



Pulse System: Pulsed Magnetic Cellular Exerciser

Informed Consent for Demonstration, FREE SESSIONS or Partnership Program Purchases

I _____, hereby request a Pulsed Magnetic Cellular Exercise session. I understand that the Pulse Centers System creates a fully adjustable pulsed magnetic field. I understand that the information shared by the demonstrator are his/her personal opinions and are intended for educational purposes only.

Product Disclaimer

The Pulse Centers System produces magnetic field energy, which passes freely through tissue for the purpose of cellular exercise to promote and support a sense of wellbeing. The FDA has not evaluated the Pulse Centers System. It is not intended for the diagnosis, treatment or cure of any medical condition. The Pulse Centers System is not a medical device and we cannot make any claims that we can affect medical conditions.

We understand this general statement regarding pulsing magnetic fields to be accurate:

"PEMF (pulsed electromagnetic field) devices do not treat a specific condition. Instead they optimize the body's natural self-healing and self-regulating function."

– Dr. Magda Havas Associate Professor of Environmental & Resource Studies at Trent University

Do not use if:

- you have an implanted electronic device including: pacemaker, defibrillator, cochlear hearing device, spinal stimulator, etc.
- you are pregnant.
- you are actively bleeding, hemorrhaging, or during heavy menstruation

Before beginning a PEMF Exercise Session we recommend the following:

- Please remove all external metal, e.g.: Electronic or battery operated devices, keys, wallets, metal belt buckles, cards with magnetic strips such as credit cards and hotel keys, jewelry, hearing aids, etc.
 - Regarding metal implants, they can be a sensitive area. Therefore, we recommend pulsing at a level where the user feels comfortable.
- if you are unsure whether pulsed magnetic cellular exercise is right for you, consult with your licensed health care provider(s)

During a PEMF Exercise Session

- if you experience natural reactions that include but are not limited to nausea, headache, fatigue or any uncomfortable sensations we recommend you suspend the session and consult your doctor

Beyond what is stated above, I _____, understand that other risks associated with a pulsed magnetic exercise session are unforeseeable and that the demonstrator, the manufacturer, the marketer, employees, agents and affiliates cannot accept any liability for loss or damages incurred as the result of the Pulse Centers System session. I reserve the right to use the knowledge I have gained in the care of my own body in any legal manner I may choose. I have read this form and voluntarily agree to the Pulse Centers System session on my person assuming all liability for any and all results or consequences.

Signature

Date

Phone Number

Print Name Clearly

Email Address

PEMF Cellular Exercise Session Tracker

Date: ____/____/20____ Current Age:____ DOB: ____/____/____

First Name: _____ Last Name: _____

Address: _____

City: _____ State: _____ Zip: _____

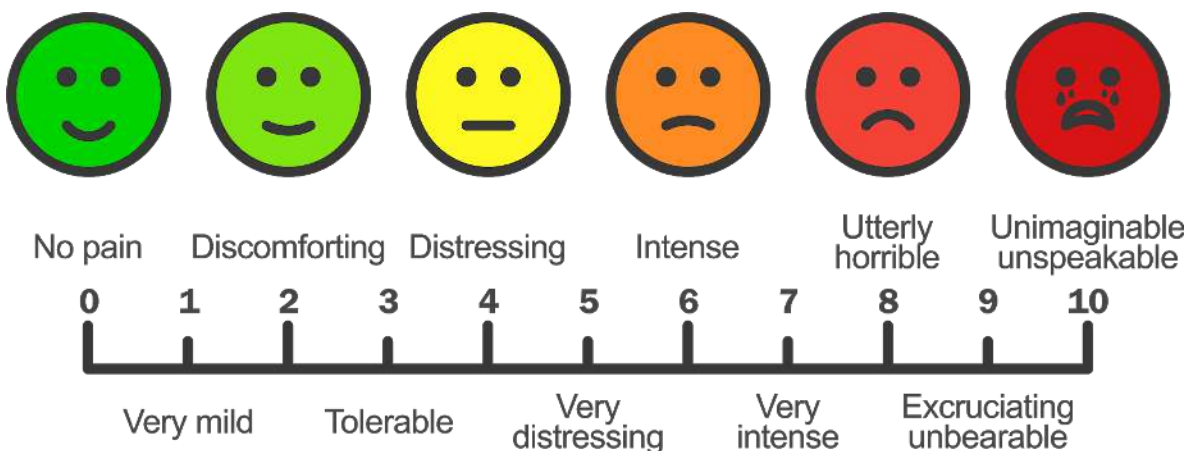
Email: _____ . _____ PH. Cell or Home () - _____ - _____

Contraindications for use:

Initial _____

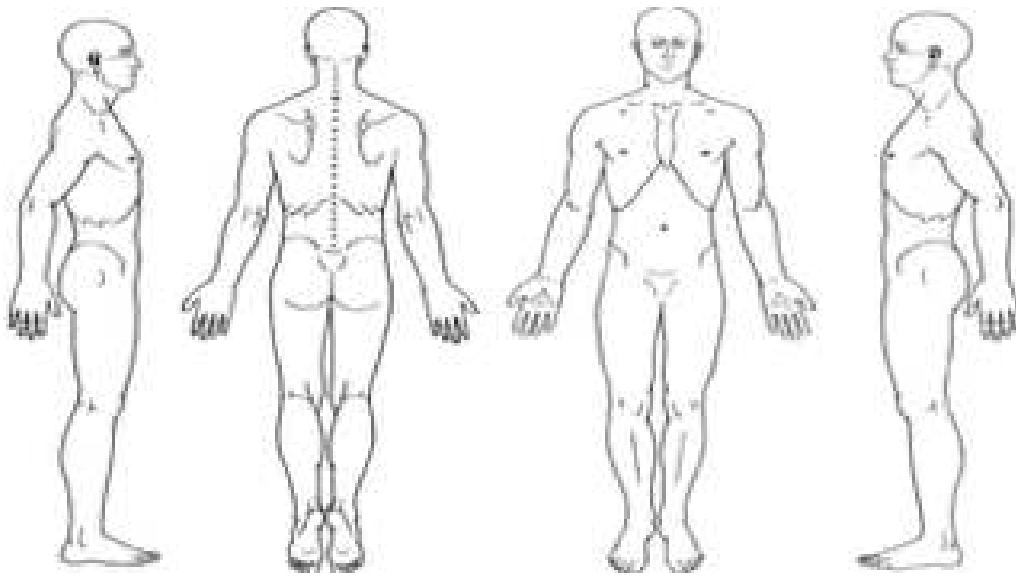
DO NOT USE IF YOU are pregnant, suspect you might be, or have implanted electronic devices.

This warning includes any implanted electronic devices such as pacemakers, defibrillators, and cochlear devices. The only absolute contraindication for use of a PEMF device / Frequency Specific Micro-current is placing an active applicator over implanted electrical devices like pacemakers, cochlear implants, intrathecal pumps, etc., because the magnetic field can shut the device off.



Use the above Pain Rating Scale to describe the level of pain, you perceive it to be. This pain scale is an excellent way to map your progress during PEMF (CE) session.

PEMF Cellular Exercise Session Tracker



Please circle or highlight the area (s) of issue or pain. Specify R for right, L for left or B for Both or Bilateral.

Brief Medical History: Only as it pertains to chronic/ acute pain issues:

Daily Activities:

Print Name _____

Sign Name _____

Date ____ / ____ / 20____

STAFF:

Print Name _____

Sign Name _____ Date ____ / ____ / 20____

PEMF Cellular Exercise Session Tracker

SESSION DATE:	SESSION TIME:	PAIN BEFORE:	PAIN AFTER:
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+
/ /	min.	1 2 3 4 5 6 7 8 9 10 10+	1 2 3 4 5 6 7 8 9 10 10+

BODY TARGETED:	ACCESSORIES USED:	PPS/MFS:	TIME:
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	
	Chair, Pad, Paddles, Rings, Bed	/	

Progress Notes: (Benefits, Decreased Pain, Increased ROM, etc.):

The word "PULSE" is rendered in a bold, blue, sans-serif font. It is centered against a dark blue background filled with a complex, glowing network of fine, interconnected lines that resemble a neural network or a web of energy. A faint, white, jagged line, similar to an ECG or pulse waveform, runs horizontally across the middle of the image, passing behind the letters.

PULSE

Pulse Centers Presents: PEMF Research Behind the Results

C O N T E N T S

What is Cellular Exercise?	3
Healing is Voltage	5
The Power of PEMF	5 - 8
How Does PEMF work?	9
'Zap' by Karl H. Schoenbach	10 - 17
'PEMF and Heart Disease' by Martin Milner	18 - 21
'Nanopulse' by Theofilos Kalabakas	22 -26

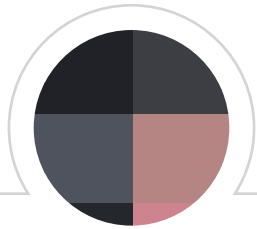
Disclaimer: The information presented in this booklet is for your information only and is not a substitute for professional health advice. The product(s) described in this booklet are not medical devices. They are not intended for the diagnosis, treatment or cure of any physical or medical condition. If you are experiencing symptoms of a physical or medical condition, you should seek the advice of your medical professional immediately.

Testimonials and quotes are the personal opinion of the authors, and based on their personal experiences; they are not intended as medical advice. Information and statements regarding these products have not been evaluated by the FDA and are not designed to diagnose, treat, cure or prevent any disease.

Cellular Exercise

is Pulsed Electromagnetic Field (PEMF) Therapy

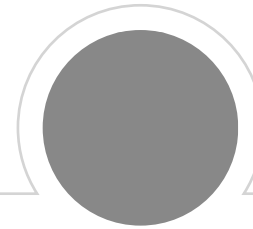
Thousands of research papers have been published on PEMF. Visit www.pubmed.gov and search for PEMF or visit www.pemfinfo.com for more information. Two respected doctors published numerous papers and books on the subject...



