and related reactive oxygen species (ROS) play an important role as regulatory mediators in the signaling process. Many of the ROS-mediated responses protect the cells against oxidative stress and reestablish redox homeostasis".

Here, it is essential to note that the C14 isotope, when its absorption occurs in a biological system, tends to decay into nitric oxide (NO) that would be lethal, as most scientists have

previously thought. However, this old thought significantly changed in recent years. "Higher organisms, however, have evolved the use of NO and ROS also as signaling molecules to other physiological functions. NO, and ROS are typically generated in these cases by tightly regulated enzymes such as NO synthase (NOS) and NAD(P)H oxidase isoforms".

"In a given signaling protein, oxidative attack induces either a loss of function, a gain of function, or a switch to a different function. In mitochondria, ROS are generated as undesirable side products of the oxidative energy metabolism. The process of aging may result, at least in part, from radical-mediated oxidative damage".

"Free-radicals are important in biology because of their advantageous effects. It was discovered the role of nitric oxide (NO) as a regulatory molecule in the control of smooth muscle relaxation and platelet adhesion inhibition. A large body of evidence shows that living organisms have not only adapted to an unfriendly coexistence with free-radicals but have developed mechanisms for the advantageous use of free-radicals. The delicate balance between the advantageous and detrimental effects of free-radicals is an important aspect of life".

I quoted this author because he indicated how biology adapted to the production and presence of free-radicals. Further, one will see that biology developed precise systems and reactions capable of de-excite or annihilate the free-radicals immediately after their mission was accomplished advantageously. Such a process prevents the occurrence of damages.

In the meantime, both papers quoted above indicate the stimulant. At the same time, the vital role of the oxidative stress that goes from increasing the cell/neuron proliferation (like in neurogenesis) to increased activation and signaling to the production of free radicals that, among other things, it seems to be the sole mechanism in charge with biophoton emission.

In an article ("*Oxygen, a Key Factor Regulating Cell Behavior during Neurogenesis and Cerebral Diseases*") written by Kuan Zhang, Lingling Zhu, and Ming Fan, and published in *Frontiers in Molecular Neuroscience*, April 4, 2011, the authors explain:

"Oxygen is a significant substrate for energy production and cell metabolism. It is interesting to note that normal oxygen levels in the tissues are always substantially lower than 156 mmHgO₂ in the air we breathe (Panchison, 2009)."

"The brain is one of the heaviest oxygen consumers in the body, which amounts to 20% of total oxygen consumption (Masamoto and Tanishita, 2009). The development of various organs of embryos, including the central nervous system (CNS), occurs in low-oxygen concentration (Fisher and Bavister, 1993. Chen et al., 1999). Apart from this, oxygen levels in brain tissues are often altered during stroke (Liu et al., 2004), brain trauma (Valadka et al., 1998), and in hyperbaric oxygen (HBO) environment (Balenane, 1982)".

However, hyperbaric oxygen therapy (HBOT) refers to the medical use of Oxygen at a level higher than atmospheric pressure (Jun Mu and John H. Zhang).

"Embryonic neurogenesis begins at the early gestation period under very low-oxygen concentration (15.2mmHg; Zhou, 2004)".

"Taken together, all of above researches indicated the significant role of the vessels as one of the important components of the neurogenesis niche, and may also imply that the higher oxygen tension around the vessels in the subventricular zone (SVZ) and Dentate Gyrus (DG) would be significant for the maintenance of the characteristics of NSCs."

"We found that the PO₂ (O₂-oxygen) levels in ventricles are in a dynamic state and fluctuate in the range of 42 to 48 mmHg at a frequency of about 3 minutes. In the hippocampus, the PO₂ level in CA1 and hilus are very stable and maintain about 2mmHg, while the PO₂ (Oxygen) in Dentate Gyrus is dynamic and fluctuates in a range of 6-8mmHg (Zhang et al., 2010)".

"The PO₂ levels in uninjured brain tissue have been measured about 25-30mmHg in the white matter of frontal lobe (Sarrafzadeh et al., 1998), 20-40mmHg in normal tissue (Hlatky et al., 2003)".

"Proliferation was promoted, and apoptosis was reduced when cells were grown in lower O₂, yielding a greater number of precursors. The differentiation of precursor cells into neurons with specific neurotransmitter phenotypes was also significantly altered".

