

BIOPHYSICS BASED TECHNOLOGY USEFUL IN THE CARE OF DISESES AND INJURIES: THE COMING CENTURY OF MEDICINE

This is very practical technology based on biophysical characteristics of health and disease and injury. These modalities include photonic, targeted pulse EMF, electrolyzed ionized strong hydrogen water, and hyperbaric oxygen therapy) that improves tissue oxygenation, decreases inflammation, edema and pain, and supports healing which is available to all that costs very little compared to conventional medicine therapies and in some cases has better outcome

Dennis T. (Tim) Crowe, Jr., DVM, DACVS - Emeritus, Charter DACVECC, FCCM,

Mobile Veterinary Surgery of Georgia, Bogart, GA 30622

www.MobileVetSurgeryGA.com; MobileVetSurgeryGA@gmail.com

cell 706-296-702 24/7 for emergencies

Director - Trauma and Acute Care Surgery and

Co-Director Critical Care and Hyperbaric Medicine

Regional Institute for Veterinary Emergencies and Referrals, Chattanooga, TN

tcrowedvm@gmail.com

Objectives:

- To review the mechanisms of action of photonic therapy and provide case examples of where it was used.
- To review the mechanisms of action of targeted pulsed electromagnetic field therapy and case examples of where it was used.
- To review the mechanisms of action of electrolyzed ionized reduced water and how its made and why it should be used in both disease treatment and in disease prevention
- To review the mechanisms of action of hyperbaric oxygen therapy and case examples of where it was used

Abstract:

Since Fritz Popp PhD and Carlo Rubia PhD from 1974-84 showed that the live body (both animal and human) is made up more of light than solid matter by nearly a billion to one, the medical applications of bio photon and biophysics based technology have been expanding in the medical care of both people and animals. Also the use of hyperbaric oxygen therapy, which has been shown to stimulate the production and release of active progenitor stem cells from the bone marrow, and modulate

inflammatory cytokines and matrix metalloproteinase, has been found to be a very important adjunctive and even primary therapy in a multitude of disorders. This session, we provide an overview of these modalities (often acting in concert and used together) and act as catalyst for their application in general as well as specialty veterinary practice.

Photonic, tPEMF, electrolyzed ionized strong hydrogen water, and Hyperbaric Oxygen Therapy in both general and specialty practice that improve blood flow, oxygenation, and decrease inflammation, edema and pain.

Objective Statement:

-To review common pathophysiology behind acute and chronic diseases and provide an overview as to why technology that increases tissue oxygenation and decreases inflammation, edema and pain will be supportive in all these conditions

-To present a the modalities of photonic therapy, electrolyzed ionized strong hydrogen water, tPEMF therapy and hyperbaric oxygen therapy

-To provide case examples of where these modalities have been used in clinical practice

Introduction to the basics of biophysics in medicine

The concepts and applications of biophysics in medicine and some of the practical equipment and therapies that are based on these concepts and used in the treatment of veterinary patients, are provided in this two part presentation. The objectives are the following:

1. To provide understand on how various types of therapy, often regarded as alternative or complementary, (designated CMT or complementary medical therapy) provide their effects on cells, tissues and organisms (patients). These include targeted pulse electromagnetic field (tPEMF) therapy, low-level-laser therapy, photonic therapy, pulse electromagnetic therapy (PST), acupuncture and acupressure, biomagnetic resonance therapy, and other biofeedback modalities.
2. Discuss, in detail, the modality of tPEMF that “signals” living cells to generate biochemical up-regulation of various enzyme systems leading to profound decreases in pain and edema and the facilitation of wound healing even in the face of infection which has recently been approved for use in humans for pain and edema by the Food and Drug Administration.
3. To provide clinical proof of the effectiveness tPEMF and if time permits that also of other CMT modalities including the most complex, that of biomagnetic resonance or BICOM therapy, which involves biofeedback mechanisms associated with specific electromagnetic frequencies.

Introduction

Other than early and aggressive nutritional support for the seriously ill or injured surgical or medical patient the next important and greatest advance I personally have seen in the daily care of emergency or critical patients in the last 20 years has been what I have been able to accomplish with the use of medical care that is based in integrating biophysics with biochemistry.

We owe much of our progress in biology and medicine to the achievements in biochemistry and the biochemical pathways, molecular cellular mechanics, genetics as well as trauma surgery. However even with all this knowledge and skill we have reached a boundary of limitations in terms of treating injuries and illnesses that have been very difficult to overcome. (List of supposedly incurable diseases and irreversible injuries.) Well the good news that with advances in biological quantum physics, and superconductivity we will have the ability to go beyond these boundaries of conventional medicine.

Not only will we be able to diagnose disease and injury faster with much more accuracy and detail we will be able to treat that illness or injury faster and more effectively by integrating directly with the living body's cellular functions with electronic, sonic, photonic, magnetic, and electromagnetic devices including those with built in computer and signal filtering and processing ability. Remember this is because all the organs, cells, and constituent molecular parts have electronic, sonic, photonic, magnetic, and electromagnetic properties without which the body with all its biochemistry would not function or coordinate at all.

This marriage of the disciplines of the sciences will give us an unprecedented ability to treat injuries and illness thought to be untreatable and un-curable. This paradigm shift will also allow us go beyond the limits of specialization to diagnose and treat patients in a way that is customized to a particular individual. In other words set we now realize that individuals with specific illness may have other underlying layered conditions that are specific to that individual that may include genetic disposition, virus, allergen, toxin, bacteria, fungi, prior injury, dietary imbalance, geopathic radiation, and lets not forget possible emotional stress.

All of the parts of the body and its conditions are interconnected biophysically and biochemically. This means we must diagnose and treat the living body this way, and with the biophysics technology before us we can accomplish this incredible feat with

astonishing accuracy and detail. And here's the kicker folks, with this biophysics technology we will even have the potential to correct DNA in damaged tissue across the entire body.

1. I realize this is a very strong statement and must be substantiated by scientific proof. Therefore the goal of this presentation is to present that proof. This done in three ways:

1. Providing a brief explanation of how these biophysics based methodologies work in a general way and then in a specific way for each modality;

2. Providing a brief summary of several scientific studies that prove the effectiveness of some of these modalities; 3. Providing clinical examples that I and the colleagues I work have witnessed. I use biophysics based modalities in the majority of all the patients that I care now, along with standard contemporary care as indicated and continue to be amazed with the improved clinical responses observed.

Fundamental Mechanisms involving Biophysics

In biology all chemical reactions and pathways are activated and regulated by biophysical signals. These signals can be in the form of mechanical vibrations, electromagnetic waves, light, sound, heat, pressure and piezoelectric stimulation as in the case of bone growth stimulators. To put this in perspective, all living mammals use frequency and amplitude modulation over a vast range from below 2 Hz to above 10^{17} Hz in 5 directional modes to activate enzymes and regulate biochemistry. Paired electron energy transfer is a dominate aspect of energy exchange and regulation.

Even DNA transcription, protein folding, the making of ATP in the mitochondria, and the generation of electrophysiological propagations such as those involving nerve conduction are associated with paired electron transfer. This is completely different than the properties of conventional electrons moving inside of a copper wire. In this situation the electrons are single. They have random spin which produces noise, friction, heat, and resistance. Whereas electrons in living tissue *always* travel in pairs with zero net spin, which results in very little noise, resistance or heat loss. When in this state these electrons travel both as particles and as waves. The particle aspect of these occurs locally across membranes whereas the wave aspect includes both local and global communications. The bodies electron pairs are extremely sensitive to magnetic flux i.e., 10^{-33} gauss.

Everything that occurs in biochemistry *in vivo* is controlled by a signal in living tissue but when outside a living tissue, such as in a beaker, this signaling is non-existent. The speed of these reactions in living cells is extremely fast (a million per second per metabolically active average cell) compared to similar biochemical reactions taking place in the beaker. There has been no artificial laboratory environment that has been able to duplicate this speed. The activation signals of these reactions are transferred through

the body's pair electrons. Electrons in this paired state can transfer vibration energy and information to coordinate all *in vivo* chemical reactions. Hence, we now have a basis for understanding such therapies as laser, pulse-signal, acupuncture, photonic, and other "signal therapies". Modulating repair mechanisms using "electroceuticals" rather than "pharmaceuticals" leads to a new paradigm in medicine: Vibrational signals, i.e, sound, heat, light, radio waves, electrical current, and magnetic induction, have a controlling influence over all biochemical reactions and pathways in living organisms. In other words biophysics is superordinate to biochemistry. There are many scientific examples that prove this fact. When the cell dies the paired electrons decouple and no further biochemical – e2 activation processed changes can occur. When the entire organism dies the phonic emission coming from the quantum changes that otherwise are occurring the paired electron high spin states ceases. Scientific studies have proven that the normal energy states of the organism deteriorate rapidly, within minutes when death occurs and this begins within the central nervous system and propagates over a finite period of time; generally complete within minutes to hours depending on the tissues oxygen requirements.

In biology it *was* convention to believe that energy patterns such as light and heat were a byproduct of biochemical and physical processes such as exercise. Now it is understood that the *paired electron emission of quantum waves are the energy transference medium that provides the subcellular, intracellular and global signaling needed to orchestrate ALL biochemical pathways and molecular changes that occur in each cell, tissue and individual animal (estimated to be 1 million per active living cell per second).*

The paired electron quantum waves and solitons are superordinate to and control every biochemical process in each living organism. These signals are resonate and have a specific EM frequency, amplitude, shape, and other characteristics that make them unique and specific for each molecular orchestration that they are involved with (termed a Soliton Wave Packet) .

Every biochemical reaction has an accompanied soliton wave packet of a specific frequency pattern without which the reactions would not take place. Biochemical reactions even in the presence of chemical enzymes are too slow to account for bio processes. Activation -deactivation signals in the form of soliton wavlets must be present to coordinate information bearing energy patterns into energy patterns that perform useful biological work. An important property of solitons is that they maintain wave-shape integrity in the presence of the natural chaotic forces of nonlinearity and dispersion. Some of the devices used in clinical medicine that we will be discussing further later, such as the targeted electromagnetic field therapy units (IVIVI loops) electro-magnetically induce a deep low frequency paired electron pulse pattern that is associated with cell regeneration much like how the body uses deep rem sleep frequency patterns to heal and regenerate. In the case of tumors, the flow of paired electrons has the ability to "denature" damaged DNA and use signals from the

surrounding healthy cells to correct the damaged DNA. Up to this point the paradigm in cancer treatment was to "kill" the cancer. In this new paradigm the process corrects the dissonant cells.

A similar device is currently used in the space program to prevent space sickness. These are Schuman wave generators. They provide quasi-standing waves that are specific and replicate the earth's electromagnetic cavity (the space between the earth's surface and the ionosphere. Like waves on a guitar string there are not present all the time but have to be "excited" to be observed. They are not caused by anything internal to the earth, its crust or core, but seem to be related to the electrical activity in the atmosphere. They occur at specific frequencies (7.83, 14, 20,26, 33, 39 and 45 Hertz (cycles per second) with a daily variation of approximately +/- 0.5 Hertz. The resonate properties of these waves were predicted and ascribed by W. O Schumann in the 1950's. These resonant properties of the Schumann waves act as "background" frequencies that influence many biological oscillators and have been found to be important in health.

As an example, without these waves being generated in the space stations astronauts develop space sickness (a complex array of symptoms and signs including nausea, anemia, bone loss, general weakness and depression) . In 1974 Schumman wave generators were added into the NASA pace program shuttles and space stations with a great reduction in this phenomena. Laboratory research has shown that exposing living cells to the Schumann resonance waves of had the effect of "protecting" them from ambient EMFs, allowing the cells to increase their immune protection, and decrease the absorption of depression-inducing chemicals.

