ORIGINAL RESEARCH PAPER

Medical Science

IONIZING AND NON-IONIZING RADIATION IN THE HEALTH PERSONNEL OF A HOSPITAL IN QUITO ECUADOR

KEY WORDS: Ionizing Radiation, Non-ionizing Radiation, Electromagnetic Radiations, Health Effects

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ABSTRACT

Due to the great technological advances of our era, what we call radiation is produced which produces energy for the operation of the different devices, for this we must distinguish between ionizing and non-ionizing radiation. Ionizing radiation has enough energy to release electrons from a atom, leaving therefore the charged atom, while the radiation non-ionizing, such as radio waves, visible light or ultra-violet radiation , it doesn't.

Today, we know more about the sources and effects of radiation exposure than almost any other dangerous agent, and the scientific community is constantly updating and analyzing their knowledge.

Most people are aware of the use of radiation in the production of electricity of nuclear origin or in medical applications. However, many other uses of the technologies are barely known nuclear in industry, agriculture, construction, research and others areas. For someone who reads on the subject for the first time, it can be a surprise that the radiation sources that cause the greatest exposure of the population are not necessarily the ones that attract the most attention.

In fact, the greater exposure is caused by natural sources always present in the environment, and the biggest contributor to exposure from artificial sources is the use of radiation in medicine worldwide. In addition, everyday experience, such as air travel and live in certain parts of the world in houses well insulated from the outside, can increase substantially radiation exposure.

ELECTROMAGNETIC RADIATIONS

DEFINITION

Electromagnetic radiation is a combination of oscillating electric and magnetic fields, which propagate through space carrying energy from one place to another. Unlike other types of waves, such as sound, which need a material medium to propagate, electromagnetic radiation can be propagated in a vacuum.

4.2. CLASSIFICATION

Waves or electromagnetic radiation can be c lasificar in:

- Non - ionizing radiation: they have enough energy p ara break the bonds that connect the atoms of the medium radiate (and TV radio waves, microwaves, visible light, etc.).
- ionizing radiation: have sufficient energy to p roducing ionization of atoms of the medium or material and s irradiated. They range from x-rays to cosmic radiation.
- therefore the word radiation used along the whole d ocument refers only to ionizing radiation.

5. IONIZING RADIATION

5.1. CORPUSCULAR RADIATION

5.1.1. DEFINITION

Also called particle radiation, is that radiation that propagates in the form of atomic nuclei or subatomic particles sometimes charged or neutral, that travel in a straight line at high speed and that transmit kinetic energy through mass.

1. ALPHA RADIATION:

It is a radiation consisting of two protons and two neutrons closely linked, so it is identical to a helium nucleus, its radioactivity type alpha occurs when very heavy elements, such as uranium, thorium and radium lose the most of their kinetic energy and become a helium atoms .

2. BETA RADIATION:

It is a radiation that is made up of electrons in the nucleus from the decomposition of a neutron of radioactive substances and that travels at speeds close to light. This type of radiation takes place in neutron-rich isotopes and is usually elements produced in natural nuclear reactions, and in nuclear power plants.

3. NEUTRONS:

They are particles from outer space, product of collisions between atoms in the atmosphere itself or more frequently of spontaneous or artificial radioactive decay within nuclear reactors.

4. COSMIC RAYS:

Cosmic radiation consists of highly energetic particles of extraterrestrial origin that bombard the Earth's surface, such as protons and secondary particles such as photons, neutrons and moons that can be generated by the interactions of primary particles with gases from the Earth. atmosphere, together with the soil and water particles, constitute background radiation.

5.1.2. APPLICATIONS

As far as applications are concerned, corpuscular radiation is used for research in General Atomic Physics, Medical Physics and Astrophysics, treatments and medical diagnoses such as: electrotherapy, nuclear medicine (such as the betatron that emits beta particles for antineoplastic treatment).), Californium skin cancer treatment and diagnosis by positron emission tomography that adds extra functional and analytical information to the imaging study. l This is why this group includes: alpha radiation, radiation beta, neutrons and cosmic rays. .

5.1.3. HEALTH EFFECTS

It is known that radiation can produce effects at the cellular level, causing death or alteration, usually due to direct damage to the chains of deoxyribonucleic acid (DNA) on a chromosome. When the number of dead or damaged cells is high enough , it could result in organ dysfunction and even death. Other damage can affect DNA without destroying the cell, and is usually completely repaired; but in those cases where such repair does not occur, the resulting alteration known as cell mutation will be reflected in subsequent cell divisions , and could ultimately lead to cancer. If the modified cells are those that transmit hereditary information to the descendants, genetic disorders may arise. Information on biological mechanisms and hereditary effects is commonly obtained from laboratory experiments.

