

Introducing Bursting Air Bubbles Shockwaves Induced Piezoelectric Effect as Additional Factor in Extracorporeal Focused Very Intense Pressure Pulse Cancer Cells Treatments

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Abstract

Introduction: The purpose of this manuscript is to introduce newly found electrical properties of bursting cavitated air bubbles sound waves interacting with eukaryotic cells. Presented are *in vitro* observations from video microscopy of the layered disruption in laminar flows of human liquid saliva samples caused by the arrival of a moving sound shockwave. Imbedded eukaryotic cells are observed being lifted, thus losing their optical sharpness (changing depth of focus). Implications of bioeffects on cancer cells caused by an induced piezoelectric effect of bursting bubbles sound shockwaves are introduced.

Materials and Methods: Human saliva drops were placed on a glass slide and covered by a similar one. Sequential microphotographs of video frames are introduced in two separate experiments before and after sound shockwaves arrival. Video recordings and still microphotographs obtained and digitally stored for subsequent evaluation.

Results: In this manuscript, the arrival of a bursting air bubble sound shockwave induced very intense pressure wave (VIPP) coinciding with a transient light ray detected by a sentinel air bubble was noticed. The VIPP is also documented altering the existing liquid saliva laminar flow equilibrium; this was evidenced by visual changes on the microscopy images sharpness of epithelial cells and other solutes coinciding with the progress of the VIPP. Cited in this report similar results from previous published experiments documentation visible light energy arising from VIPP.

Discussion: VIPP has been described to induce mechanotransduction bioeffects on eukaryotic cells. The microscopic image resolution in the *in vitro* experiments herein presented did not allow observing for impairment of the bilayer membrane. Instead, in this manuscript, documented are displays of visual light radiation (electrical charges) detected in a floating air bubble caused by an arriving VIPP. Previously published experiments by this author support the herein reported piezoelectric finding as follows: Correctly attributing the blurry images of cells to laminar flows changes, light emission by lipid droplets, demonstration of dried saliva proteins emission of induced electrical activity by VIPP; and the penetration of an VIPP secondary wave inducing light rays.

Keywords: Sound Shockwaves; Cancer Treatments; Cell Signaling; Cells Permittivity; Laminar Flow Disruption; Sound Shockwave Piezoelectricity; Cancer Cells Apoptosis

Introduction

The purpose of this manuscript is to introduce newly found electrical properties of bursting cavitated air bubbles oscillating sound waves interacting with eukaryotic cells. Presented are *in vitro* observations from video microscopy of the layered disruption in laminar flows of human liquid saliva samples caused by the arrival of a fast moving sound shockwave [1] (Figure 1). Imbedded eukaryotic cells are observed being lifted, thus losing their sharpness (focusing) (Figure 2-5). Due to the presence of collagen, compressed tissue can generate electrical changes when squeezed [2], thereby Implications of an electrical piezoelectric effect on cancer cells caused by extracorporeal focused very intense pressure pulse (VIPP) is introduced. Of relevancy also is the property of low permittivity of cancer cells. Low permittivity is defined as the ability to resist an electrical field [3,4]. Molecular mechano-transductions and the generation of electrical charges by the piezoelectric effect are discussed in the setting of VIPP claims in cancer cure treatments [5-8].

Figure 1: Demonstration of laminar flow in equilibrium showing floating oxygen bubble in saliva adhered epithelial cells. Red Arrow= Air bubble. Orange Arrows= Epithelial cells floating in same plane as air bubble. Black Arrows= Free moving cells below surface, not deformed by oxygen bubble effect. For further details please link to: <https://youtu.be/orMTRmUqwQc> or scan QR Code on right upper quadrant.

Figure 2: Initial microphotograph from video recording of air bubble floating in liquid saliva showing: Dark arrow= Undisturbed air bubble. X= Control size bubble center. Dark orange arrow= Cheek cell in focus. Left black arrow= Out of focus cheek cell in deeper laminar flow. For additional details please link to: <https://youtu.be/gCg65sUymN8> Or scan QR Code in right corner of image.

Figure 3: Stage 1. Arrival of sound shockwave piezoelectricity demonstrated by light beam reaching bubble. Black arrow= Pointing at light beam now reaching bubble. Dark orange arrow= Cell now showing initial reversal of laminar flow. Left black arrow= Cell also showing initial reversal of laminar flow. X= Air bubble center now starting to dilate. For additional details please link to: <https://youtu.be/gCg65sUymN8> Or scan QR Code in right corner of image.