Some researchers believe that by producing a 7.83 Hz pulse with a field generator (Schumann device) placed in the area where organisms live, even just here on earth, can counter the effects of the EM fields. Recent research on injured white rabbits in New Zealand revealed that when exposed to alternating electromagnetic field for 12 hours per day (72 Hertz, 380 usec duration, 2 gauss, 1.4 mV/cm bone) the rabbits showed an increase in the rate of revascularization and bone remodeling of the femoral head. The study found that "in both the descriptive and quantitative analysis, an increase in vascular associated with the PEMF exposure occurred in the early stages of circulatory recovery. This is just one of many studies that have been completed with PEMF. This type of induced soliton (paired electron) current will also removed harmful physical and chemical blocks and strengthen the EM energy forces within the entire body and all tissues. The EM energy forces in this case are defined as soliton pulses that can take the form of a sound pulses, a light pulses, a heat pulses, electric pulses, magnetic pulses, or pressure wave pulses. In most cases paired electron waves are involved in this transference. This induced soliton activity is a type of superconductivity-superfluidity that allows for increased ability to uptake nutrients, expel toxins, uptake hormones,

neurotransmitters, even the ability to transcribe DNA then create and transport folded proteins along appropriate pathways.

Although general paired electron flow and bio-soliton regulatory activity is improved by electroceutical devices such as the IVIVI tPEMF loop, low-level laser units (ranging from uv and infrared), and ultrasound, more specific focused modulation of repair mechanisms requires a device that has biofeedback capability that incorporates the patient's own individual signals into the therapy. In the case of a patient having a condition that involves multiple layers of chemical stressors it is critical to have a means for separating harmonic and disharmonic patterns from the patient and inverting these disharmonic patterns. The patient's electromagnetic, heat, and vibrational signals are modulated onto appropriate wave channels like music through a radio station. This way multiple blocks and toxins can be cleared that are specific to the individual. In the near future we will use this paradigm not just to identify genomic damage and treat the symptoms with some expensive brute force drug, but to correct the DNA.

In fact we will have the ability to adjust and correct any biochemical-biophysical process using the tools of quantum physics. This has begun to emerge with some therapies.. Currently Dr. Hilty Burr, a practitioner in Young Harris, GA as a patient, a 13 year old Cocker Spaniel that provides preliminary proof that this cancer resolution capability, using EM frequency modulation, is possible. A fibrosarcoma was diagnosed and surgically removed at three different times. Then with the tumor's reappearance after the third surgery, treatment was begun with an IVIVI loop (tPEMF). Following treatment with the tPEMF twice each day for 30 days the tumor began visibly regressing.. Within the second month of therapy the tumor was no longer visible. A complete description of tPEMF is next provided below:

Targeted Pulse Electromagnetic Field (tPEMF) Therapy

In this part of the presentation we will discuss our experience with a relatively new device commercially available for veterinary medical use that involves targeted Pulsed Electromagnetic Field Therapy or tPEMF. The device "SofPulse", manufactured by IVIVI Health Sciences and sold by Assisi Animal Health (www.ivivihealthsciences.com and www.assisi-loop.com) received FDA approval in 2008 for use in the management of acute pain and edema in humans. Its technology arose initially from the work done by Bassett, Pawluk, and Pilla who developed a magnetic induction coil, that when placed over fractures strongly influenced the local paired electrons and generated micro-current that induced osteoid production.

The SofPulse" which involves a 7.5" loop of copper wire connected to an electrical pulse generator, battery, switch and timer all encased in a firm rubber protective cover. (Figure 1) The micro-electrical signal (27.12 MHz carrier frequency delivered in 2millisecond

bursts, twice a second (2Hz), with an amplitude of 0.05 Gauss), is only 1/1,000 the strength of a typical cellular telephone. This very small field strength is provided to the tissues under the influence of the loop for also a very small period of time (approximately 6 seconds of actual tPEMF in a 15 minute treatment time). The tissues that are affected are either within the loop or are within 5 inches of the loops edge like a cylinder extending above and below where the loop is laid. The induced electrical micro-current in the tissues within the EMF cylinder is configured a priori to accelerate the binding of Ca cation to calmodulin. This complex, in turn, binds to the constitutive nitric oxide synthetase (endothelial and neuronal) and accelerates the production of the anti-inflammatory cascade through nitric oxide. The increased production of nitric oxide causes vasodilation and increased blood flow and tissue oxygenation physiologically and also accelerates production of the downstream constituents of the anti-inflammatory cascade leading to a reduction in pain and edema. There is also increased cGMP production and then growth factor production (FGF-2, TGF-b, and others). The physiological effects include increased angiogenesis, tissue regeneration and ultimately tissue remodeling. .

In addition to the effects on the anti-inflammatory pathway, other calcium/calmodulin dependent pathways, when up-regulated by the EMF, may be accelerated. In the neurological arena, calmodulin dependent protein kinase II (CaM PKII) is a candidate. This system is well-known for the effects on pain, but more prominently, the regulation of memory and, through serotonin, mood. This is beyond the scope of this paper other than to mention that it is also possible that improvement in patient calmness that has been seen with the use of the loop (in both cats and dogs) might be explained by this increase in central serotonin levels.

The “loop”, as we will call it in this report, is typically applied in the following way:

1. Activating the pulse electromagnetic pulse generator by pushing on the “internal switch”, easily recognized by noting the switch symbol on the surface of the round 3 inch disc of the “SofPulse. and then noting that the two small green diode lights are flashing, indicating the unit is working and sending out the electromagnetic (EM) pulse. The EM pulse generated goes through the center of the loop and extends approximately 5 inches on either side of the loop. The electromagnetic field generated is approximately 2/3 the diameter of the loop so if the shape of the loop is changed, the depth of field and hence tissue penetration is also changed. Because the entire system is portable it is important to conserve the battery use as much as possible. Therefore it is recommended NOT to turn the unit until absolutely ready to be used and immediately after the application time of 10-20 minutes is reached the unit should be turned off. With this careful attention to battery life the unit will generally provide 80-110 uses averaging 15 minutes.

2. The loop is then laid on the patient where the clinical problem is located. The loop is maintained within a few centimeters of the surface of the tissues to ensure good tissue

depth penetration of the EM waves generated . It can also be applied directly to the skin or wound (preferred to be covered with a sterile plastic sheet if an open wound is present). An affected part of the body can also be placed within the loop such as an appendage or neck. No appreciable heat is generated when the loop is on the skin and the pulse signal is being generated.

After 10-20 minutes the loop is removed from the surface of the body and the switch turned off. If the switch is not activated the loop will be automatically turn itself back on after 4 or 8 hours depending how many times the loop had been used.

It is important that when the loop is being used that it is away from metal cages sides and metal cage floor or metal tables at least 6 inches to prevent interference with the electromagnetic signal. For further information the reader is encouraged to visit the web site: www.assisvetrx.com.

An alternative to the use of the portable SofPulse unit is use of the “Roma”, a non-portable unit that provides the same targeted pulse electromagnetic field but requires an AC outlet for the connection of the transformer. The loops are also connected to the generator via a small flexible cord. The generator also contains a timer that counts down the minutes of application from 30. Three loop size diameters are available 7 and 5 inch being the most common and a 14 inch.

Experimental Studies with tPEMF

There have been multiple laboratory studies involving the assessment of tPEMF technology. In a laboratory induced pain and edema model, carrageenan was injected to the paws of rats and the edema and hyperalgesia was scored. The group of rats that received the tPEMF therapy revealed results that were at least as comparable as those treated with non-steroid anti-inflammatory medications. (1).

Degenerative Joint Disease: There is existing evidence that PEMF therapy, initially invented and developed by Bassett, Pawluk, and Pilla through the work of Ciombor et al, may improve the underlying health of cartilage. Ciombor’s work in guinea pigs suggested that use of tPEMF can slow the progression of OA in animals (2). The treated group had PEMF therapy done 30 minutes BID while the sham (untreated) group only had a device that appeared like that of the active device with no PEMF being administered. The severity of osteoarthritis (OA) was measured using a standardized measurement technique (Mankin scoring method). Lower Mankin scores indicate greater preservation of cartilage. In this experiment the untreated group showed an average score of 11.7 with a low score of 9 and a high score of 14. The group treated with PEMF had an average score of 3.5 with a low score of 0 and a high score of 8. The p value was less than 0.001 (indicating a very significant difference). Another investigator, Fini, working with cartilage cells in tissue culture also showed that PEMF had a positive

effect . Targeted signals were shown by work done by Fitzsimmons to modulate chondrocyte proliferation through a pathway which is mediated by nitric oxide. This is the same pathway that has been elucidated prior for its anti-inflammatory and analgesic effects by Strauch (3)

Postoperative Wound Healing: Using the tPEMF therapy immediately after a surgical procedure and in the days after surgery been shown to accelerating the reduction of swelling and pain. Published studies have shown that tPEMF is associated increased angiogenesis and an acceleration of tendon healing by up to 69% (2). The tendon repair model used was a standard model used to measure the rate of healing. The tendons of the treated group with the active devices showed a 69% greater tensile strength when compared to the group treated with the sham device. The comparison of tendon tensile strength was made a 21 days postoperatively. The p value was less than 0.001.

Postoperative Pain - Studies in the rats in which an irritant (carrageenan) was injected into the paw of to induce pain and inflammation have demonstrated that the tPEMF base technology is at least as effective as the use of anti-inflammatory medications. (1). This occurred without any clinically noted side effects. This model is employed by many drug and device manufacturers to measure pain control. Here PEMF caused a 100% inhibition in the treatment (active device) group verses a 50 decrease in pain tolerance in the sham (non-active device) group. P value was less than 0.001 (indicating a significant difference between groups) beginning at 4 hours post carrageen injection.

Clinical Studies with tPEMF

Regarding Analgesia - Clinical studies in human patients have been performed in several areas including postoperative pain control, wound care, cardiac revascularization and angina relief, and chronic pain and osteoarthritis control. All have shown positive effect and some results have lead to very significant improvements in patients lives. One example is the dramatic reduction in post-operative pain that was observed in a series of patients receiving radical reconstructive surgery. (4) Effects of pulsed electromagnetic field therapy on postoperative pain in a double-blind randomized pilot study. In that study by post-op day 1 the pain was decreased by 87% in treated group compared to 32% in the sham group that had the same care except the loop was not active. This represented a 2.7 fold decrease in pain relief by the PEMF therapy.

Regarding Wound Healing - Because of the increase in blood flow that is a cornerstone for the way tPEMF works, wounds that have been very difficult to heal, such as chronic decubiti and those with draining tracts and deep tissue infections have be successfully healed with the application of the loop over several weeks. This is phenomenal when one considers that some of these wounds had been treated in many other ways for years without resolution.

Regarding Angiogenesis -This last spring a study was presented at the American College of Cardiology meeting in 2009 that revealed a significant improvement in human patients

with severe ischemic cardiomyopathy (5). The study involved 32 patients that had ischemic cardiomyopathy. The loop was applied twice a day for 30 minutes each day. This was done for 60 days and during that time studies were done to assess cardiac function and angina and exercise tolerance. At the conclusion of the study it was noted that there was a statistically significant increase in cardiac function with increased exercise tolerance, noticeably less angina and better exercise tolerance. The patients were then not treated for another 90 days and then the cardiac function tests were repeated. The data revealed that the positive effects that were observed during the treatment with the loop had continued. This has astounded the specialists in cardiology as there has never been any other types of treatment for ischemic cardiac disease that have sustaining effects.

Veterinary Clinical Trial - The way that I (DTC) got involved with tPEMF therapy and use of the IVIVI loop was initially through personal experience. There was a significant decrease in pain. Using a pain scale developed by Dr. Laurie McCaulie, where the scale 0 referred to no pain and 10 referred to the most severe pain, there were noted decreases in the scale of pain when the loop was used. Publication of this study is in preparation (6). In one case (DTC) following a intervertebral disc rupture) use of the loop took the pain scale level from 9 and 10 down to a 5 and 6 after only one 20 minute application. Successive use of the loop decreased the pain to a 3-4 level. The second case (loved one of LM) not only reduced pain significantly, but eliminated the need for meniscal surgery within two days of treatments. Shortly after those experiences DTC and LM both became "clinical investigators" where the device began to be used on a series of veterinary cases (dogs, cats) that suffered both acute and chronic conditions. The investigational hypothesis was that loop application would result in substantial and clinically recognizable decreases in pain and edema in the patients treated. Investigations began independently in April, 2009 for both Crowe and McCauley.

