Intravenous C Band Ultraviolet Light Therapy (IVUVLT) as a Treatment for Bacterial and Viral Infections Including COVID-19

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ABSTRACT

Introduction: Antibiotic resistance developed by micro-organisms is getting scary day by day. WHO estimates that if no action is taken, then drug-resistant diseases could cause 10 million deaths each year by 2050 and damage to the economy as catastrophic as the 2008-2009 global financial crisis.[1] By 2030, antimicrobial resistance could force up to 24 million people into extreme poverty.

Initial research, looking only at part of the impact of antibiotic resistance, shows that a continued rise in resistance by 2050 would lead to 10 million people dying each year and a reduction of 2% to 3.5% in Gross Domestic Product (GDP). It would cost the world up to 100 trillion USD.[2,3] To solve this problem, I started my own research and a greater number of patients to know more about it. The therapy has a potential to save many patients worldwide from variety of infections. The therapy can be used as an immediate measure in epidemics and pandemics for new infections with unknown micro-organisms even before a specific vaccine and treatment is developed.

MATERIALS AND METHODS:

Intravenous Ultraviolet Light Therapy (IVUVLT) illuminates ultraviolet light of 254 nm wavelength into a peripheral vein with a fiber optical device. The device is made up of a 3-watt ultraviolet light bulb of quartz material. A PMMA (Poly methyl methacrylate) fiber carries UV light of 254 nm wavelength and delivers it through an angiocath to the patient's blood in a peripheral vein.

Discussion: The UV light of 254 nm wavelength kills all bacteria, viruses, fungi and molds in 60 seconds. PMMA material is non-reactive to blood and already FDA approved for use inside human body. The device for IVUVLT is commercialized for a reasonable cost of Rs. 15,000. The probe of the device is reusable, detachable and sterilized by ETO gas or by putting in Formalin chamber for 30 minutes. IVUVLT and its device are reported for the first time in medical literature.

UV light of 254 nm wavelength is a non-ionizing radiation and proved to be safe in many studies done on human body. The blood cells are exposed to UV light only for few seconds and the progenitors in bone marrow are not exposed keeping them safe. Ultraviolet Blood Irradiation (UBI) is a procedure that exposes the blood to UV light to heighten the body’s immune response and to kill infections. It is similar to IVUVLT in many ways and has shown positive effects on RBCs, neutrophils, lymphocytes, on phagocytosis and on redox status. The light of 254 NM splits the 2% dissolved Oxygen in the blood and converts it into molecular Ozone O3. Ozone is a non-toxic gas and kills all micro-organisms like bacteria, fungi, viruses and molds in just 60 seconds. It is effective in little concentration as 0.04 ppm and human toxicity starts at 3 ppm indicating a huge safety limit. Ozone is a strong modulator of immune system. Inside the blood, it creates a mild oxidative stress which makes the immune system produce a large quantity of Interferons, agents that attack micro-organisms and kills them. No resistance is reported to Ozone and UV light making them a never-failing solution to micro-organisms. There are numerous studies in the medical literature which show that the UV light kills bacteria and viruses in the animal studies as well as studies done on human body.

IVUVLT is going to be effective against vast number of viral infections such as HIV- AIDS, COVID 19, Swine flu, Dengue fever, Japanese encephalitis, Rabies, viral diarrheas, rabies etc. which kill millions of people yearly worldwide. It will also be effective against bacterial septicemia, tetanus, meningitis, Diphtheria and against Methicillin-resistant Staphylococcus aureus (MRSA) etc. It will also be effective against systemic fungal infections and molds. The therapy will work against unknown organisms leading to pyrexia of unknown origin (PUO). I do not claim to know everything about IVUVLT. A lot of research and numerous clinical trials will be necessary to know about its exact mechanism of action, dosages and indications. This is only the beginning of this kind of research.

Conclusions: IVUVLT is a potentially safe, cheap and effective therapy for septicemia secondary to vast majority of viral and bacterial infections including COVID 19. We need more research and a greater number of patients to know more about it. The therapy has a potential to save many patients worldwide from variety of infections. The therapy can be used as an immediate measure in epidemics and pandemics for new infections with unknown micro-organisms even before a specific vaccine and treatment is developed.