Jerry Tennant, MD, MD(H), PSc.,D

Author of "Healing is Voltage" states;

- All life is energy, and all energy is electromagnetic.
- The cells in the body require electricity.
- When the cells drop their electrical charge to a certain level, they become sick.
- The first sign of illness is usually pain.
- Chronic disease (pain) is always defined by low electrical charge.
- Concluding, "With enough voltage and raw materials, the body can heal almost anything."



Harold Saxton Burr, PhD

Professor of Anatomy at Yale University School of Medicine, published 93 papers on biological electricity.

- Burr discovered that measurable imbalances in the electrical field of an organ precede the onset of disease.
- If the electrical imbalance is corrected, the disease does not manifest.

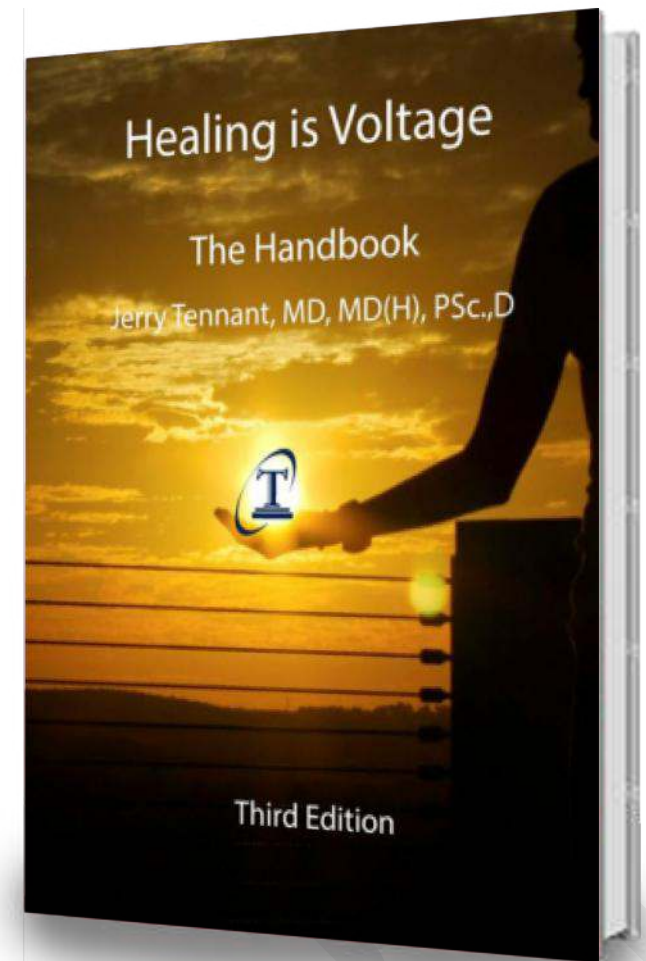
Healing is Voltage

Chapter 3 Summary Pg. 164

“The cells in the body are designed to run at -20 to -25 millivolts. To heal by making new cells, we must achieve -50 millivolts. We get chronically sick when voltage drops below -20 millivolts.

When voltage drops below -20 millivolts, we get chronic pain. In addition, oxygen levels drop since they are controlled by the voltage level. When oxygen levels drop, metabolism changes to where we only get two molecules of ATP instead of thirty-eight molecules per unit of fat processed. Cells struggle to function when they are getting ‘two miles to the gallon.’ In addition, the trillion or so ‘bugs’ that are in our bodies wake up when oxygen levels drop. They begin to ‘have lunch’ by putting out enzymes that dissolve our cells. These enzymes enter our blood and damage cells throughout the body.

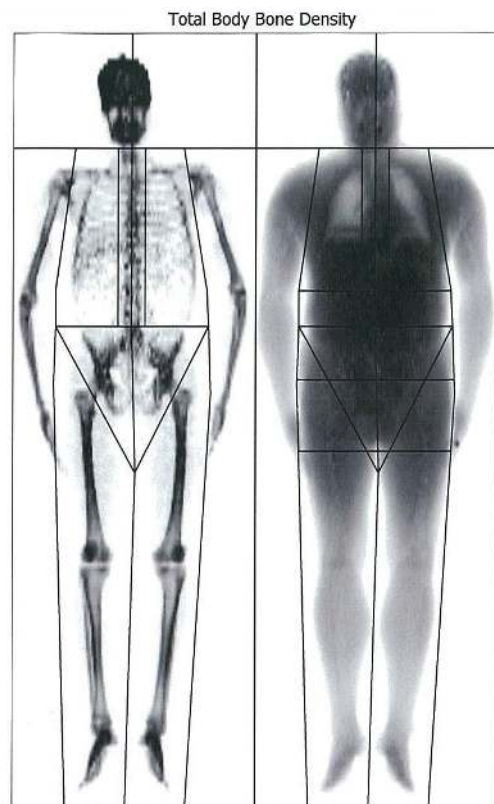
Thus chronic disease is always defined by low voltage.”



The Power of PEMF

Total Bone Density test of Pulse Centers founder

The Integrative Longevity Institute of Virginia conducted a Total Bone Density test of Paul Webb, founder of Pulse Centers. Paul uses the Pulse XL PRO system every day, logging thousands of hours on it over the years. The little square at the top of the grid are Paul's results, the highest percentile possible. Dr. Parker, MD, in 30 years of testing has never seen a perfect score before this test.



Integrative Longevity Institute of Virginia - ILIV

5041 Corporate Woods Drive; Suite 200

Virginia Beach, VA 23462

Patient:	Webb, Paul	Referring Physician:	L. Titus Parker
Birth Date:	05/23/1963 50.3 years	Facility ID:	
Height / Weight:	69.0 in. 203.0 lbs.	Measured:	09/12/2013 11:14:51 AM (12.30)
Sex / Ethnic:	Male	Analyzed:	09/12/2013 11:14:51 AM (12.30)

Total Body (Total) Results

BMD (g/cm²) ¹	1.450
T-Score (SD of young-adult BMD) ²	2.9
Z-Score (SD of age-matched BMD) ³	2.3

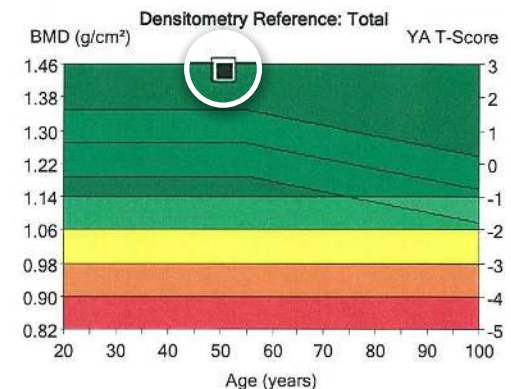


Image not for diagnosis

Printed: 09/12/2013 11:15:30 AM (12.30)76:0.15:153.85:31.2 0.00:-1.00
4.80x13.00 16.0:%Fat=30.2%
0.00:0.00 0.00:0.00
Filename: 04q0tmc2k.dfb
Scan Mode: Standard 0.4 µGy

1 - Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for Total Body Total)
2 - USA (Combined NHANES (ages 20-30) / Lunar (ages 20-40)) Total Body Reference Population (v112)
3 - Matched for Age, Weight (males 25-100 kg), Ethnic

Whole Body Assessment

Whole Body Assessment of Pulse Centers founder, Paul Webb. Dr. Martin Milner conducted a capacitance test.

Phase Angle is the measurement of your body's overall health; lower phase angles appear to be consistent with either cell death or a breakdown of the cell membrane. Higher phase angles appear to be consistent with quantities of intact cell membranes and body cell mass.

Capacitance, somewhat like phase angle, is a measurement of cell membrane health that can change dramatically depending on disease or good health. Paul tested 602 points above the norm (1574 vs 972). This is the highest capacitance score ever recorded.

"Using bioimpedance (body composition) equipment, I documented well above optimal levels of cellular capacitance in [Paul], who in his personal use has completed over 1,200 (as of 6/08) hours of high-intensity PEMF. In thousands of patients, over ten years of bioimpedance testing in my practice I have never recorded such high levels. These objective results are verification of the exceptionally enhanced ability of Paul's cell membranes to take in nutrients and remove waste products of metabolism."



Dr. Martin Milner

Center for Natural Medicine Professor, Portland OR

WHOLE BODY BALANCE ASSESSMENT

Body Composition and Nutritional Status, copyright 2000,

NAME: Paul Webb AGE: 45 IDEAL WT: 166
 DOB / ID#: (M) / F HEIGHT: 5'10"
 DATE: 6/19/08

	TEST #1	TEST #2	TEST #3	NORMS
BODY COMP				
% Fat	<u>15.1</u>	<u>17</u>		<u>17.6</u>
% BCM	<u>47.1</u>			<u>40.5</u>
% ECM	<u>37.8</u>			<u>41.9</u>
Fat lbs.	<u>29.5</u>			<u>21.1</u>
BCM lbs.	<u>92.4</u>			<u>48.6</u>
BMI	<u>28.1</u>			<u>27.49</u>
Weight	<u>196</u>			<u>166</u>
Exercise Level (0-4)	<u>1</u>			
Resistance	<u>326</u>			
Reactance	<u>54</u>			
FLUID BALANCE				
ICW	<u>67.5%</u>			<u>64.8%</u>
ECW	<u>32.5%</u>			<u>35.2%</u>
Total Body H ₂ O%	<u>63.7%</u>			<u>57.6</u>
CELLULAR HEALTH				
Capacitance	<u>1574</u>	<u>972</u>		<u>972</u>
Phase Angle	<u>9.2</u>			<u>8.2</u>
BMR	<u>2196</u>			<u>1781</u>
Daily Calories				
Other				
Other				

Normal body fat: Age 20-30 M 16-18% F 18-22% Age 40-50 M 20-30% F 25-35%
 Optimal Intracellular Fluids: Men 63%+ Women 60%+

FDA approved for bone growth

Dr. Blackman's amazing recovery

The FDA has approved PEMF devices for bone growth. Dr. Blackman's fractured arm is an example how 'high intensity' PEMF helped repair his arm in just 9 days (note European dates are day-month-year) to the point where there is no visible sign of any fracture remaining. Dr. Blackman is an owner of our PEMF Cellular Exercise system and practices in Amsterdam Netherlands.





