Minimizing Oxidative Stress

Peer review status:
No

Corresponding Author:
Dr. Luke R Ocone,
none, none, 8513 Widener Road, 19038 - United States of America

Submitting Author:
Dr. Luke R Ocone,
none, none, 8513 Widener Road, 19038 - United States of America

Previous Article Reference: http://www.webmedcentral.com/article_view/5079
Article ID: WMC005098
Article Type: Case Report
Submitted on: 12-May-2016, 02:06:04 PM GMT  Published on: 12-May-2016, 02:06:54 PM GMT
Article URL: http://www.webmedcentral.com/article_view/5098
Subject Categories: BIOCHEMISTRY
Keywords: Aging, Cancer, Neurology, Alopecia, Arthritis, Radiology, Trauma, Cardiovascular, Viruses, Pain
How to cite the article: Ocone LR. Minimizing Oxidative Stress. WebmedCentral BIOCHEMISTRY 2016;7(5):WMC005098
Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC-BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Source(s) of Funding:
This work was not funded.

Competing Interests:
There were no competing interests.
Minimizing Oxidative Stress

Author(s): Ocone LR

Abstract

A wearable device is described that reduces arthritic pain and promotes re-growth of hair by maintaining the body at a negative electrostatic potential during most of the day. The reactive oxygen species (ROS) responsible for alopecia differs from that which causes arthritic inflammation. These results and other reports in the literature suggest negative charge may inhibit oxidative attack by many ROS. The procedure described might therefore be useful for treating or preventing the development of many other conditions that involve attack of ROS on biological molecules and structures, including those generated iatrogenically; for example, in cancer treatment and surgery. It is suggested that prophylactic use of the device by healthy individuals may prevent the cumulative oxidative damage to organs and structures responsible for age-related conditions. It is also suggested that ambient static charge may affect the folding of proteins, nucleic acids and other macromolecules and, thereby, those conditions that are the result of mis-folding.

Background

Reactive oxygen species, including hydrogen peroxide, organic hydroperoxides, hypochlorite anion, singlet oxygen, ozone, superoxide anion, peroxyxynitrite anion, hydroxyl ion and alkoxy, proproxy, and hydroxyl radicals, are produced in the body by normal metabolic processes, and also in response to injected, infused, ingested and respired toxins, by the interaction of high-energy, penetrating radiation with molecules in the body and by both surgical and accidental trauma. One or another of these oxidants attacks every functional molecule and structure in the body. Lipids are especially vulnerable to oxidative attack, but proteins, and other functional molecules are also damaged. Among other things, they are a cause of mitochondrial mutations [1]. ROS are responsible for both the acute episodes of distress that characterize some conditions and the cumulative damage that results in partial or complete loss of function of organs and other body structures. The roles of oxidative stress in the conditions such as those listed below in Section IV A and B have been documented in hundreds of publications.

Endogenous antioxidants such as glutathione, superoxide dismutases, catalases and melanins normally reduce the concentrations of these reactive species and, thereby, minimize oxidative damage. However, the availability of these vital antioxidants can be reduced by disease and by exogenous agents that inhibit their production. These natural defenses can also be overwhelmed if ROS are produced too rapidly and in high concentrations, for example, by radiation treatment for cancer or accidental exposure to radiation. In addition, some compounds of multivalent metals can increase oxidative stress.

There are two reports in the literature describing the effects of applied charge on biological systems. The first is that of Molnar [2], who reported in 1972 that the average life spans of mice maintained at a negative potential were significantly greater than those maintained at a positive potential and that negative charge gave relative protection against the effects of x-radiation. In 1974, Pammenter, et al. [3] reported that the viability of Zea mays seeds was extended if stored at a negative potential. Both Molnar and Pammenter referred to these effects as cathodic protection.

These reported effects indicate the reactions of ROS with healthy tissue is inhibited at negative potential, and I suggested in a November 19, 2010 publication, Effects of Ambient Electric (static) Charge On Biological Systems [4] that patients might be treated for acute episodes of degenerative oxidation in a safe way by putting them in a negatively charged Faraday cage. I found no other evaluations of applied charge, but I did find many phenomena consistent with the assumption that oxidative stress is inhibited at negative static potentials. Among these were the effects of grounding the body to earth, or “earthing.” Some of the claimed benefits of this somewhat controversial procedure, such as control of inflammation and autoimmune diseases, have been confirmed by recent studies and attributed to negative charge supplied by the earth. For example, Oschman, Chevalier and Brown [5] report that grounding an organism produces beneficial changes in the concentrations of white blood cells, cytokines and other molecules involved in the inflammatory response, and they suggest that free electrons from the Earth’s surface create an antioxidant microenvironment that slows or prevents damage to healthy tissue from ROS.
A Novel Approach to Control of Oxidative Stress