KEYWORDS

Ultraviolet C band Ultraviolet Light Therapy (IVUVLT), Ultraviolet blood irradiation, Antibiotic resistance, Therapy for antibiotic resistance, Therapy for Covid 19 infection.
I wanted an energy which kills micro-organisms efficiently and still does not produce any significant damage to the human body. I also wanted my new energy to be free of antibiotic resistance. In my research, I found 2 such energies which are part of the nature and having above qualities. One is sunlight and another is Ozone gas.

Since time immemorial, sunlight is killing micro-organisms and saving us from them. [6] The sunlight is 10% ultraviolet by volume which has antimicrobial activity. Out of total sunlight, only 1% sunlight is C band ultraviolet which as maximum antimicrobial activity with wavelength of 100–280 nm. Maximum antibacterial and antiviral activity of C band ultraviolet light was found in the wavelength of 254 nm. [7] Hence it is used in my device to kill micro-organisms. Ultraviolet (UV-C) light kills or inactivates microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. Wavelengths between about 200 nm and 300 nm are strongly absorbed by nucleic acids. The absorbed energy can result in defects in pyrimidine dimers. These dimers can prevent replication or can prevent the expression of necessary proteins, resulting in the death or inactivation of the organism. My device uses a low-pressure mercury lamp that effectively generate UV radiation at 254 nm wavelength. Even today ultraviolet in sunlight kills micro-organisms as efficiently as before. Viruses like HIV die within 8 seconds of exposure to ordinary sunlight. Micro-organisms and sunlight both are present since millions of years. Still micro-organisms could not develop resistance to the ultraviolet light. The 1903 Nobel Prize for Medicine was awarded to Niels Finsen for his use of UV against lupus vulgaris, tuberculosis of the skin.

For more than 100 years now, billions of people are drinking water treated by C band ultraviolet light. In UV water purifiers, the water moves through a transparent glass tube with a speed of 100 ml per minute. Around this glass tube an ultraviolet tube light with 254 nm wavelength is placed. As water is exposed to UV light 99.99% micro-organisms are killed. [8] Dosages of UV light for a 99.99% killing of most bacteria and viruses range from 2,000 to 8,000 μW·s/cm².

The ultraviolet light of 254 nm wavelength is invisible light and does not pass through ordinary glass. Hence, the bulb used in the device is made up of special quartz material. The ultraviolet light also cannot pass through glass fiber. Hence a special fiber made up of PMMA[9] (Poly methyl methacrylate) is used for the purpose. PMMA is already FDA approved [10] to be used on human body for a variety of purposes. Poly methyl methacrylate (PMMA), commonly known as bone cement [10], and is widely used for implant fixation in various Orthopedic and trauma surgery. In the 1970’s, the U.S. Food and Drug Administration (FDA) approved bone cement [10] for use in hip and knee prosthetic fixation. PMMA has also been used [11] for (a) bone cements; (b) contact and intraocular lens; (c) screw fixation in bone; (d) filler for bone cavities and skull defects; and (e) vertebral stabilization in osteoporotic patients.

Application of UV light to kill micro-organisms in the human body is challenging. There are types of sepsis, one is localized tissue infection and the another is generalized septicemia where the micro-organisms are present in the blood. The micro-organisms in the blood need to be killed immediately as it is far more dangerous than tissue infection.

The blood flows through peripheral circulation with a speed of 25-40 ml per minute [12] which is 4 times slower than the ultraviolet water purifier. It means the blood will be exposed to UV light 4 times more than water making it 4 times more effective. The physics of light tells us that the light is absorbed best by the opposite color. The red color of blood is almost opposite of ultraviolet. That makes the blood absorb maximum UV light making the therapy super effective. With exposure to UV light, bacteria and viruses in the bloodstream absorb five times as much photonic energy as the red and white blood cells. Thus, IVUVLT directly kills micro-organisms in the blood as it moves across the light drop by drop. The total blood volume in adult is about 5 liters. With a blood flow of 25-40 ml per minute, it will take about 3 hours for the complete blood to pass and get exposed to UV light in a peripheral vein. Hence the therapy time is kept as 3 hours.

