

Chapter 5

**WAVECEUTICALS:
THE POTENTIAL DOSAGE FORM IN
ALTERNATIVE MEDICINE**

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ABSTRACT

Life in today's modern society has caused a remarkable increase in the exposure of electromagnetic (light) and mechanical (sound) waves to human beings. This issue has primarily been addressed in context of the deleterious effects it can have on life. However, its brighter side is still awaiting appropriate attention from the scientific community. Various traditional healing systems utilize these waves, but there is a lack of suitable scientific evidence or rationales to justify their use. Search of literature also revealed numerous evidence (conventional and quantum level), which supports the therapeutic role of these waves. There has been

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a significant decline in the marketing of new chemical and protein based medicines over the years. This gap could be filled with standardized and metered exposure of aforementioned waves for the treatment of various illnesses. The word “waveceuticals” is coined for this newer dosage form. The present chapter highlights the healing potential of light and sound waves. The objective is to encourage present day researchers to grant appropriate attention to “waveceuticals” in developing new therapeutic strategies.

Keywords: electromagnetic waves, sound waves, therapeutics, dosage form, waveceutical

ELECTROMAGNETIC AND MECHANICAL WAVES

Humans are surrounded by waves of several types and shapes. They are classified on various bases, including their ability to pass or transmit energy through vacuum. This basis classifies waves as electromagnetic and mechanical (Figure 1).

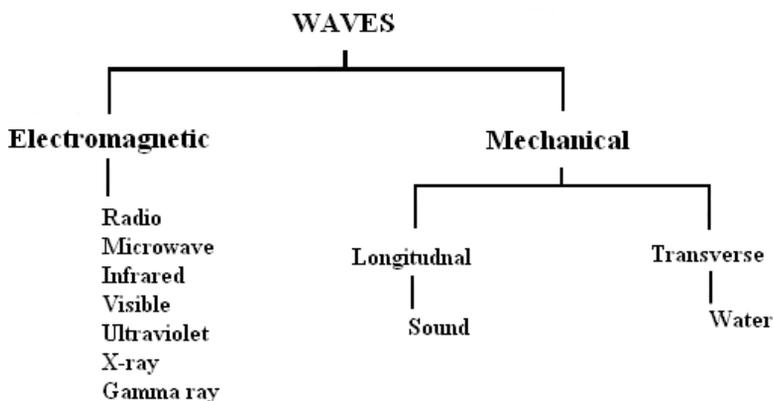


Figure 1. Types of waves.

Electromagnetic waves are produced due to vibration of charge particles and do not require any medium for propagation. Light wave is an example. It behaves both as a wave (reflection, refraction and diffraction) and particle (Photons in quantum mechanics). Electricity and magnetism were

previously considered as separate forces. However, in 1873, James Clerk Maxwell proposed a unified theory of electro-magnetism. This means that both electricity and magnetism exist like hand-in-glove (Figure-2).

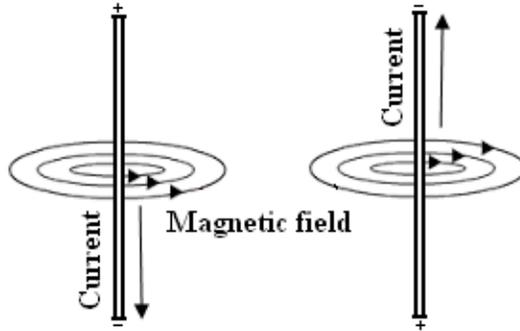


Figure 2. Co-existence of electricity and magnetism.

In contradiction to electromagnetic waves, the mechanical ones require a medium for their propagation. These waves have a physical impact and can be further classified into longitudinal and transverse waves. Sound and water waves are the examples, respectively. Longitudinal waves are composed of compression and rarefaction areas, whereas transverse waves possess crest and trough (Figure-3).

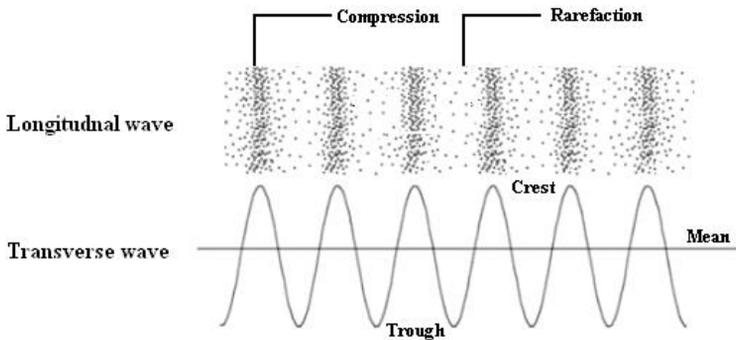


Figure 3. Types of mechanical waves.