Criteria for entrance into the study was any patient (dog or cat) having recognized pain, edema, or redness, or a traumatic wound or a surgical procedure or condition involved with inflammation. In all cases the loop was turned on and placed over the area of concern; where perceived pain, edema, or redness was present, and held in that location or temporarily taped in place for 10-20 minutes (averaging approximately 15 minutes for each location). Visible flashing of the two small green diodes in the face of the loop's generator was used to signify that the device was operating. With the AC plug in unit an indicator disc that detects the electromagnetic pulse coming from the loop was used to determine if it was working effectively. Clinical changes in the patient's demeanor, actions, breathing characteristics, visible redness or swelling or any other physical signs were used to determine the effect of the device on each patient were recorded. Owners were asked to report the observations they saw and provide a pain scale number before and after treatment. These observations as well as those seen by the investigators were then compiled. Descriptions of the patient's response were used for pain assessment

and a scale number was assigned retrospectively when the recorded scale in the chart was not provided.

In some cases the changes in pain scale were arrived at only after one in-house treatment time of from 10-30 minutes. In others they received as many as 30 treatments of 10-20 minutes done twice to three times each day for 15 days. The pain scale that was present at the initiation of the first tPEMF therapy was then compared to that observed at the conclusion of the therapy. Where multiple applications were performed the lowest and highest scale numbers were reported for the comparison. Results were that pain scores were significantly less after treatment in both those investigated by Crowe (by a factor of 4) and by McCauley (by a factor of 3) and an average of 3.5 when all pre-treatment and post-treatment scores in the 53 patients were compared.

Here is a portion of a paper that was published by Crowe, McCauley, Chiaramonte and Pilla in the FVMA Proceedings April 2013 that I have maintained the copyright so can share it here with you now. NOTE: A few of the patients reported in this paper also had other biophysics based modalities used in their care. These included low level laser, photonic therapy, electrolyzed reduced water and hyperbaric oxygen therapy.

Use of a Targeted Pulsed Electromagnetic Field Coil in Practice

Dennis T Crowe¹, Laurrie McCauley², Deirdre Chiaramonte³, Arthur A Pilla⁴

¹Regional Institute for Veterinary Emergencies and Referrals, Chattanooga, TN;

²TOPS Rehabilitation For Animals, Grayslake, IL;

³ NYC Mobile Vet and Assisi Animal Health, NY;

⁴Departments of Biomedical Engineering, Columbia University and Orthopedics, Mount Sinai School of Medicine, NY

Introduction:

Non-thermal and non-invasive pulsed electromagnetic fields (PEMF) have been successfully employed in human applications since the 1970s. The primary applications have been as adjunctive therapy for the treatment of delayed- and non-union fractures, fresh fractures and chronic wounds. As the mechanism of action of PEMF has become better understood, the signals could be configured to target specific pathways. This has permitted technologic advances allowing the development of PEMF devices which are portable and disposable, can be incorporated into dressings, supports and casts, and can be used over garments or simply held over the area of the body requiring the therapy as most treatment times are just minutes long. This advancement in understanding the mechanisms of action broadened the use of non-pharmacological, non-invasive PEMF therapy to the treatment of post-operative pain and edema to enhance surgical recovery. The result is PEMF therapy is now part of the standard armamentarium of the orthopedist and plastic surgeon and is rapidly becoming an

integral part surgical care. There is active research in clinical applications for osteoarthritis, brain and cardiac ischemia, multiple sclerosis and traumatic brain injury. It is only in the last decade that PEMF therapy has seen increased application to veterinary problems. This review will summarize the basic and clinical research, which led to the Assisi Loop and present clinical examples in the veterinary arena; and hopefully lead to more use of this therapeutic technology.

The tPEMF Signal:

PEMF signals with a vast range of waveform parameters have been reported to reduce pain and inflammation [1], and enhance healing [2]. A common unifying mechanism was proposed, which involves Ca^{2+} /calmodulin CaM-dependent nitric oxide NO/cyclic guanosine phosphate cGMP signaling, to quantify the relation between signal parameters and bioeffect [3]. The CaM/NO/cGMP signaling pathway is a rapid response cascade which can modulate peripheral and cardiac blood flow in response to normal physiologic demands, as well as to inflammation and ischemia [4]. This same pathway also modulates the release of cytokines, such as interleukin-1beta (IL-1 β) which is pro-inflammatory [5], and growth factors such as basic fibroblast growth factor (FGF-2) and vascular endothelial growth factor (VEGF) which are important for angiogenesis, a necessary component of tissue repair [6]. Studies at the cellular level showed tPEMF could modulate NO and cGMP release from challenged cells [3]. These studies employed CaM antagonists and nitric oxide synthase NOS inhibitors which blocked the tPEMF effect, confirming the validity of the proposed mechanism. Other cellular studies showed that the master pro-inflammatory enzyme interleukin-1beta IL-1 β could be down-regulated by tPEMF [7]. This enabled the parameters of the tPEMF signal to be defined as a 2 msec burst of a 27.12 MHz radio frequency carrier repeating at 2 bursts/sec. The induced magnetic B field is $4 \pm 0.4 \mu\text{T}$ and electric E field is $4 \pm 0.4 \text{ V/m}$. This tPEMF signal can be delivered by portable battery-operated devices such as the Assisi Loop.

Animal and Clinical Studies:

Blinded studies in the rat showed that tPEMF accelerated wound repair by 60% [8] and tendon repair by 70% [9] using tensile strength testing. Other animal studies showed tPEMF reduced IL-1 β in cerebrospinal fluid 6 hours after post-traumatic brain injury in a rat model [10]; down-regulated IL-1 β and upregulated IL-10 (anti-inflammatory cytokine) in a mouse cerebral ischemia model [11], and upregulated IL-10 within 7 days in a chronic inflammation model in the mouse [12]. In randomized studies in the clinical setting tPEMF enhanced the management of post-operative pain and inflammation by significantly accelerating post-operative pain and inflammation reduction, and, concomitantly, reducing post-operative narcotic requirements [13-15]. Two clinical studies in humans [14,15] showed IL-1 β in wound exudates of active patients was 50% of that for sham patients at 6 hours post-operative; wound exudate volume at 12 hours post-operative was approximately 2-fold higher in sham vs active patients in both studies. Reductions in IL-1 β and wound exudate volume are consistent with a tPEMF

effect on inflammation via CaM/NO/cGMP signaling. In an unpublished veterinary study that started in April, 2009 (Crowe and McCauley) 80 pet dogs and cats were treated with the Loop by two veterinarians. In all cases the portable device was placed over the area of pain, edema or redness for 15 minutes. Clinical changes in the patient's demeanor, actions, breathing characteristics, visible redness or swelling or other physical signs were observed and recorded. When able a 10-point pain scale developed to compare pain before and after therapy was applied. Loops were often continued to be used in treatments after the pet was discharged from the hospital following owner instruction and asked to provide observed signs that they saw in their pets at home before and after treatment. Both veterinarians often observed decreases in pain, improvements in mobility, and decreases in edema and redness in wounds, and in some cases, quite obvious improvements. This study is described in more detail and a few of these patients are described later in this publication and presentation.

A few Examples of Papers Previously Published

Use of Pulsed Electromagnetic Fields for Ischemic cardiomyopathy Therapy (EFFECT Trial): A Randomized, Double-Blind, Parallel, Placebo-Controlled, Prospective Trial from the Cleveland Clinic –Florida, Weston, FL and Columbia Univ., NY, NY by M. Shen, C. Casher, M Chandy, et al. Poster AHA Annual Meeting 2009.

Evidenced-Based Use of Pulsed Electromagnetic Field Therapy in Clinical Plastic Surgery. Strauch B, Herman C, Dabb R, et al: Aesthetic Surgery Journal Vol 29, No 2, March/April 2009, pages 135-142

Limited Myocardial Muscle Necrosis Model Allowing for Evaluation of Angiogenic Treatment Modalities Mitesh K. Patel, M.D.,¹ Stephen M. Factor, M.D.,² Jennifer Wang, B.A.,¹ Suman Jana, M.D.,³ and Berish Strauch, M.D.¹ JOURNAL OF RECONSTRUCTIVE MICROSURGERY/VOLUME 22, NUMBER 8 NOVEMBER 2006 pages 611-615

ABSTRACT: The currently accepted model for creating infarcted cardiac tissue in a rat model involves ligation of the left anterior descending artery (LAD), either proximally or at the bifurcation level. This procedure requires significant technical expertise and, even in skilled hands, commonly results in a 30 percent to 60 percent animal mortality. The authors propose a new model for creating a limited area of myocardial muscle necrosis that can be effectively studied. It involves a distal electrocautery occlusion of the LAD terminal branches and coagulation of the surrounding muscle. The model is consistently reproducible and decreases the morbidity of the study animals. It provides a cardiac muscle necrosis model not dependent on survival, while allowing study of the post injured state of the muscle and surrounding scar. This allows researchers to evaluate neovascularization and healing of the scar and peri-necrotic muscle, to assess improving blood flow with treatment by techniques designed to improve and stimulate

angiogenesis, and to measure the outcome of stem-cell transplants for potential clinical use. KEYWORDS: Myocardial necrosis, rat, electrocautery,

Protective Effect of Low Frequency Low Energy Pulsing Electromagnetic Fields on Acute Experimental Myocardial Infarcts in Rats Alberto Albertini,¹ Patrizia Zucchini,^{2*} Giorgio Noera,³ Ruggero Cadossi,² Carlo Pace Napoleone,³ and Angelo Pierangeli³ *1Hospital S.M. Misericordia of Udine, Udine, Italy 2Department of Medical, Oncological and Radiological Sciences, University of Modena, Modena, Italy 3Department of Heart and Great Vessel Surgery, University of Bologna, Bologna, Italy Bioelectromagnetics 20:372–377 (1999)*

ABSTRACT: This series of experiments assessed the effect of exposure to low-frequency pulsing electromagnetic fields (PEMFs) in 340 rats with acute experimental myocardial infarcts. The left anterior descending artery was ligated with suture thread, and the rats underwent total body exposure to PEMFs until they were killed. Twenty-four hours after surgery, the necrotic area was evaluated by staining with triphenyltetrazolium chloride. A significant reduction of the necrotic area was observed in the animals exposed to PEMFs compared with the nonexposed controls. Exposure for up to 6 days does not appear to affect the area of necrosis, although in exposed animals an increase of vascular invasion of the necrotic area is observed: 24.3 % as against 11.3 % in controls. No effect on the necrotic area size from exposure was found when the left anterior descending artery was occluded for 60 min, followed by reperfusion. The results reported showed that exposure to PEMFs was able to limit the area of necrosis after an acute ischemic injury caused by permanent ligation of the left anterior descending artery. These data are in agreement with the protective effect of PEMFs observed on acute ischemia in skin free flaps in rats and in cerebral infarcts in rabbits. Bioelectromagnetics 20:372–377, 1999.

Myocardial function improved by electromagnetic field induction of stress protein hsp70 *Journal of Cellular Physiology Early View (Articles online in advance of print) Published Online: 29 Apr 2008* Isaac George **1**, Matthew S. Geddis **2**, Zachary Lill **1**, Hana Lin **3**, Teodoro Gomez **2**, Martin Blank **4**, Mehmet C. Oz **1**, Reba Goodman **3** * **1**Department of Surgery, Division of Cardiothoracic Surgery, Columbia University College of Physicians and Surgeons, New York, New York **2**Department of Surgery, Division of Surgical Sciences, Columbia University College of Physicians and Surgeons, New York, New York **3**Department of Anatomy and Pathology, Columbia University College of Physicians and Surgeons, New York, New York **4** Department of Physiology and Cellular Biophysics, Columbia University College of Physicians and Surgeons, New York, New York **email:** Reba Goodman (rmg5@columbia.edu)

ABSTRACT: Studies on myocardial function have shown that hsp70, stimulated by an increase in temperature, leads to improved survival following ischemia-reperfusion (I-R).