The device is reusable and is commercialized for a reasonable cost of Rs. 15,000. The probe of the device is detachable and sterilized by ETO gas or by putting in Formalin chamber for 30 minutes. The application of the device requires minimal skills and even a staff nurse can manipulate the device on the patient. Hence it can be used in epidemics to be applied on large number of children and adults. The therapy is extremely affordable and...
the running cost per therapy sessions is only pennies. Hence it has a potential to have a huge positive impact on public health worldwide.

The argument of safety of my device is as follows. PMMA material is biocompatible and already approved by FDA to be used inside the human body. It is inert material and does not react with blood. The device illuminates the blood flowing through a vein. The blood is exposed to UV light only for few seconds. Although very few cells can develop mutations, they are easily killed by the immune system. Every day, our body produces cancer cells but the immune system kills them and does not allow developing cancer. The blood cells have a life of only 120 days and they die after that time span. The progenitors of blood cells in the bone marrow have a long life as much as the human body and they are not exposed by the therapy. The progenitors in the bone marrow retain full capacity of blood regeneration.

Ultraviolet light of 254 NM is safe and is a non-ionizing radiation. Ionizing radiation starts at 100 NM and below and are harmful to the body which are not used in this therapy. It takes thousands of hours of exposure to UV light to develop cancer. Here, therapy time is only 3 hours which is far less than that. Since blood is flowing in peripheral vessels with a speed of 25-40 ml per minute, the blood cells are exposed to UV light only for few seconds. There are studies now which show that when human wounds were exposed by UV light to kill the micro-organisms in the wound, the cells of the wound showed no damage by UV light of 254 NM wavelength. [13]

Ultraviolet Blood Irradiation (UBI) (Figure 3) is a procedure that exposes the blood to UV light to heighten the body’s immune response and to kill infections. It was extensively used in the past when there were no antibiotics and antiviral drugs. No side effects were noted in the patients who underwent UBI in the past with long follow ups. IVUVLT has a lot of things in common to UBI. IVUVLT will have the same benefits as UBI which is extensively studied in the past. The UBI technique involves removing approximately 3.5 mL/kg venous blood, citrating it for anticoagulation, and passing it through a radiation chamber and reinfusing it [14]. Exposure time per given unit amount was approximately 10 seconds, at a peak wavelength of 253.7 nm (ultraviolet C) provided by a mercury quartz burner and immediately re-perfused [14]. In this technique, only a small amount of blood is treated instead of entire blood volume. IVUVLT is superior to UBI as it covers whole blood volume compared to UBI which covers only 10-15 % of the total blood volume.

The use of UBI has been described to affect many different components of the blood. UBI can alter the function of leukocytes as well as blood components with a speed of 25-40 ml per minute, the blood cells are treated instead of entire blood volume. IVUVLT is superior to UBI as it covers whole blood volume compared to UBI which covers only 10-15 % of the total blood volume.

In the second half of the 19th century, the therapeutic application of sunlight (known as heliotherapy) gradually became popular. In 1855, Rikli from Switzerland opened a thermal station in Veldes in Slovenia for the provision of heliotherapy [17]. In 1877, Downes and Blunt discovered [18] by chance that sunlight could kill bacteria. They noted that sugar water placed on a window-sill turned cloudy in the shade but remained clear while kept in the sun. Upon microscopic examination of the two solutions, they realized that bacteria were growing in the shaded solution but not in the one exposed to sunlight.

In 1904, the Danish physician Niels Finsen was awarded the Nobel Prize in Physiology or Medicine for his work on UV treatment of various skin conditions. He had a success rate of 98% in thousands of cases, mostly the form of cutaneous tuberculosis known as lupus vulgaris [19]. Walter H Ude reported a series of 100 cases of erysipelas (a cutaneous infection caused by Streptococcus pyogenes) in the 1920s, that were treated with high cure rates using UV skin irradiation [20].

Emmett K Knott in Seattle, WA reasoned that the beneficial effect of UV irradiation to the skin might (at least partly) be explained by the irradiation of blood circulating in the superficial capillaries of the skin. With his collaborator Edblom, an irradiation chamber was constructed that allowed direct exposure of the blood to UV light. The irradiation chamber was circular and contained a labyrinthine passage connecting the inlet and outlet ports underneath the quartz window that formed the top of the chamber. The irradiation chamber was so designed as to provide maximum turbulence in order: (a) to prevent the formation of a film of blood on the chamber window that would absorb and filter out much of the UV; (b) to insure that all the blood passing through the chamber was equally exposed to UV [21].