Waves are characterized by various means. A wavelength is the distance between two consecutive peaks of a wave. This distance is given in meters

(m) or its fraction. Frequency is the number of waves formed in a given length of time. It is usually measured as the number of wave cycles per second and presented as hertz (Hz). A short wavelength means higher frequency and vice versa. The electromagnetic waves are generally characterized by means of their frequency, wavelength or energy. Based on these properties, the electromagnetic spectrum can be classified as radio waves, microwaves, infrared (IR), visible light, ultraviolet (UV), X-rays and gamma rays. Regarding mechanical waves, humans can hear the sound ranging from 20 - 20 000 Hz. The sounds below 20 Hz and above 20, 0000 Hz are termed as infra and ultra sounds, respectively.

HARMFUL WAVES

Life in today's modern society has caused a remarkable increase in the exposure of electromagnetic and sound waves to human beings. Radars, cell phones, mobile towers, smart watches, wireless headsets, televisions, commercials, advertisement and loud speakers are increasingly being used with the passage of time. Deleterious effects of waves on cell health have been debated extensively (Hossmann and Hermann 2003; Hatori et al. 2017; Lai 1996; Zhi, Wang, and Hu 2017). The strategies to counter these harmful effects is also a focused area of research; for example spin trap compounds (e.g., melatonin) were reported to ameliorate the harmful effects of electromagnetic radiations (Lai and Singh 1997). This has created a general impression among the population that these waves jeopardize the human race. Paracelsus, in his infamous statement in the field of toxicology, described that everything in this world is poison. However, it is actually the dose which determines toxicity of the substances; physical or non-physical. It should be taken into consideration that these waves can offer benefits as well, but only upon appropriate use. The modern day imaging and diagnostic technologies are extensively using these waves (Bushberg 2002). However, their therapeutic role is either yet to be deciphered or under-utilized.

TRADITIONAL USES

The field of therapeutics is as old as the human race itself. Anecdotal evidence reveals that humans have already been using various electromagnetic (light) and mechanical (sound) waves for medicinal purposes. These practices continue to date under the umbrella of complementary and alternative medicine. Above all, chromatherapy has cherished the highest level of appreciation. It is the term used for healing methods involving different colors of light. Historical analysis reveals that the ancient Greek, Egyptian, Chinese and Indians were practicing it with a strong belief that every creature is engulfed in color, which affects its overall well-being (K. S. Azeemi 2010). The Egyptians and Greeks utilized minerals, stones, dyes and shaded sanctuaries of different colors for the treatment of diseases. In the Ayurvedic system of healing, there is a famous and ancient concept of “chakras.” According to this, humans have seven energy centers inside their bodies with specific functions. The concept of “energy” lies central to the traditional systems of healing. During health, all seven chakras provide exactly the right amount of energy to every part of the physical (body) and non-physical (mind and spirit) self of a human. The imbalance in this energy system leads to disease. The light-chakra theory has linked specific color to each chakra. This means that chakras can be modulated with exposure to particular colors of light and hence the balance can be restored (Cherry 2015). Moreover, these chakras can also be specifically stimulated by the sound of specific characteristics (Bair and Bair 2006). Notably, chromatherapy is often used traditionally for the treatment of cancer (K. S. Azeemi 2010). Modern day science also believes that light, especially the visible spectrum (380-780 nm), has a definite impact on our emotions and behaviors. Insufficient exposure of light can lead to seasonal affective disorder and light therapy is recommended (Meesters, Duijzer, and Hommes 2018). Human chemistry, especially cortisol and melatonin, is influenced by light (Boivin and Czeisler 1998). Search of literature revealed a plethora of reports addressing the role of specific wavelength on the levels of the aforementioned hormones. More recently, laser therapy was reported to enhance the plasma testosterone levels in rats without producing any

change in the testis tissue architecture (Ahn, Kim, and Rhee 2013). Hence, laser therapy holds potential to be used as hormone replacement therapy. The impact of color on human behavior is one the core areas of healing. The color red is reported to evoke strong emotions, yellow elicit anxiety, while blue improves performance and green makes people calm. Red versus blue has opposite effects on cardiovascular parameters. The role of color therapy on psychological, biological and behavioral responses of humans, along with its historical evolution has previously been reviewed (O'Connor 2011; S. T. Y. Azeemi and Raza 2005).