Figure 4: Orange arrow= Light ray on bubble is now a flat line. Black arrow= Pointing at new air bubble illuminated external surface. Orange Arrow=The light beam is now flat. X= Bubble inner core undergoing expansion/contraction. Orange black arrow= Laminar flow disruption (cell now out of focus). Left black arrow= Reversal of laminar flow (cell now in focus). Both cells and bubble changing vertical plane (no lateral cells displacement yet). Cells out of focus, theorized cause is the arrival of the shockwave leading edge. For additional details please link to: <https://youtu.be/gCg65sUymN8> Or scan QR Code in right corner of image.

Figure 5: Main shockwave arrived. Highlighted black arrows= Sudden lateral displacement of cheek cells by arriving shockwave. Black Arrow= Pointing at illuminated bubble external edge + light beam now a flat line. Left black arrow= Shockwave has arrived altering the laminar flow spatial arrangement and laterally displacing cheek cells. X= Change in bubble inner and outer core. For additional details please link to: <https://youtu.be/gCg65sUymN8> Or scan QR Code in left corner of image.

Materials and Methods

Main author's saliva drops were placed on a clean 25 x 75 x 1 mm glass slide and covered by a similar slide; this assembly was dubbed a sandwich (SDW). Video recordings and still microphotographs were obtained by a video microscope (Celestron, LCD model # 44348 Torrance California, USA) and digitally stored for subsequent evaluation in an Apple Mac Book computer with apple Inc. iPhoto 8.1.2. Application. These images were compared with changes caused by the arrival of an unseen bursting air bubble sound shockwave. Video Images were obtained via a video-microscope Celestron, LCD model # 44348 Torrance California, USA; and digitally stored in an Apple Mac Book computer with apple Inc. iPhoto 8.1.2. Application for subsequent evaluation.

Results

Air bubbles, eukaryotic cheek cells and debris were observed floating in discreet laminar flow layers after liquid saliva drops on a slide was covered by another slide. This slide assembly is referred as a sandwich or (SDW). Bursting air bubbles are known to create a VIPP, a.k.a. Air Bubble Sound Shockwave; therefore, in the *in vitro* experiments the arrival of VIPP is documented by seen uplifting changes in the liquid saliva discreet laminar flows central axis. This was inferred by changes in optical sharpness (loss of focus). The experiments $n = 2$ quoted in this manuscript show the presence of light indicative of an electrical phenomena. In This phenomenon had been observed and reported in previous experiments (Exhibits I, II, III, IV, V and VI).

Discussion Inferred shockwave arrival

It could be argued that in Figures 2 through 5, the actual site of the origin of the shockwave was not shown, that the resulting shockwaves effects are only inferred. The findings are supported by the process of inference accepted by the scientific community;

for example in Astronomy this technique is commonly used i.e. The presence of unseen planets could be inferred by abnormalities in the orbital motion of distant stars [9].

Sound shockwave arrival and piezoelectricity

In physics the term “piezoelectricity” implies an electric charge that accumulates in certain solid materials (such as crystals, certain ceramics, and biological matter such as bone, DNA and various proteins) in response to applied mechanical stress. The term piezoelectricity means electricity resulting from pressure [10]. As a note of interest it was discovered by the brothers Curie Jacques and Curie Pierre [11].

The images presented in figures 2 through 5 describe and support the observations stated in this manuscript.

Prior publications correlating air bubble bursting sound shockwave and piezoelectricity

Besides the *in vitro* experiments introduced in this manuscript, this author and others have documented via different techniques the correlation of air bubbles bursting shockwaves and piezoelectricity.