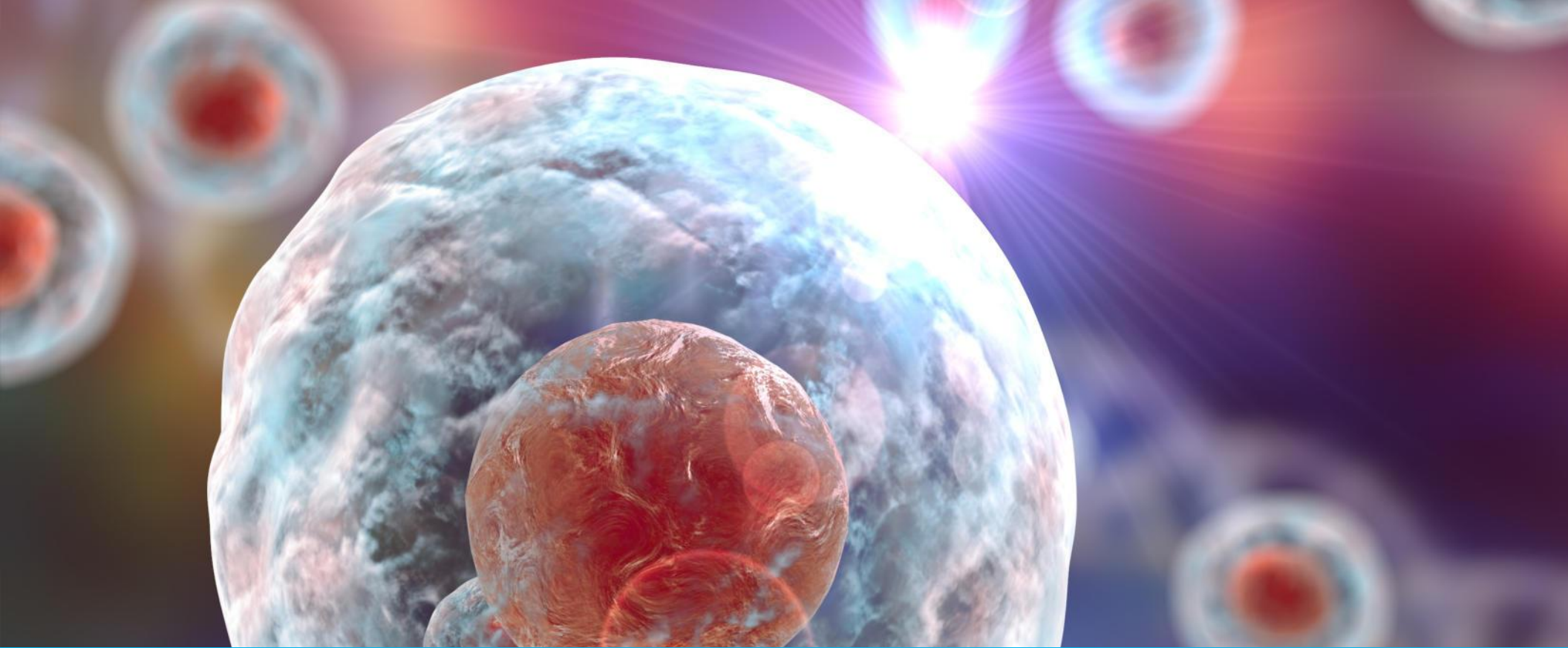
Electromagnetic augmentation of antibiotic efficacy in infection of orthopaedic implants.

Pickering SA1, Bayston R, Scammell BE.

Infection of orthopaedic implants is a significant problem, with increased antibiotic resistance of adherent 'biofilm' bacteria causing difficulties in treatment. We have investigated the in vitro effect of a pulsed electromagnetic field (PEMF) on the efficacy of antibiotics in the treatment of infection of implants. Five-day biofilms of *Staphylococcus epidermidis* were grown on the tips of stainless-steel pegs. They were exposed for 12 hours to varying concentrations of gentamicin or vancomycin in microtitre trays at 37 degrees C and 5% CO₂. The test group were exposed to a PEMF. The control tray was not exposed to a PEMF.

After exposure to antibiotic the pegs were incubated overnight, before standard plating onto blood agar for colony counting. Exposure to a PEMF increased the effectiveness of gentamicin against the five-day biofilms of *Staphylococcus epidermidis*. In three of five experiments there was reduction of at least 50% in the minimum biofilm inhibitory concentration. In a fourth experiment there was a two-log difference in colony count at 160 mg/l of gentamicin.

Analysis of variance (ANOVA) confirmed an effect by a PEMF on the efficacy of gentamicin which was significant at $p < 0.05$. There was no significant effect with vancomycin.



How Does PEMF work?

Bioelectrics Professors from Old Dominion University published numerous papers on the positive effects of nanosecond pulsed electromagnetic fields.

Discovered that powerful, ultrashort voltage pulses harmlessly slip past a cell's exterior to shock the vital structures within. The effects of such pulses on living tissue are profound and varied.

Zap

By Karl H. Schoenbach, Richard Nuccitelli, and Stephen J. Beebe

40 Thousand volts, four thousand amperes, and over one hundred million watts squeezed into a cubic centimeter. You'd think that would be enough to vaporize just about anything, and it certainly doesn't seem like the kind of electricity you'd want to apply to your body. But if our research continues to succeed as it has, years from now we'll be asking some cancer patients to do just that. And it might just save their lives.

The trick is to apply that gargantuan jolt for only a few billionths of a second. That's so brief a time that the energy delivered is a mere 1.6 joules per cubic centimeter—barely enough to warm a thimbleful of water by a third of a degree Celsius. **But these powerful, ultrashort voltage pulses do something nothing else can—harmlessly slip past a cell's exterior to shock the vital structures within.**

The effects of such pulses of power on living tissue are profound and varied. Malignant tumors—in mice, at least—can be completely wiped out, even by significantly lower power levels; new genes can be efficiently inserted into living cells in the hope of correcting genetic defects; and immune-system cells can be marshaled to fight off invading microbes.

A new field of research, Bioelectrics, is emerging to study these effects, as well as the naturally occurring electric fields in biological systems. Bioelectrics relies on a curious pairing of disciplines that until now have had almost nothing to do with each other: high-voltage engineering and cell biology. In particular,

the new field depends on advanced pulsed power technology. That's the ability to switch on and off thousands of amperes of current and just as many volts in **mere nanoseconds** (the kind of parameters needed to detonate nuclear bombs, it so happens).

The use of high voltages and currents to manipulate structures inside cells is barely five years old, but it is a fast-growing international research endeavor. The largest R&D program at the moment is being supported by the U.S. Air Force Office of Scientific Research, in Arlington, Va. That program supports work at a new center established jointly by Old Dominion University and Eastern Virginia Medical School, where we authors are working, as well as at several other institutions in the United States, including the Massachusetts Institute of Technology, the University of Texas Health Science Center, the University of Wisconsin–Madison, and Washington University. Progress in this program has already sparked interest and some excellent science at academic institutions in Japan, China, and the state of California. And more institutions, notably in the UK, France, and the state of Missouri, are planning bioelectrics research.

It's easy to see the attractions for biologists and for engineers. For biologists, it's the potential scientific payoff: these strong but exceedingly brief electric fields act as a kind of electrical probe, letting scientists prod key structures inside cells—making the cells expel certain vital chemicals or begin the production of others—with the aim of understanding basic biological processes. For engineers, it's the opportunity to forge an important new application of pulsed power technology, which even 10 years ago was seldom used outside the military.

The most promising and practical result so far has been our recent discovery that certain pulsed electric fields can wipe out skin tumors in mice. Melanoma, the skin cancer we've worked with, is an extremely aggressive disease that kills about 8000 people a year in the United States alone. A few hundred pulses

totaling just 120 microseconds of treatment shrank tumors in mice by 90 percent. A second treatment, days later, destroyed the tumors completely.

Biomedical science is, of course, littered with cancer cures that work in mice but fail or are impractical in humans. And it will be many years before we know if bioelectrics will even be worth testing in humans. Nevertheless, even at this early stage, bioelectrics seems to offer a totally new therapeutic avenue—one that could lead to a therapy free of the debilitating side effects of chemotherapy drugs and the tissue damage of radiation.

To understand what happens when a cell is hit with tens of thousands of volts, and why it may help cure disease, you have to know something about cells themselves. At its simplest, **a cell is a pocket of water containing a bunch of small functional units called organelles, which are bounded by oily membranes. These organelles are the cell's version of internal organs: they perform the functions that keep the cell alive, just as the brain, kidneys, and lungs, among other organs, keep the body alive.**

Cells do the things they need to do—contract if they are muscle cells, sense light if they are retinal cells, transport oxygen if they are blood cells—because they produce proteins with specialized functions. The creation of proteins begins in the nucleus; the cell's most prominent and arguably most important organelle. It houses the cell's fantastically complex genetic programming apparatus, which lets the cell repair itself and tells it how and when to reproduce, what to do when it detects a particular hormone, and how and when to die. Errors in these genetic programs go to the heart of most of the diseases suffered by humankind. These errors can predispose a person to heart disease, cancer, schizophrenia, and countless other maladies.