Knott and co-workers then carried out a series of experiments using UV irradiation of blood extracted from dogs that had been intravenously infected with Staphylococcus aureus and hemolytic Streptococcus, and then the treated blood was reinfused. They found that it was unnecessary to deliver a sufficient exposure to the blood to kill all the bacteria directly. It was also found unnecessary to expose the total blood volume in the dogs. The optimum amount of blood to be irradiated was determined to be only 5-7% of the estimated blood volume or approximately 3.5 mL per kg of body weight. All the treated dogs recovered from an overwhelming infection (while many dogs in the control group died), and none showed any ill effects after four months of observation [21].

The first treatment on a human took place in 1928 when a patient was determined to be in a moribund state after a septic abortion complicated by hemolytic streptococcal septicaemia. UBI therapy was commenced as a last resort, and the patient responded to treatment and made a full recovery [21]. She proceeded to give birth to two children.

Hancock and Knott [22] had similar success in another patient with advanced hemolytic streptococcal septicaemia. These workers noted that in the majority of cases, a marked cyanosis was present at the time of initiation of UBI. It was noted that during (or immediately following) the treatment a rapid relief of the cyanosis occurred with improvement in respiration accompanied by a noticeable flushing of the skin with a distinct loss of pallor.

These observations led to application of UBI in patients suffering from pneumonia. In a series of 75 cases in which the diagnoses of pneumonia were confirmed by X-rays, all patients responded well to UBI with a rapid fall in temperature, disappearance of cyanosis (often within 3-5 minutes), cessation of delirium if present, a marked reduction in pulse rate and a rapid resolution of pulmonary consolidation. A shortening of the time of hospitalization and convalescence occurred regularly.

Following are numerous studies which show that the UV light kills bacteria and viruses in the animal studies as well as studies on human body. In 1801 Johann Wilhelm Ritter, a Polish physicist working at the University of Jena in Germany discovered a form of light beyond the violet end of the spectrum that he called “Chemical Rays” and which later became known as “Ultraviolet” light [15]. In 1845, Bonnet [16] first reported that sunlight could be used to treat tuberculosis arthritis (a bacterial infection of the joints).
by a mercury quartz burner and immediately re-perfused [21].

George P Miley at the Hahnemann Hospital, Philadelphia, PA published a series of articles on the use of the procedure in the treatment of thrombophlebitis, staphyloccocal sepsis, sepsis, botulism, poliomyelitis, non-healing wounds, and asthma [23–36].

Henry A Barrett at the Willard Parker Hospital in New York City, in 1940 reported on 110 cases including a number of infections. Twenty-nine different conditions were described as responding including the foal with anemia, erythema migrans, scarlet fever, peritonitis, tuberculosis, pneumococcal meningitis, streptococcal pharyngitis, typhoid fever, and typhus fever [39–43]. Robert C Olney at the Providence Hospital, Lincoln, NE, treated biliary disease, pelvic cellulitis and viral hepatitis with UBI [42–46].

UV light irradiation of blood was hailed as a miracle therapy for treating serious infections in the 1940s and 1950s. However, in an ironic quirk of fate, this time period coincided with the widespread introduction of penicillin antibiotics, which were rapidly found to be an even bigger miracle therapy. Moreover, another major success of UBI, which was becoming used to treat polio, was also eclipsed by the introduction of the Salk vaccine. Starting in the 1960s UBI fell into disuse in the West and has now been called “the cure that time forgot” [47].

Effect of UV light on red blood cells is as follows. Anaerobic conditions were reported to strongly restrict the process by which long wave ultraviolet light could induce loss of K+ ions by red blood cells. Kabat showed that UV-irradiation could have an effect on the osmotic properties of red blood cells, altering their submicroscopic structure and affecting the metabolism of adenine nucleotides. Irradiation times (60, 120, 180, 240 and 300 minutes) were used. ATP decreased while content while ADP, AMP and adenosine compounds increased. It was also found that hypotonic Na+ and K+ ion exchange and hematocrit values increased [48].

