Ozone therapy as a primary and sole treatment for acute bacterial infection: case report

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Abstract

The world is facing a crisis of antibiotic resistance, which impacts every treating physician on the planet. Thousands of patients die yearly in the USA from infections that have failed to respond to anti-infectives. Alarms have been ringing about bacterial infection fatality resurgence, the end of the antibiotic era, a calamity in progress. Ozone therapy has been used in medicine since World War I. However, it is not patentable and has suffered from lack of private source funding for research sufficient to have it accepted by the mainstream. Basic science, both *in vivo* and *in vitro*, research has found it to have several effects including modulating the immune system, enhancing circulation, destroying microorganisms including bacteria and viruses, and enhancing oxygen delivery and consumption by the body. This report presents background basic ozone science and a case report of acute bacterial infection – tick bite cellulitis, which immediately responded to ozone therapy as the sole treatment, and which fully resolved within 24–48 hours. Ozone therapy could be considered as an adjunctive or alternative therapy for bacterial infection.

Key words: ozone therapy; infection; antimicrobial; cellulitis , antibiotic resistance, immune modulation, oxygenation, reactive oxygen species

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Introduction

The world is facing a resurgence of infectious disease deaths due to organisms easily dispatched in the early days of antibiotics. News reports of published science are dubbing it the "end of the antibiotic era".[1] This is not an overstatement. Liu et al.[2] reported the rapid emerging of resistance in humans and animals to the last class of antbiotics. In the USA alone there were 46 deaths per 100,000 population.[3] Recently, there have been published reports of emergence "super bugs" resistant to every known antibiotic and resulting in death.[4] Ventola[5] reported that "The rapid emergence of resistant bacteria is occurring worldwide, endangering the efficacy of antibiotics. The antibiotic resistance crisis has been attributed to the overuse and misuse of these medications, as well as a lack of new drug development by the pharmaceutical industry due to reduced economic incentives and challenging regulatory requirements." Harvard scientists have graphically shown in a cinema how fast bacteria will naturally become resistant to antibiotics and simply grow right into the drug laced medium given a short period of time.[6] A *JAMA* "Special Communication"[7] lamented the lack of development of new antibiotic drugs which research is hurt for economic incentive reasons. It further states, "Antimicrobial resistance poses significant challenges for current clinical care. Modified use of antimicrobial agents and public health interventions, coupled with novel antimicrobial strategies, may help mitigate the effect of multidrug-resistant organisms in the future." Even if a multitude of new antibiotics were suddenly developed, based on repeated medical history, there can be little doubt that any new breakthrough will be short lived. This is vividly demonstrated in real life hospital situations over the past few decades, evidenced by the Harvard team.

The following case reports bring forward ozone therapy as a long practiced and "novel antimicrobial strategy." Basic medical science suggests ozone therapy might provide that alternate medical paradigm to counter the looming victory of pathogens.

Ozone (O_3) is an allotrope of oxygen. It is the strongest naturally occurring oxidant. It is produced in nature by lightning and ultraviolet irradiation. Ozone can be created similarly with a corona high arc discharge.

A succinct summary of ozone history and use can be found in the review by Elvis and Elka.[8] Nikola Tesla patented (U.S. Patent Number 568177) the first commercial ozone generator. Medical ozone is made by passing medical grade oxygen through the discharge. This creates a gas mixture of 1–5% ozone and 95–99% oxygen, which is the "ozone" used for treatment. Germans doctors in the trenches used ozone to disinfect wounds during World War I. German doctors expanded the world of ozone by introducing ozone treat blood, either by direct gas administration or removing 50–200 mL blood, ozonating it, and returning it.

Basic research from Italy (Bocci)[9] and Cuba (Menendez)[10] has led to publication of books containing their published studies. Both researchers have independently confirmed: 1) immune system modulation balancing its inflammatory/anti-inflammatory cytokines, 2) increase in production of red blood cell (RBC) 2,3 diglycerophosphate (DGP) (greater oxygen release), and improved rheology properties of blood (increased RBC flexibility) 3) elevation of key anti-oxidant enzymes such as superoxide dismutase (SOD), and increased glutathione, achieving a redox cell balance.

