

# **An electromagnetic Antenna for induction of virtual T-cells within blood vessels and cancer treatment**

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**Abstract:** Cancer cells make a PD1/PD-L1 bridge with T-cells and inject death factors into them. Recently, many methods and drugs have been proposed to prevent of PD1/PD-L1 connections, however, most of them are very expensive and couldn't work good. We propose a theoretical model for an electromagnetic antenna which induces virtual T-cells within the blood vessels. These electromagnetic T-cells deceive cancer cells and their virtual PD1s are connected to real PD-L1s. Consequently, number of real PD1/PD-L1 connections decrease and real T-cells could have the opportunity to kill the cancer cells.

**Keywords:** Antenna; T-cell; Cancer; Blood; Electromagnetic Wave

## **I.Introduction**

Up to many scientists have used of electromagnetic waves to treat cancers and tumors. For example, some authors have summarized the history of EMF from the 1890's to the novel and new innovative methods that target and treat cancer by non-ionizing radiation [1]. In another article, authors have considered the recent development of electromagnetic nanomedicines into combinational cancer immunotherapy. In this research, the mechanisms of electromagnetic nanomedicines in reprogramming the immunosuppressive tumor microenvironment and sensitizing tumors for cancer immunotherapy were highlighted [2]. In another work, it has been argued that electromagnetic fields increased the expression of critical proteins leading to cell cycle arrest and reduced stemness as evidenced by decreased expression of stemness genes. Also, the proliferation rate in electromagnetic-exposed cancer cells is reduced compared to that in nonexposed cancer cells [3]. In another research, authors have discussed that cancerous cells emit different frequencies respect to normal ones and for this reason, one can use of electromagnetic waves to diagnose cancers [4]. In another investigation, authors have shown that millimeter wave frequencies could be

applied in imaging some cancers like breast cancers [5]. Also, in another papers, it has been shown that millimeter waves could be used in diagnosing skin cancers, while micrometer waves could be applied in imaging lung and breast cancers and more shorter wavelengths could detect early-stage tumors that reside in deeper tissue layers [6-8]. Motivated by these researches, we propose a new model for treatment of cancers through induction of virtual T-Cells within blood vessels by using electromagnetic waves.

## II. A model for induction of T-cells within the blood vessels

In this section, we propose a model to induce virtual T-Cells and deceive cancer cells. This technique helps us to prevent of PD1-PD-L1 connections [9,10] and death of T-cells. Using this technique, we can kill cancerous cells and reduce expenses.

Up to date, it has been known that cancer cells create PD-1/PD-L1 connections with T-cells and induce death factors within them. On the other hand, T-cells create TCR/MHC connections with cancer cells and inject death factors to them (See figure 1). If we could prevent of PD-1/PD-L1 connections, we can rescue T-Cells and kill cancer ones.