Acupuncture is another traditional system of healing. It is based on the principle that “Qi” is the major cosmic force behind existence of life. One should remain in contact with it to stay healthy. The fine needles are applied at various body points to disturb the energetic field and create electrical gradients. This in turn facilitates the conduction of electromagnetic “Qi” through the body and provides healing (Cocilovo 1999). Search of literature revealed that light is able to penetrate deep inside the body (2-30 mm) depending upon the frequency. It is worth noting that the places in the body, where light can penetrate deeply, correspond to the specific acupuncture points. Keeping this in view, the hybrid method i.e., color (light) plus pressure (acupuncture) has emerged and is termed as colorpuncture or choromopressure (und Zeit 1991; Mandel 1986).

Acoustics is yet another area traditionally used for healing purpose. Pythagoras (560-480 BC) is credited with the exploration of harmonic ratios of sound, which govern this universe. He considered this world as a huge “monochord,” between earth and heaven. Based on his study, the theory of musical harmonic ratio was postulated and was hypothesized to exist in basic fundamental laws of all natural sciences (Kayser 1950). Hazrat Inayat Khan (1882-1927) is the founder of the sufi order in the west. He said that “The knower of the mystery of sound knows the mystery of whole universe” (Khan 1996). Rythmic chanting and drumming has been long known to affect human behavior. The Pyramids of Chi (Bali, Indonesia) are one of most remarkable examples of the use of ancient knowledge of sounds for therapeutic purpose. The rhythms, beats and vibrations of the gongs, drums and Didgeridoo, are famous for reducing the beta-waves and increasing the

intensity of theta-waves within the brain, thereby relaxing the subjects. It is a common practice that “Lullaby,” although sound, is used throughout the globe for the induction of sleep in children. In several traditions, one can often find recitation of specific verses from holy books for therapeutic purposes. The healers of alternative medicines are even using the lub-dub sound of heart for various illnesses. Their concepts are based on the fact that the “lub-dub” sound is the very first one, which humans hear in the womb. Hearing this sound again and again creates connection within us, thereby eliciting serenity and peace, which ultimately helps in healing various ailments (Pearson and Perason 1989). Physiologically, the lub sound is louder than the dub sound. The change in intensity order was reported to weaken the heart (Bair and Bair 2006). Sound can pass through water more readily than air. Our bodies are made up of >70% of water, thereby providing a suitable medium for its propagation.

There are several traditional and unique methods of healing such as asking a chicken pox inflicted subject to wear red colored clothes. Magnetic rings and bracelets are also advised in certain conditions. In several cultures, spiritual healers say some words or recite verses from their holy books/scriptures followed by blowing air onto the diseased subject or into the water and make the patient drink it to attain a cure. What makes the ordinary water into curable water is the secret worth investigation (Bair and Bair 2006). The effect of various sound waves and its rhythms on the crystallization pattern of water is yet another fascinating area, which can pave the way towards understanding the aforementioned sound therapy (Emoto 2011).

The pyramids of Egypt also hold tremendous secrets within their geometry. The shape of the pyramids has been reported to act as an antenna, capable of interacting with universal energy. A lot has already been written on the significance of the shape. We would like to briefly highlight a few reports addressing its effect on the biological system. It was reported that their design causes rapid dehydration, which leads to mummification without decomposing the bodies. It is assumed that there is a relationship of the shape of pyramids and the physical, chemical and biological processes going on inside that space (Smith 1998). This shape-energy nexus has been

reported to elicit several beneficial biological actions, as previously reviewed (Gin 2015). Briefly, the pyramid geometry is being reported to retard the growth of cancer (Nahed et al. 2010). Commercial scale pyramids are being used for wound healing, anti-stress, optimization of the immune system and slowing senescence (www.pyramidoflife.com). Modern science now-a-days is addressing the impact of building architecture on the process of healing (Huisman et al. 2012). It appears that, the traditional healers of the Egyptian era were well aware of the field of bio-geometry.