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Menendez's group has gone further in the field of infection. In a series of articles, they found: 1) Simply preconditioning rats with intraperitoneal ozone gas followed by intraperitoneal injection of a lethal amount of polymicrobes from fecal material increased the survival of the animals to 33% compared to 0% survival in controls. When the antibiotic combination Tazobactam/Piperacillin was added, survival increased to 93%.[11] 2) Ozone preconditioning of rats improved survival of a lethal injection of fecal material into the peritoneum up to 62.5%.[12] 3) Ozone preconditioning of rats induced reduced levels of tumor necrosis factor alpha (TNF-α) when the rats were given induced sepsis by fecal material.[13] Ozone is directly germicidal, kills 99% of bacteria in a few seconds and is 100× more effective at destroying bacteria than bleach.[14,15] Ozone, bleach and hydrogen peroxide have been used for generations as germicides, without any development of resistance. It has been known for decades that our body produces abundant oxidants to hurl at invading pathogens, such as hydrogen peroxide, superoxide,[16] hypochlorite, and singlet oxygen. Recently, Scripps reported a revolutionary discovery that our bodies actually generate ozone as part of its oxidative armamentarium in fighting infection.[17]

Ozone therapy is exceedingly safe – complication rate of only 0.7 per 100,000 treatments. Virtually all such complications reported were secondary to improper administration.[18]

A very common form of ozone administration worldwide is direct application of intravenous gas (personal knowledge). Intravenous oxygen has been administered for decades as a treatment in Europe. It has been shown to provide powerful immunological effects, improve blood rheology and oxygenation,[19] and even increase the important prostacyclin/thromboxane ratio.[20] The most accepted form of ozone administration is "major auto hemotherapy". This administration is accomplished by removing an aliquot of blood, heparinating it, then adding oxygen/ozone gas, mixing, and returning it under gravity. This method has been improved with newer technology in a procedure called "hyperbaric ozone therapy" (HBO_3). In this method, the blood, generally 200 mL, is withdrawn into a vacuum glass bottle and heparinated. Oxygen/ozone gas, at 30−70 μg ozone/mL, is pumped into the bottle under pressure, up to 2 atmospheres absolute (ATA, 2.066 kg/cm^2) . This constitutes a single pass. The method, developed by German physician Horst Kief,[21] provides for better mixing of the gas and blood, more rapid execution and delivery of the treatment and additional beneficial effects of dissolved oxygen gas.

By Henry's law of gas diffusion into liquid, 200 mL of blood pressurized at 2 ATA would be expected to carry about 4.4 mL of solubilized oxygen per 100 mL blood. This could provide significant benefit described in the reports on intravenous oxygen gas administration. Johann Lahodny, MD of Austria, has furthered the hyperbaric method (personal instruction) by repeating this treatment for 10 passes of 200 mL of blood with 200 mL of oxygen ozone gas at 70 μg/mL for a total delivery of ozone of 140,000 μg in one sitting. Aside from more ozone, this method would carry up to 88 mL of dissolved oxygen per treatment, well in line with intravenous oxygen gas volume used in European studies, and its beneficial effects in stimulating a key anti-inflammatory enzyme 15-lipooxygenase-1 (15-LOX-1).[22] The foregoing biochemistry and physiochemistry suggests that ozone therapy might provide hope, help, answers, and a well published non-antibiotic approach to the growing crisis of antibiotic resistance.

Finally, bacterial infections have recently been noted to take on an ominous dimension – biofilms, virtually impossible to conventionally treat.[23] Ozone gas is known to quickly cut through and destroy biofilms.[24] This property suggests activity by ozone against resilient biofilm establishes microbial communities, where antibiotics generally fail.