UV light illumination on Rh-positive blood significantly increased the Immunoadsorption activity. Immunoadsorption is a blood purification technique used to eliminate pathogenic antibodies. Vasiëva et al [49] suggested that some structural disturbances in the state of the erythrocyte glycosylay were related to UV-irradiation when it was used as a clinical treatment. Cytochemical and iso-serological methods were used to show that blood autotransfusions were improved after UV irradiation.

ICHII et al. [51] showed that the erythrocyte cellular volume and the membrane potential were changed by UV irradiation. Lower doses (≤ 0.1 J/cm²) give contamination, and comparable protective effect of peroxides (H2O2) which was the most pronounced among different blood cells. However an increased dose decreased the production, while the peroxide production in platelets was lowest at the lower dose, but it increased abruptly at doses above 0.4 J/cm². The UV light exposure had following effect on neutrophils. The oxidative effects of UBI on neutrophils could be inhibited by arachidonic acid or lysophosphatidylcholine (LPC), as well as the complex-forming agent alpha-tocopherol. These compounds inhibited the interaction of UVR with phagocytes [52]. In chronic inflammatory disease, the concentration of large IC-IGg, IgM, and small IC-IgM immunocomplexes showed a linear and inverted correlation when UBI was compared with an autotransfused blood. Due to the function of UV-B irradiated mononuclear cells derived from human peripheral blood could be enhanced by deoxyriboseoxide supplementation, and also

UV light illumination on Rh-positive blood significantly increased the Immunoadsorption activity. Immunoadsorption is a blood purification technique used to eliminate pathogenic antibodies. Vasiëva et al [49] studied varying irradiation levels of UV on both red blood cells and leucocyte-thrombocyte suspensions. The immunoadsorption activity increased immediately after irradiation in the whole blood and red blood cells, however, the Immunoadsorption capacity in leucocyctic – thrombocytic suspensions was lost after two days later.

A two-phase polymer system including poly-dextran was used to study the interaction of UVR with phagocytes [52]. The function of UV-B irradiated mononuclear cells derived from human peripheral blood could be enhanced by deoxyriboseoxide supplementation, and also

UV light illumination of blood autotransfusions were improved after UV irradiation. The function of UBI in Escherichia coli septilamin plus abortifacient, leucocyctic–thrombocyctic suspensions was lost after two days later.

Schieven et al observed that after surface immunoglobulin cross-linking, UV-induced tyrosine phosphorylation in B cells was very similar to that seen after Ca2+ signaling in T cells. This means that the UV irradiation effect on lymphocyte function could induce both tyrosine phosphorylation and Ca2+ signals. Ca2+ channels in lymphocyte membranes are sensitive to UV irradiation. UV radiation can cause damage DNA through activation of cellular signal-transduction processes. UV radiation depending on dose and wavelength can not only induce tyrosine phosphorylation in lymphocytes, but also induce Ca2+ signals in Jurkat T cells and associated proteins synthesis. Furthermore, the pattern of surface immunoglobulin cross-linking was very similar to the UV-irradiated B cells and Ca2+-treated T-cells. In this research it was found that CD4+ and CD8+ normal human T-lymphocyte cells gave strong reactions during UV-irradiation induced producing Ca2+ responses [59].

In another similar study, Spielberg et al [60] found that UV-induced inhibition of lymphocytes accumulation by a dose of Ca2+ inhibitors to UV-effect was dependent on Na+-dependent, which have different effects on lymphocyte membranes. They found the presence of Ca2+ channels in lymphocyte membranes that were sensitive to UV irradiation. Indo-1 and cytofluorometry, was used to measure [Ca2+]i kinetics was in UVC- or UVB-exposed human peripheral blood leucocytes (PBL) and Jurkat cells in parallel with functional assays. The UVC-induced (Ca2+)-i rise in extracellular calcium, and it was more pronounced in T than in non-T cells. It was observed that [Ca2+]-i increased within 2–3 h of irradiation; these increases were UV-dose dependent and reached maxim of 240% and 180% above baseline level (130 nM) for UBV and UVC. The UV-induced more [Ca2+]-i rise in T cells than in non-T cells, due to the influx of extracellular calcium. UV-induced calcium shifts and UV irradiation on the plasma membrane decreased the sensitivity of response to phytomelagglutinin (PHA) and its ability to stimulate a mixed lymphocyte culture, because UV produces [Ca2+]-i shifts.
A series of studies confirmed that UVR irradiated lymphocytes were not able to induce allogeneic cells in a mixed lymphocyte culture (MLC) as first reported by Lindahl-Kiessling [61,62,63]. Clusters formed by specific accessory cells such as dendritic cells (DC), after mitogenic or allogenic stimulation, were necessary for lymphocyte activation to occur. Aprile found that UV irradiation of DC before culture completely abrogated the accessory activity and was able to block both cluster formation and proliferation [64].