Early health effects are caused by extensive cell damage / death; such as skin burns, hair loss or fertility disorders. These health effects are characterized by a relatively high threshold that must be exceeded in a short period of time for the effect to appear. The severity of the effect increases with increasing dose once the threshold has been exceeded.

Generally, acute doses greater than 50 Gy generate such damage to the central nervous system that death occurs within a few days. Even at doses less than 8 Gy, people have symptoms of radiation sickness, also known as acute irradiation syndrome. This syndrome includes nausea, vomiting, diarrhea, intestinal cramps, salivation, dehydration, fatigue, apathy, languor, sweating, fever, migraine and low blood pressure. The term acute refers to medical problems that occur immediately after exposure, compared to those that develop after a long time. However, victims can survive in the first instance and die from gastrointestinal damage a week or two later. Low doses may not cause intestinal damage but still cause death after a few months, mainly due to bone marrow damage. Even lower doses can delay the onset of the disease and produce less severe symptoms. Approximately half of those who received doses of 2 Gy suffer vomiting after about three hours, but it is unusual for this to occur for doses less than 1 Gy.

5.2. ELECTROMAGNETIC RADIATION

5.2.1. DEFINITION

They are produced by the oscillation or acceleration of an electric charge. Electromagnetic waves have electrical and magnetic components. Electromagnetic radiation can be ordered in a spectrum that ranges from very high frequency waves (small wavelengths) to very low frequencies (high wavelengths). Visible light is only a small part of the electromagnetic spectrum. In decreasing order of frequencies (or increasing wavelengths), the electrom agnetic spectrum is composed of gamma rays, hard and soft X-rays, ultraviolet radiation, visible light, infrared rays, microwaves and radio waves. Gamma rays and hard X-rays have a wavelength between 0.005 and 0.5 nanometers (one nanometer, or nm, is one millionth of a millimeter). Soft X-rays overlap with ultraviolet radiation at wavelengths near 50 nm. The ultraviolet region, in turn, gives way to visible light, which ranges from approximately 400 to 800 nm. Infrared rays or 'heat radiation' (see Heat transfer) overlap with microwave radio frequencies, between 100,000 and 400,000 nm. From this wavelength to about 15,000 m, the spectrum is occupied by the different radio waves; beyond the radio zone, the spectrum enters the low frequencies, whose wavelengths are measured in tens of thousands of kilometers.

5.2.2. APPLICATIONS

In the environment in which we live, there are electrom agn etic fields everywhere, but they are invisible to the human eye. Electric fields are produced by the accumulation of electric charges in certain areas of the atmosphere due to storms. The terrestrial magnetic field causes the orientation of the compass needles in the North-South direction and the birds and fish use it to orient themselves.

In addition to the natural sources, in the electromagnetic spectrum there are also man-generated sources: To diagnose the breakage of a bone by a sports accident, X-rays are used. The electricity that arises from any outlet has associated electromagnetic fields of low frequency In addition, various types of higher frequency radio waves are used to transmit information, either through television antennas, radio stations or mobile phone base stations.

5.2.3. HEALTH EFFECTS

Biological effects are measurable responses to a stimulus or change in the environment. These changes are not necessarily harmful to health. For example, listening to music, reading a book, eating an apple or playing tennis are activities that produce various biological effects. However, we do not expect any of these activities to produce health effects. The organism has complex mechanisms that allow it to adjust to the numerous and varied influences of the environment in which we live. Continuous change is part of our normal life, but, of course, the body does not have adequate mechanisms to compensate for all biological effects. Irreversible changes that force the system for long periods can pose a health hazard.

A detrimental effect on health is that which causes a detectable dysfunction of the health of the exposed persons or their descendants; on the contrary, a biological effect may or may not produce a detrimental effect on health.

It is not questioned that above certain thresholds electrom agnetic fields can trigger biological effects. According to experiments carried out with healthy volunteers, short-term exposure to levels present in the environment or at home does not produce any manifest detrimental effect. Exposure to higher levels, which could be harmful, is limited by national and international guidelines. The controversy that arises today focuses on whether low levels of long-term exposure may or may not cause biological responses and influence people's well-being.