Low frequency electromagnetic fields (EMFs) also induce the stress protein hsp70, but without elevating temperature. We have examined the hemodynamic changes in concert with EMF preconditioning and the induction of hsp70 to determine whether improved myocardial function occurs following I-R injury in Sprague-Dawley rats. Animals were exposed to EMF (60 Hz, 8 μ T) for 30 min prior to I-R. Ischemia was then induced by ligation of left anterior descending coronary artery (LAD) for 30 min, followed by 30 min of reperfusion. Blood and heart tissue levels for hsp70 were determined by Western blot and RNA transcription by rtPCR. Significant upregulation of the HSP70 gene and increased hsp70 levels were measured in response to EMF pre-exposures. Invasive hemodynamics, as measured using a volume conductance catheter, demonstrated significant recovery of systolic contractile function after 30 min of reperfusion following EMF exposure. Additionally, isovolemic relaxation, a measure of ventricular diastolic function, was markedly improved in EMF-treated animals. In conclusion, non-invasive EMF induction of hsp70 preserved myocardial function and has the potential to improve tolerance to ischemic injury. *J. Cell. Physiol.* © 2008 Wiley-Liss, Inc.

PEMF Signals Protect Dopaminergic Neurons from Lipopolysaccharide-Induced Inflammation in Culture. Diana Casper, Eric Taub, Luna Alammar, Ann Pidel, Arthur A Pilla. Neurosurgery Laboratory, Montefiore Medical Center and the Albert Einstein College of Medicine, Bronx, NY and Department of Biomedical Engineering, Columbia University, New York, NY

ABSTRACT: PEMF increased neuronal survival in response to post traumatic inflammation in laboratory neuronal rat cells by daily applications of the IVIVI loop. The PEMF reduced microglial activity and it increased Ca calmodulin dependent NO levels (nNOs). The PEMF also decreased Ca/CaM- independent NO levels and it also increased cGMP in the injured neuronal cells. Potential applications include Parkinson's disease, Alzheimer's disease, Amyotrophic Lateral Sclerosis, Huntington's disease and possibly age related diseases.

Description of a tPEMF Treatment

1. The device is turned on by a switch, and the self-contained timer is started. 2. The loop is laid on the patient where the clinical problem is located), directly or maintained within a few centimeters of the surface of the tissue, as the fields generated will penetrate dressings, casts, etc.. An affected part of the body, such as an appendage or neck, may also be placed also within the loop). No heat is generated by the pulsed signal. It is important that the loop be kept at least 6 inches away from metal cages sides or metal floor and metal tables, to prevent interference with the electromagnetic signal. If there is a large amount of metal within the patient it will still be effective but the metal can act as a shield from the incoming signal.

Therefore the loop should be placed where the shielding will be minimized by the

anatomic location. As an example, if there is a large bone plate on the lateral aspect of the femur then the loop should be placed on the medial side of the leg when providing treatments. Simply re-orient the loop so the volume of the metal in the field is minimized. After 15 minutes treatment is complete and the device is manually turned off. For further information the reader is encouraged to visit the following web site:

www.assisianimalhealth.com,

Veterinary Clinical Experience with tPEMF

Case Inclusion: We (Crowe and McCauley) began to document and track the small animal cases reported here after witnessing dramatic results in our own practices. Investigation began independently in April, 2009). Other investigators added treated cases as well. We treated any patient having recognized pain, edema, or redness, traumatic wound, a surgical procedure or condition thought to be involved with inflammation. This included both acute and chronic conditions. A total of 80 patients were observed with a positive response in most (70) and with a common verbal responses from both owners and veterinarian as “fantastic “and “amazing”. We present 5 illustrative cases below.

Methods and Materials: Treatment was administered both in the office, and/or by the owner after discharge home using the portable device (see individual reports, below). In all cases the loop was placed over the area where pain, edema, or redness was present and held in that location or temporarily taped in place for about 15 minutes. Clinical changes in the patient’s demeanor, actions, breathing characteristics, visible redness or swelling, or any other physical signs were observed and recorded. When appropriate, we applied a 10-point pain scale developed by McCauley to compare pain before and after therapy (Table I). As appropriate, owners were asked to report observations, and to provide a pain scale number pre- and post-treatment. These observations, as well as those made by the authors were compiled. In some cases the changes in pain scale were arrived at after only a single in-office treatment. In others patients received as many as 30 total treatments, 2 or 3 times each day for 15 days. Where multiple applications were performed the lowest and highest scale numbers were reported for the comparison.

Results: We observed a marked reduction in pain (dropping from 1 to 3.5 on the pain scale) when all pre-treatment and post- treatment scores were analyzed for 60 patients (where pain scale comparisons were able to performed). Edema was also observed to be improved (comparison photos or circumferential measurements). In some cases the results were clinically very apparent and some of these will be discussed in the presentation.

Case Descriptions of tPEMF Treatment

Case 1 (Figure 1). "Rayne," a 15-month-old Great Dane presented with all the clinical

signs of a cervical malformation - myelopathy, unable to rise without assistance, diminished proprioception, and a typical “Wobbler” disease gait. Radiographs confirmed the vertebral malformation at C4- 5, C5-6. The loop (orange) was placed over her head and positioned over the affected portion of the neck. The first 20-minute application improved coordination, and she able to rise on her own with difficulty. The dog’s gait continued to improve according to the owner, and after 2 weeks of twice a day applications she stopped placing the loop on the dog’s neck. She has also been treated with photonic and BICOM therapy, but has had no surgery. Follow-up: The patient continued to do well four 1.5 years post-therapy. Rayne showed only a very slightly slower than normal CP, but otherwise deficits were not detectable and she ran and played without any or very little compromise. A video of this patient can be observed on the web site at www.ivivihealthcare.com .



Figure 1 Rayne with loop (orange) on her neck

Case 2 (Figure 2). “Pepe” a 10-week-old Maltese presented with a severe head injury. On admission he was obtunded and had the first of several seizures. Loop treatments began approximately 12 hours post injury. A total of 7 treatments were completed, with the loop applied every 4 hours for approximately 20 minutes. The patient also received 9 sessions of Hyperbaric Oxygen Therapy. Applying the loop appeared to calm him and help him sleep. Circling behavior and torticollis to the right also seemed to lessen after tPEMF treatment. Pepe was able to rise at discharge, with less miosis and more positive menace response to light. His owners continued treatment and after approximately 2 weeks he began making significant improvement. Follow-up 4 months post treatment he was “nearly normal,” but still not able to see. Pain scale assessment: pretreatment= 5; post-treatment 0.



Figure 2 Pepe with the loop (white) on his head

Case 3 (Figure 3). “Panda,” a 6-year-old Australian Shepherd received a primary diagnosis of Metaldehyde toxicosis. While receiving acute care, Panda aspirated Toxiban. He was treated with methocarbamol, diazepam, phenobarbital, and supportive intravenous fluids. The initial hyperthermia was treated with cold application. Clinical evidence of difficulty breathing was treated with nasal oxygen bilaterally, however pulmonary failure progressed and ventilator support was required. The loop was used on both sides of the thoracic cavity and over the head for 30 minutes every 8 hours to decrease secondary edema and inflammation. Immediately following the first therapy it was noted that the patient seemed more comfortable, even when on a ventilator. Panda was weaned off the ventilator in 24 hours. After several more days of intensive care support he was discharged with good neurologic and pulmonary function. Pain scale assessment pre-treatment = 6-8; post-treatment = 0-1. Panda was doing well at a 1 year- follow-up.



Figure 3 Panda with loop (white) on his head

Case 4 (Figure 4) “JD” a MN Golden Retriever following a road rash injury to his nose and left frontal region. The owner had not witnessed the trauma. He also was much quieter than he is normally, according to the owners observations. He was hospitalized and observed through the week-end for a concern that he had been struck by a moving vehicle and a possible concussion had occurred. The ICU technicians stated that he was much brighter after the first tPEMF treatment and continued to improve throughout his hospitalization. He was treated with tPEMF treatments were done for 15 minutes every 8 hours and then the Loop sent home for continued treatments . The wounds were cleaned with electrolyzed oxidized water and left open. No dressings were applied. Impression: significant healing in just 2 days compared to other wounds seen with comparable trauma and then at 5 days the results were impressive.



Figure 4 JD Photo on the left is before treatments began. Photo on the right is post 5 days of therapy (3 Loop applications per day).

Case 5 (figure 5) “JR” is a middle-aged Jack Russell Terrier presented with acute respiratory distress *. It was believed that may started as tracheobronchitis and after

coughing through the night he suddenly got much worse. He was cyanotic and presentation and the sounds from his upper airway were quite apparent. The airway generated sounds could be heard from across a room and both a mixture of pharyngeal and laryngeal in nature. The dog was in a panic and was noted to be difficult to manage in previous visits so all doctors and technicians were concerned that the dog could also try to bite as his past medical history indicated. After placing on a treatment table and trying to deliver supplemental oxygen to him a Loop was eased over his head so that he could wear it as a collar on his neck. Within 5 minutes the loudness of the airway sounds were greatly diminished and his tongue color became pink again. He also appeared to be breathing with less effort on inspiration. In another 5 minutes the airway sounds had just about diminished to being nonexistent and now there was no additional respiratory effort observed and he was much more calm. The patient was then given some butorphenol and acepromazine and a physical exam and thoracic and cervical radiographs were completed. No obvious abnormalities were observed. The patient was still making some abnormal sounds and the thought was that he could still have a foreign body somewhere lodged in his airway region so he underwent a laryngoscopic and bronchoscopic examination and no foreign bodies were noted. There was some mild evidence of edema and redness of the larynx on some tendency toward tracheal collapse but no other findings and he was recovered and later discharged with no obvious airway or pulmonary difficulties.

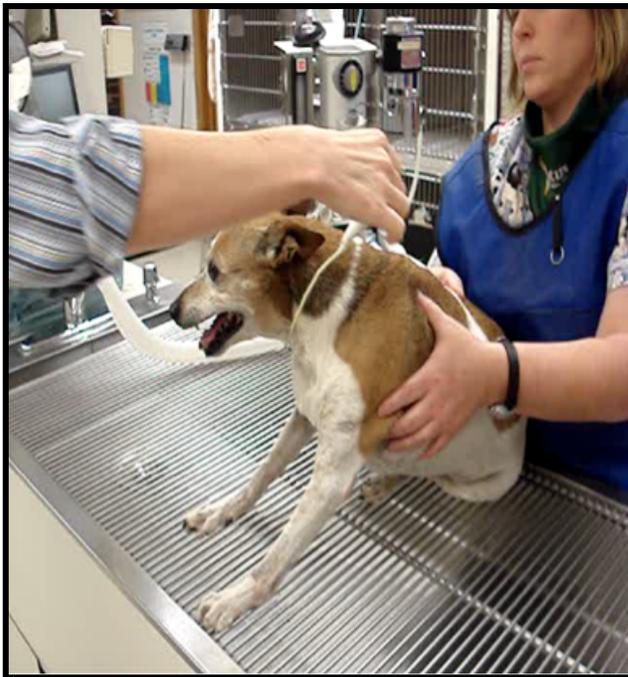




Fig. 5 – JR left photo - The loop on his neck approximately 5 minutes; right photo –10 minutes later with him showing no further breathing difficulty; airway sounds greatly diminished

Case 6 “Shep” a 7 year old MN German Shepard dog that had a maxillary malignant fibrosarcoma that was operated twice for removal (once with conventional surgery and once with CO2 laser surgery) and after the tumor returned within weeks of the second surgery the area was treated twice each day with tPEMF therapy. Initially the first observation was that it appeared that the tumor growth had arrested or at least slowed down dramatically and the dog appeared to be much more comfortable. In 6 weeks the owners said that thought the mass was getting smaller. This was verified on subsequent examinations. At a 6 month follow-up there was no further tumor visibly present on physical exam. The owners and stop using a loop and within six months the tumor had returned. Again the loop began to be used again for therapy but this time the tumor did not respond to the therapy. Eventually the dog was euthanized.