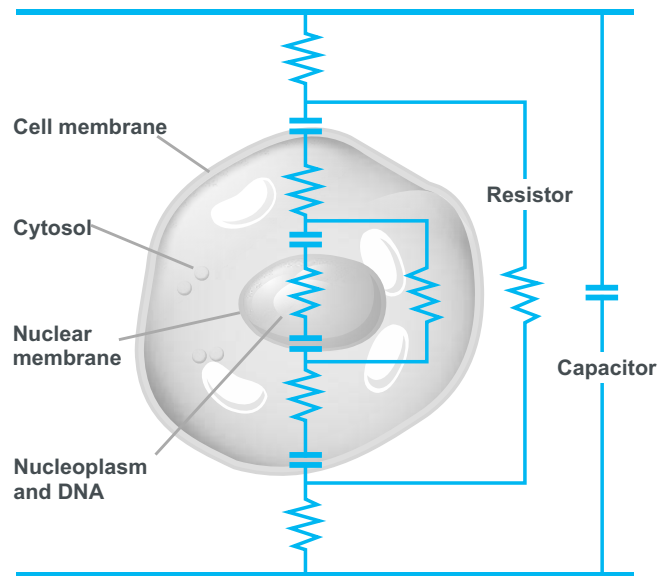
The programs are written into your genetic code. This code exists physically as a set of 23 pairs of chromosomes that reside in the nucleus. Each chromosome is a rod-shaped or threadlike structure

of deoxyribonucleic acid, or DNA, made up of a sequence of four chemical building blocks. The sequence of these building blocks—there are tens of millions of them on a single chromosome—is the code, and the “words” of this code are genes. In effect, genes are segments of a chromosome's DNA. They are groups of many thousands of building blocks that encode a specific protein, with each chromosome containing thousands of genes.

These genes are the blueprints for the proteins that determine whether you have brown or blue eyes, whether your hair is straight or curly, whether you are tall or short, and whether you are likely ever to suffer from depression, schizophrenia, or cancer. That's why gaining control of what goes on inside the nucleus—which genetic programs are turned on or off and when—has been a primary goal in biomedical science practically since the discovery of the structure of DNA about 50 years ago. It is the object of the long-standing, multimillion-dollar research endeavor called gene therapy, which after decades of work in some of the world's foremost laboratories has had mixed results.

Basically, **our work with nanoseconds-long, high-voltage pulses offers a way to gain access to the cell's organelles, including its nucleus—something that has historically bedeviled biomedical scientists. Remember that the cell and its organelles are bound by membranes. The main component of these 5-nanometer-thick boundaries is called a phospholipid bilayer. It is an oily barrier that blocks the flow of water and ions and therefore also blocks the flow of electric current.**

However, the membranes are also studded with proteins, some of which form nanometer-scale channels designed to allow specific ions to flow in a direction useful to the cell. In a way, a cell's membranes are like leaky capacitors. (Some, such as the one surrounding the nucleus, leak more than others.) To extend this analogy, the briny fluid within the membranes, the cytosol, is conductive and can be thought of as a resistor **[see illustration].**



Cellular Circuit: A cell can be thought of as a circuit made up of capacitors and resistors. Its membrane and those of its organelles, such as the nucleus, act like capacitors. The briny liquid encased within the membranes, the cytosol and nucleoplasm, is conductive and so can be modeled as resistors.

Now consider what happens when you apply a pulse to the cell. In general, there are four important characteristics that determine the precise effects. These are how fast the pulse comes on, or its rise time; how long the pulse lasts; how many pulses there are; and, of course, how great the peak voltage is. Different values for each produce a range of effects, but it's a very fast rise time that makes it possible to electrically manipulate organelles.

To see why rise time is critical, imagine a long voltage pulse applied to the cell that comes on rather slowly, in milliseconds. This slow-rising pulse will set up an electric field across the cell membrane. In response, ions dissolved in the cell's cytosol will stream to the cell membrane, charging it up to counteract the

applied field. Because the voltage is rising rather slowly, the ions have enough time to accumulate at the cell membrane and cancel out the electric field, thereby shielding internal structures, such as the nucleus, from the voltage.

Now, as with any capacitor, if too much charge gathers at the cell membrane, the electric field there breaks the membrane down. In a cell, this means large holes, or pores, form in the membrane and allow ions to pour across, short-circuiting the cell. This effect is called **electroporation**, appropriately enough, and it is generally reversible and even useful. Scientists hoping to kill tumors more efficiently, use electroporation experimentally, for instance, to increase the amount of chemotherapy drugs that tumors take up. In fact, San Diego-based Inovio Biomedical Corp. is in the late stages of clinical tests on such a cancer treatment for tumors of the head and neck.

To manipulate a cell's internal structures, we want instead to generate a strong electric field inside the cell, and do it before too much charge has accumulated at the cell membrane and turned it into Swiss cheese. Take the case of a brief pulse with a fast rise time, reaching its full force in a matter of nanoseconds. With so brief a rise time, not enough ions will have time to reach the cell membrane to counteract the sudden electric field, so the nucleus and other organelles will feel the field's full effect.

For pulses with a fast rise time, then, the electric field charges up the membranes of both the cell and its organelles. Generally, the cell's plasma membrane doesn't fully charge to the point where large pores form in it until it's been exposed to at least a microsecond and typically tens of microseconds of voltage. Because the organelles are much smaller than the cell itself, however, they reach their maximum charge much more quickly. Ending the pulse after the organelles are charged up, within a few hundred nanoseconds but before large pores appear in the cell's own membrane, lets you focus the electric field's effects on the organelles,

such as the nucleus, while leaving the cell membrane relatively untouched. That, in turn, lets you do the complex and varied things medical science is interested in, such as killing tumor cells or triggering an immune system response.

This new ability to electrically tweak a cell's insides would not exist without pulsed power technology: generating, measuring, and using extremely high-power electric pulses. Developed initially to power radar in World War II, pulsed power technology now drives X-ray imagers, particle accelerators, and nuclear weapons, to name a few applications.

The kinds of pulses that work best in bioelectrics are simple rectangular waves. There are a few ways to make such a pulse. The simplest is to discharge a capacitor. Provided that the time it takes the capacitor to discharge is long in comparison to the length of the pulse, you get a roughly rectangular pulse. The problem is that the pulse length is determined by the closing and opening of a switch. And no high-voltage mechanical switch can open and close in the few nanoseconds we need.

Certain types of transistors can do the trick, but they can switch only 1 kilovolt or less, and we usually need 10 kilovolts or more. Switches that can handle that kind of voltage can reliably close in just nanoseconds, but they can't open so quickly.

What's needed is a way to separate the length of the pulse from the speed of the switch. A transmission line pulse generator does just that. In electric power, transmission lines are generally paired conductors, such as coaxial cables, that are long in comparison to the wavelength of the signal they carry. In particular, we make use of transmission line generators in a Blumlein configuration, named for the British stereo recording and radar pioneer Alan Blumlein.

Picture two long rectangular conductors sandwiching a thin layer of insulation "Power Pulse" One conductor is divided into two pieces of equal length, and the load—in our case, a small tube of

cells or a patch of tumor-riddled skin—is placed between them. The other conductor is charged up because it's connected at one end to a high voltage. And the bisected conductor is grounded at the same end.

A Blumlein generator produces brief high-voltage pulses when electromagnetic waves change polarity and collide.

Closing a switch connects the two conductors, discharging the device and setting up waves of voltage that rocket along it [see bioelectric researcher Juergen F. Kolb's animated clip of the waves in the online version of this article at www.spectrum.ieee.org/blumlein]. These waves travel in a way not unlike a wave that you'd set up on a length of rope by holding one end and snapping it.

When the switch closes, waves travel both toward and away from the load. For those initially traveling toward the load, some portion reflects off it, and the rest transmits right across it. For those waves traveling away from the load—including the portions that have now transmitted across—what happens depends on which end of the device they encounter.

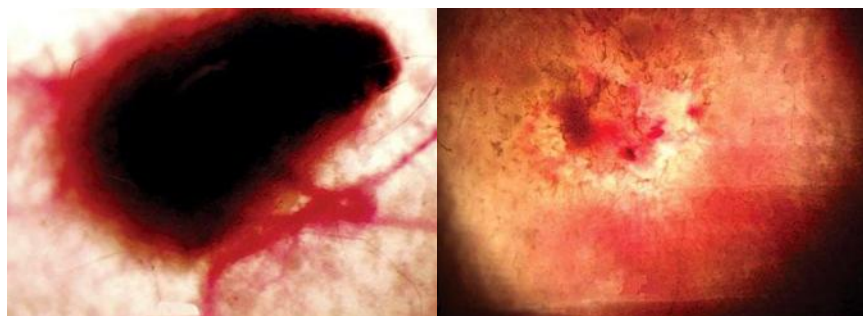
Taking the rope analogy again, note that if you send a wave down a rope, the wave will reflect off the end and head back toward you. If the end is hanging loose, the reflection will be of the same phase as the initial wave. That is, if the voltage change was positive, the reflection will be, too. But secure the loose end and the wave will invert when it reflects. The unsecured rope is analogous to the end of the transmission line opposite the switch. The secured end, on the other hand, is like the end at the closed switch.

The voltage pulse comes about when the inverted reflection and the non-inverted reflection crash into each other at the load. The pulse ends when the trailing edge of each wave has completed its trip down the transmission line to the load. Therefore, it is not necessary to open a switch to terminate the pulse; it simply ends

abruptly when there is no energy left in the line. What's more, you can easily adjust the duration of the pulse by either adding or subtracting length from the transmission line.

So what happens to a cell when you zap its innards with so much power? We're still working out the biological details, but experiments using cancer cells suspended in liquid or even growing as tumors in mice have yielded a good deal of insight.

In our most recently reported experiments, we injected melanoma cancer cells under the skin of 120 mice and allowed tumors to form [see photo].