A recent, severe flare-up of arthritic inflammation and pain created an opportunity to test the speculation that inflammation is inhibited at negative static potentials. The pains in my joints, particularly my hands and feet were excruciating, and I was not able to grasp anything with even moderate force or walk even a hundred yards. The various non-steroidal anti-inflammatory agents that had been prescribed had little effect on the level of pain so I decided to evaluate the effects of negative charge. I had already discontinued use of the NSAIDs that had been prescribed, but, except as noted below, I continued to take the two 81 mg tablets of aspirin daily that had been prescribed for cardio-protection. Figure 1 is a diagram of the device I used to keep my body at a negative potential. It has two 23A (12V) dry cells in series with the free cathode of the battery assembly in contact with the stainless steel tube. The device was hanging on a lanyard around my neck. The body is normally insulated from other voltage sources by rugs, clothing, shoes and furniture so the potential on all parts of my body was minus 24V when measured from the free positive end of the battery assembly. This was so except when I touched a grounded object such as a water tap.

The effect on my arthritic pain was dramatic. The severe pain I was experiencing disappeared almost completely within days, and I have remained pain-free for more than 16 months as long as I kept the charging device in contact with my body. After several pain-free months, I deliberately stopped using the device in order to determine whether it was really the device that was keeping the pain at bay. Severe pain returned within days, but it disappeared just as rapidly when I started using the device again. Some months later, the pain returned when I was using the device. I found that the dry-cells had shifted in the tube, and the negative terminal was no longer in contact with the stainless steel tube. When this was corrected, the pain diminished rapidly. Also, within this 16-month period, I discontinued the prophylactic use of aspirin for several weeks because of nasal and hemorrhoidal bleeding, and there was no perceptible increase in pain. These three experiences are strong indications that it was the applied negative charge that was inhibiting pain and that the low, prophylactic doses of aspirin did not have a significant role in pain reduction. These results suggest that the oxidation of healthy tissue by peroxynitrite, which has been identified [6] as the main ROS responsible for arthritic inflammation, is inhibited at negative potentials.

After several months of using the device as described above, I noticed that some hair was growing in areas of my scalp that had been bald for decades. It has been established that hair loss is associated with the accumulation of hydrogen peroxide, in hair follicles [7] so it appears that the activity of another ROS is also inhibited at negative potentials. These results and those in the literature cited above indicate negative charge inhibits the reaction of biological molecules with a variety of ROS and suggest that keeping the body at a negative potential may have therapeutic value in a large number of diseases involving oxidative stress, including those summarized below in Section IV.

Potential Applications

Oxidation has been identified as the operative stress in each of potential applications listed below except for those under IV C below: ‘Exposure to High-Voltage Fields’ and ‘Flight and Space,’ which are more speculative. The rationale for each of these potential applications was summarized in Reference 4.

A. Oxidative Stress Diseases

Listed below are some of the conditions that involve oxidative attack. Use of a wearable charging device may provide symptomatic relief and prevent the periodic acute phases of some of the conditions listed below. If use of the device begins when people are in good health, the cumulative oxidative damage that leads to deterioration and loss of function in old age, such as arthritis, osteoporosis, hair loss, macular degeneration and Type 2 diabetes may be delayed.

1. Autoimmune reactions

There are more than 80 types of autoimmune conditions. Some of the more common ones associated with oxidative stress are: Parkinson’s disease, Multiple sclerosis, Crohn’s disease, Diabetes, Rheumatoid arthritis, Systematic lupus erythematosis and Psoriasis. Some of the other conditions below may also be initiated by immune reactions.

2. Neurological Disorders

Alzheimer’s and Huntington’s diseases, Schizophrenia, Dementia and Epilepsy.

3. Cancer

Prostrate, Breast, Lung, Colorectal, Bladder, Uterine, Ovarian, Skin and Stomach cancers, Liver cancer and
other wasting diseases and Lymphoma.

4. Liver Diseases
Toxic Hepatitis, Viral Hepatitis, Chronic Hepatitis and Cirrhosis.

5. Lung Diseases
Asthma, Emphysema, Pneumonia, Bronchitis (chronic and acute), Cystic fibroses, Pulmonary fibroses, Chronic obstructive pulmonary disease and Adult respiratory distress syndrome.