6. NON-IONIZING RADIATION

6.1. ELECTROMAGNETIC FIELDS

6.1.1. DEFINITION

An electromagnetic field is the force field created around an electric current; It is composed of an electric field and a magnetic field.

The electric fields have their origin in voltage differences: the higher the voltage, the stronger the resulting field will be. Magnetic fields have their origin in electric currents: a stronger current results in a stronger field. An electric field exists even if there is no current. When there is current, the magnitude of the magnetic field will change with power consumption, but the strength of the electric field will remain the same.

One of the main magnitudes that characterize an electromagnetic field (EMF) is its frequency, or the corresponding wavelength. The effect on the organism of the different electromagnetic fields varies depending on their frequency.

6.1.2. CLASSIFICATION

They occur both naturally and due to human activity. Natural electromagnetic fields are, for example, the static magnetic field of the earth to which we are continuously exposed, the electric fields caused by electric charges present in the clouds, the static electricity that occurs when two objects rub each other or the electric fields and sudden magnetic resulting from the rays.

Electromagnetic fields of human origin are, for example, generated by extremely low frequency (FEB) sources such as power lines, wiring and appliances, as well as higher frequency sources, such as radio and television waves or, more recently, mobile phones and their antennas.

6.1.3. ELF RADIATION

6.1.3.1. DEFINITION

Electromagnetic fields are a combination of electric (E) and magnetic (H) waves that travel simultaneously, as shown in the following diagram. They propagate at the speed of light, and are characterized by a frequency and a wavelength. The frequency is simply the number of wave oscillations per unit of time, measured in multiples of one hertz (1 Hz = 1 cycle per second), and the wavelength is the distance traveled by the wave in an oscillation (or cycle).

The ELF fields are those of frequencies above 300 Hz. At this very low frequency level, the wavelengths in the air are very long (6000 km at 50 Hz, and 5000 km at 60 Hz) and, in practice, the electric and magnetic fields act independently and are measured separately

6.1.3.2. APPLICATIONS

At frequencies of 50/60 Hz, the electric and magnetic fields of natural origin have very low intensities, of the order of 0.0001 V / m and 0.000001 μT, respectively. The exposure of people to ELF fields comes, for the most part, from the generation, transmission and use of electrical energy. The sources of the ELF fields and the maximum values that they can reach in the population centers, at home and in the workplace are indicated below.

All electrical equipment and cables used in industrial facilities generate electric and magnetic fields. Technicians who maintain the transmission and distribution lines may be exposed to very intense electric and magnetic fields. In the stations and generating substations there may be electric fields greater than 25 kV / m and magnetic fields greater than 2 mT. Welders can be exposed to magnetic fields of up to 130 mT. Near the induction furnaces and electrolytic batteries for industrial use, the magnetic fields can exceed 50 mT. In the offices, workers are exposed to much smaller fields when they use devices such as photocopiers or video monitors.

6.1.3.3. HEALTH EFFECTS

In practice, the only way in which ELF fields can interact with living tissues is to induce electric fields and currents in them. However, at the levels that are common in our environment, the magnitude of these currents is less than the currents that our body spontaneously produces.}

6.1.4. RADIO FREQUENCIES

6.1.4.1. DEFINITION

The term is applied to define a part of the electromagnetic spectrum. Specifically, the part with less energy of this. The transmission of the waves occurs when generating a current through a conductor, and is received with an antenna. The clearest example is that of a radio station and a receiving device, like that of our car The term is applied to define a part of the electromagnetic spectrum. Specifically, the part with less energy of this. The transmission of the waves occurs when generating a current through a conductor, and is received with an antenna. The clearest example is that of a radio station and a receiving device, like that of our car

6.1.4.2. APPLICATIONS

APPLICATION IN COMMUNICATIONS

Normally we refer to radio waves as the means by which radio frequency reaches communication equipment such as walkie talkies and commercial radios. However, these waves cover all the communication devices we have. Like television, GPS system or mobile networks. They are also present in the world of radio amateurs and any other type of element that has a wireless transmitter and receiver.

RADIO FREQUENCY IN MEDICINE

Radio waves have been applied for decades in medical treatments, both incisive and non-invasive. From scalpels that cauterize as they open the body to the popular MRI machine, in medicine there are many devices and techniques that use these emissions.

AESTHETIC TREATMENTS

It is well known for its application in beauty care. In these cases, less intense frequency waves are used than those applied in an operation. Depending on these frequencies, they can be applied to reduce wrinkles, help heal wounds or stimulate the production of certain substances in the body.