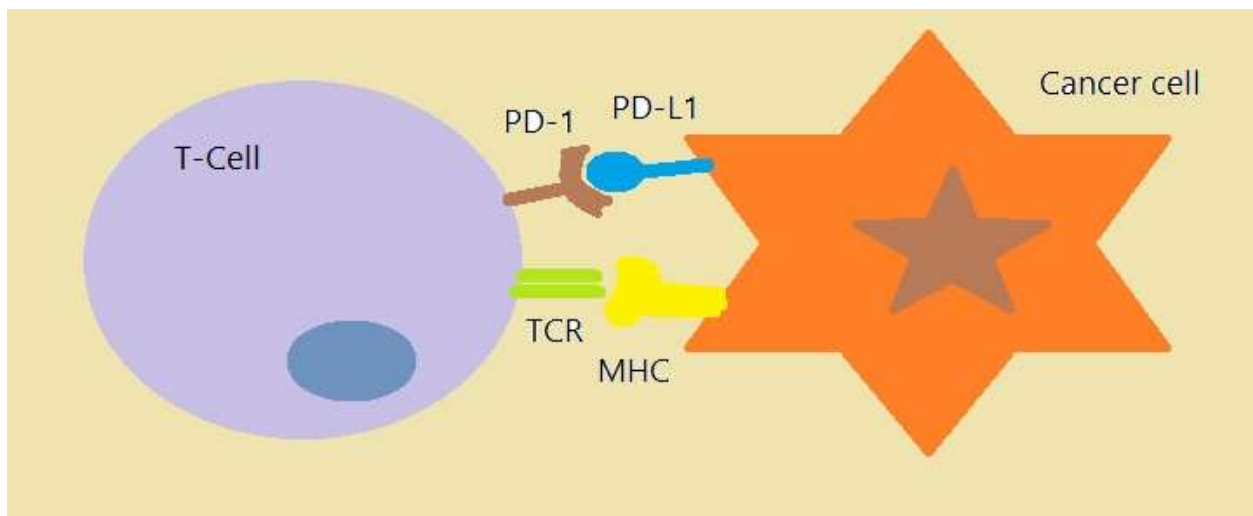


Figure 1: The interaction between T-cells and cancer ones.

There are several methods to reduce PD1/PD-L1 connections. In some of these methods, some types of chemical drugs are used. However, these drugs are expensive. If we could increase number of T-cells within blood vessels such as their numbers be more than number of cancer cells, we can obtain more number of TCR/MCH connections respect to PD1/PD-L1 ones and consequently, more cancer cells will be died (See Figure 2).



Figure 2: T-cells move within blood vessels and archive to cancer cells.

To increase, number of T-cells within the blood vessels, we can use of electromagnetic waves. We design an antenna which its size is equal or less than the separation distance between cells or their centers. Then, we connect this antenna to an oscillating potential which its frequency is like the frequency of passing T-cells from cancer cells. We put some molecules of T-cells on this antenna and bring it near blood vessels around cancer tissue. This antenna emit some waves which T-cells form some electromagnetic holes within their wave shapes. These waves are absorbed by blood vessels and induce virtual T-cells within them (See figure 3). These virtual T-cells deceive cancer cells and create virtual PD1/PD-L1 connections. Consequently, real T-cells could be rescued and induce death factors to them. This causes that number of cancer cells is reduced significantly and tumors could be controlled very good (See figure 4). This model is very cheaper than known expensive methods which use some cancer drugs.