QUANTUM BIOLOGY, HEART AND BRAIN

In order to comprehend the medicinal value of waves, the subject should ideally be dealt with at the quantum level. Albert Einstein and Nikola Tesla are the two greatest physicists who ever lived on the face of the earth. The following remarks of both also suggest that energy (waves) has an impact on our lives beyond what is generally believed. Nikola Tesla once said that “If you want to find the secrets of the universe, think in terms of energy, frequency and vibration.” The infamous law of attraction/vibration describes that everything is energy. All five senses are made of different wavelengths vibrating at different frequencies. Our brain is like a translator with an ability to interpret various frequencies. Our thoughts are non-physical energy. Good thoughts have higher frequency and vice versa. As vibration grows, it becomes stronger and more stable, which enables it to attract more similar frequencies. The more focus given to a particular thought, the more thoughts of similar vibrations (frequency) will join it and therefore more evidence shall be seen by the person or people who support that thought. This is the law of attraction in action. Likewise, if someone thinks that the world is a terrible place; similar news around the world will find that person thereby strengthening the belief. Presumably, the good news about the earth shall annoy that person. Emotions affect our body on a biological level but also beyond our body into the physical world at a quantum level (Atkinson 1906). Einstein once described that if we are the objects with mass “m” and exposed to a very powerful and high intensity electromagnetic field, we will

gradually be transformed from matter into energy. In the form of energy, a superior level of consciousness can be obtained, which can direct the flow of energy and not be restricted by the limited dimensions of space-time. Hence, the boundary of time can be surpassed and one can travel among various time zones i.e., past, present and future. In addition to the fact that we are an energy source that possesses conscious wisdom, we have the capability to transform ourselves back to the physical form. If we change the field of energy around the atom, the characteristic spectral line of the atom changes. In other words, the atom is no more the same; the phenomenon is termed as Zeeman/stark effect (Schuda, Stroud Jr, and Hercher 1974; Herbst and Simon 1978). The aforementioned text is suggestive of the remarkable effect of waves and their fields on the biological systems. The underlying philosophy behind wave therapy is that everything in this universe is energy and vibrating at a specific frequency, which is essential for its well-being and existence. The slower and dense vibration allows the physical existence (matter), while the higher vibration cannot be seen and becomes energy. In biological context, the deviation from this inherited and coherent frequency results in the disease (diseased life energy). Both light and sound have an ability to interfere with the vibration state of substances. Hence, if appropriately used, they can be used to re-attain the normal frequency. Research revealed that there is an electromagnetic glow (aura, kirlian photograph) around each individual and the disease first appears in this aura followed by its penetration into the physical body (Moss 1979; K. S. Azeemi 2010). The application of a high voltage electric field creates the colored halo (aura) of the subject on the photographic plate (Priyadarsini, Thangam, and Gunasekaran 2014; Alipal, Lee, and Farzamnina 2017). All cells of the body are reported to emit light (bio-photon), which are the carrier of information in the living systems (Hyland 1998; Cohen and Popp 1997). Absorption of specific colors or sound may lead to restoration of coherent vibration at molecular level, an area worth investigating in the field of quantum biology.

In the human body, the application of aforesaid principles of quantum biology can be best explained in the heart and brain. They are among the major vital organs, and generators of electromagnetic and mechanical

waves. Applying the knowledge of quantum physics, the Institute of Heart Math has performed remarkable work on bi-directional communication between heart and brain (www.heartmath.org). The very first organ which develops and starts function during embryonic life is the heart. Ancient traditions and spiritual institutions pay special attention to the heart and consider it as the central and most important organ, which controls bodily functions. Modern science, however, restricts its action to the pumping of blood. The work done at the aforementioned institute suggests that magnetism and electric power of the human heart is 5000 times and 100 fold more than the brain, respectively. Hence, it creates a strong energy field which not only engulfs the human but also its environment to a certain extent. This magnetic field of heart has been described to affect the functioning of the brain. The optimum coherence frequency between heart and brain is reported to be 0.10 Hz. This state of organ “coherence” is associated with improved higher level functioning, lower blood pressure and cortisol levels, and an improved immune system function. It is now well accepted that the heart communicates to the brain in four major ways (McCraty et al. 2009): neurologically (through the transmission of nerve impulses), biochemically (via hormones and neurotransmitters), biophysically (through pressure/mechanical waves) and energetically (through electromagnetic field interactions). Coherence among the resonant bodily structures and with the environment is essential for the well-being of an individual (Childre 2010). Moreover, the debate of “brain versus mind” has hit almost every lab working in the area of neuroscience. Many believe that the brain is actually the matter, while the mind is the energy. The aforementioned text implicates the impact of light and sound energy waves on our body; a therapeutically rich area awaiting appropriate attention from the scientific community. However, these concepts can only be comprehended at metaphysical/quantum level or bio-energetic.