UV-induced differentiation of human lymphocytes could accelerate the repair of UV-irradiation damage in these cells [65]. Exposure to UV radiation was more effective than combination of UV-irradiation with methyl methane sulfonate (MMS) in the unscheduled DNA synthesis value, especially when MMS was given prior to the UV-irradiation (either at 2 hour or 26 hours incubation) because the MMS has an effect on the DNA repair polymerase by alkylating DNA [66]. Photo modification of HLA-D/DR antigens could be a trigger mechanism for activation of immunocompetent cells by UV-irradiation. Lymphocytes were isolated from a mixture of non-irradiated and UBI irradiated blood at different ratios (1:10, 1:40, 1:160) [68].

Pamphlet reported that platelet concentrates (PC) could become non-immunogenic after being irradiated with ultraviolet light (UVL) and stored for 5 d in DuPont Stericell containers. Lactate levels, beta-thromboglobulin and platelet factor were increased, while white blood cells were decreased with an irradiation dose of 3000 J/m² at a mean wavelength of 310 nm in DuPont Stericell bags [69]. Ultraviolet B (UVB) irradiation of platelet concentrate (PCs) accelerated dose-dependent irradiation of CD4 and non-specifically increased the loss of monocytes by inhibiting the upregulation of ICAM-1 and HLA-DR. However, UV radiation of platelet concentrates reduced the induced immunological response in a cell suspension [70,71,72].

Deeg et al studied a model where administering blood transfusions to littermate dogs led to rejection of bone marrow grafts even though the grafts were DLA-identical, while untransfused dogs uniformly achieved sustained engraftment. UBI of the blood before transfusion prevented bone marrow graft rejection in vivo. 9.2 Gy of total body irradiation (TBI) was also used and 2.8±2.1×108/Kg donor marrow cells were infused, and whole blood was exposed for 30 minutes to UV light for 1.35 J/cm², then injected into the recipient dogs. The control group transfused with sham-exposed blood rejected grafts, while no rejection appeared in the treatment group, which received UEXP-exposed blood before transplanted marrow. UV irradiation of blood lessened activation of DC by eliminating a critical DC-dependent signal; therefore, subsequent DLA-identical marrow graft was successfully engrafted [73].

Oluwole et al [74] suggested that transfusion of UV-irradiated blood into recipients could be used prior to heart transplantation to inhibit immune response and reduce lymphocyte reaction. Three strains of rats (ACI, Lewis, W/F) were used for heart transplantation in their research. When ACI rats received a Lewis rat heart, giving 1 mL transfusion of donor-type blood with or without UV-irradiation transfusion at 1, 2, and 3 weeks prior to the transplantation, the mixed lymphocyte reaction with ACI lymphocytes showed a weaker response to Lewis lymphocytes than without UBI and the similar results were obtained with the other two strains of heart transplantation. UV irradiation of donor rhesus-positive blood can be used for increase in therapeutic effect of blood exchange transfusion in heart transplantation. UV irradiation of donor rhesus-positive blood with or without UV-irradiation (UVB) accelerated and 3 non-specifically increased the loss of monocytes by inhibiting the upregulation of ICAM-1 and HLA-DR [75].

Kovacs et al [76] found that DNA repair synthesis was dependent on the dose of UV-C light between 2 and 16 J/cm². This was evaluated in irradiated and unirradiated lymphocytes in 51 healthy blood donors. Irradiation (253.7 nm) of 2.48 and 16 J/m² was used, then DNA synthesis was measured by [3H] thymidine incorporation in the presence of hydroxystar (2mM × 106 cells) added 30 min before irradiation to inhibit the DNA-replicative synthesis. No significant age-related difference was seen between 17 and 74 years.