Closing Summary

Our experience (Crowe, McCauley) with the Assii Loop device, both for inpatient and home treatment, suggests that this treatment modality is efficacious and cost effective for the treatment of pain, edema, and inflammation, without adverse effects. In addition, the availability of a clinic-based unit supplemented by a portable unit prescribed for use at home creates the opportunity to an excellent continuum of care. Further research is underway to analyze other outcomes and possible uses of this technology. The mechanism of action holds promise for a broad range of syndromes that have previously

cluded reliable treatment. Currently the authors recommend the use of the technology in any patient with pain, edema, or disease or injury where ischemia is thought to be present. This includes such conditions as intervertebral disc herniation, pancreatitis, severe wounds, fractures, post neurologic and orthopedic surgeries and ligament injuries as well as chronic osteoarthritis, neuropathies and myopathies..

Table I Pain Scale (Courtesy of Dr. Laurie McCauley, TOPS Vet Rehab)

0. No Pain - Alert and Happy
1. Occasional Pain - Happy most of the time
2. Mild Pain - Can be Ignored (distracted) easily
3. Mild Pain - Can be Ignored (distracted) with a bit of effort
4. Moderate Pain - Changes in breathing pattern (pants more often or more frequently when heat is not a factor)
5. Moderate Pain - Pain interferes with some difficult tasks (difficulty getting on the bed)
6. Moderate Pain - Pain interferes with some easier tasks (difficulty going up or down stairs; getting into/outof the car)
7. Pain interferes with Concentration - Change in attitude (grumpy; loses patience easily)
8. Pain interferes with Daily Function of Living behaviors (difficulty getting up; difficulty maintaining a squat to urinate or defecate)
9. Severe Pain - does not want to do anything or even get up; not wanting to eat.
10. Severe Pain - Worst pain possible; moaning; crying out often; glazed look in their eye

References:

1. Ross CL, Harrison BS. The use of magnetic field for the reduction of inflammation: a review of the history and therapeutic results. *Altern Ther Health Med.* 2013;19(2):47-54.
2. Pilla AA. Mechanisms and therapeutic applications of time varying and static magnetic fields. In: Barnes F and Greenebaum B (eds): *Biological and Medical Aspects of Electromagnetic Fields.* Boca Raton FL: CRC Press, 2006;pp.351-411.

3. Pilla AA, Fitzsimmons R., Muehsam DJ, Rohde C, Wu JK, Casper D. Electromagnetic Fields as First Messenger in Biological Signaling: Application to Calmodulin-Dependent Signaling in Tissue Repair, *Biochem Biophys Acta*, 2011;1810:1236-1245.
4. Bredt DS, Snyder SH. Isolation of nitric oxide synthetase, a calmodulin-requiring enzyme. *Proc Natl Acad Sci USA*. 1990;87:682-685.
5. Ren K, Torres R. Role of interleukin-1beta during pain and inflammation. *Brain Res Rev* 2009;60:57-64.
6. Werner S, Grose R. Regulation of wound healing by growth factors and cytokines. *Physiol Rev* 2003;83:835-870.
7. Moffett J, Fray LM, Kubat NJ. Activation of endogenous opioid gene expression in human keratinocytes and fibroblasts by pulsed radiofrequency energy fields. *J Pain Res*, 2012;12:347 - 357.
8. Strauch B, Patel MK, Navarro A, Berdishevsky M, Pilla AA. Pulsed magnetic fields accelerate wound repair in a cutaneous wound model in the rat. *Plast Reconstr Surg*. 2007;120:425–430.
9. Strauch B, Patel MK, Rosen DJ, Mahadevia S, Brindzei N, Pilla AA. Pulsed magnetic field therapy increases tensile strength in a rat Achilles' tendon repair model. *J Hand Surg*. 2006;31:1131–1135.
10. Rasouli J, Lekhraj R, White NM, Flamm ES, Pilla AA, Strauch B, Casper D. Attenuation of interleukin-1beta by pulsed electromagnetic fields after traumatic brain injury. *Neurosci Lett*. 2012;519:4-8.
11. Pena-Philippides JC, Yang Y, Bragina O, Hagberg S, Nemoto E, Roitbak T. Effect of Pulsed Electromagnetic Field (PEMF) on Infarct Size and Inflammation After Cerebral Ischemia in Mice. *Transl Stroke Res*. 2014;5:491-500.
12. Pena-Philippides JC, Hagberg S, Nemoto E, Roitbak T. Effect of pulsed electromagnetic field (PEMF) on LPS-induced chronic inflammation in mice. In: Markov MS (ed): *Electromagnetic Fields in Biology and Medicine*. Boca Raton FL: CRC Press. 2015, in press.
13. Hedén P, Pilla AA. Effects of pulsed electromagnetic fields on postoperative pain: a double-blind randomized pilot study in breast augmentation patients. *Aesthetic Plast Surg*, 2008;32:660-666.
14. Rohde C, Chiang A, Adipoju O, Casper D, Pilla AA. Effects of Pulsed Electromagnetic Fields on IL-1 β and Post Operative Pain: A Double-Blind, Placebo-Controlled Pilot Study in Breast Reduction Patients. *Plast Reconstr Surg*, 2010;125:1620-1629.
15. Rohde C., Taylor E, Alonso A, Asherman J, Hardy K, Pilla AA. Pulsed Electromagnetic Fields Reduce Post-Operative IL-1 β , Pain and Inflammation: A

Double-Blind, Placebo-Controlled Study in TRAM flap Breast Reconstruction Patients. *Plast Reconstr Surg*, 2015. in press.

Acknowledgements. The author (Crowe) would like to recognize Dr. Joey Gross at Mars Hill Animal Hospital, Bogart, GA and Dr. Hilty Burr at Lake Chatuge Animal Hospital, Young Harris, GA and all the doctors and staff at the Regional Institute for Veterinary Emergencies and Referrals, Chattanooga TN for their contributions to cases studied and presented.

Water Ionization and Its affects when ingested – biophysics based technology changing the structure of drinking water

Now the following paper is presented that will summarize the scientific use of another biophysics based technology in clinical medicine and veterinary medicine. I initially presented a portion of this paper in London in April 2013 at an international water congress and then also at another international congress in Borovets, Bulgaria in October, 2013. The research is continuing in this important water that is generated from electrolysis using platinum as the electrodes that also change the water biophysically to a resonating water that more closely fits the resonance qualities of normal and healthy cells; and more effective as hydration medium that bulk water with a hexagonal structure rather than polygonal bulk water. The ionizer that is commercially available (and there are several - those that are certified by the World Quality Association with an ISO 13485 certified water ionizer) also removes the chlorine and fluoride and also effectively removes many chemical contaminants that are in public water systems today (In a New York Times article published in 2009 after they performed an investigation stated the following “scientific research indicates that as many as 19 million Americans may become ill each year due to just the parasites, viruses and bacteria in drinking water. Certain types of cancer — such as breast and prostate cancer — have risen over the past 30 years, and research indicates they are likely tied to pollutants like those found in drinking water.

I was very clueless on this topic until a retired doctor visited me in our practice and gave me some information on the water problem regarding quality and stated he had a solution that I would be interested in. He introduced to myself and two other veterinarians in the practice to a medical grade water ionizer that is manufactured in Japan and has a fair amount of scientific studies that have been done with it. Here is some of the studies and information about the ionizer and the water; also this paper presents an observational study that was performed in six veterinary practices regarding the results that were seen when client owned animals, with their owners permission, were given the water generated from the SD501 Enagic 7 platinum plate water ionizer that was moved from hospital to hospital or in some cases the water generated from the

ionizer was simply placed into gallon water containers and taken to patients at these hospitals

Electrolyzed Water in Clinical Practice¹

Dennis T. (Tim) Crowe, Jr., DVM, DACVS - Emeritus, Charter DACVECC, FCCM,

Regional Institute for Veterinary Emergencies and Referrals, Chattanooga, TN

1. from Proceedings of the Florida Veterinary Medical Association Annual Conference, Orlando, FL April 6, 2015

Introduction

The electrolysis of water is a process in which electrical current passes through water. Single negatively charged free electrons are added to the water at the positive cathode (reduction) side of a semipermeable membrane and electrons are removed from the water at the negative anode (oxidization). The following reaction summarizes the chemical reactions that occur at the cathode: $4\text{H}_2\text{O}_2 + 4\text{e}^- \Rightarrow 2\text{H}_2(\text{gas}) + 4\text{OH}$ and at the anode: $2\text{H}_2\text{O} \Rightarrow \text{O}_2(\text{gas}) + 4\text{H}^+ + 4\text{e}^-$ [1]. Water generated at the cathode is termed electrolyzed reduced water (ERW). This water is alkaline (basic) in pH and has a negative oxidative-reduction potential (-200 to -1200 mv). Water generated at the anode is termed electrolyzed oxidized water (EOW). This water is acidic and has a positive oxidation-reduction potential (+200 to +1200 mv). Water electrolysis units for home and industrial / medical use are commercially made and sold for the generation of both of these types of water. One such unit generates 9 levels of pH in the electrolyzed water (2.5, 4.5, 5.0, 5.5, 7.0, 8.5, 9.0, 9.5, 11.5 pH) and is made with 7 x 5 inch platinum coated titanium electrodes (SD501 Enagic, Inc., Osaka, Japan). The company that manufactures this unit as well as others has made claims that the water produced has health benefits.

The commercial water electrolizer (also called an ionizer), used at RIVER and which is available to anyone_a, first flows water through a high-grade carbon filter to remove trace organic and inorganic water contaminants. This filtered water then flows over a series of 7 platinum coated titanium plates (the platinum acting as a catalyst) in the presence of trace amounts of commonly present calcium, magnesium and sodium that provides ions necessary to allow approximately 230 watts of electrical power to pass through the water and produces structural changes in the water [1]. The unit sits on the counter and the water flows through it via a connection hose to the water supply. The water flowing out of the ionizer is divided into a alkaline water that comes from a hose that extends from the top of the unit and an acid water that flows out of a gray hose that extends from the

bottom of the unit. Approximately 3 -4 liters of each type of water (ERW and EOW) flow from the ionizer each minute.