MODERN DAY EVIDENCE

Phototherapy for neonatal jaundice is one of the widely used and popular applications of wave therapy in clinical practice now-a-days (Mreihil et al. 2018). Search of literature revealed ample studies exhibiting the therapeutic potential of light and sound waves. These reports are primarily addressing central nervous system disorders, probably because the brain is famous for its electrical property. Some of this evidence is as follows:

Central Nervous System

Alzheimer's disease (AD) is the leading cause of dementia. The electroencephalography (EEG) synchronization was reported to be disturbed and gamma frequency bands (25-140 Hz) were found to be reduced in AD subjects (König et al. 2005). Literature revealed that exposure to flickering light can significantly reduce the amyloid plaque load in the visual cortex of mice engineered for amyloidosis. This decline was attributed to enhanced clearance of plaques by activated microglia. Moreover, 40 Hz acoustics was also shown to reduce amyloid-beta ($A\beta$) load on auditory cortex as well as hippocampus (Iaccarino et al. 2016; Wilson 2018). Moreover, the ultrasound therapy was also reported to clear $A\beta$ and tau protein in AD subjects (Nisbet and Götz 2018). Proteins are important bio-molecules primarily responsible for structure and function of the body. Any alteration in their function can have a dramatic effect on the cellular physiology. Electromagnetic fields are reported to affect the conformation and aggregation of various proteins such as myoglobin (Mancinelli et al. 2004), pepsin (Zhao and Yang 2009), citrate synthase (D. F. George, Bilek, and McKenzie 2008), albumin and insulin (de Pomerai et al. 2003). Even the spin of one protein can induce complimentary motion on the nearby protein falling within the field of its energy (Oschman 2015). The structural orientation of the biomolecules was reported to be extremely sensitive to the electromagnetic field (Laurence et al. 2000). Hence, these waves can be useful for the neurological disorder attributed to protein mis-folding and aggregation. Literature revealed that

delta waves reduce with age (Ehlers and Kupfer 1989). The pink noise (sounds like waterfall) was reported to elicit delta oscillations and its application during sleep was shown to enhance the memory performance in older human subjects (Papalambros et al. 2017). Cognition is also affected in brain trauma. A study revealed that the scalp application of red and near-infrared (NIR) light-emitting diodes (LED) could improve cognition in patients with chronic, mild traumatic brain injury (mTBI). Application of red/NIR light improved mitochondrial function (especially in hypoxic/compromised cells) and promoted adenosine triphosphate (ATP) important for cellular metabolism. Nitric oxide was released locally thereby increasing regional cerebral blood flow. Participants reported improved sleep, and fewer post-traumatic stress disorder (PTSD) symptoms and better ability to perform social, interpersonal, and occupational functions (Naeser et al. 2014). Literature revealed that the neuropsychological testing after 9 months of trans-cranial LED caused significant improvement (+1, +2SD) in executive function and memory, as well as reduction in post-traumatic stress disorder. Cognition improved following treatment with red and near-infrared light-emitting diodes (LEDs), applied transcranially to forehead and scalp areas (Naeser et al. 2011). Hence, both light and sound waves are endowed with the potential to heal cognitive impairments.

Depression is a prevailing psychiatric disorder. Transcranial magnetic stimulation (M. S. George et al. 1995), deep brain stimulation (Mayberg et al. 2005) and electroconvulsive therapy (Avery and Winokur 1977) are examples of some well-established methods, whereby waves are used for the treatment of depression. Moreover, far infrared ray therapy was reported to be useful for mildly depressed patients with appetite loss and subjective complaints. The plasma ghrelin and caloric intake was also significantly improved (Masuda et al. 2005). Another study concluded that near-Infrared photo-biomodulation therapy can be useful for the treatment of depression and other psychiatric disorders (Schiffer et al. 2009). Transcranial near-infrared radiation (NIR) was considered as an innovative treatment for major depressive disorder (MDD), but clinical evidence for its efficacy is limited (Cassano et al. 2015). Studies on regulation of circadian rhythm revealed that the retinal photoreceptors involved are stimulated by a narrow band of