Teunissen et al [77] suggested that UVB radiation neither selectively affects Th1 or Th2 nor CD4 or CD8 T cell subsets. Compared with different dose of UBV irradiation, although the phototoxic effect was not induced in the normal cells, a dose of 2.8±2.1×108/Kg donor marrow cells were infused, whole blood was exposed for 30 minutes to UV light for 1.35 J/cm², then injected into the recipient dogs. The control group transfused with sham-exposed blood rejected grafts, while no rejection appeared in the treatment group, which received UEXP-exposed blood before transplanted marrow. UV irradiation of blood lessened activation of DC by eliminating a critical DC-dependent signal; therefore, subsequent DLA-identical marrow graft was successfully engrafted [73].

UV light has following effect on phagocytic activity. Phagocytic activity (PhA) was one of the first mechanisms to be proposed to explain the immune correction by UBI therapy. In Samo-Iova's research, non-irradiated blood mixed with 1:10 volumes of irradiated blood were used to test PhA of monocytes and granulocytes. An increase of 1:4–1:7 times in PhA compared with non-irradiated blood, was seen when UV-irradiated blood was transfused into healthy adults. The enhancement of PhA depended on its initial level and may occur simultaneously with structural changes of the cell surface components [79].

Simon et al [80] showed that UBV could convert Langerhans cells (LC) or splenic adherent cells (SAC) from an immunogenic to a tolerogenic type of APC (LC or SAC). In his research, single dose of irradiation (200 J/m²) was used on LC and SAC. The Th1 level of response after preincubation with keyhole limpet hemocyanin (KLH) was studied with UBV-LC or UBV-SAC. Furthermore, the loss of responsiveness was not related to the release of soluble suppressor factors but was Ag-specific, MHC-restricted, and did not last for a long time. Functional of allogenic LC or SAC deliver a costimulatory signal(s) was interferes by UBV, because unresponsiveness by UBV-LC or UBV-SAC could not induce by unirradiated allogenic SAC.

UV-irradiation increased phagocytic activity of human monocytes and granulocytes; the improvement in phagocytic index was related to the irradiation dose, and the initial level. A lower initial level would increase proportionately more than a higher initial level after UV-irradiation. It was found that UV irradiation enhanced the phagocytic activity directly [83].

UV light has following effect on low-density lipoprotein (LDL), Roshchupkin et al [81] found that UVB irradiation played a core role in lipid peroxidation in the membrane of blood cells. UVB irradiation on blood stimulated arachidonic acid to be produced by a cyclooxygenase catalyzed reaction. UV induced a process of dark lipid oxidation which continued for some time afterwards producing free radicals. It contributed to lipid photoperoxidation producing lipid peroxides.

An UV irradiated lipid emulsion greatly enhanced reactive oxygen species (ROS) production by monocytes. Highly atherogenic oxidized LDL could be generated in the circulation. UV irradiation of the lipid emulsion called "Lipofundin" (largely consisting of linoleic acid oxidized either by lipoxygenase, Fe3+ or ultraviolet irradiation) was injected into rabbits. Blood samples were taken from the ear vein with EDTA before and 6 hours after lipofundin treatment. Though UV-oxidized lipofundin induce less chemiluminescence from monocytes compared with Fe3+ oxidation, it lasted 2.3 times longer. UV-oxidized lipofundin could more effectively stimulate H2O2 production by cells, than LDL altered by monocytes, even with the same concentration of thiobarbituric acid reactive substance (TBARS). Six hours after injection of oxidized lipofundin, the lipid peroxide content was significantly increased; however neutral lipids of LDL separated from rabbit plasma showed no significant difference to the monocyte-oxidized human LDL [82].