The electrolysis of the water using the platinum coated electrodes as previously described causes multiple structural changes in the water. These changes have been summarized by others [1, 2, 3] and are listed below:

1. The water's oxygen and hydrogen molecular bonding becomes disrupted with the generation of hydrogen (H^+) ions and hydroxyl (OH^-) ions which are associated with a low pH (acid) water and a high pH (alkaline) water respectively;
2. Free electrons (negative hydrogen ions) are generated at the cathode. These are associated with platinum nano-particles and form "Active Hydrogen" which produces reduced water that has a very low oxidation - reduction potential (ORP) (from -200 to a - 1200 mv);
3. The removal of free electrons from the water facilitated by platinum nano-particles with the generation of oxygen gas which literally transfers the water into oxidized water with a very high ORP (from +200 to + 1200 mv);
4. The nano-clustering of the water in which there is a reduction in nuclear magnetic - resonance and the generation of small clusters of water containing 6 molecules in each cluster. This hexagonal structure is very stable with a resultant hydrogen bond angle of approximately 118 degrees and facilitates water absorption through cell membranes. This is opposed to that seen in standard bulk, tap bottled, reverse osmosis or distilled water that have larger clusters containing 10 to 50 water molecules and a smaller hydrogen bond angle of approximately 108 degrees. The smaller sized clusters enhance the ability to hydrate tissues through its ingestion of the water. The smaller sized clusters (termed micro or nano clusters) also enhances the water's ability to move into the dermis with topical application;
5. A restructuring of the water via the change of the vibrational frequency of the water molecule from approximately 128 Hz to approximately 42 Hz which is also one of the causes of the creation of smaller water clusters;
6. The generation of the fourth phase of water also termed liquid crystalline water or hydrogel those recent investigations by water researcher Dr. Gerald Pollack discovered
b. This fourth phase of water is water has also been discovered in living animals by water researcher Dr. Mae-Wan Ho [4];

Scientific Studies

Various research studies have been published concerning the use of either alkaline electrolyzed reduced water as drinking water or the use of acidic electrolyzed oxidized water topically on wounds or as a disinfectant. This is a brief list of some of the results from such studies:

1. Effective management support of metabolic acidosis associated with renal failure and urinary diversion [5];
2. Support of patients with insulin dependent diabetes that are under additional oxidative stress, as the water is an antioxidant and decreases stress hormones. The feeding of ERW to mice genetically bred to insulin resistant type 2 diabetes significantly reduced blood glucose. [6];
3. Anticancer effects were seen when ERW was fed to rats injected with melanoma cells. This was noted through a decrease in reactive oxygen species (ROS) and the induction of cytokines suggesting a strong immunomodulating effect as well [7];
4. Its effect in decreasing tumor growth through the suppression of tumor vascular growth [8]. In this study laboratory mice were injected with malignant melanoma cells and the mice either drank tap water (control group) or ERW (treated group). There was a significant difference tumor grow rate and in longevity between the groups with the animals drinking the ERW living twice as long as the tap water group with tumor growth and burden being substantially less.
5. Its effects on the prevention of stress inducted impairments in learning tasks [9];
6. Its hepatoprotective effect when toxic materials are ingested [10]; The use of the water (oxidized electrolyzed) for the successful used in the treatment of burn wound infections [11];
7. The effective use of the water (oxidized electrolyzed) in decreasing pathogenic bacterial on tooth brushes and in the mouth as a mouth wash [7];
8. The effective use of the water (electrolyzed oxidized) for the decreasing of pathogenic bacteria in hospital environments [12];
9. Improves ability to effect hydration [13];
10. Decreases insulin requirements in diabetic rats [14];
11. Antineoplastic effect in various types of cancer [15];

Clinical Study

In an open study involving pets at several veterinary hospitals including three emergency centers electrolyzed reduced water (alkaline) (pH 8.5 through 11.5) was given to the pets for drinking. Electrolyzed oxidized water (pH 2.5) was used for topical application on contaminated or infected wounds and burns; in the oral cavity; in ear canals; on table-top surfaces, floors and on various tubes and other surgery equipment. All pets were first introduced to the water either while an inpatient or as an outpatient, with the water being sent home with owners.

There were approximately 100 dogs and 30 cats where the alkaline water for oral consumption in which enough follow-up information was noted to be able comment on the results of placing the pets on the water. It is estimated that there were a total of over 300 pets that received the alkaline water for drinking. It was noted consistently that when the pets were given a choice between the hospitals' tap (municipally supplied) water or freshly made (generated by the ionizer but still using the same water source) alkaline water that they all chose to drink the alkaline water if they did drink. In some cases, documented by video, the dogs would literally "turn their noses away" from the tap water and then seek the alkaline water that had been generated by the water ionizer. Owners commented frequently that their dog or cat appeared to prefer the water compared to the previously offered and consumed tap water. When offered a range of pH, 8.5, 9.0, and 9.5 the pets each appeared to prefer one of the three. 8.5 pH water was generally provided as the initial type that was provided based on previous observations made by another veterinarian [2]. When he was initially giving the dogs alkaline water to his own personal dogs, 8.5 pH was well tolerated. However when 9.0 water was given initially this would result in the production of soft stool. When beginning with 9.5 pH water some developed diarrhea. Therefore 8.5 pH water was generally the pH strength initially used. However there were exceptions: In selected cases 9.5 pH water was initially used and 11.5 pH water was also sent home to be given by the owner in small amounts (15 - 30 ml per Kg body weight per day. These "selected cases" were those that had been diagnosed with a malignant neoplastic condition or had a significant inflammatory skin, bowel, bladder, respiratory or musculoskeletal condition. The reason for this, as recommended by another health care professionals, was to provide an increased amount of free hydrogen based electrons being absorbed and eventually "donated" to neutralize peroxide radicals known to be in increased amounts in inflammatory and neoplastic conditions.[2]

Regarding the humans in the observational study: These were most often the owners of the pets being treated. Some of these owners had chronic degenerative diseases while other were considered healthy.

When various types of water including the ERW was placed in a bowl and offered to each pet, the pet chose to drink the ERW over all the other types (various bottled types, tap water, well water, water from an osmosis unit, and distilled water). Owners reported that in most cases they saw a *very visible* improvement in the pet's condition when compared to how they were before the electrolyzed water was started. In some the results were so obvious that the owners called or upon their next visit would go out of there way to tell everyone that they saw at the veterinary clinic of hospital about how well there pet was doing after starting in the ERW. Physical examination of the skin, ear and paw of patients with redness and chewing showed significantly less intensity of these signs. There was less diarrhea or multiple bowel movements, less mucus in the stools, less lameness and stiffness. Results were especially apparent in the older animals or

those with degenerative joint disease. Most of the changes took several days of water consumption to see. There were no long term side effects in any of the dogs and cats given the water that were noted. Water consumption time ranged from just a few days while the pet was in the hospital to those that continue to be drinking the water.

There were 10 dogs and 1 cat that had topical treatment with the 2.5 pH acidic electrolyzed oxidized water that were able to be assessed well enough to be able comment of the results that were observed. In all cases the topical use of the water was tolerated well. A few seemed to complain slightly following the topical application as if it was causing the sensation of stinging. In one patient with an open fracture and resultant osteomyelitis involving several types of pathogenic bacteria (Pseudomonas sp., Staphylococcus sp., E. coli, etc.). he topical use of the 2.5 pH water was effective in suppressing the bacterial numbers in the affected tissues to the point where no bacterial growth was cultured. The 2.5 pH water was used on 3 burn wound cases, two of which survived and the burn wounds healed well following advancement flap. application and grafting while the third was euthanized due to severe respiratory complications.

All 11 patients that received the topical 2.5 pH water as part of their therapy also received 8.5 to 9.0 pH water for oral consumption. Ten of these 11 cases also were treated with hyperbaric oxygen therapy (HBOT), which can lead to the generation of further reactive oxygen species (ROS) [3]. It was thought that HBOT was another reason for the administration and consumption of the water (author's opinion); the use of the alkaline water would "scavenge" the ROS and help decrease the inflammatory cascade; that the ERW appeared to suppress the inflammatory associated clinical signs . These included redness and swelling of the skin in dermatitis, conjunctivitis, uveitis, and otitis.

The following cases are provided as examples where the use of the electrolyzed water either had a profound - "thought to be associated with the use of the water effect" or just the opposite, where the water's oral ingestion did not prevent the development of neoplasia or the further progression of the cancer:

A 15-year-old neutered male Border Collie with significant progressive degenerative joint disease and moving with difficulty. Then he had an acute onset of vestibular disease (severe head tilt to the left, falling over to the left, rolling, grimacing, horizontal nystagmus). He stopped eating and would only eat if was fed by hand. The owners were considering for euthanasia. He was stated on 8.5 pH water with the water bowl placed in front of him. He would drink readily. Within one week he improved significantly and has recovered approximately 90%. Following the placement of him on the water his gait and movement improved and this has been continuing. According to his owner he is continuing to play with his ball and enjoying life.

A 3-year-old male neutered Mixed breed dog with a TPLO postoperatively was found in the hospital run with an open comminuted fracture of the proximal tibia with much soft tissue injury. The fracture was fixed with a long bone plate and the site grafted with cancellous bone. Unfortunately the repaired fracture site became infected. Topical application of the water (2.5 pH) and the ingestion of 8.5, then 9.0 and then 9.5 pH water was provided. The bacterial infection eventually cleared after 2 months of daily applications of the 2.5 pH water and him drinking the 9.5 water. Hyperbaric oxygen had been used on a daily bases to stimulate healing for approximately 4 weeks. His wound was closed surgically as the fracture was appearing to heal radiographically.

A 1-year-old female spayed Toy Poodle with a large full thickness burn was topically treated with the 2.5 pH water daily until the wound and granulation bed was able to have an advancement of the skin edges and then full thickness grafting (at 7 days post burn). The graft took approximately 5 days to be able to see that it had indeed survived. The dog went on to do well. Hyperbaric oxygen therapy was also used on a daily bases to stimulate healing for approximately 2 weeks.

A 5-year-old male neutered Welch Corgi that initially seemed to have abdominal pain, but after a few hours was noted to have back pain and began losing the ability to walk in the rear limbs. An intervertebral disc herniation was suspected and confirmed with a myelogram and computerized tomography. Alkaline pH 8.5 water was begun after his hemilaminectomy and discectomy. The owners also started drinking the water when they noticed the dog drinking it readily (more than his regular tap water) and had noted how good it tasted. They also said that when they saw how the dog had now more energy and recovered well, gaining his ability to use both rear legs within a week after the surgery, they became convinced that they too had to be drinking the water.

A 2-year-old male Weimaraner that arrived after being severely injured by a large dog that attacked him in his own yard. A very significant bite wound with a loss of part of his ear and neck was apparent. The owner had initially taken him to be a primary care veterinarian who attempted to clean the wound, place drains and suture it closed. The veterinarian exclaimed that this was one of the worst bite wound cases you never seen. He sent the patient to us for continued care including further surgery because the wound had now been becoming necrotic. After further debridement, irrigation with 2.5 pH water and commencing with the dog drinking only 8.5 pH water the wound was eventually able to close the wound with a advancement flap. The flap survived and healed well but a small cavern alongside the anchoring of the advanced flat developed. At this time the small cavern is being irrigated with 2.5 pH water and the cavern like sinus is gradually filling in with granulation tissue.

11-year-old neutered male Doberman that had been suspected of having Lyme disease and the owner thought the dog was getting "so bad " that he was scheduled to be

euthanized at the conclusion of the week as he could no longer walk well and seemed to be in chronic pain. He was only eating and drinking minimally and had lost approximately 8 kg of body weight. The dog was very depressed when I first saw him. The referring veterinarian accompanied me when I saw the patient and remarked that the dog was so much worse. A bowl of 8.5 pH water was placed in front of him and he readily began drinking it. The patient tested positive for Lyme disease with a biotensor_e and he was treated with the EM frequencies tested and found to be needed using bioresonance unit _f. The EM signals were also transmitted into the 8.5 pH water specific for patient based on biofeed back from the bioresonance unit [16]_f. He continued to be offered and drinking the alkaline water and within 3 days the owner reversed her decision to have him euthanized. The owner had remarked that the dog was "a different dog" and starting to walk so much better and had begun eating and even playing. Incidental to the dog's treatment the owner also began feeling so much better after she also began drinking the 8.5 pH water.

An 18-year-old male neutered Domestic Shorthaired cat that was receiving subcutaneous fluids three times a week for chronic renal failure. He also had a house mate that was also similar in age and size and had similar health issues (chronic renal insufficiency). Both cats were receiving subcutaneous fluids 2-3 times each week. Both were started on 8.5 pH water and received biomagnetic resonance therapy and the EM signals were also transmitted into the water[16]. Within a few days both cats were visibly feeling much better and the owner was able to stop giving them subcutaneous fluids. Their appetites had also improved. The subcutaneous fluid support was no longer needed for approximately 4 months and then these were begun again but only needed once every 1-2 weeks. According to the owner the cats were "running around the house as if they were only 5-7 years old". The owner was so impressed with the electrolyzed reduced water therapy that she also stated drinking the water. She bought a water ionizer unit and continues to this day to drink the water. She recently has introduced two younger cats, starting when they were kittens, to the 8.5 pH water and they are thriving better than any other cats she has ever had she said.