The exhibits I through VI are graphic examples of the piezoelectric effect of sound shockwaves on:

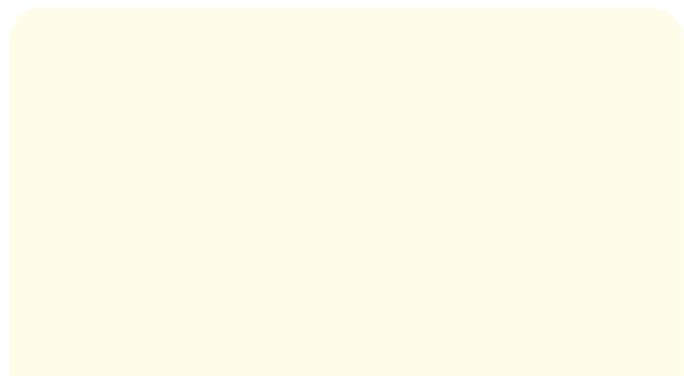


Exhibit I: Intact air bubble sandwiched between two glass slides. The black line delineates the dry (evaporated) side from the wet (liquid saliva). Image reproduced from: Cite This Article: Abraham A. Embi Bs MBA. (2019) [16].

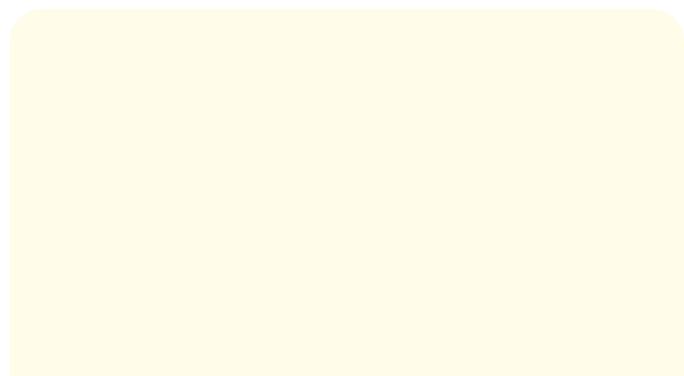


Exhibit II: Unpublished video frame photograph recorded immediately after the bursting of oxygen bubble shown in Exhibit I above. Note the temporary induced light effect from the shockwave penetrating across the evaporation line in the SDW (black line).



Exhibit 3

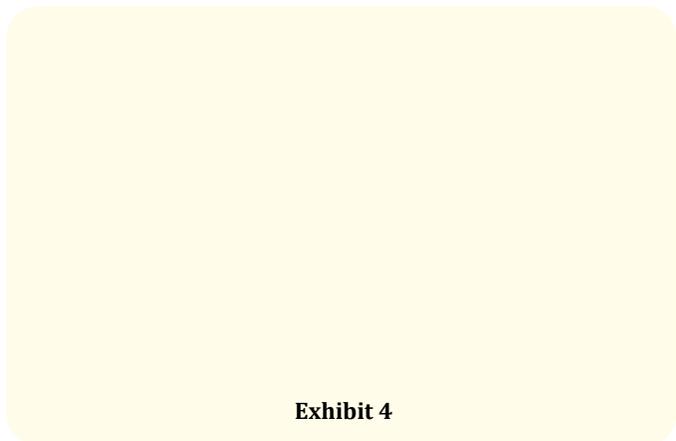


Exhibit 4

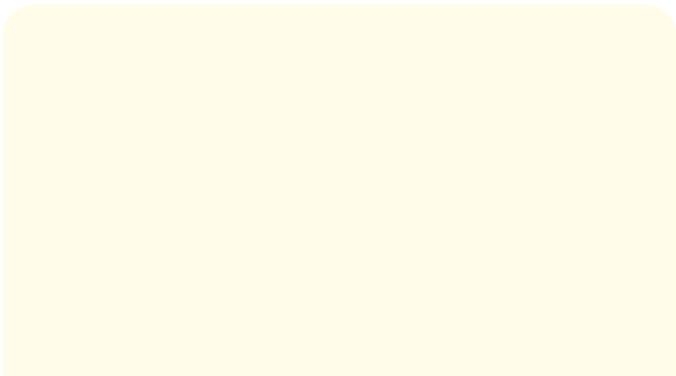


Exhibit 5: Demonstration of energy from bursting oxygen bubbles causing saliva crystals (proteins) to express electrical discharges. Image duplicated from: Reproduced from: Embi AA. (2019). “Introducing in vitro experiments of oxygen bubbles shockwaves triggering intracellular lipids luminescence: implications in cancer etiology”. *IJGR* 7(4), 355-364. <https://doi.org/10.5281/zenodo.2667714>. Details by scanning QR Code below: or linking to: For additional details, please link to: <https://youtu.be/pVYQD64PB-o>