Case Report

A 56 year old male presented with an acute right thigh cellulitis from a tick bite which occurred 1−2 days before. At presentation he was afebrile, but with a rapidly spreading rash on his upper leg (**Figure 1**).

The patient was a long-term patient of our clinic. He had received ozone from us 3 years before for Lyme disease (without antibiotics), and fully recovered. He was offered antibiotics to take immediately for medical-legal reasons but refused due to his past success with ozone therapy. He did depart with a written prescription upon my demand. He received ozone therapy by the hyperbaric method described above, receiving 144,000 μg over one hour at an average pressure of 1.9 ATA. He returned the following photograph two days later reporting that he made good on his decision not to take antibiotics. The rash began disappearing the following day and disappeared on the second day.

Discussion

While most tick bite cellulitis is thought to fall into the realm of Lyme disease, the mouth of any organism might carry any number and kinds of bacteria. Lyme "cellulitis" generally takes

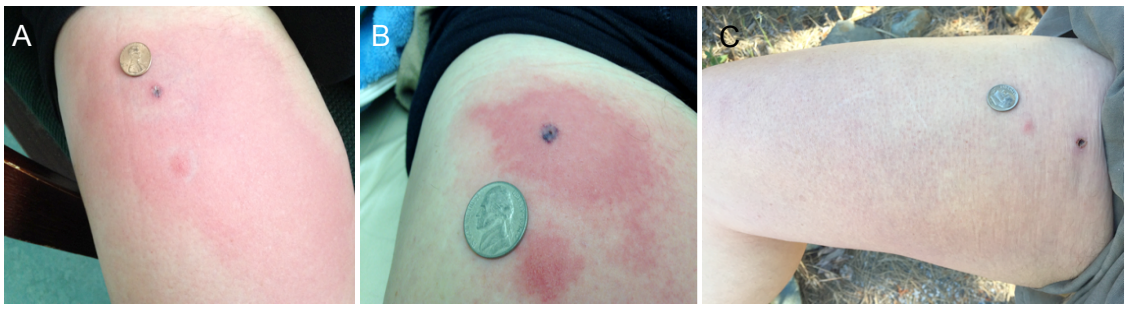

Figure 1: Photos show the extent of the cellulitis on presentation and 3 days post treatment.
Note: (A, B) Thigh on presentation; (C) thigh on day 3 post treatment.

several days to show up. The U.S. Centers for Disease Control (CDC) says the rash generally will occur in 3−30 days with an average onset at day seven.[25] It is entirely possible that this case involved Lyme disease, but we felt it more likely to be a non-Lyme more acute bacterial cellulitis.

In one published case, a tick bite cellulitis was first felt to be caused by *Staphylococcus*, but upon microbial investigation, was definitely identified as *Fancisella tulaensis*,[26] a highly pathogenic organism. This demonstrates the breadth of potential organisms in a tick bite inoculum. Nevertheless, it is entirely possible that Borellia (Lyme) organisms could be present in any such bite. However, in our case, the rash quickly remitted and the patient did not suffer evident Lyme symptoms further, even months/years later. I believe it is probable that infections like this, due to a bite, could be multi microbial.

The CDC reports that recovery from Lyme disease does not confer immunity for a subsequent infection. This patient had recovered from Lyme disease in our clinic with ozone therapy a few years before this tick bite. Hence, it is possible he had Lyme cellulitis, and/or a more acute/common cellulitis bacterial organism. (The author has seen another case of acute tick bite with a highly aggressive purpuric cellulitis completely recover within 18 hours of hyperbaric ozone therapy, 14,000 µg delivered, and absent antibiotic use.)

My experience with ozone therapy has been considerable, spanning over 30 consecutive years. In 2014, my group reported 5 (out of 5 cases treated) consecutive rapid Ebola cures in Sierra Leone that recovered fully within 48−72 hours with direct intravenous ozone gas.[27] None of the patients deteriorated after their first treatment (The fifth case misrepresented herself to us as asymptomatic high-risk exposure. Months later, she admitted she was actually symptomatic, but was afraid to tell us, fearing government quarantine, and denial of ozone treatment by authorities in an epidemic that claimed the life of her physician consort just hours before). These results happening by pure chance would be less than 1%, in an epidemic that killed 60% of its victims regardless of treatment. The materials for these ozone treatments, excluding the ozone generator, cost less than 5 USD per patient.