6. Cardiovascular Diseases
Heart failure, Heart attack, High blood pressure, Stroke, Impaired circulation, Cholesterol and Plaque formation and Sickle-cell anemia.

7. Digestive Diseases
Ulcerative colitis, Gastritis, Stomach cancer, Pancreatitis, and Peptic ulcer.

8. Kidney Failure
Kidney failure and Renal toxicity.

9. Infectious Diseases and Immunology
Viral infections, Toxic Hepatitis and Cirrhosis, Viral hepatitis (type A, B and C), Herpes, Common cold, Bacterial infection and Chronic fatigue syndrome.

10. Skin Disorder
Eczema, Polymyositis, Mycosis fungoides, Scleroderma, Pemigoid, Atopic dermatitis, Contact dermatitis, Sebbohreic dermatitis, Dermatitis herpetiformis, Acne conglobata and Acne vulgaris.

11. Eye, Ear, Nose, Throat and Teeth
Cataracts, Glaucoma, Macular degeneration, Hearing loss, Ear infection, Sinusitis, Periodontal (gum) disease and Nose, mouth and throat diseases.

12. Pregnancy, Lactation and Childbirth
Pre-eclampsia, eclampsia, hypertension, fetal alcohol syndrome and damage to the fetus by other toxins and administered drugs.

13. Male Problems
Prostrate enlargement, Prostrate cancer and male infertility.

B. Iatrogenic Oxidative Stress
The body generates often dangerous levels of ROS in response to common medical procedures severely limiting treatment options and effectiveness. Keeping the body at a negative potential during and, if necessary, after procedures, with either a Faraday cage or a wearable charging device may protect patients from oxidative stress and facilitate treatment. Following are some potential applications:

1. Cancer Treatment
To protect healthy tissue from oxidative attack by the ROS deliberately generated in high concentration in both radiation treatment and chemotherapy in order to destroy cancer cells. These oxidants can destroy healthy cells and vital structures far from the target cells producing side effects such as hair loss, deafness, nausea and neurological damage.

2. Radiology
To minimize the side effects of diagnostic medical and dental x-rays,

3. Drug Side-effects
To improve the therapeutic index of drugs by inhibiting oxidative side-effects. It may then be possible to use already approved oxidative side-effects. It may then be possible to use already approved agents more effectively and to employ other agents that are currently unusable,

4. Surgery
To minimize generation of ROS in tissue damaged by surgical procedures,
To minimize the sometimes permanent post-operative cognitive disorders induced by anesthesia, which include loss of memory, reduced ability to reason, impaired judgment and personality changes,
To minimize the side effects of oxygen administered for life support. The most familiar examples are permanently damaged eyesight and hearing in premature babies. However, people of all ages, including full-term babies, can also be susceptible. It is likely that the immature organs of a fetus are susceptible to the same kinds of damage by oxygen administered to pregnant women,
To minimize the generation of ROS when blood flow is interrupted in medical procedures and also when blood vessels are reperfused,
To inhibit the oxidative deterioration of stored organs awaiting implantation and stored blood and to prevent the failure of skin grafts and the rejection of transplanted organs and in vitro fertilized ova.

5. Trauma
To minimize the oxidative stress induced by trauma, inflicted by accident or sustained on a battle field or playing field, which often impedes healing and leads to permanent damage, especially in the case of concussions and spinal injuries.

C. Other Applications
1. Non-medical Radiation Exposure
To reduce the cumulative effect of background radiation, which has been associated with aging and
for protection against high-intensity sources created by accident or deployed as weapons,

2. Exposure to High-voltage Fields
To protect employees of electric utilities who have a higher-than-normal incidence of amyotrophic lateral sclerosis, presumably because they spend a lot of time close to high-voltage lines,

3. Flight and Space
To counteract the acceleration of oxidative processes at the highly positive static potentials encountered at high altitudes and in space. Airline crews have a higher-than-average incidence of melanoma and amyotrophic lateral sclerosis. Positive charge may be partly responsible for “economy-class” syndrome, and

4. Winter Ills
To inhibit viral infections such as the common cold that may be promoted by seasonal differences in the vertical atmospheric potential gradient. In summer, the gradient is 60 to 100 volts per meter, while in winter it can be as high as 300 to 500 volts per meter. Therefore, a person spends more time in a more electrically positive static environment in the winter than in the summer. Keeping the body at a more negative potential with a wearable device may reduce susceptibility to viral diseases at all times but especially in winter.