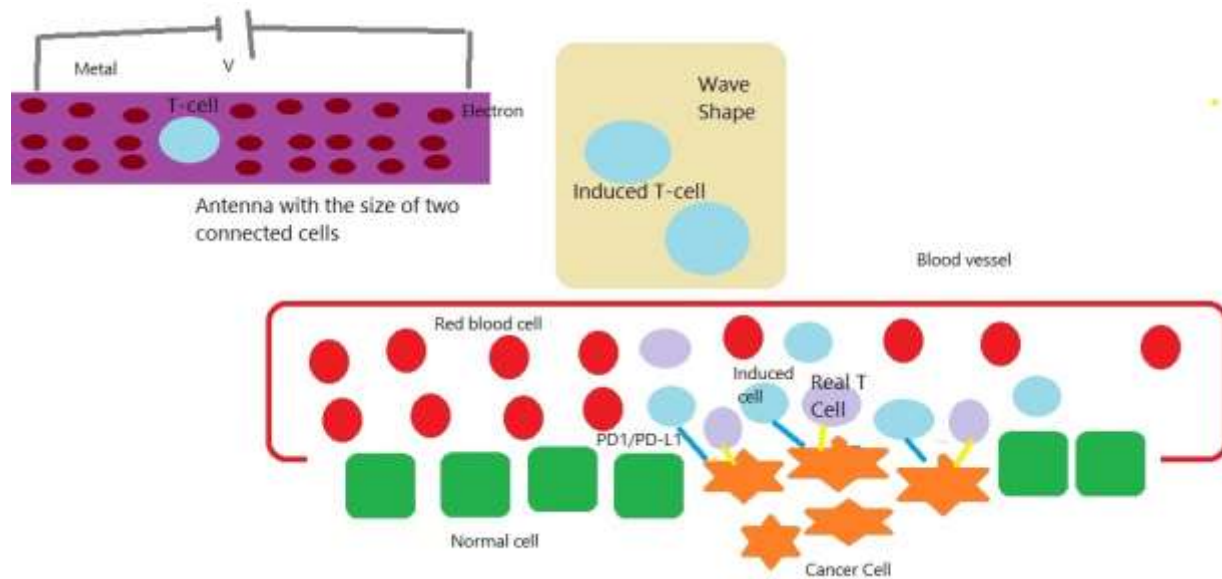


Figure 3: A micro antenna could help us to induce T-cells within the blood vessels

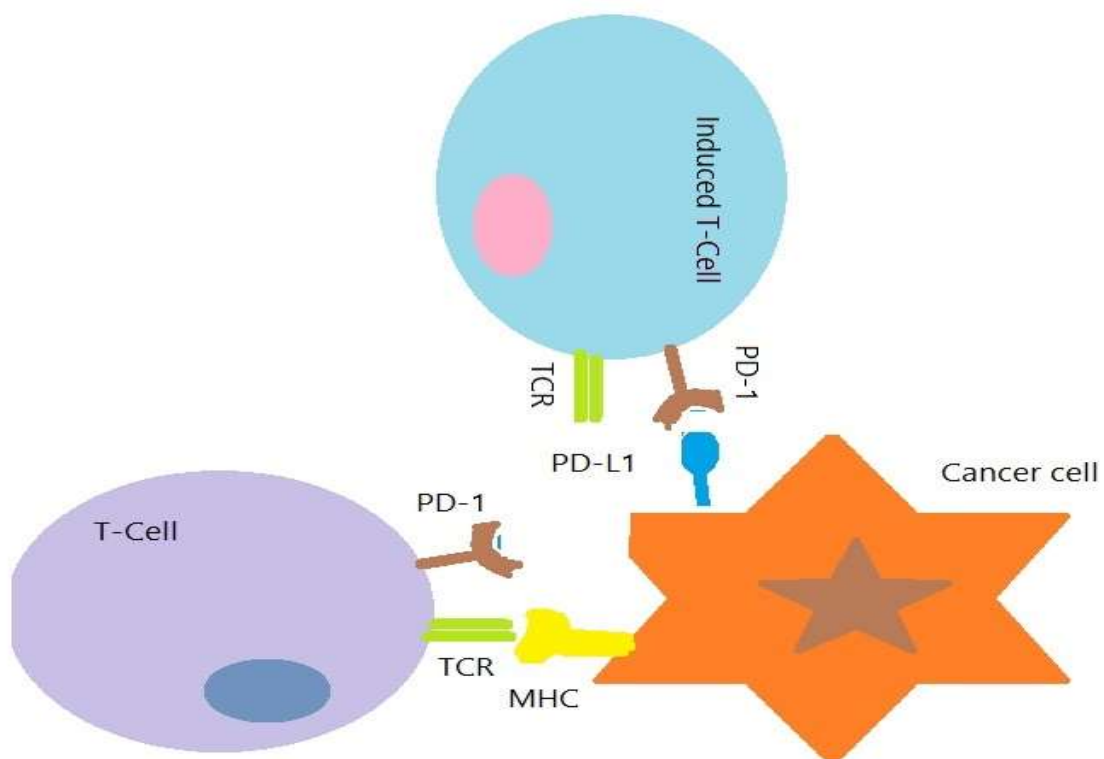


Figure 4: Induced T-cells deceive cancer cells and produce virtual PD1-PD-L1 connections.