wavelength i.e., 450 nm (blue color). This has introduced a newer concept of “virtual darkness” by selectively blocking this wavelength by using specific glasses. This method have paved the way for the development of strategies for the management of bipolar disorder and insomnia (Phelps 2008). The blue blocking color glasses were reported to be beneficial to regulation of mood in maniac patients (Henriksen et al. 2016). Presumably, the blue light therapy was shown to have a beneficial effect on depressed subjects (Esaki et al. 2017), both seasonally affected (Gagné et al. 2011) and elderly (Lieverse et al. 2011). Blue light increased vigilance and caused insomnia via altering melatonin levels (Chellappa et al. 2013; Shechter et al. 2018). Keeping aforementioned outcomes in view, the blue color glasses could come in handy for the treatment of narcolepsy.

Cerebral blood perfusion is affected in the case of traumatic brain injuries. The near infrared irradiation was reported to increase regional blood flow in mice via nitric oxide dependent mechanisms, furthermore, exhibiting neuroprotection (reduced apoptosis) in an animal model of transient cerebral ischemia (Uozumi et al. 2010). In human subjects with severe head injury, the transcranial LED was reported to increase regional cerebral blood flow with improvement of neurological condition (Nawashiro et al. 2012).

Parkinson disease (PD) is a neurodegenerative disorder characterized mainly by motor deficits. The beta frequency band of EEG was reported to be decreased in PD subjects, which was normalized after L-dopa administration (Melgari et al. 2014). Similarly the effectiveness of transcranial magnetic stimulation (TMS) in PD was also linked with generations of beta waves (Van Der Werf et al. 2006).

Schizophrenia is a mental disorder characterized by audio-visual hallucinations. Repetitive transcranial magnetic stimulation (rTMS) was shown to be beneficial in treatment resistant auditory hallucinations in schizophrenic patients. This effect was linked to decreased metabolism in the cortex (Horacek et al. 2007).

Anxiety is the un-proportional response of the body against threatening stimuli. Search of literature revealed that the sound of heartbeat has the ability to trigger the panic attacks in anxiety sensitive subjects. On the contrary, the normal subjects did not perceive this sound as a fear-related

cue (Pollock et al. 2006). Hence, the science of acoustic can be useful in devising therapeutic strategy for the management of anxiety.

Inflammation and Oxidative Stress

Therapeutic ultrasound is also becoming mainstay for the treatment of soft tissue injury, bone fractures and osteoarthritis. Ultrasound therapy was reported to improve the function, pain and psychological status of bilateral knee osteoarthritis patients thereby improving the conduct of daily activities (Yildirim et al. 2014). Moreover, ultrasound (low intensity) therapy was reported to reduce pain and inflammation in arthritic joints (Chung, Min, and Baik 2016). The electromagnetic fields were also reported to increase the rate of fracture healing/fusion in both long bones and spine (Ryaby 1998; Oishi and Onesti 2000). Pulse electromagnetic fields were also reported to be beneficial in osteoporosis via relieving pain and increasing bone mineral density (Huang et al. 2008). Moreover, extensive electrical stimulation was reported to reduce the femoral bone mineral density loss following acute spinal cord injury via maintaining the osteocalcin levels (Groah et al. 2010). Laser light therapy has been shown to decrease healing time of wounds and ulcers, decrease edema, and facilitate bone re-mineralization (Breiling 1995). In diabetic rats, the wound healing was reported to be enhanced by exposure to low level laser therapy (LLLT) (Dancáková et al. 2014). There has been a lot of literature regarding oxidative stress and abnormalities in these various waves, however, their one form i.e., low intensity ultrasound was shown to offer protection against oxidative damage in retinal pigmental epithelial cells (N.K. Kim et al. 2015). This further highlights that the harmful effects of these waves should not be generalized. Moreover, the static magnetic fields have been reported to ameliorate edema in rats (Morris and Skalak 2008).

Cancer

Earlier studies revealed that the static magnetic fields (SMFs) possess potential against cancer. However, this action is dependent upon the direction of magnetic fields. For adhered cancer cells (lung, colon and breast) and tumors in nude mice, the upward SMFs were found to reduce the cell viability. However, the downward SMFs failed to cause such an effect. The suspended leukemia cells were shown to be affected by both upward and downward SMFs. Although, the rational and mechanistic insight is missing but this differential effect is worth further investigations (Tian et al. 2018). Furthermore, the static magnetic field (using NMR) promotes apoptosis in tumor cells. Hence, it can be used as adjunct in chemotherapy (Ghibelli et al. 2006). On the contrary, these fields were reported to enhance cell survival by inhibiting the apoptosis (Fanelli et al. 1999). This is suggestive of the differential effect of magnetic fields on apoptosis. The sound was also reported to have an anticancer effect and around 30-40 decibel sound was reported to disintegrate HeLa cells, while the healthy ones remained unaffected (Maman 1997).