Discussion

Many studies indicate that earthing can have beneficial effects, probably because it moves the static potential of the body in a negative direction. However, the earth is not a dependable potential source. The local ground potential is affected by atmospheric charges, which change hourly and seasonally in complex cycles [8]. It is also affected by random events such as cloud cover and lightning discharges. In addition, local ground potential is often affected by the almost universal use of the ground as a conductor in power transmission. This practice can change local ground potentials and sometimes create hazardous situations for animals and people [9]. Grounding therefore exposes the body to unknown voltages that may not be optimum or even negative enough to effectively inhibit oxidative stress and that might occasionally be hazardous. In addition, most of us cannot spend much of our day walking barefoot on the grass so the practice of earthing during much of our usual daily activities requires modifications to buildings to provide conductive paths to earth and shoes with conductive soles. In contrast, exposure to the cathode of a battery while electrically isolated from ground or other potential sources charges the body to a known potential (compared to the anode of the battery). The body is, in effect, an extension of the cathode. It will keep the body at desired static potential except during activities such as showering and swimming or when contact is made with ground, and there is no danger that any significant current will pass through the body. A wearable device may be able to provide symptomatic relief and protection against oxidative stress during most of the day without impeding normal activities. It could, for example, be worn prophylactically during most of a person’s daily activities. Other considerations are discussed below.

A. Electrical Hazards
The choice of 24 volts in the trial described above was arbitrary. The various ROS differ from each other, and it reasonable to expect that controlling each may require a different minimum applied voltage. Unless special efforts are made to maintain electrical isolation, the practical voltage limit for a wearable device may be about 327 volts in dry air at Standard Temperature and Pressure. A person charged above this limits will experience a tingle or jolt upon touching a grounded conductor, which can be unpleasant but not normally dangerous, even when the body carries a fairly high voltage. Dielectric breakdown of dry air between spherical conductors occurs at approximately 30 kv/cm, or 3 kV/mm. It is easy to produce an electrical discharge more than one millimeter long by approaching a grounded conductor after walking across a carpet on a dry day, which demonstrates that a person can carry a charge of at least 3,000 volts and experience the discharge of this voltage without apparent harm. The reason, of course, is that very few electrons are required to raise the static voltage on a person’s body to these high levels and the discharge current is very small. The same voltage limitations do not apply to treatment in a Faraday Cage. A person can accumulate a static charge of many thousand volts in such a device without sensing a current flow.

B. Side Effects
It must be determined by experiment whether inhibiting oxidation with applied charge also inhibits any beneficial roles ROS may have in therapy and in ordinary biological processes. It may, for example, inhibit the reaction of nitric oxide with superoxide that produces antimicrobial reactive nitrogen species (RNS), which is part of the cell’s response to bacterial pathogens [10]. If it does, it may be possible to increase the effectiveness of these RNS by applying positive charge with a device like that in Figure 1,
reconfigured to deliver a positive charge. RNS are oxidants so the side effects of a more positive static charge would be increased oxidative stress on the whole body, but this would be limited to the treatment period.

There is evidence that it is the ROS produced by some chemotherapeutic agents that kill cancer cells. For example, kaempferol seems to induce apoptosis in glial cells by increasing production of ROS and reducing concentrations of the ROS-scavenging agents superoxide dismutase and thioredoxin [11]. It must be determined experimentally whether inhibiting oxidative stress during treatment does, in fact, reduce the effectiveness of radiation and chemotherapeutic agents. However, an imposed negative potential used after treatment might still be useful for preventing hair loss and other side effects. Positive static charge used during treatment might increase the effectiveness of both radiation and chemical agents.

Protein Folding

Misfolding of proteins and other macromolecules is considered the cause of many neurodegenerative diseases including cystic fibrosis and Alzheimer’s, Parkinson’s, Huntington’s, Creutzfeldt-Jacob, and Gaucher’s diseases. It is conceivable that folding to functionally effective configurations is prevented by oxidation of one or more sites on the protein itself or by oxidatively disabling chaperone molecules. However, it is also possible that folding is affected just by the static potential. Folding is guided by electrostatic attraction, and the relative shielding of different positive charges on the nuclei of a macromolecule may change at different static potentials so that the molecule folds to different configurations.

References

4. Ocone, L., WebmedCentral: WMC001185
8. The Feynman Lectures on Physics, 2nd Ed, Addison Wesley, Sec 9
9. Dahlberg, D.A., Ground Currents, downloadable
11. Sharma, V., Mol Cancer Ther, 2007 Sep; 6(9):2544-53
Illustrations

Illustration 1

Figure 1: Stainless steel battery holder