"In summary, the moderate low-oxygen (15.2-38mmHg) concentration was able to promote the proliferation of NSCs from various resources and enhance the differentiation of NSCs into the TH-positive neurons. It was found that the metabolism of cells would consume the Oxygen of the medium".

I like to quote Amandeep Goyal, Tyler Chonis, and Jeffrey S. Cooper with their paper "*Hyperbaric Cardiovascular Effects*," published by Stat Pearls Publishing, January 2019.

"HBOT initiates generalized vasoconstriction of healthy blood vessels. Exposure to Oxygen's pressure of at least 2 ATA is known to induce arteriolar vasoconstriction and increase systemic vascular resistance. The primary mechanism that leads to this vasoconstriction involves a reduction of nitric oxide production in the endothelium. The hyperoxic environment leads to increased oxidation of nitric oxide (NO) radicals produced by the endothelium, leading to a loss of the vasorelaxant effect. Additionally, some research has shown that HBOT leads to alterations in other vasodilator compounds, such as prostaglandins, contributing to the net vasoconstriction effect.

Hyperoxia stimulates the sympathetic nervous system to promote vasoconstriction. Humans have been shown to have an augmentation of sympathetic nervous system activity."

"Although vasoconstriction partially impedes blood flow, the hyperoxygenation of the plasma results in an overall gain in delivered Oxygen. Short-term hyperoxia causes increased cerebral vasoconstriction and further the reduction of blood flow. However, even with the

reduction of cerebral blood flow, the cerebellum receives more Oxygen than it would otherwise".

"The brainstem neurons play important roles in the cardioinhibitory center and underlie the hyperbaric reflex bradycardia. HBOT leads to parasympathetic activity and increases vagal tone. It has been suggested that another factor leading to the slowed heart rate is a nitrogen-dependent beta-blockade of the heart."

"Reduction of blood flow secondary to vasoconstriction leads to corresponding edema reduction."

C 14 variability during geomagnetic excursions and the biological effect

Now, I like to connect the information about C14-labeled products and naturally occurred atmospheric showers of C14 isotopes due to the effect caused by the diminishing of the geomagnetic field intensity.

The geological samples, coral, tree-rings, and several other sources provide a record of the concentration of C14. In the past 42,000 years, our planet was subject to a high-frequency of short-bursts of gamma radiation, followed by showers of radionuclides, which we're incorporating the mentioned C14 isotope.

The C14 on the ground was absorbed by plants' photosynthesis and passed to animals and humans. Such absorption/incorporation process is similar to making C14-labeled products used as tracers for medical investigations. In the meantime, the C14-labeled products proved to act as biological stimulants, increasing metabolism and oxygen consumption. Such "increased oxygen production" from C14-labeled products was similar in many respects to "hyperoxia" also produced in the medical field.

In short, the release of Oxygen by neuronal processes exposed to the absorption of C14 isotopes generated a hyperbaric oxygen condition (vascular constriction).

Paul M. Macey, Mary A. Woo, and Donald M. Harper, of University College of London, United Kingdom, published an article titled "*Hyperoxic Brain Effects Are Normalized by Addition of CO₂*" in PLOS/Medicine on May 22, 2007.

The authors show that "despite the objective of improving the tissue oxygen delivery, hyperoxic ventilation could accentuate ischemic trouble and impair the outcome. But several cortical, limbic, and cerebellar brain areas regulate these autonomic processes".

"We found, using functional magnetic resonance imaging, that 2 minutes of hyperoxic ventilation (100% O₂) following a room air baseline elicited pronounced responses in autonomic and hormonal areas, including the hypothalamus, insula, and hippocampus, throughout the challenge".

"The addition of 5% CO₂ to 95% O₂ abolished the responses in the hypothalamus and lingual gyrus, substantially reduced insular, hippocampal, thalamic, and cerebellar patterns in

the first 48 seconds, and abolished signals in those sites after that. Only the dorsal midbrain responded to hypercapnia, but this would be abolished, too, by additional CO₂".

At the beginning of this paper, I indicated that the pharmacological research with C14-labeled Glucose experimentally produced a twofold reduction of Glucose and a trifold increase of CO₂.

Here, a neural mechanism was unveiled, which automatically, within 48 seconds (to two minutes), would naturally reduce the effects of hyperoxia (generated by C14-labeled products and/or hyperbaric therapy).