One of the most outstanding areas noted was the health of the teeth and oral cavity. We've also seen many animals (both dogs and cats) with chronic joint disease, inflammatory bowel disease, chronic vomiting without a definitive cause, asthma, obesity, wound infections, external ear inflammation and infection, diabetes, hepatitis, cholecystitis, intervertebral disc disease, orthopedic and soft tissue injuries, eye infections, and pancreatitis most have which benefited from being given the electrolyzed reduced water to drink, and electrolyzed oxidized water for wound irrigation. In many case the owners would see how well their dogs and cats did on the water, that they then to begin using the water to drink. Most owners said that not only did their pets appear to feel better but they also felt better. On occasion, diarrhea was note. In those in those cases of diarrhea most often was associated with to rapid an increase in the pH of the

water. The diarrhea was felt to be due to a detoxification process that was occurring more rapidly than expected. When this was seen, a lower pH was selected (8.5) in the diarrhea would generally clear in one to three days and then pH would be gradually increased more slowly. Patience with gastric or gastro-esophageal reflux were noted to improve within hours the beginning the electrolyzed reduced water.

For those with severe wound infections and burns, use of the water appeared to be effective. It is presumed that many of the patients in the study were chronically dehydrated, and that this was linked to various disease processes. This was suspected especially in pets that were on municipal water were especially prone to dehydration. It is suspected they can smell the chlorine in the water, and possibly other contaminants.

When the electrolyzed reduced water was started some owners felt that the dog or cat was acting like he or she was years younger. In the case of Sampson's owner he was very impressed with Sampson's ability to walk much more rapidly than he thought he would. Owners with animals that were pregnant explained that the animal's delivery was easier, the pets made more milk, and the puppies and kittens appeared stronger when they were drinking the electrolyzed reduced water as compared to other litters where regular tap water had been provided to the dam and puppies. Patients that had cancer were noted by the owners to feel and eat better and had more normal stools where previously, before the introduction of the ERW there was more constipation.

Patients with specific diseases that particularly benefited from the ingestion of the alkaline water were those in the following disease states: Chronic renal disease; Chronic liver disease; Mammary gland cancer; Dental disease (treatment and recovery, disease prevention; Prostatic disease; Degenerative joint disease; Asthma; Chronic lung disease; Pneumonia; Heart disease; Autoimmune hemolytic anemia; thrombocytopenia; Degenerative disc disease; Post-trauma, post-surgical; HBC (hit-by-car) injuries; Fractures; Snake bite; Bite wounds (minor to severe); Burn wounds; Post Joint Surgery (knees); Post foreign body removal; Post dental surgery; Post use of the hyperbaric oxygen chamber; chronic wound infections; sinus infections; skin diseases; otitis externa; conjunctivitis;

The following conditions were found to have positive effects from the topical use of oxidized reduced water: acute wounds (to help prevent infections); infected wounds (both acute and chronic; sinus infections; skin diseases; otitis externa; conjunctivitis; dental disease (gingivitis).

Regarding the results in the humans drinking the water or using it topically: The humans that were owners either voluntarily stated that they were drinking the water too and noticed considerable improvement in their own chronic degenerative condition (such as osteoarthritis with more mobility and less pain) or did not report any changes in their

health if they were of those that felt they were already healthy. Observations of the electrolyzed oxidized water (EOW) used topically in wounds revealed not adverse effects. Both fresh wounds and those over several hours old that were treated with the EOW showed a positive response with none that provided a positive wound culture after treatment. All healed, even those that were major. Systemic side-effects were observed in some people drinking the ERW if they had significant disease conditions. These side-effects observed were the following: diarrhea, malaise, nausea, a tingling in the mouth or "bad taste" in the mouth as they were drinking the water. Lowering the alkaline pH level or changing briefly to clean water resolved the reported problems in all those making and reporting these observations.

This small investigation into the effects of electrolyzed water in pets has been previously reported. The following conclusions are made: Use of the water clinically both systemically and topically was associated with positive results. The few adverse responses (diarrhea, not wanting to drink) responded completely by decreasing the alkaline pH.

The following conditions were found to have positive effects from the topical use of oxidized reduced water: acute wounds (to help prevent infections); infected wounds (both acute and chronic; sinus infections; skin diseases; otitis externa; conjunctivitis; dental disease (gingivitis).

References:

1. McKnight, T. Confessions of a skeptical physician. YNR Publishing, (and6A Tools). California, 2012.
2. Parker, P. Turning back the hands of time. First Edition. Simple Health Network, Spokane, WA, 2013
3. Carmo, M; Fritz, D; Merge, J; Stolten, D: A comprehensive review of PEM water electrolysis. J Hydrogen Energy 10:1016, 2013
4. Ho, Mae-Wan. Living Rainbow H₂O. World Scientific, Singapore, 2012
5. Abol-Enein H, Gheith OA, Barakat N, Nour E, Sharaf AE Ionized alkaline water: new strategy for management of metabolic acidosis in experimental animals. Ther Apher Dial. 2009 Jun;13(3):220-224.
6. Kim MJ, Kim HK. Anti-diabetic effects of electrolyzed reduced water in streptozotocin-induced and genetic diabetic mice. Life Science. 2006 Nov 10 79(24):2288-92. Epub 2006 Aug 2.
7. Lee SH, Choi BK. Antibacterial effect of electrolyzed water on oral bacteria. J Microbiol. 2006 Aug;44(4):417-422.
8. Ye J, Li Y, Hamasaki T, Nakamichi N, Komatsu T, Kashiwagi T, Teruya K, Nishikawa R, Kawahara T, Osada K, Toh K, Abe M, Tian H, Kabayama S, Otsubo K, Morisawa S, Katakura Y, Shirahata S. Inhibitory effect of electrolyzed reduced water on tumor angiogenesis. Biological & Pharmaceutical Bulletin. 2008 Jan; 31(1):19-26.

9. Nagata K, Nakashima-Kamimura N, Mikami T, Ohsawa I, Ohta S. Consumption of molecular hydrogen prevents the stress-induced impairments in hippocampus-dependent learning tasks during chronic physical restraint in mice. *Neuropsychopharmacology*. 2009 Jan;34(2):501-508.
10. Tsai CF, Hsu YW, Chen WK, Chang WH, Yen CC, Ho YC, Lu FJ. Hepatoprotective effect of electrolyzed reduced water against carbon tetrachloride-induced liver damage in mice. *Food Chem Toxicol*. 2009 Aug; 47(8): 2031-2036
11. Nakae H, Inaba H. Effectiveness of electrolyzed oxidized water irrigation in a burn-wound infection model. *J Trauma*. 2000 Sep;49(3):511-514.
12. Vorobjeva NV, et al. The bacterial effects of electrolyzed oxidizing water on bacterial strains involved in hospital infections” *Artificial Organs*. 2004, June; 28 (6): 590-592.
13. Heil DP. Acid-base balance and hydration status following consumption of mineral-based alkaline bottled water. *Journal of the International Society of Sports Nutrition*. 2010 September;7(1):29
14. Jin D, Ryu SH, Kim HW, Yang EJ, Lim SJ, Ryang YS, Chung CH, Park SK, Lee KJ. Anti-diabetic effect of alkaline-reduced water on OLETF rats. *Biosci Biotechnol Biochem*. 2006 Jan;70(1):31-37
15. Ye J, Li Y, Hamasaki T, Nakamichi N, Komatsu T, Kashiwagi T, Teruya K, Nishikawa R, Kawahara T, Osada K, Toh K, Abe M, Tian H, Kabayama S, Otsubo K, Morisawa S, Katakura Y, Shirahata S. Inhibitory effect of electrolyzed reduced water on tumor angiogenesis. *Biological & Pharmaceutical Bulletin*. 2008 Jan; 31(1):19-26.
16. Zhalko-Tytarenko O, Liventsov V, Lednyiczky, G. Endogenous electromagnetic field pattern formation in water. *Proceedings, Unconventional Therapies Conference, Monte-Carlo, Monaco, Dec 6-7, 1996.*

Footnotes:

- a. SD501 Enagic Inc., Osaka, Japan
- b. Gerald Pollack, PhD; verbally reported at the Colors of Water Festival, London, England, April 21, 2013.
- b. Milwaukee SM500 ORP Meter, Milwaukee Instruments., Rocky Mount, North Carolina, USA
- c. Rehmel, R. Notes of observations made after providing electrolyzed reduced water to his own personal dog. Mars Hill Animal Hospital patient record. 2011
- d. Stewart, R, Comments made from his experiences as a chiropractor using the alkaline (electrolyzed reduced) water.
- e. BICOM Biotensor. Regumed. Regulative Medizintechnik GmbH, Grafelfing, Germany
- f. BICOM Optima Portable. Regumed. Regulative Medizintechnik GmbH, Grafelfing, Germany

*This paper was first presented, in part, at an international water conference in April, 2013 (<http://www.i-sis.org.uk/coloursofwater/>) in April 2013 in London by the author.

Hyperbaric oxygen therapy – a tool that improves tissue oxygenation, and decreases inflammation, edema and pain

Hyperbaric Oxygen Therapy

What, Why, When and How

A powerful therapy for tissue ischemia, hypoxia, and edema, infections, degenerative diseases, significant inflammations, autoimmune diseases, some drug toxicities, chronic pain, neurological conditions and cancer, and more to come

D. Tim Crowe, DVM, DACVS, DACVECC, FCCM, NREMT-I ,
Certified Firefighter, Rescue Specialist,
Member, American College of Hyperbaric Medicine

Introduction - What can I do to improve outcome? Thought I often have in the OR, ER, ICU, on the road and in practice;

Historically this goes back to my days as a high school student when I did a science fair project on gastroenteritis in dairy calves that were dying of scours within 3-4 days of birth. There was a bacteria I cultured from their liver, mesenteric lymph nodes and gut that had a hot Salmonella typhimurium, varience Copenhagen and found that chloramphenicol was very effective on sensitivity testing. The veterinarians I was working with began using the antibiotic and had the dairyman give it to the calves on the day the calves were born. This decreased the death rate to near zero compared to the loss of over 1/3 of the calves born in that part of Wisconsin that winter. That was in 1963-64. I was hooked on trying to find ways to save lives – It was a great feeling. I was awarded a trip to the AVAM Convention in 1965 to present my findings – It was nervous. But I remember it like it was yesterday.

Then as a veterinary student 'intern' hired by Iowa State University to receive all the emergency patients and start administering care and calling the appropriate faculty member and alerting them that they were needed at the clinic. On the small animal side I would literally set up the OR to receive dogs and cats and if necessary begin shock therapy by starting an IV and fluids and giving oxygen from the hose of an anesthetic machine. Having this all set up saved valuable time in the treatment of shock and I know that saving time in providing this also saved lives. Again I was hooked on doing what I could to generate a better outcome.

Then fast forward and as a surgical resident in 1975-76 at the Ohio State University. I did some rotations in surgery at the 950 bed human hospital a few miles from my house and met a general surgeon that taught me a much different way to close the abdomen than I had ever seen that of a closure that was done with a continuous pattern rather than the interrupted pattern, that as far as knew, was what every veterinary surgeon did, believing that continuous closures were fraught with the danger of commonly falling apart. I started doing a small series of cases and found that the continuous pattern of

polypropylene was very effective and saves a significant amount of time compared to simple interrupted closures. This experience was later published in Veterinary Surgery in 1978, after I had followed over 550 patients! I wanted to make sure that what I was proposing was again going to save time and hopefully then save lives....and it has!

I believe I got a lot of this “wanting to continue to make things better” from my Dad as he was always developing and inventing ways to make trucks perform better – today the gears he invented when he worked at a truck manufacturing company I am told are still used for heavy equipment hauling type rucks around the world.

In 1986 came the idea of using an indwelling catheter in the noses of dogs and cats, foals and calves to provide supplemental oxygen; in 1989 then catheters that went from the nose to the esophagus or stomach to provide nutritional support (the NG or NE tube) and then to place a catheter through the skin and down into the esophagus to also provide nutrition (the esophagostomy tube). That was also in '89. These were again based out of an intense desire to make things better for patients..