Salmon [83] found that UBV (280–315 nm) irradiation could easily damage LDL and high-density lipoprotein (HDL) tryptophan (Trp) residues. The TBARS assay was used to measure the photooxidation of tryptophan residues which was accompanied by the peroxidation of low- and high-density lipoprotein unsaturated fatty acids. Vitamin E and carotenoids naturally carried by low- and high-density lipoprotein unsaturated fatty acids. Vitamin E and carotenoids naturally carried by low- and high-density lipoprotein unsaturated fatty acids. Vitamin E and carotenoids naturally carried by low- and high-density lipoprotein unsaturated fatty acids. Vitamin E and carotenoids naturally carried by low- and high-density lipoprotein unsaturated fatty acids. Vitamin E and carotenoids naturally carried by low- and high-density lipoprotein unsaturated fatty acids.
oxidation during irradiation. UVA irradiation of undiluted suction blister fluid induced apo-A-1 aggregation; however, purified lipoproteins were not degraded. During UV irradiation of suction blister fluid, the lipoproteins as well as the plasma proteins were fragmented and polymerized. Activated oxygen radicals in the suction blister fluid during UV irradiation were derived from lipid peroxidation in HDL. Furthermore, they suggested that lipid peroxidation of was caused by a radical chain reaction and could transfer the initial photodamage. UV-light irradiation could play an important role in triggering inflammation and the degeneration caused by induced lipoprotein photo-oxidation with systemic effects.[84]

Artyukhov et al.[85] found that dose-dependent UV-irradiation could activate the myeloperoxidase (MPO) and the NADPH-oxidase systems and lipid peroxide (LPO) concentration in donor blood. Two doses of UV-light were used (75.5 and 151.0 J/cm2) in UV-induced priming of neutrophils (NP). A higher dose activated more free radicals and H2O2 from NP than a lower dose. Two groups were divided by the type of relationship between MPO activity and UV light dose (from 75.5 to 1510 J/m2). A low enzyme activity (group 1) increased under the effect of UV exposure in doses of 75.5 and 151.0 J/m2, while in group 2 this parameter decreased. MPO activity showed the same result in dose-dependent UV-irradiation; however, increasing the dose to 1510 J/m2 did not increase the activity of MPO. In the next series of experiments, LPO concentration was evaluated after UV exposure of the blood. Two groups of donors were distinguished by the relationship between blood content of LPO and UV exposure dose. UV irradiation at low doses (75.5–151.0 J/m2) decreased initially high LPO and increased initially low LPO levels. In phagocytes, NADPH-oxidase plays one of the most important role of photoreceptors for UV light. Which cause the superoxide concentration to increase after UV-irradiation by activating the enzyme complex. UV irradiation decreases intracellular pH that is raised by activation of NADPH-oxidase complex.

UBI can reduce the free radical damage and elevate the activity of antioxidant enzymes after spinal cord injury in rabbits. 186 rabbits were divided into 4 groups randomly, (control, blood transfusion, injured and UBI). UV irradiation (wavelength 253.7nm, 60 seconds. (54,55) It is effective in little concentration as 0.04 ppm kills all micro-organisms like bacteria, fungi, viruses and molds in just 60 seconds. (54,55) It is effective against systemic fungal infections and molds. The therapy can be used as an immediate measure in epidemics and pandemics for new infections with unknown micro-organisms before a specific vaccine and treatment is developed.

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15) UVVLT is going to be effective against vast number of viral infections such as HIV, AIDS, COVID 19, Swine flu, Dengue fever, Japanese encephalitis, Rabies, viral diarrhea, Hepatitis B and C, rabies etc. which kill millions of people yearly worldwide. It will also be effective against bacterial septicemia, tetanus, meningitis,Diphtheria and against Myeloblastic-resistant Staphylococcus aureus (MRSA). It will also be effective against systemic fungal infections and molds. The therapy will work against unknown organisms leading to pyrexia of unknown origin (PUO). There are thousands of micro-organisms which can infect human body, but we have diagnostic tests and specific treatment only for few of them.UVVLT can act against all microorganisms including the one that caused the SARS-CoV-2 epidemic, which has brought the greatest discovery of 19th century but lost its charm due to antibiotic resistance. Since micro-organisms can’t develop resistance to UV light and Ozone gas, UVVLT will always be effective against them. UVVLT and its device are reported for the first time in the medical literature. It may be useful in organ transplanted patient due to its immune-modulatory effect. We need more research and a greater number of patients to know about the UVVLT’s exact mechanisms of action, dosages and indications. This is only the beginning of this discovery.

17) The therapy can be used as an immediate measure in epidemics and pandemics for new infections with unknown micro-organisms before a specific vaccine and treatment is developed.


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