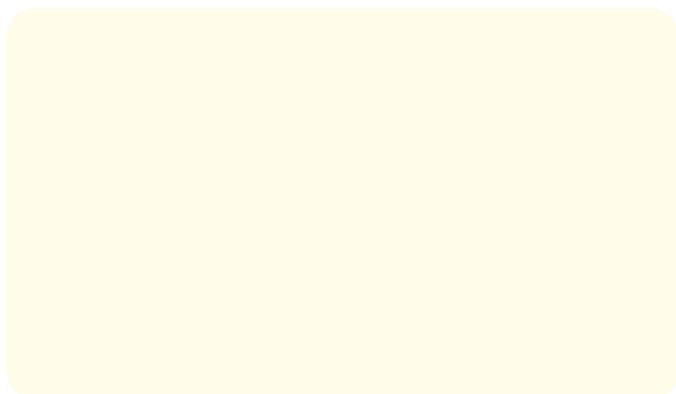


Exhibit 6: Selected frames from video recording showing human DNA precipitates fibers and lipid droplets in SDW affected by arriving sound shockwaves (SSW). Panel A: Control Panel B= Post SSW. Black arrow lipid droplet luminescence. Orange arrows= Showing air bubbles changes.

Reproduced from: Embi AA. (2019). "Introducing in vitro experiments of oxygen bubbles shockwaves triggering intracellular lipids luminescence: implications in cancer etiology". *IJGR* 7(4), 355-364. <https://doi.org/10.5281/zenodo.2667714>. Details by scanning QR Code below: or linking to: For additional details, please link to: <https://youtu.be/pVYQD64PB-o>

Exhibits I, II: Sequential video frames showing the sound shockwave inducing a piezoelectric effect from a bursting bubble penetrating a dry field in the sandwiched slide assembly. The sequence of events caused by in an underwater bubble bursting has been previously reported [12-14].

Exhibits III, IV, V: Demonstrating the shockwave inducing piezoelectricity as documented in dry saliva proteins crystals. In these examples, the illumination of the structures was caused by a sound shockwave. A water plume was not involved in the process.

Exhibits VI: A demonstration of energy transfer from the piezoelectric effect of bursting sound shockwaves into intracellular lipid droplets from precipitated DNA samples.

Summary and Conclusions

In this report, the origin of a light ray seen detected by a sentinel air bubble was demonstrated to be from the inherent uplifting energy of an unseen bursting air bubble in a liquid (saliva). Important to note that the bursting bubble was sandwiched (trapped) between two glass slides. *In vitro* experiments also show via video-recordings that the arrival of a VIPP induces two effects on eukaryotic cells and lipid droplets, namely a physical one by causing deformations [15,16]; and a piezoelectrical one caused by laminar flow changes causing cells compressions. There have been claims to a "Cancer Cure" by bombarding tumors cells with "very intense pressure pulses". Supporting that claim, listed in the literature are multiple papers reporting the anti-cancer effect of a VIPP both in vitro and In vivo on human cancer cell lines. For example laminar shear stress reducing bladder cancer motility [17], effects on

HeLa-cells cellular membranes permeability via sonoporation [18] acoustic shockwaves on chlorogenic growth of tumor cells [19], enhancing of chemotherapeutics effect [20], and possibly by promoting cells apoptosis by activating mechanosensitive Piezo 1 Channels amongst others [21]. The introduction of an induced piezoelectric effect from bursting bubbles shockwaves a.k.a. VIPP is introduced. A literature review and research results herein introduce piezoelectricity emitted by sound shockwaves as a possible new factor in cancer cells apoptosis.

Cancer and bioelectricity

It has been proposed that "our body is full of electricity that could help us fight cancer... and reprogramming a cell's electricity could provide an alternative to standard toxic cancer drugs and their unpleasant side effects [22]. This is supported by the concept of the "Bioelectric Code" described as "an important mechanism by which cellular networks implement pattern regulation and plasticity. All cells, not only nerves and muscles produce and sense electrical signals *in vivo*, these processes form bioelectric circuits that harness individual cell behaviors toward specific anatomical endpoints" [23,24]. In this manuscript, an electrical component (piezoelectricity) was found to result from mechanical insults to eukaryotic cells by the arrival of a pressure shockwave. It is hypothesized that focused very intense pressure pulse (VIPP) treatments could "kill" cancer cells by altering its bioelectric circuits. The need for further unbiased research on the efficacy of extracorporeal VIPP is warranted.

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