Diminished: A skin tumor in a mouse before [left] and 16 days after [right] treatment with nanoseconds-long pulses of voltage.

Images: Frank Reidy Research Center for Bioelectrics

We then used a Blumlein pulse generator to subject the tumors to electric field pulses 300 nanoseconds long—too short to cause classical electroporation—that reached 90 percent of their peak of 40 kilovolts per centimeter in just 30 ns. We hit the tumors with a total of 400 pulses, one every other second. Over the course of two weeks, the tumors shrank by 90 percent. Then they began to grow again. But in a few experiments, we subjected the tumors to subsequent sets of pulses, and they were destroyed completely and did not grow back.

We believe our ultrashort electric pulses killed the tumor cells by kick-starting a cellular phenomenon called apoptosis, but proving that theory beyond a doubt is difficult. Apoptosis is also called cell suicide or programmed cell death. In apoptosis the cell disassembles itself in an orderly fashion in minutes or hours, leaving behind only fragments useful as recycling material for the body. It is a process that allows the removal of cells that are no longer needed by the organism or of cells that pose a threat to it. As part of the apoptosis system, cells can sense if they are too badly damaged to reproduce correctly. **Almost by definition, in cancers, the apoptosis system is off-line, allowing a dangerously aberrant cell not only to survive but also to multiply.**

We saw two nearly immediate effects of the pulses in the mouse tumors that could indicate apoptosis. First, within just a few minutes, the tumor cell nuclei had shrunk to half their original sizes, suggesting that the electric field had either directly or indirectly damaged the cell's DNA.

Also, separate experiments done on cells in a liquid suspension showed that similar pulses resulted in broken DNA and that genetic programs involved in DNA repair became more active in the pulses' aftermath. DNA damage can trigger apoptosis, but such damage also occurs during apoptosis. However, a classic experiment to prove that apoptosis is in progress, measuring the amount of a chemical called caspase in cells, showed no change and no apoptosis.

We think that's because of the second immediate effect we observed: within minutes of treatment, blood stopped flowing to the tumor. It takes energy for a cell to kill itself—in other words, apoptosis can't happen without a steady supply of nutrients and oxygen from the blood. Though we don't know the exact reason blood stops flowing, stopping the flow is clearly helpful in destroying tumors. Malignant tumors can grow to dangerous proportions only because they have the ability to trick the body

into growing new blood vessels to feed them. Developing drugs to starve tumors by disrupting their blood supply and their ability to build a new supply is a major goal of many pharmaceutical firms. And it appears that **disrupting the blood supply is something that nanoseconds-long pulsed electric fields can do.**

A key measure of how useful a cancer treatment might be is if it is more harmful to tumors than to normal tissue. When we shocked vials containing both cancer cells and normal cells, the pulses killed only the cancer cells. However, in the mouse experiments, our pulses did some damage to healthy skin surrounding the mouse tumors. But this blackening was temporary, and within a couple of weeks, the skin had healed. Minor tissue damage is common in cancer therapies. In fact, most treatments, such as chemotherapy, are damaging to tumors and healthy tissue alike, but they rely on the fact that healthy tissue has working genetic programs that allow it to survive the chemical attack and tumors do not.

We are probably years away from performing a similar test of ultrashort high-power pulses on human cancer patients. But even if those tests are successful, there will be many hurdles to overcome for nanosecond pulsed electric fields to become a viable treatment in the clinic. For one thing, we must be able to deliver gigawatts of power accurately to sites deep within the body—not just at the skin surface where we can pinch the tumor between two parallel plates or poke it with pin electrodes. And we must be able to do so with little or no harm to the surrounding healthy tissue.

So this summer we are working with antenna expert Carl E. Baum, at the University of New Mexico, in Albuquerque, to build a device to let us beam the pulses at cells deeper inside the body. When pressed against the skin, such a pulse generator's half-ellipsoid antenna should focus an electric field pulse to a small volume several centimeters inside the body. The antenna is only at the modeling stage, but using our existing laboratory equipment we

have begun to examine what sorts of pulses it would create and what those pulses would do to living cells.

For the time being, though, and notwithstanding the fact that we've made a lot of progress observing the effect of this high-voltage treatment on tumors in mice, we know far too little about it now to move on to experiments in humans. It's important to keep in mind that the majority of new therapies that show promise in the lab never develop into approved treatments. We hope nanosecond pulses will, but the road ahead will be twisty and difficult.

Cancer cells are just one target of ultrashort pulsed electric fields. By lowering the power and altering their target, for example, we can also use the pulses in gene therapy. For instance, in proof-of-principle experiments, we used the pulses to insert new genes into chromosomes in the nuclei of cells—one of the key challenges of gene therapy.

For various reasons, the enormous potential of gene therapy has largely eluded medical researchers. Basically, the techniques have proven difficult for physicians to execute and dangerous for patients subjected to them. A prominent example of gene therapy in humans was a trial in Europe in the 1990s to treat severe combined immune deficiency syndrome. Commonly called "bubble boy" syndrome, the disease is caused by an inherited defect in a single gene, which cripples the body's defense against infection.

To combat the disease, doctors introduced a corrected copy of the gene into the nuclei of the children's immune-cell-generating tissue. Encouragingly, the therapy defeated the disease, but unfortunately, three of the first 11 patients developed leukemia, caused by the way the new gene inserted itself into their existing DNA. Despite the setbacks, medical scientists have not given up on gene therapy for bubble-boy syndrome and are also trying it out for nerve damage from diabetes, heart failure, hemophilia,

and a host of other diseases.

Another reason to insert new genes into people is to immunize them against a particular disease. Ordinary vaccines provide immunity because they are made up of crippled or dead versions of a disease-causing microbe. Exposure to a neutered version of the microbe enables our immune systems to recognize the chemical characteristics of the weakened microbe and to mount a fast, effective defense against the real version. However, the vaccine must be refrigerated, and if the microbe is not weakened enough—and this only very rarely occurs—it can cause rather than protect against the disease.

Partly because of these drawbacks, researchers have become intrigued with the idea of injecting a person with the DNA that codes for one of the infectious bug's proteins. Some of the person's own cells take up the DNA, produce the protein, and trigger the immune system to learn to recognize and defend against any microbe carrying that protein.

Among the chief technical difficulties with these DNA vaccines, as well as with gene therapies, is getting the DNA into cells. Simply injecting a dollop of DNA into someone is not good enough, because the cell membrane is such a strong barrier against DNA. One popular solution is to actually genetically engineer the DNA into a virus. Viruses infect us by "sneaking" their genetic material through the cell membrane and tricking the cell into copying it. So scientists have sought to include the DNA they want into harmless viruses, with which they then infect the patient in the hopes that the virus will deliver the new gene to the place it needs to go.

The problem is that the virus can stitch the new gene into a bad spot in the cell's own DNA, disrupting an important chemical program and causing disease, as happened when the immune-deficient children developed leukemia. Or the virus itself can cause a runaway immune system reaction that can kill the patient,

as seems to have happened in a gene therapy trial several years ago at the University of Pennsylvania, in Philadelphia.

Pulsed electricity may offer a safer solution. First we can use strong, but rather long-lasting, electric fields to induce electroporation, the state we mentioned earlier in which the cell's outer membrane temporarily becomes porous. This works, to a point, because although the new DNA can now enter the cell, it must still get past the nucleus's membrane for the cell to decode it.

Because the ultrashort pulses we've worked with appear to affect subcellular membranes, such as the double membrane that bounds the nucleus, we figured they might help genes make it through that last step of their journey by opening pores in the nuclear membrane. As a test, we tried to insert a certain gene from a jellyfish into bone marrow cells in a test tube. If this gene makes it into the nucleus and is decoded, it produces a protein that glows green.

By itself, electroporation improved the amount of the gene that was taken into the cells' nuclei by 260 percent, as measured by the number of cells glowing and the strength of the green glow. But following electroporation with a nanoseconds-long pulse aimed at opening the cells' nuclei increased gene uptake by a whopping 900 percent—potentially enough to improve the efficiency and safety of gene therapies or DNA vaccinations.

The list of effects that scientists have achieved using nanoseconds-long pulses is growing rapidly, though their actual use as a medical treatment is still years away. For example, brief pulses cause platelets, cellular fragments in the blood, to begin the complicated cascade of steps needed to form clots. Though the experiments were performed in a test tube rather than on a human being, we hope the effect might one day be used in healing wounds.

In other research, E. Stephen Buescher, a professor of pediatrics at Eastern Virginia Medical School, did a fascinating set of experi-

ments with white blood cells that also might ultimately help heal wounds. In it, he observed the effect of ultrashort pulses on the release of calcium inside cells from internal stores. Calcium acts as a kind of signal transducer in many cells, translating an external signal such as a hormone into some cellular action, such as manufacturing a protein.

In a type of white blood cell whose purpose is to seek out foreign material and digest it, for example, the release of calcium allows the cell to follow an invader's chemical trail. When Buescher subjected these cells, called leukocytes, to nanoseconds-long, 12-kV/cm electric fields, the cells immediately, but briefly, spilled calcium from their internal stores into their own cytosol. In experiments where the cells were actively crawling over a microscope slide, hot on the simulated trail of an invader, pulsing stopped them in their tracks and then sent them marching off in the direction of the electric field. One day doctors might use such an effect to recruit immune cells to the site of an infection.

The list of cells and the effects of pulsed power on them goes on and will only get longer as more laboratories begin work in bioelectrics. Scientists at Kumamoto University, in Japan, for example, are studying the subcellular effects of high-power RF pulses. **Those at Karlsruhe University, in Germany, are testing nanopulses for killing bacteria.** And researchers at the University of Southern California are studying how the pulses cause dying cells to signal other cells to consume them. Whether or not pulsed power becomes a cancer treatment, a gene therapy technology, or an infection fighter, ultrashort electric fields have already proved a powerful research tool. And the mark they ultimately make on medicine may be in allowing scientists unprecedented access to the internal workings of cells.