RFID RADIO FREQUENCY

We have already talked about RFID tags and their use in various fields. These labels use different electrical frequencies, with which a message can be sent to the receiver. Some of them need food, while others can do without it, depending on their use. The most common example today are supermarket anti-theft tags. When passing through an arc that emits waves, this receiver identifies them and can activate an alarm.

6.1.4.3. HEALTH EFFECTS

As immediate or early side effects can be cited:

- Sensation of heat or discomfort.
- Moderate erythema
- Inflammation.
- Hypersensitivity or dysesthesia to the touch.
- Burns, very rarely.

Some late-type side effects are described as:

- Purple
- Hives
- Headaches
- Fat atrophy

6.1.5. MICROWAVE OVEN

6.1.5.1. DEFINITION

Microwave radiation causes molecular vibrations, producing heat,

hence its domestic and industrial employment, causing burns from a certain amount of radiation absorbed.

The electromagnetic waves are called microwaves; generally between 300 MHz and 30 GHz, 1 which involves an oscillation period of 3 s (3 × 10 9 s) at 33 s (33 × 10 12 s) and a wavelength in the range of 1 m 10 mm Other definitions, for example those of the IEC 60050 and IEEE 100 standards, place their frequency range between 1 GHz and 30 GHz, that is, wavelengths between 30 centimeters to 10 millimeters.

6.1.5.2. APPLICATIONS

One of the best known applications of microwaves is the microwave oven, which uses a magnetron to produce waves at a frequency of approximately 2.45 GHz. These waves make the water molecules vibrate or rotate, which generates heat. Because most foods contain a significant percentage of water, they can be easily cooked in this way.

In telecommunications, microwaves are used in broadcasting, since they easily pass through the atmosphere with less interference than other longer wavelengths. There is also more bandwidth in the microwave spectrum than in the rest of the radio spectrum. Usually, microwaves are used in television news programs to transmit a signal from a remote location to a television station using a specially equipped van. 802.11g and b protocols also use microwaves in the ISM band, although the 802.11a specification uses an ISM band in the 5 GHz range. In the arms industry, prototype weapons have been developed that use microwave technology for momentary incapacitation or permanent of different enemies in a limited radius.

Microwave technology is also used by radars, to detect the range, speed, weather information and other characteristics of remote objects; or in the maser, a device similar to a laser but that works with microwave frequencies.

6.1.5.3. HEALTH EFFECTS

Microwaves are especially dangerous due to the health effects derived from the great heating capacity they possess, as they soften when they affect water molecules that are part of the tissues. Microwaves are especially dangerous due to the health effects derived from the great heating capacity they possess, as they soften when they affect water molecules that are part of the tissues.

The thermal effects affect to a lesser extent the little cardiovascular organs such as the eye and the testis.

Likewise, effects on the nervous system and behavior, the cardiovascular system, hematopoietic, on hearing, genetic and on reproduction have been related.

Non-thermal effects have been much less studied, citing interferences with biological membranes, direct interference with bioelectric phenomena and alterations in the transmi ssion of genetic information.

Absolute priority should be given to collective protection measures against personal protection equipment, with special emphasis on the safe design of the equipment through shielding, enclosures, interlocks

6.2. OPTICAL RADIATION

6.2.1. DEFINITION

Optical radiations are non-ionizing radiation, that is, they do not have enough energy to produce ionization of matter. They are more energetic radiation than those classified as electromagnetic fields but of lower energy than ionizing radiation.

In this group we find infrared radiation, visible light and ultraviolet radiation. All of them can have a natural or artificial origin and are present in virtually all situations where a work activity takes place.

6.2.2. CLASSIFICATION

Ultraviolet radiation is an optical radiation with a wavelength between 100 and 400 nm. The ultraviolet region is divided into UVA (315-400 nm), UVB (280-315 nm) and UVC (100-280 nm). One characteristic to consider in UVC radiation is that when its photons collide with oxygen atoms, ozone is formed.

Visible radiation, or simply "light," is that capable of causing a visual sensation; Its wavelength is between 380 and 780 nm. Infrared radiation is an optical radiation with a wavelength between 780 nm and 1 mm; The infrared region is divided into IRA (780-1400 nm), IRB (1400-3000 nm) and IRC (3000 nm-1mm).

IRA and visible radiation penetrate the skin until it reaches the dermis and even the subcutaneous layer. In long-term exposures (more than 10 seconds), a general increase in body temperature may occur, which could pose a risk of thermal stress.
Regarding the effects on the eyes, chronic exposure to IRB or IRC radiation can cause cataracts.

