

# Electric Field Therapy as an Alternative Medicine in the Clinical Management of Cancer

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**Abstract:** The company Novocure has developed a viable chemotherapy alternative in the form of electric field therapy. This Novocure product has been given FDA approval for recurrent glioblastoma. However, they currently have Phase I, Phase II and Phase III clinical trials underway for a variety of other cancers. The treatment is a noninvasive monotherapy and incorporates Tumor Treating Fields to interrupt mitotic division in rapidly dividing cells with a low number of adverse effects. Dr. Palti spearheaded this product and has outreached to over 2,200 patients, allowing them to receive treatment without major lifestyle modifications.

## Introduction

Cancer is the second leading cause of death in the United States, according to the American Cancer Society<sup>1</sup>. The cancer death estimate for 2014 was around 585,720<sup>1</sup>. Of that number 310,010 were males and around 275,710 females<sup>1</sup>. Primarily there are three predominant options to treating and addressing cancer; chemotherapy, surgery, and radiation. Chemotherapy has been used as a cancer treatment starting from the early 1960s<sup>2</sup>. Surgery has been performed to treat cancer starting in the 19<sup>th</sup> and early 20<sup>th</sup> centuries<sup>3</sup>; meanwhile, radiation was discovered as a curative method in the beginning of the 20<sup>th</sup> century<sup>4</sup>. Unfortunately, all three of these options can lead to devastating effects on the diagnosed patient's daily life or could potentially completely render the patient to a vegetative state that has the potential to induce high amounts of pain and discomfort or even lead to death. Recent developments discovered by Yoram Palti, MD, PhD<sup>5</sup> have opened up a new opportunity for advancement in electric field-based alternative therapy specifically targeting abnormal neoplastic masses. This new treatment option for patients has been termed as Tumor Treating Fields or TTFIELDS<sup>6</sup>. The advancements in the electric field based therapy and those that have led up to the formations of the TTFIELDS should be considered a viable alternative medicine in regards to targeting and treating patients diagnosed with cancer.

## Novocure Product

The company that furthered this new wave of medical exploration into electric field therapy is Novocure. Their product is intended to be an

alternative for standard medical therapy after both radiation and surgical options have been exhausted<sup>7</sup>. They have produced an FDA-approved treatment option for recurrent glioblastoma that is worn by the user in a backpack fashion that contains the electric field generators and the transducer array for delivery of the therapy in addition to the necessary power supply attachments<sup>8</sup>. TTFIELDS utilize low-intensity alternating frequency electric fields<sup>9</sup> that inhibit proper spindle microtubule attachment in mitosis, causing the cell to stall and be flagged for apoptosis<sup>10,11</sup>. TTFIELDS paired with traditional chemotherapeutic agents led to a more effective treatment over several cancerous cell lines<sup>10</sup>. TTFIELDS are considered to be noninvasive and have been cleared for use by the FDA and has obtained the CE mark in Europe<sup>6</sup>. Many of the pre-clinical trials that Novocure has undergone passed<sup>12</sup> such as those focused upon: breast cancer, cervical cancer, colorectal carcinoma, gastric adenocarcinoma, hepatocellular carcinoma, liver metastases, malignant melanoma, prostate cancer, and renal adenocarcinoma<sup>12</sup>. In addition to the pre-clinical applications Novocure has completed Phase II trials for squamous non-small cell lung cancer and is currently in progress on brain metastasis, ovarian cancer, pancreatic cancer, and mesothelioma<sup>12</sup>. Novocure does have one Phase III trial that has been completed for newly diagnosed glioblastoma<sup>13</sup> as their current product NovoTTF<sup>TM</sup>-100A, also known as Optune<sup>TM</sup>, was produced as a therapy for recurrent glioblastoma<sup>13</sup>.

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Findings from Novocure using TTFields have provided statistically significant results in users that are currently wearing the Optune™ product for the therapy of glioblastoma multiform or GBM<sup>7</sup>. This can clearly be seen in the studies that were performed on mice and New Zealand white rabbits<sup>14</sup>. After being injected or implanted with cancerous tissue they were observed for survival or utilized for analysis<sup>14</sup>. Results showed a longer survival period than expected in addition to decreased growth and spread rates<sup>14</sup>. These positively correlated results enabled the progression of the clinical trials through all phases including obtaining clearance from the FDA to open Novocure's product, the Optune™, up for public utilization. Now Novocure currently has a rough estimate of around 2,200 patients using their treatment of TTField therapy<sup>15</sup>. The continued use of the Optune™ within the public is generating not only positive experiences but also positive results, especially when chemotherapy may not have created the desired effects the patient sought after. The company is finding other clinical aspects that their product can be applied to; specifically those in the pre-clinical or various trial phases previously listed above<sup>12</sup> are at. It can be seen that all of the success of the Novocure's TTField therapy and the possible future applications that are surfacing has positioned this new wave of electric field therapy as a viable medical alternative when attempting to treat patients diagnosed with cancer, specifically GBM.

Novocure began to effectively research behind the electric field therapy and its effect on the mitotic division of a cell back in 2000 when Dr. Palti first started research upon electric field therapy<sup>5</sup>. The product statistically aids with the targeting and reduction of abnormal neoplastic masses; meanwhile, the patient is able to maintain normal daily activities. The Optune™ product is to be worn for at least 18 hours per day by adults over the age of 22<sup>16</sup> and is considered a monotherapy<sup>17</sup>. This monotherapy<sup>17</sup> also includes placing and maintaining the transducer arrays up to 4 to 7 days<sup>16</sup> before needing to replace due to sanitary health concerns, including cleaning of attachment sites<sup>18</sup>. When comparing the adverse effects of the Optune™ to BSC (best supportive care) chemotherapy, there is an estimate of a 66% overall drop in statistically significant adverse effects with dermatological being the primary effect<sup>19</sup> caused by the attached transducer arrays. Those dermatological effects have low statistical percentages of occurring more than once, resulting in something more than a dermatological concern. These dermatological concerns can generally be treated with adjusted placement of the transducer arrays in addition to topical corticosteroids<sup>17</sup>. When considering the Optune™ therapy in comparison to just the BSC, the effects seem to be easily manageable and more favorable of the Optune™ due to its simplicity of care and prevention as it is considered to be

equivalent to BSC chemotherapy with the toxicity removed<sup>13</sup>. It also allows the user to maintain their normal life activities without having a significant lack of energy or impaired cognitive function.

### Conclusion

Novocure has formed a very competitive option that should be considered when looking for an alternative therapy when treating cancer. Novocure utilizes TTFields that inhibit the cancerous cell from dividing, leading it to apoptosis<sup>10, 11</sup>. The Optune™ device that transmits the TTFields is stored in a backpack worn by the user at least 18 hours of the day for 4 to 7 days at a time, before swapping out transducer arrays<sup>16</sup>. The statistical significance of the adverse effects is skewed in favor of the Optune™ monotherapy treatment when compared to BSC treatment in regards to number of adverse effects<sup>17,19</sup>. This field in electric field therapy is advancing as new applications for other cancerous tissues are currently underway. This could lead to cancer patients circumventing the traditional chemotherapy, surgery, and radiation approaches and allow them to be addressed and treated in a whole new manner that would reduce the drastic physiological changes. Novocure's FDA-approved cancer alternative incorporating TTFields should be considered when addressing other options for the diagnosed patient after surgery and radiation.

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