Still, we hope for more practical—and potentially lucrative—possibilities. While treatments for cancer and genetic diseases would be revolutionary, somewhat more prosaic applications are in the offing. We at Old Dominion University have recently used nano-

second pulsed electric fields to destroy fat cells. Think of it as electric liposuction. Hey, if it helps pay for the research needed to fight dread diseases, we're all for it.

About the Authors

Karl H. Schoenbach, an IEEE Fellow, holds the Frank Batten Endowed Chair in Bioelectric Engineering at Old Dominion University, in Norfolk, Va. There he directs the Frank Reidy Research Center for Bioelectrics.

Richard Nuccitelli is a biophysicist at Frank Reidy who has studied the role of ion currents and ion concentration changes in the regulation of cell physiology for 30 years. He was the lead investigator on the melanoma project.

Steven J. Beebe is a faculty member in the department of physiological sciences and pediatrics at Eastern Virginia Medical School, in Norfolk, and is on the staff at Frank Reidy. He has studied mechanisms for signal transduction and apoptosis regulation for decades.

Acknowledgments

The authors would like to thank Peter F. Blackmore, E. Stephen Buescher, Ravindra P. Joshi, Juergen F. Kolb, and R. James Swanson.

To Probe Further

Proceedings of the IEEE devoted its July 2004 issue to pulsed power technology and its applications. The issue includes a more detailed look at bioelectrics: "Ultrashort Electrical Pulses Open a New Gateway Into Biological Cells," by Karl H. Schoenbach et al., pp. 1122–37.

For more on the effects of nanosecond pulses on cell biology, see "Nanosecond Pulsed Electric Fields Modulate Cell Function Through Intracellular Signal Transduction Mechanisms," by Stephen J. Beebe et al., *Physiological Measurements*, Vol. 25, 2004, pp. 1077–93.

For the latest on the authors' experiments on melanoma, see "Nanosecond Pulsed Electric Fields Cause Melanomas to Self-destruct," by Richard Nuccitelli et al., *Biochemical and Biophysical Research Communications*, 5 May 2006, pp. 351–60.

PEMF and Heart Disease

Reversal of a Case of Advanced Coronary Artery Disease with Unstable Angina Using Pulsed Electromagnetic Field (PEMF) Cellular Exercise

by Martin Milner, ND

It is wonderful to both the patient and physician when, after years of failed trials in both conventional and alternative medicine, a safe, natural method of cellular exercise makes dramatic change in a case of serious chronic disease. This case is an extraordinary example of reversing end-stage coronary artery disease with pulsed electromagnetic field cellular exercise (PEMF). The case also elucidates critical monitoring and decision-making horizons throughout patient management.

The Case

SH, a 65-year-old, very pleasant white Caucasian female, presented to our clinic with advanced coronary artery disease, diabetes, hypertension, and obesity. Her cardiac history began in 1996, when she went into cardiac arrest and was successfully defibrillated and brought back to life. She did lose sensation in two of her toes at discharge from this hospitalization. This loss of sensation was presumed to be a complication of chest defibrillation. During this hospitalization, significant ischemic heart disease was diagnosed on cardiac catheterization, and two stents were deployed into the left anterior descending and right circumflex coronary artery.

Progression to Advanced Coronary Artery Disease

As time progressed, her disease advanced, and a second angiogram involved the deployment of a third stent in her left

anterior descending coronary artery. Her ischemic heart disease progressed further, and in 2005 she underwent three vessel coronary artery bypass graft surgery where the LAD stents were bypassed along with bypass surgery of the left circumflex and bypassing a new occlusion in the right anterior descending coronary artery. At the time of this hospitalization, she was diagnosed with non-insulin-dependent diabetes mellitus and hypertension. Her diabetes advanced, and she became insulin dependent in 2008.

Cardiac Selective Beta 1 Blocker Affecting Asthma

SH began seeing me in January 2006. At that time, her biggest concern was to be able to reduce her prescription drug load. She had a history of asthma and was being prescribed atenolol for hypertension. Even though atenolol is a cardiac-selective beta 1 blocker, it may aggravate asthma in sensitive patients. Recall that beta 1 cardiac-specific blockers do not affect beta 2 receptors and in general do not exacerbate asthma, unlike beta nonselective blocking drugs such as propranolol. The uncommon effect of beta 1 blockers' aggravating asthma may be due to their tendency to reduce sympathetic tone overall beyond the heart causing bronchial constriction.

Drug Side Effects and Gradual Weaning of Atenolol

Additional side effects that she was experiencing included leg

cramps from Lipitor and a dry cough from lisinopril. She was taking bioidentical hormones via her obstetrician. Through 2006 she was very gradually weaned off Atenolol over a six-month period. She experienced great difficulty getting off the last 6.5 mg, with rebounding rapid heart rate. It is important to always wean any cardiac arrhythmic or coronary artery disease patients off beta blockers gradually. The rebounding tachyarrhythmia induced by too-abrupt weaning can be life threatening. Once we successfully brought her down to 6.25 mg, her asthmatic breathing resolved. Apparently, in this patient, the cardiac specificity of Atenolol crossed over and somehow affected beta 2 adrenal receptors in the bronchial tubes, aggravating her asthma.

Modifiable Metabolic Markers of Heart Disease

Our initial work-up included a comprehensive profile of modifiable metabolic markers of heart disease, including a lipid panel with lipoprotein A and lipid fractionation, homocysteine, CRP-HS, fibrinogen, and bleeding time. Her homocysteine had not been formerly measured and was 11.4 in January 2006, reduced to less than 6 since June 2006 with routine homocysteine-lowering B vitamin therapy, including B6, B12, and folic acid.

Advanced Coronary Artery Disease Progressing to Congestive Heart Failure, then Remitting

This first year of management also focused on better control of her hypertension. However, she developed progressive unstable anginal chest pain at rest. An April 2007 angiogram reveals severe obstructive disease involving a nonrevascularized diagonal branch of the LAD with the native bypass graft unchanged. A high-grade distal lesion at LAD evolved into worsening chest pain.

Continuous Nitrate Prescribing Adjustments from Arginine to Isosorbide

During SH's enhanced external counterpulsation (EECP) treatment, the referring cardiologist in collaboration with our office adjusted the nitroglycerine management. I had initiated the pre-

scribing of arginine 900 mg, 2 t.i.d. with gamma-tocopherol 200 IU, b.i.d. in March 2007. This was unsuccessful in controlling chest pain and was discontinued in September 2007. Concurrent nitrate therapy was added with isosorbide dinitrate ER, 40 mg q.d. in April 2007 to further aid in the management of her ischemia and unstable chest pain at rest. This was increased to 40 mg b.i.d. and ultimately one every six hours after arginine was discontinued in September 2007 to adequately control her progressing unstable chest pain at rest. At this point, SH was completely disabled, with unstable chest pain at rest with no activity.

Most ratings of coronary artery disease disability follow the following table from the New York Heart Association.

New York Heart Association (NYHA) Cardiac Disability Rating Scale:

- I = no symptoms
- II = symptoms with ordinary activities of daily living
- III = symptoms with less than ordinary activity
- IV = symptoms at rest

End Stage Coronary Artery Disease

It doesn't get any more disabling than persistent unstable angina at rest. Having failed EECP and progressing to unstable angina with extensive prior CABG (coronary artery bypass graft) and stent deployments, conventional as well as alternative medicine interventions seemed to be used up. Although intravenous chelation was discussed, I questioned its ability to improve end stage disease and suggested we begin a trial of pulsed electromagnetic field (PEMF) cellular exercise.

Living Cells Are Direct Current Systems: Treating the Electrical Cause of Disease

Our living cells are electrical direct current (DC) systems. In fact, all life generates an electrical DC charge. This natural charge is

created by the movement of ions in and out of cell membranes, creating and maintaining a membrane charge of approximately 70 mV. Any challenge to the cell, such as oxygen/ nutrient deficiency, toxicity, tissue changes, or inflammation alters ion movement, and the charge on the cell membrane changes. This altered charge profoundly affects metabolic nutrition into and waste products out of the cell.

Pulsed Electromagnetic Field Cellular Exercise

PEMF takes alternating current (AC) and transforms it into DC, producing variations ranging from low to high voltage. This voltage is passed through a coil, generating a safe, pulsed magnetic field around the coil. As the magnetic field is pulsed on, electrons are excited, and cells exposed to the magnetic field are exercised and expanded. The electrically charged cell membrane is gently pulled by the pulsing magnetic field, and the matter as well as the space around matter is recharged. On the off phase of the pulse, the cells relax. This is profoundly beneficial cellular exercise and cellular rehabilitation. As cells expand and relax, they rehabilitate, ion movement improves, and the membranes' electrical charge begins to return to optimal. As cells recharge themselves, they heal and return to optimal function. High-intensity PEMF is not a medical device in the US. It simply produces a pulsed magnetic field of varying strengths functioning as a cellular exerciser. It is not intended for the treatment, diagnosis, or prevention of any disease or condition.

Recovery of Toe Paresthesia After One Session

We started using PEMF with SH in June 2008. After the first session of approximately 10 minutes over her chest and heart, she fully regained the sensation in the two toes of her left foot that had permanently lost sensation for the last 12 years. This lack of sensation has not returned as of this writing (February 2010). While this may sound miraculous, it actually makes sense, since it was hypothesized that the defibrillation during her cardiac arrest

induced the nerve damage. PEMF could very well recover that nerve damage. Nerve and heart cells are both extraordinarily ionically sensitive cell structures and respond exquisitely to the cellular exercise of a pulsed magnetic field.