6.2.3. INFRARED RADIATION

6.2.3.1. DEFINITION

Infrared (IR) radiation is one of the many types of light that make up the electromagnetic spectrum (EM). The wavelengths of infrared radiation are greater than those of visible light, which comprises between 4000 and 7000 Angstroms (or 0.4 and 0.7 microns). Astronomers generally divide the infrared part of the electromagnetic spectrum into three regions: the near infrared (0.7 - 5 microns), the median infrared (5 - 30 microns) and the far infrared (30 - 1000 microns).

6.2.3.2. APPLICATIONS

Particularly, the infrared sensor is an electronic device capable of measuring the infrared electromagnetic radiation of bodies in their field of vision. All bodies reflect a certain amount of radiation that, as I said before, is invisible to our eyes but not to these electronic devices.

For domestic applications, infrared sensors are used in white goods such as microwave ovens, for example, to allow measurement of the temperature distribution inside. These devices are also used in house climate control to detect temperature fluctuations in a room. This approach allows the air conditioning system to react before the room temperature varies. Infrared sensors can also be used as gas sensors.

Infrared is also used to communicate computers with their peripherals at close range. Devices that use this type of communication generally meet a standard published by the "Infrared Data Association".

6.2.3.3. HEALTH EFFECTS

If our thermal receptors feel excess heat in the body they act by

sending an impulse to the brain and this allows us not to burn. The eyes are another defense that allow us to evaluate the intensity of light in the range between 0.78 µm and 0.38 µm.

The wavelength of the infrared-C emitted by Celsius Panel (electric heating panel, infrared sauna, towel warmer), is healthy for the skin, not penetrating deeply leaves our defenses that are in the papillary layer active. With heating panels can not accidentally burn Celsius, being issued only infrared-C 7? m to 11? m.

The transmission and absorption of heat from the source to the consumer can happen in several ways. The human body can be heated by means of a heat carrier (water, air, etc.), or by the irradiation that allows the transport of energy in empty spaces, as in nature it happens with solar irradiation. The sun's rays extend over a wide range of wavelengths, only part of the spectrum reaches us, the other is restrained and attenuated by the atmosphere, like the most damaging ranges of ultraviolet.

6.2.4. VISIBLE LIGHT

6.2.4.1. DEFINITION

Visible light is one of the ways energy moves. Light waves are the result of vibrations of electric and magnetic fields, and that is why they are a form of electromagnetic radiation (EM).

Visible light is just one of many types of EM radiation, and occupies a small range of the entire electromagnetic spectrum . However, we can perceive the light directly with our eyes, and because of its great importance to us, we raise the importance of this small window in the EM ray spectrum.

The light waves have wavelengths between 400 and 700 nanometers (4,000 and 7,000 Å). As the rainbow is filled with nuances, our eyes perceive different lengths of light waves. The red light has relatively long wavelengths, approximately 700 nm (10-9 meters) long. Blue light and purple light have short waves, approximately 400 nm. Shorter waves vibrate at higher frequencies, and have higher energies. The red light has an approximate frequency of 430 terahertz, while the frequency of the blue light is approximately 750 terahertz. Red photons have approximately 1.8 electron-Volt (eV) of energy, while each blue photon transmits approximately 3.1 eV.

6.2.4.2. APPLICATIONS

Emitted by light bulbs, flashlights, flashlights and other devices.

6.2.4.3. HEALTH EFFECTS

In recent decades there have been great advances in the knowledge of the biological effects of ultraviolet radiation, but recent studies have shown that visible light, which we see and contains the rainbow's range of colors, also interacts with the skin and affects to pigmentation.

This is one of the issues that have been analyzed in the first Pierre Fabre Dermatological Forum, held in Paris, with the assistance of nearly 800 specialists in this discipline who discuss the latest advances that have been made to address the diseases that affect the skin.

7. CONCLUSIONS

- It is concluded that all people are exposed to non-ionizing radiation, sometimes you can feel the effects such as temperature rise, induction of electrical current in tissues but on other occasions they will not cause any change in our biological system because it depends on the power of the NIR to which we are exposed.

- There is a natural protection for RNI is hydrogen which is found in water and ma t erials derivatives plastic other natural source is cadmium should be considered that materials such as lead, steel or other non serve as protection for The exhibition.

- The International Telecommunications Union implem ented the maximum radiation levels for both the people who work in the environment and for the population in general, these are currently in force in the SUPERTEL regulations.

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