This little introduction brings me to the reason I am now here speaking to you and writing to you about what I was originally introduced to in 1993...HYPERBARIC OXYGEN At the Shock-Trauma Center in Baltimore, MD when I was doing a rotation there from the Animal Emergency Center in Milwaukee. At first I was only introduced to it as a way to get increased oxygen levels to the tissues and that it especially healing of wounds that were having difficulty. But that was only the beginning.. As I began researching the literature and speaking to professionals such as Dr. Roy Meyer at Shock Trauma, Dr. Eric Kindwall at Saint Luke's in Milwaukee and Dr. Richard Neubauer in Florida I was convinced I needed to learn much more and actually to get a hyperbaric chamber for the practice and begin using it for my animal patients. That was in 1996 (again in Milwaukee at the Animal Emergency Center where that started).

So here I am after more than 20 years later still learning about all the things that Hyperbaric Oxygen Does and what its such a powerful tool and it can be used for so many conditions.

I am a bit like a Dr. Cunningham that was introduced to hyperbaric medicine when he was an internist and anesthesiologist and taught anesthesiology at Kansas University Medical School and worked in hospitals in Kansas City. Dr. Cunningham had noted that victims of the influenza epidemic of 1918 did better if they were at sea level versus those that were up in the mountains. Joe's dying of influenza were cyanotic and blue and start for oxygen Windy came down from the mountains they picked up and they seem to do better. Patients that had rheumatism heart disease high blood pressure or pneumonia rough and brought down to lower altitudes to leave he ate their symptoms. This got

Cunningham to consider the reasons for this and it came to his idea that it was due to pressure of the gas is especially oxygen that made the difference in these people.

Cunningham thought that if he could create a controlled environment of artificial high-pressure he might be able to help flu victims and based on his personal experience that he had about infections and what caused them he thought to that placing patients in a higher pressure environment might also help in the healing of wound infections especially those that were anaerobic. Cunningham was well known for his keen engineering mind by the surgeons he worked with in the Kansas City Hospital's. He was a good researcher and did his homework and found that if he named French physiologist named Paul Bert had designed a model for the first compressed air tank and he took the drawings from this model they were also invented by CW more in English engineer who is the first to operate a medical lock in the treatment of tunnel workers suffering from caisson's disease. Using this information and his exceptional technical skills Cunningham designed to think that could be used to treat up to four people and also accommodate the doctor. This tank was equipped with hatches and in your locker similar to the design used by many hyperbaric chamber's today.

The first tank build was on the campus of the new medical school and he made it from pieces that he found in the machine shops pipes in junkyards and two boilermakers you found in the stockyard. The dean of the medical college had persuaded the college president to allow his experiment to be done, first on monkeys and then guinea pigs and then rabbits as his patients.

After the tank was built there was a young man, a personal friend of one of Cunningham's coworkers that was found dying of pneumonia. No medication had been able to help the man and his lips were blue-black and he was totally unconscious. Out of desperation Cunningham and the other doctor took this young man out of the hospital bed where he was dying and put him in the tank on a temporary wooden bunk that was placed into the tank. They covered him up in an army blanket and they started up the tank. They built the air pressure up in the tank to approximately 10 pounds per square inch in there they kept the young man for an hour. During that hour the man had begun to open his eyes and his skin had begun to start turning a more normal color. .

Over the next three days Cunningham gave the man additional treatments. He called these treatments "Dives" after the calculations developed by Paul Bert the physiologist who was working on a decompression chamber for divers the young man survived and over the course of the next few days he saved the lives of several other patients who had pneumonia and were within just a few hours or less of death according to their personal physician. (AS A NOTE – This still is happening today in much the same way where hyperbaric treatments are done only as a "last resort" when all other treatments have failed.

This, in a way is also what happened to me. I had a very severe leg wound infection that was getting into the bone and intravenous antibiotic being given by a PICC line we're not making a difference. I was told by a good friend who is a neurosurgeon that I might even lose and he was so very worried. Even though I was candidate for hyperbaric therapy with my leg wound infection I had to convince the two doctors who were caring from me that my leg really needed hyperbaric therapy; but insurance company was not convinced.. no were my medical doctors. So I found a friend who had a human chamber – he could have gotten in a lot of trouble – but another story. As soon as I got into the chamber and the pressure was added the intense pain I was having left me. It was amazing. And I could feel the edema in my leg literally disappear. When I was done with that first treatment I was even not chilled and it seems that I had more energy. I had been barely able to work.

That was the first time I was brought out of a severe infection by the use if hyperbarics. Then fast forward another 10 years and I received another serious wound on my leg. In almost the same place – right on the leading edge of my chin. It was as though the leg was sensitized by bacteria that were there - This time I required major debriding surgery and a wound vac and multiple types of intravenous and oral antibiotics... AGAIN the doctors including 2 surgeons, a wound care expert, and an infection disease specialist never thought of hyperbaric oxygen but as soon as saw that the treatments were not working and the infection was getting into my tibia and spreading to include more surrounding tissue I again searched for a hyperbaric chamber! I found one – a podiatrist said he would treat me even though the infection was not on the foot. He was probably taking a big chance but I was at least able to get the treatments even though insurance was again not going to cover it. I am happy to report again that as soon as the treatments started that the wound began to much less painful! And the swelling dissipated and the redness also subsided. That was over 5 years ago – I still have my left leg. Thanks to hyperbaric oxygen treatments and the doc who cared enough to see that I got the care that was needed. He believes in hyperbaric therapy.. and I certainly believe in hyperbaric therapy.

So from the RA COWLEY SHOCK TRAUMA CENTER time in 1993 until now I have been very active in learning and using hyperbaric oxygen. It does so many more things than just provides oxygen into tissues.

Because of the shortness of time I will only lose them:

Improves tissue oxygenation – moves through the plasma, interstitial tissues, cells by significant degree more than normal because of the added pressure.

Decrease in swelling from tissues, organs to cells, cytosol and mitochondria

Decreases pain substantially

Decreases inflammation substantially

Decreases infection from many different mechanisms

Releases Stem Cells (CD 34) active progenitors from the bone marrow

Stephen R Thom, et al Am J Physiol Heart Circ Physiol 290:1378 – 1386, 2006

CD 34 increases 50% after one HBOT and 8 times after a series

Is it enhances angiogenesis

Increases circulation in general

Saves renal, intestinal, brain, spinal cord, heart cells from death in ischemic or hypoxic situations.....

Behaves like an effective antibiotic with no microbe resistance.....

Suppresses bacterial growth

Suppresses endotoxin production

Suppresses mycotic organism growth and invasion

Suppress viral replication

Potentiates rehabilitation effects

Improves wound healing

Improves T cell function

Suppresses neoplastic growth

Stimulates NrF2 and generates SOD and catalase

Stimulates nitric oxide synthetase

Decreases air bubbles and air within containers (pleura, intestinal lumen)

Boyle's law tells us that the density of oxygen is directly proportional to its pressure. (molecule density = increases with increasing pressure) so air mass gets smaller
The way to temporarily decrease distention of bowel during foreign body obstructions

Increases the solubility of oxygen in all liquids that helps place oxygen into all cells, tissues as cells and tissues are mostly water

Water within cellular structure turns to fourth phase of water more completely and allows more electromagnetic frequency transmission

Causes are in a transduction of genomic structured messenger RNA to key structures to be produced that are in telomere savers – increasing longevity of healthy cells

More hydrogen gas solubility in a liquid as this is proportional to the partial pressure of the gas on the liquid - Henry's Law hydrogen is linked also to increased ability to decrease inflammation as its an idea electron donor to negate ROS

Hyperbaric oxygen (HBO) therapy: the therapeutic use of oxygen under pressure. (use of a pressurized oxygen enriched atmosphere generally produced by the placement of a patient (or patients) within a chamber that then is filled with pressurized gas (20 to 100 % oxygen) for various periods of time (generally 30 to 90 minutes).

Hyperbaric: pressure in the chamber that is used to achieve physiological effects - generally varies from 1/3 to 1 added atmosphere (4.85 to 14.7 psi)

Definition – Hyperbaric Oxygen

Specific Hyperbaric Oxygen (HBO) Therapy involves intermittent inhalation of oxygen under a pressure greater than 1 atm.

Air with pressure to get the increase in oxygen

Air supplemented with oxygen

100 % oxygen (generally accepted as most effective)

What are the reasons for providing this type of treatment? To produce increased levels of oxygen within the tissues and blood stream

Compressed air therapy – British clergyman – Henshaw in 1662 “ It seemed like a good idea” was gentle pressure...

Mobile operating room that could be pressurized - French surgeon – Fontaine in 1879 @ 2 or more ATA

The scientific study of the effects of HBOT began as early as 1895, when Scottish physician John Scott Haldane evaluated its effect on carbon monoxide toxicosis in humans.

History 1956 Professor Boerema - Surgeon Professor - University Amsterdam

Vascular & Cardiac Surgery...

Maintenance of normoxia in critical tissues during full cardiac standstill 30 minutes;
restarted easily; normal brain & heart function; repaired IC defects

Positive results in cardiovascular surgery

Gas gangrene and severe infected wounds

FIRST INTERNATIONAL CONGRESS ON HBOT - University Amsterdam 1963

NATIONAL ACADEMY of SCIENCES

National Research Council - Division of Medical Sciences Committee, 1966

Recognized that HBOT had significant merit in the management of certain clinical
conditions (primary, adjunctive)

Mission - to provide guidelines to US gov.

- use in severe infected wounds

skin flaps under danger, free skin grafts

glaucoma, near arrests, ischemic conditions

“Monoplace” chamber ~ 1965

Basic facts

Oxygen needed for cellular metabolism

The generation of energy (ATP) requires O₂

(2ATP versus 36 ATP per gram of glucose)

No area in the body stores O₂

Cerebral metabolism closely tied to CBF

Brain 2% of body weight but consumes 20% of all O₂ available = cellular injury within 3-4
minutes of ischemia... difficult to recover from

continued mitochondrial changes

X13.000

Pressure exerted by gases in our atmosphere at sea level (AT)

Standard atmospheric pressure is 101,325 Pa

= 101.325 kPa

= 1.01325 bar

= 0.101325 MPa

= 760 Torr or 760 mmHg

= 14.696 psi

= 1ATA (Atmosphere Absolute)

= 33 feet of sea water

More about the pressure used

Increasing pressure in HBO therapy is often expressed in multiples of atmospheric
pressure absolute (ATA); 1 ATA ≈ 760mm Hg. (approx. 14.6 psi) (approx. 1 Bar)

Most HBO treatments are performed at from 1.4 ATA to 3 ATA. (mostly 1.5 to 2 ATA)

In air embolism and decompression sickness, where pressure is crucial to therapeutic effect = to decrease all bubbles so none will be in vessels
= treatments frequently start at 5 ATA.

Gas Laws in the Context of Hyperbaric Oxygen Therapy

Four physical laws pertaining to the properties of gases are important in understanding HBOT In the context of HBOT:

Dalton's law of partial pressures tells us that 100% oxygenation maximizes the partial pressure of P_{O_2} . $760 \text{ mm Hg} \times \% O_2$; ($760 \times 100\% = 760$)

Other Biophysics Based Clinical Modalities:

Examination of other CMT modalities suggests that many too have biophysics actions as their primary mechanism of action. These include low-level laser light, photonic near infrared therapy, pulse signal therapy, certain types of chiropractics, massage, acupuncture, electro-acupuncture, acupressure, and bioresonance. Bioresonance is based on quantum physics supported by the work of Carlo Rubbia (Nobel prize winner 1984) and R.P Feynman, J.Schwinger, S. Tomonaga (Nobel prize winner in Physics, 1965). There are many evidenced based experimental and clinical studies that prove bioresonance therapy effectiveness, yet further research is required to determine the full effects and possible uses of this technology. The mechanisms of action support the new paradigm in medicine, that biophysics mechanisms are superordinate over biochemistry. From my personal experience I am convinced of this.

Acknowledgements and references cited are available on request from the author.

FOLLOWING THIS LAST LECTURE – GIVEN TO BOTH VET TECHS AND VETS TOGETHER THERE WILL BE REFRESHMENTS PLANNED PROVIDED BY A SPONSOR: SECHRIST VETERINARY HEALTH -