Remission of Unstable Angina at Rest

SH continued with PEMF session of 30 to 60 minutes two to three times a week. She became able to perform activities of daily living without chest pain after the first month of PEMF and was no longer experiencing chest pain at rest. Her isosorbide dose was lowered from three times daily back to twice daily. Her BNP dropped from a high of 699 to 126 by December 2008, confirming resolution of ischemic heart failure. Partial Relapse Followed by Remission She experienced a partial relapse with reduction of PEMF sessions from three times weekly to once weekly. However, upon purchasing her own machine in June 2009 and increasing the sessions to one to two hours daily, her ischemia improved further. She improved again to the point of never getting chest pain at rest or with mild activities of daily living. She was able to mildly exercise without chest pain, and her BNP was low at 134 as of July 2009.

Toward the end of December 2009 and thereafter, the patient upgraded her PEMF machine with enhancement in its pulse pattern. There were no other changes in her health-care regime. A BNP in Feb.

2010 came back very low at 63, indicative of further improvement in heart failure from the new pulse upgrade to the PEMF machine. She remains well as of this writing (February 2010) with no unstable chest pain episodes at rest.

Brain Natriuretic Peptide (BNP) as a Marker of CHF

SH developed congestive heart failure in April 2007 due to advanced coronary artery disease verified with a mild elevated BNP of 342 pg/mL. BNP levels are the best blood marker for

heart failure. For patients with heart failure, BNP values will generally be above 100 pg/mL. A BNP above 100 pg/mL has a sensitivity of 90% and specificity of 76% for heart failure. A more conservative interpretation of the BNP is a normal value less than 50 pg/mL with a diagnostic “gray area” between 100 and 500 pg/mL, for which the test may be considered inconclusive. Values above 500 pg/mL are generally considered to be positive for heart failure. This gray zone has been addressed in several studies referenced below. It is best to combine BNP findings with clinical history, physical signs, and symptoms of heart failure along with periodic echocardiogram findings to aid in stratifying diagnostic severity. We were able to pull her out of heart failure for the entire second half of 2007 with levels well below 100 pg/mL.

Date	BNP pg/mL
May 2007	315
June 2007	699 Definitive ischemic CHF
July 2007	319
Aug. 2007	44
Oct. 2007	61
Dec. 2007	31

BNP levels were brought to a low of 31 pg/mL in December 2007 using bed rest (essential in unstable heart failure), an array of nutritional support, no or minimal Atenolol, and a referral for concurrent 45, one-hour, EECF treatments from July 2007 through January 2008. While SH was better during the EECF sessions, she quickly relapsed after completion of the 45th session, and just three months later she developed a recurrence of heart failure in April 2008 with a BNP of 291 pg/mL.

Date	BNP pg/mL
April 2008	291 relapse a few months after EECF
Oct. 2008	233 PEMF started 1-3 times weekly July 2008
Dec. 2008	126

Apr 2009	180
Jul 2009	134 PEMF sessions increased to daily June 2009
Oct. 2009	250
Nov. 2009	229
Feb. 2010	63 out of heart failure after one month of PEMF with upgraded technology

Conclusion

A review of the electrophysiological effects of pulsed electromagnetic fields and the presentation of this case compel the reader to consider PEMF as one of greatest hidden breakthrough technologies of cellular exercise and cellular rehabilitation of the last century. Over 5,000 studies have been published worldwide over the last 40 years. It definitely warrants further investigation.

Full Disclaimer

Pulsed electromagnetic fields (PEMF) are generators that produce a DC pulsed electromagnetic field of varying strengths delivered via insulated cables. No current of any kind comes into contact with the body. The magnetic field energy produced at the cable passes freely through living tissue for the purpose of cellular exercise to promote and support a sense of well-being. It is not a medical device. It has not been evaluated by the FDA. It is not intended for the diagnosis, treatment, or cure of any physical or medical condition. If you are experiencing the symptoms of a physical or medical condition, you should seek the advice of a medical professional before using PEMF as a form of cellular exercise.

About Dr Millner

Dr. Milner received his ND from National College of Natural Medicine in 1983. He has remained at his alma mater for the past 23 years as professor of cardiovascular and pulmonary medicine. Dr. Milner is also the CEO and medical director of the Center for Natural Medicine Inc. (1983–present) in Portland, Oregon. CNM is in its 11th year providing a clinical training ground for naturopathic medical student interns and resident doctors, supervised by Dr. Milner. He is well published in endocrinology, cardiology, pulmonology, oncology, and environmental medicine. Dr. Milner cofounded BioMagnetic Relief LLC, dedicated to researching pulsed electromagnetic field as a form of cellular exercise.

**See back cover for article references*

Nanopulse

Dr. Panos Pappas is often credited with creating the first commercial high-voltage PEMF therapy system.

Below is a report from Theofilos Kalabakus detailing the PAP-IMI machine as well as a letter from the University of Agriculture in Athens on the use of the PAP-IMI on plants.

What is the *Nanopulse PAP-IMI therapy system*?

Nanosecond, electropulse, impulse (the medical term is nanopulse)

The *Nanopulse PAP-IMI therapy system* is a medical ion induction therapy system certified by the German safety standards authority TÜV. It is used to promote therapeutic and regenerative processes, especially in case of injuries, edema, and even serious diseases such as cancer, and to relieve pain.

In addition, it has been successfully used for performance enhancement and performance maintenance in the fields of health and sports.

There is also evidence that the *Nanopulse PAP-IMI therapy system* especially boosts the immune system of the body, which is an outstanding result considering there are no side-effects.

The *Nanopulse PAP-IMI therapy system* was developed by the physicist and mathematician **Prof. Dr. P. Pappas** from Greece at the beginning of the nineties of the 20th century. Based on an induction pulse generator, which originates from research on nuclear physics, the device produces a voltage of 40,000 V. The energy

produced is transferred via a tube to a plastic ring in the form of magnetic fields. From there, it exerts a gentle effect on the treatment area of the human or animal body through the application of cyclic nanosecond pulsed electric fields (nanopulses).

These magnetic fields penetrate about 20 cm into the body.

According to **Faraday's Law**, the cells are exposed to the different forms of energy mentioned below by the conversion of magnetic fields into cyclic nanopulses/impulses in an extremely short time of about 1/1,000,000 s.

This extremely short time prevents temperature changes or genetic cell changes and, thus, adverse side effects or aftereffects from occurring.

The forms of energy resulting from nanopulses are the following:

- **Working energy** (ensures the provision of energy to the functional circuits of the cell)
- **Combustion energy** (conversion of glucose to ADP & ATP)
- **Information energy** (coordination of the different functions of the cell)
- **Transformation energy** (integration and transformation of electromagnetic signals)
- **TMP (Transmembrane Potential) energy**
- **Energy for growth** (form and function)
- **Specific energy** (molecular composition of the tissue)

The balance between these various forms of energy, which is normally produced by the mitochondria (powerhouses of the cells), ensures the maintenance of optimal cell function.

If the balance of these energy forms is disturbed or disrupted,

the *Nanopulse PAP-IMI therapy system* may decisively contribute to the recovery of optimal cell function. For scientific research results, please visit: <http://bit.ly/2bvFu5e>

It is known from experience that these various energy forms have the following positive effects on human and animal organisms:

- Stimulation of the production of enzymes and hormones
- Increase in cell membrane potential
- Increase in the permeability of the cell membrane for ions
- Increased DNA and RNA synthesis
- Increased protein synthesis
- Increased production of collagen
- Optimized cell growth and cell differentiation
- Better immune response against bacterial infections
- Increased formation of red blood cells
- Improvement of the immune system
- Increased formation of antibodies in the spleen
- Increased production of prostaglandins
- Activation of the ion metabolism
- Stimulation of the production of cellular energy via the ADP/ATP system

The Ski World Champion *Hermann Maier* benefited from the advantages of the *Nanopulse PAP-IMI therapy system* using expert help from his orthopedic and other specialists. His spectacular comeback provides evidence for the efficiency of the *Nanopulse PAP-IMI therapy system*, not only in the therapeutic treatment of nerve and muscle tissue and bones after his serious accident, but also in the field of performance enhancement and performance maintenance after successful

rehabilitation and his return to competitive sport. According to the opinion of physicians, the efficiency of this therapy is mainly due to the dynamic effect of nanopulses inside the body of *Hermann Maier*.

The German press wrote:

The following is a list of the documented advantages resulting from the treatment of athletes and sport horses with the *Nanopulse PAP-IMI therapy system*:

- Considerable reduction in the periods of physical inactivity in athletes and horses with injuries through the stimulation of therapeutic and regenerative processes (the period of therapy is about six times shorter compared with conventional therapies)
- Stabilization of the general training condition and of the horse's condition for the race through regular energy supply.
- Performance increase and maintenance through continuous energy supply by regular application of the Nanopulse PAP-IMI therapy system

In the last six years, researchers in medical sciences have assigned a special and clearly defined role to nanopulses in the treatment and cure of diseases.

Research studies indicate that the Nanopulse technology can be used as an **all-purpose or universal technology** for the treatment of any organic disease and, therefore, positively contributes to the effort of any physician to cure a disease.

As of 2004, most medical scientists who used the Nanopulse technology in their studies spoke about the necessity of developing a system that allows the application of nanopulses not only to the body surface but also within the body.

The patented and TÜV-certified medical *Nanopulse PAP-IMI therapy system* was launched early in 1990. Through the production of magnetic fields, the *Nanopulse PAP-IMI therapy system* generates nanopulses, which are a kind of all-purpose or universal therapy inside the body.

Since then, the inventor of the *Nanopulse PAP-IMI therapy system*, Prof. Dr. P. Pappas, has conducted a statistical analysis of the results obtained from 1,100 subjects treated with the *Nanopulse PAP-IMI therapy system* worldwide, and has entered the results into a database for analysis.

The statistical analysis and its positive treatment results refer to about 390 different conditions and diseases and to especially innovative medical results (for details, please visit: www.papimi.gr and www.papimi.com).