Ion Channels Modulation and Analgesia

Electromagnetic exposure can cause the alteration of charge distribution on the membranes. This can have a significant impact on the functioning of ion-channels. Search of literature revealed that the firing rate of sensory neurons (dorsal root ganglion) can be modified specifically by field exposure of 50/60 Hz via modulating calcium currents (Marchionni et al. 2006). This has an implication for the analgesic-like action of these waves. Moreover, extremely low frequency (50 Hz) electromagnetic waves were shown to affect the dynamics of calcium in cultured entorhinal cortex neurons without effecting the calcium channel (Luo et al. 2014). The LLLT also possess analgesic action (Cotler et al. 2015). Search of literature also revealed the therapeutic potential of color therapy for pain. In this regard, green color light exposure (LED) was reported to produce anti-nociceptive

effect in rats with neuropathic pain. The effect appeared to be mediated via calcium signaling (Ibrahim et al. 2017).

Cell Differentiation

Static magnetic field was reported to enhance the rate of cardiomyocyte differentiation of embryonic stem cells via calcium and reactive oxygen species (ROS) dependent pathways (Bekhite et al. 2013). Hence, there is no need of chemical or genetic manipulation. Moreover, low intensity magnetic field was reported to differentiate rat chromaffin cells to neuron-like morphology. This effect was also attributed to alteration in calcium kinetics (Morgado-Valle et al. 1998). Under similar conditions, the corticotrope-derived AtT20 D16V cells undergo differentiation into neuro-secretory-like cells (Lisi et al. 2006). It is worth mentioning that the important phenomenon of neurogenesis was also reported to be enhanced by these magnetic fields (Piacentini et al. 2008). Moreover, biphasic electric stimulation was reported to enhance the differentiation of human mesenchymal stromal cells into osteoblast, the outcome useful in bone tissue engineering (I. S. Kim et al. 2009). The electromagnetic field also affects the differentiation of osteoblasts, which can be useful in bone repair (Ryaby 1998). Search of literature revealed that the magnetic fields increase the expression of voltage gated calcium ion channels, which primarily underlies the differentiation related outcomes in cells (Grassi et al. 2004). and the blockade of calcium channels was assumed to stop the effect of these fields on cells (Gmitrov and Ohkubo 2002). One way to trigger cell division is external application of electromagnetism to the affected body part (Kitchen, Bazin, and Bellis 2002).

Obesity and Cosmetics

The ultrasound shear wave therapy combined with radiofrequency was reported to selectively and progressively deform and disrupt adipose tissues

without affecting the neighboring cells (epidermis and dermis) (Maruyama; Kapoor, Shome, and Ranjan 2017). Infra orbital laxity (IFUS) is a common problem that increases with age. Intense focused ultrasound can be used as a non-invasive, skin-tightening procedure for infra orbital laxity. No serious, permanent, or delayed side effects were noted up to 6 month post treatment. Thus, this procedure can be effective and safe in the treatment of decreased laxity of the lower eyelids (Suh et al. 2012).

Drug Delivery and Membrane Permeability

Enhancing safety and efficacy of drug delivery to the target site is one of the most important challenges in therapeutics these days. Among various types of waves, ultrasound was mainly reported to affect the permeability of plasma membrane. This action can be manipulated to increase the delivery of drug to target area/cells. In this regard, the toxicity of curcumin on breast cancer cells was reported to be enhanced by ultrasound exposure via increasing plasma membrane permeability (Li et al. 2016). Moreover, the cellular uptake of chitosano tri-polyphosphate nano-particles was significantly increased by ultrasound in murine pre-osteoblast cells (Wu et al. 2014). It is worth mentioning that focused ultrasound enabled the delivery of genes to specific regions of the brain via altering local blood brain barrier (BBB) permeability (Lin et al. 2016). Hence, the ultrasound has also shown its potential as a valuable aid in gene therapy. Furthermore, low intensity ultrasonic acoustic was shown to enhance the efficacy of epigenetic modulators (sodium butyrate and short chain fatty acids) by increasing their penetration into human dermal fibroblasts (Maeshige et al. 2017; Maeshige et al. 2015). Vaccines play an important role in the prevention of disease and the demand is continuously rising. Literature revealed that vaccine production can also be increased by ultrasound waves. This action has been attributed to increased movement of nutrients and waste due to an increase in cell permeability (Xing et al. 2017). Hence it is evident from aforementioned experiments that permeability alteration ability of low intensity ultrasounds can be useful in targeted drug delivery systems and

vaccine production. However, most of the work is performed on cell lines, which needs to be validated in vivo.