Our in-office ozone experience has been anecdotal. But with what would generally be considered hard to believe results (due to the medical "tomato effect") we are now taking to report them, to encourage further study with ozone therapy. (The tomato effect is defined in medicine as occurring "when an efficacious treatment for a certain disease is ignored or rejected because it does not "make sense" in the light of accepted theories of disease…)[28]

As in the presented case, we have seen considerably good results in other patients with documented Lyme disease, even those who have failed antibiotics. A recent case of a septic prosthetic hip, which resolved using ozone absent any surgery/debridement or IV antibiotics, has been submitted for publication as a world first such case result.[29]

There are many reasons ozone therapy could be expected to provide results like these. Ozone reacts immediately with blood components to produce less powerful but still potent redox oxidizing molecules (ozone peroxides) as ozonides, aldehydes, hydrogen peroxides, organic peroxide. These molecules have been found to serve as messengers to modulate the immune system and improve blood rheology, with published basic science articles well summarized in the works of Bocci[9] and Menendez.[10] These researchers independently verified that ozone improves cellular redox balance, and improves red cell 2,3, DGP leading to release of oxygen into tissues. This would well assist the urgent need for satisfaction of the phagocyte "respiratory burst" where the protective cells increase oxygen consumption up to 50× over the resting state,[16] and which cells are the ultimate anti-microbial, utilizing reactive oxygen species. Perhaps the therapy simply critically supplements the innate immune system's own defensive production of ozone.[17]

Additionally, and not previously speculated, ozone by the hyperbaric method might have a hidden side benefit: mimicking the benefit of actual hyperbaric oxygen (HBO). Thom reports, "Principle mechanisms of HBO [in promoting healing] are based on intracellular generation of reactive species of oxygen and nitrogen." "It is well accepted that oxygen at greater than 1 ATA increases the production of these species."[30] With hyperbaric ozone, we are creating pressures of oxygen in an aliquot of blood at up to 2 ATA. Hence, similar beneficial molecular signaling molecules generated by HBO could also be generated by the hyperbaric ozone method.

Ozone belongs to the "oxidation" family of medical therapies. These include intravenous hydrogen peroxide, ultraviolet blood irradiation therapy, and intravenous vitamin C therapy. All have been shown to have significant efficacy in curing bacterial and/or viral infections.[31-35] The NIH reported that intravenous vitamin C acts as a prodrug in enhancing the production and delivery of hydrogen peroxide within interstitial fluids of the body.[36]

These orphan therapies have largely been ignored, or simply have fallen by the wayside with the advent of chemical patented antibiotics, highly promoted by the pharmaceutical giants. Ozone is not patentable, rendering the modality virtually helpless for full study. However, with the era of antibiotic fast cure rapidly ending, medicine could consider turning to its oxidation therapy roots in the treatment of infectious diseases in the effort to save lives.

Ozone therapy, as a sole treatment, is shown in this case to quickly and completely resolve a rapidly advancing case of tick bite cellulitis. Basic science literature has demonstrated prophylactic ozone therapy significantly enhances antibiotic efficacy in animals given experimental sepsis with fecal organisms. Ozone has been shown to have significant circulatory and immune enhancing physiological effects, which would be expected to augment the body's own innate defenses. Ozone is microbicidal, along with other oxidants produced by phagocytes.

With the emergence of bacteria totally resistant to conventional forms of therapy, ozone therapy urgently needs further and formal study as a primary or adjunctive treatment (together with antibiotics) to prevent morbidity and mortality from infections.

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Reviewer: Wen-Wu Liu, Secondary Military Medical University, China.
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