The results from a clinical study conducted by a research team headed by the physician Prof. Tom Vernier from the University of Southern California in Los Angeles (please see study by Vernier PT, Sun Y, Gundersen MA 2006: Nanoelectropulse-driven membrane perturbation and small molecule permeabilization, BMC Cell Biol 7,37) demonstrate that nanopulses represent a universal medical therapy that make ulcers and fat tissue shrink and wounds heal exceptionally fast (New Scientist 2004).

In addition, the team found that healthy cells are not destroyed. Instead, enzymes are activated that cause malignant cells to self-destruct.

According to the statistical analysis of Prof. Dr. Pappas, all physicians and other users who treat their patients with the *Nanopulse PAP-IMI therapy system* confirm that:

- Pain of any kind, be it acute or chronic, is effectively reduced (e.g., inflammations, swellings, edema)
- The self-healing forces of the body are stimulated, which

is, for example, reflected in an increase in the cell's membrane potential and an increase in immune stimulation and antibody formation, leading to more vitality and performance.

- No temperature changes, genetic cell changes, or other adverse effects or aftereffects occur as a result of the use of the *Nanopulse PAP-IMI therapy system* in humans or animals.

In the last years, numerous scientific studies have shown very positive results regarding the effect of nanopulses.

- Simulation studies of ultrashort, high-intensity electric pulse induced action potential block in whole-animal nerves. Joshi RP, Mishra A, Song J, Pakhomov AG, Schoenbach KH. IEEE Trans Biomed Eng. 2008 Apr;55(4):1391-8. PMID: 18390330 [PubMed- indexed for MEDLINE] Related Articles

Result: Nanopulses have a positive effect on neuromuscular disorders.

- Nanosecond pulsed electric fields induce apoptosis in p53-wildtype and p53-null HCT116 colon carcinoma cells. Hall EH, Schoenbach KH, Beebe SJ. Apoptosis. 2007 Sep;12(9):1721-31. PMID: 17520193 [PubMed - indexed for MEDLINE] Related Articles

Result: Nanopulses make colon carcinoma cells shrink and induce necrosis in these cells. In addition, they have a similar therapeutic potential as radiation therapy, but without its adverse effects.

- Subcellular effects of nanosecond electrical pulses. Schoenbach KH, Joshi R, Kolb J, Buescher S, Beebe S. Conf Proc IEEE Eng Med Biol Soc. 2004;7:5447-50. PMID: 17271579 [PubMed] Related Articles

Result: Nanopulses enhance the activity of genes and have a positive effect on the function of healthy cells.

- **Nanosecond pulsed electric fields cause melanomas to self-destruct.** Nuccitelli R, Pliquett U, Chen X, Ford W, James Swanson R, Beebe SJ, Kolb JF, Schoenbach KH. Biochem Biophys Res Commun. 2006 May 5;343(2):351-60. Epub 2006 Mar 10. PMID: 16545779 [PubMed - indexed for MEDLINE] Related Articles Free article in PMC | at journal site

Result: Nanopulses penetrate skin tumor cells and make melanoma shrink by over 90% within two weeks.

- **Nanosecond pulsed electric fields modulate cell function through intracellular signal transduction mechanisms.** Beebe SJ, Blackmore PF, White J, Joshi RP, Schoenbach KH. Physiol Meas. 2004 Aug;25(4):1077-93. PMID: 15382843 [PubMed - indexed for MEDLINE] Related Articles

Result: Nanopulses may both regulate cell function and enhance the capability of the cells to regenerate.

- **Selective field effects on intracellular vacuoles and vesicle membranes with nanosecond electric pulses.** Tekle E, Oubrahim H, Dzekunov SM, Kolb JF, Schoenbach KH, Chock PB. Biophys J. 2005 Jul;89(1):274-84. Epub 2005 Apr 8. PMID: 15821165 [PubMed - indexed for MEDLINE] Related Articles Free article in PMC | at journal site

Result: Nanopulses stimulate intra- and extracellular calcium homeostasis.

- **Diverse effects of nanosecond pulsed electric fields on cells and tissues.** Beebe SJ, White J, Blackmore PF, Deng Y, Somers K, Schoenbach KH. DNA Cell Biol. 2003 Dec;22(12):785-96. PMID: 14683589 [PubMed - indexed for MEDLINE] Related Articles

Result: Nanopulses reduce fibrosarcoma tumors in mice in vivo and have a positive effect on the activity of healthy cells.

The following is an account of my own outstanding experience with the Nanopulse PAP-IMI therapy system.

I received the diagnosis of serious locomotor problems by the orthopedic specialist Dr. A. Bendas, who explained to me the underlying causes of my chronic pain.

In spite of all medical measures taken, my pain, which had lasted for several years, persisted. Therefore, medical specialists suggested two surgical procedures:

a) one to be performed on the spine and

b) another to be performed on the right shoulder blade because my shoulder was at risk due to ankylosis (stiffening of a joint)

The unexpected therapeutic effect of the Nanopulse PAP-IMI therapy system achieved by the delivery of nanopulses deep into my body allows me today to move without pain and without undergoing surgery.

In 2000, I was diagnosed with cardiac arrhythmia in a cardiology practice, which would have required the urgent placement of a catheter. However, my type II diabetes was expected to worsen my heart condition. Therefore, I had to take antihypertensive medications for many years.

In 2006, a new cardiologic examination was made in the same cardiology practice. It showed that my heart condition had stabilized.

My blood pressure, too, has returned to normal. The intake of antihypertensive medications is no longer necessary.

These improvements are also due to the effect of the Nanopulse PAP-IMI therapy applied inside my body.

This account clearly demonstrates the savings that my statutory health insurance company (HEK) has gained from this treatment. The costs of the following procedures were saved:

- **Spine surgery**
- **Operation on the right shoulder (ankylosis)**
- **Heart catheter**
- **No further antihypertensive treatment**
- **Prostate surgery**

This spectacular device called *Nanopulse PAP-IMI therapy system*, which generates nanopulses inside the body, was invented and launched worldwide by Prof. Dr. P. Pappas.

Please note: The specifications of the *Nanopulse PAP-IMI therapy system* cannot be compared to those of electromagnetic pulse devices offered on the market.

©Copyright by Theofilos Kalabakas
Consultant & Manager

** The diagnoses mentioned above will be readily made available to you upon request.*

UNIVERSITY OF AGRICULTURE IN ATHENS DEPARTMENT OF
VEGETATION/PLANTS IERA ODOS STR. 75 - 118 55 ATHENS

From:

PROFESSOR P.G. EFTITHIADES
Phone: 210-529 44 86
Fax: 210-970 02 35
e-mail: efthymiadis@ana.gr

To:

Dr. Panagiotis Pappas

Prof. ATEI ATHENS

Athens, April 21, 2003

Dear colleague,

It is with special delight that I take this opportunity to present to you today the results of our eight-year-long research conducted by our research team at the University on the *PAP-IMI* device. The research was focused on the effect of the magnetic field on plant development, and resulted in the award of five intermediate examination certificates and in a doctoral thesis. All research studies were awarded excellent grades by a three-person committee.

- The results from our research are as follows:
- The magnetic field promotes growth and quality of the seed.
- It accelerates plant growth.
- The good quality of the seed can be recovered and enhanced.
- It brings sick plants back to a healthy state so that the production of plants can be increased with respect to quality and quantity.

After continuous treatment of the plants with magnetic fields (60 minutes per day during a 30- day period), no genetic changes were observed.

No laboratory assistant who used the device had temporary or chronic health problems. On the contrary, one coworker with rheumatic problems experienced improvement of the symptoms.

Yours sincerely,

P. Efthimiades



The science presented in this brochure, as well as other research and the practical application throughout the years, is the foundation of Pulse Centers PEMF technology.

We recognize all PEMF based on this science is good for the user, but what sets our technology apart from others is our ability to adjust frequencies, intensities, and our unique accessories for maximizing PEMF benefits.

To learn more visit www.pulsecenters.com

References:

Atisha D, Bhalla MA, Morrison LK, et al. A prospective study in search of an optimal B-natriuretic peptide level to screen patients for cardiac dysfunction. *Am Heart J.* September 2004;148 (3): 518–523.

Brenden CK, Hollander JE, Guss D, et al. Gray zone BNP levels in heart failure patients in the emergency department: results from the Rapid Emergency Department Heart Failure Outpatient Trial (REDHOT) multicenter study. *Am Heart J.* May 2006;151(5):1006–1011.

Bibbins-Domingo K, Gupta R, Na B, Wu AH, Schiller NB, Whooley MA. N-terminal fragment of the prohormone brain-type natriuretic peptide (NT-proBNP), cardiovascular events, and mortality in patients with stable coronary heart disease. *JAMA.* January 2007;297(2):169–176.

Fitzgerald RL, Cremo R, Gardetto N, et al. Effect of nesiritide in combination with standard therapy on serum concentrations of natriuretic peptides in patients admitted for decompensated congestive heart failure. *Am Heart J.* September 2005;150(3):471–477.

Jerabek J, Pawluk W. *Magnetic Therapy in Eastern Europe: A Review of 30 Years of Research.* Rancocas, NJ: W. Pawluk; 1999.

Malmivuo J, Plonsey R. *Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields.* Oxford University Press; 1995.

Strunk A, Bhalla V, Clopton P, et al. Impact of the history of congestive heart failure on the utility of B-type natriuretic peptide in the emergency diagnosis of heart failure: results from the Breathing Not Properly Multinational Study. *Am J Med.* January 2006;119(1):69.e1–11.

www.BioMagneticRelief.com – link to worldwide research



{ energize your life }

www.pulsecenters.com

34 Center Rd. Cartersville, GA. 30121 T: 770.334.2226 E: info@pulsecenters.com