It should be assumed that, during our recent prehistory, the same neural mechanism was in charge of reducing the natural hyperoxia produced at the time in the brains of our ancestors by the absorbed C14 present in their food and derived from a high concentration of this isotope in the terrestrial atmosphere.

Such a safety procedure was built-in into our neural network. It reduced the mentioned encounter to a series of short-term pulses, and where such short-pulses prevent the development of free-radicals.

I indicated that the concentration of atmospheric C14 isotopes was varying from 20-30% to 70-80% higher than usual for a period of almost 30,000 years in our recent prehistory (from 42,000 years ago to 2,500 years ago).

Conclusion

However, now I would assume that the past-occurrence of a high concentration of C14 isotope was producing a cerebral pulsing-process with durations of less than 48 seconds.

Such pulse-process, developed over 10,000 years, was the natural stimulus affecting increased neurogenesis that shaped our modern brain into producing the plasticity necessary to create that language with which was buildup our civilization.

Here, it should be noted that an increase in the oxidative-stress produces free-radicals; the deexcitation of free-radicals generates biophotons. In the case of C14 isotope infliction, the neuronal absorption process also produces oxidative-stress. And this last process, where the oxidation is termed hyperoxic, produces vessel constriction that mounts hyperbaric pressure; here, the nitric oxide radicals (NO) appear when the oxidation is longer than 48 seconds. The problem is resolved by a vessel relaxation that follows due to a subsequent increase in CO₂ production in the brain.

There is possible that the C14 isotopes could generate oxidative stress, while two distinct processes annihilate the stress:

-the deexcitation of radicals that produces biophotons;

-increased local production of CO₂ that relaxes the constricted vessels, terminating the hyperbaric stress and its oxygen production.

Suppose the hypothesis of a single cause for oxidative-stress could be proved. In that case, it may result that the same C14 infliction, in a particular era in our prehistory, generated simultaneously, but developed in two distinct processes, increased neurogenesis, and separately, it increased the biophoton production.

Here, the biophoton production can represent the source of a proposed neural optic communication. It could also serve as a fundamental for imaginary thinking that is activated during entanglement.

I like to bring to this end several quotes from two recent papers.

One of these papers indicates strong evidence that "*Long Course Hyperbaric Oxygen Stimulates Neurogenesis and Attenuates Inflammation after Ischemic Stroke*" (a paper of a large team of researchers from National Cheung Kung University, Kaohsiung University, Southern Taiwan University, all of them in Taiwan, published by Hindawi Publishing Corporation, Volume 2013).

The second paper shows that "*Hyperbaric oxygen therapy promotes neurogenesis*" (written by a research team from Loma Linda University, US, and Chongqing Medical University, China, published online 2011, June 27).

In the first paper, the authors said: "Several studies provided experimental evidence concerning the neuroprotection benefits of hyperbaric oxygen (HBOT) therapy and the influence of this therapy on the migration of BMSCs, neurogenesis, gliosis, and inflammation."

The second paper suggests that hyperbaric oxygen therapy enhances neurogenesis. The authors demonstrate the influence of HBOT on cellular transcription factors, including hypoxia-inducible factors.

To conclude, I would suggest a potential influential pathway of a high concentration of atmospheric C14 with significant impact on our brain in prehistoric times.

Atmospheric C14 is assimilated by plants during photosynthesis, helping the sucrose formation that is half Glucose and half fructose. Further on, in this case, the Glucose becomes animals ingest the C14-Glucose along with the plants they consume.

In the human case, high C14-Glucose must increase nitric oxide production because it reduces blood glucose by uptake to skeletal and muscle systems. Ultimately, after a pulse of increased production, it occurs a general reduction of nitric oxide in some of its components.

Lesser nitric oxide generates the vasoconstriction that increases the oxygen tension in the cells and increases the neuroblast proliferation (neurogenesis). Vasoconstriction in the brain stimulates neurogenesis, and consequently, brain plasticity and cognition.

The decrease in some nitric oxide components produced an increased resistance to viruses and pathogens. Such novel immunity helped with the migration out of Africa and adaption to new ecological conditions.

Acknowledgment

This paper's scope was to collect information on the exogenous conjecture of geophysical forcing events that drove the human brain into a fundamental while unique transformation, giving rise to a language-ready intellect that made us distinct from anybody else on this planet.

This paper provides the core support for my hypothesis on the emergence of Homo loquens species just right out of the Homo sapiens precursors.

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