CONCLUSION

An increasing body of evidence suggests that conventional science is catching up with lots of traditional healing practices revolving around electromagnetism and acoustics. Although elementary, the proof of concepts and principles of these historical methods can now be provided. The lack of mechanistic interpretation of these effects in literature is primarily due to lack of attention towards bioenergetics. Conventional science has always probed for the physical means of interaction within the biological systems. It is high time to direct our studies for identification of antennas in our own selves capable of receiving, interpreting and propagating electromagnetic and mechanical signals. For instance, magnetoception (magnetoreceptors) has been reported to be present in many animals, except humans, for decades. They mainly use it for orientation and navigation purpose (Fitak et al. 2018). It is worth mentioning that magnetic sense is emerging as the sixth sense in humans (Baker 1980). A protein in the human eye (cryptochrome) is assumed to act as a magnetic sensor (Foley, Geger, and Reppert 2011). Lack of evidence does not mean the lack of presence. It may be the lack of technological advancement rendering us to reach concrete evidence. The microelectromechanical devices and the cantilever technology used in atomic force microscopy (AFM) can be useful in conducting research in this area. Till that time, the metaphysical perspective can keep us on the path to explore the healing potential of waves. The underlying philosophy is that we are made up of different energy levels i.e., physical, mental, emotional and spiritual. Each of these levels has a specific vibrational frequency, which combines to create the overall vibration of human beings. Not only humans, everything in this universe is vibrating at a particular frequency too. There is coherence within our own selves and with the outside world. Any harm to this internal or external coherence jeopardizes life and its habitat. Resonance phenomena occur with all types of vibrations including light and sound

waves. The effect of incoming electromagnetic and mechanical waves on the resonance status of cells, its organelles and bio-molecules should be the target area under investigation. The objective is to see whether the incomings are causing us to resonate at healthy frequency or otherwise.

Literature suggests that both light and sound waves are interrelated. The sound was reported to have electromagnetic components as well. Hence, the aforementioned effects of sound can probably be due to their electromagnetic component, not the sound itself (Reid 2006). Keeping in mind the primary sensors of light and sound waves, the emphasis should be given to visual and auditory cortex followed by investigating the non-visual and non-auditory effects. Moreover, the penetration of these waves into the body needs to be thoroughly investigated in order to know the depth of effect. Literature revealed the extensive role of intracellular calcium on the effect of low frequency magnetic field. Therefore, calcium dependent signal transduction mechanisms may provide mechanistic insight. These waves are known for their thermal effect. It should also be considered while undertaking studies in this area.

Literature revealed that light and sound waves of diverse characteristics were used for healing purpose. The terminologies like “frequency,” “power,” “energy,” “duration,” “static” and “pulse” were used throughout the methodologies. We have deliberately not mentioned these details of the waves in order to avoid complexity in the very beginning. However, this information is equivalent to “dose” and “dosage form” of conventional medicines. Hence, it needs to be validated against particular diseases and populations under study.

Finally, humans have trillions of cells, acting as capacitor, transistor and resistor. They store and release energy. Each cell of the body resonates at specific frequency. Hence, it can influence and be influenced by vibration energy waves. Ample evidence has been accumulated to exhibit the therapeutic potential of electromagnetic and mechanical waves, which should be studied not only at traditional and conventional but quantum level too. It is high time that the drug developers begin to consider modulation of bio-energy as possible pharmacological targets. It is high time to understand our physiology and pathology at quantum level. Current statistics revealed

that there has been a significant decline in introduction of new chemical and protein based medicines. Wave therapy has the potential to fill in this gap, if granted appropriate attention by drug developers. The way forward is to connect the healing wisdom of old with modern science at the interface of quantum biology. We believe that the results would be greater than the ancient traditions and present day science all by itself. One significant and remarkable outcome could be “waveceuticals.”

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