### III. A mathematical technique to design the shape of waves , potential and antenna

To design antennas and equipment's in this model, we need consider the relation between potentials, currents, frequencies and T-cells. In this model, first, we put molecules of T-cells on an antenna and connect an oscillating potential to it. We can write:

$$V = v_0 \sin(\Omega t)$$

Where V is the potential and  $\Omega$  is it's related oscillating frequency. This potential causes to the emergence of a current:

$$\begin{aligned} V &= v_0 \sin(\Omega t) = R I \\ \rightarrow I &= i_0 \sin(\Omega t) \end{aligned}$$

Where I is the electrical current and R denotes the resistance.

This current causes to motion of electrons and also force on the charges of T-cell. Consequently, T-cells also move however, their masses are very bigger of electrons and consequently, the velocity and the frequency of their motions may be very slower than electrons. By motion of electrons and T-cells, a wave is emerged. The shape of this wave depends on the shape of antenna and molecules of T-cells. Energy of these waves could be obtained from below equation:

$$E = N h f$$

Where E is the energy, N is the number of waves and f is the frequency of emitted waves. This frequency has the below relation with the wave-length:

$$f = \frac{c}{\lambda}$$

Where  $\lambda$  is the wave-length of emitted wave and c is the velocity of light.

To induce T-cell-shape waves within blood vessels, we need to design an antenna which its length depends on the wave-lengths. On the other hand, wavelengths

depend on separation distance between cells and have a direct relation with number of T-cells which pass a cell in each second.

$$\lambda = \frac{\text{separation distance between cells}}{\text{number of T cells in each seconds}}$$

These wavelengths take shape of antenna and cause to the emergence of an entropy and temperature. In fact, energy of this system has the below relation with temperature and entropy

$$E = T \text{ Entropy}$$

Where T is temperature. Previously, Tsallis has been shown that the entropy has the below relation with area [11]:

$$\text{Entropy} = \gamma A^\beta$$

Where  $\gamma$  and  $\beta$  are some constants and A is the area of wave. Area of a wave depends on the area of antenna. Since the velocity of T-cells is lower than the velocity of electrons, shape of these molecules cause to the emergence of some holes in total shape of waves. We only want to calculate area of waves including T-cell holes. Thus, we can write:

$$A = [\text{Area of antenna} - \text{Area of T cells}][\text{number of T cells in each seconds}]$$

To calculate the area of T-cells, we have to know its electrons, photons and atoms. We can write below action [12]:

$$S = \int d^3 l \sqrt{\eta^{ab} g_{\mu\nu} \partial_a \psi^{\mu\uparrow} \psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \psi^{M\uparrow} + \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu + 2\pi \tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_i)}{i! \lambda}}$$

Where  $\varphi$  is the molecule wave functions,  $\psi$  is the semi-coupled electron, g is the metric of system and F is the photonic field strength with below relation:

$$F = F_{\mu\nu}F^{\mu\nu}$$

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$$

Where F is the field strength and A is the photon. For above action, we can write below momentum density:

$$\text{III} = \frac{2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_{i-1})}{i! \lambda} F_{01}}{\sqrt{\eta^{ab} g_{\mu\nu} \partial_a \psi^{\mu\uparrow} \Psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \Psi^{M\uparrow} + \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu + 2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_i)}{i! \lambda}}}$$

For this density, we can obtain the below Humiltonian:

$$H = \int d^3 l \text{ III } \partial_t \tilde{A}_1 - L = \int d l [l^2 \text{ III } F_{01} - \partial_t (l^2 \text{ III }) \tilde{A}_0] - L$$

From above equation, we find that momentum density has the below relation with radius of cell:

$$\begin{aligned} \text{III} &= \frac{K^2}{l^2} \\ &= \frac{2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_{i-1})}{i! \lambda} F_{01}}{\sqrt{\eta^{ab} g_{\mu\nu} \partial_a \psi^{\mu\uparrow} \Psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \Psi^{M\uparrow} + \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu + 2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_i)}{i! \lambda}}} \end{aligned}$$

Where l is the radius of cell. Thus, we have:

$$l = \left[ \frac{K^2}{\frac{2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_{i-1})}{i! \lambda} F_{01}}{\sqrt{\eta^{ab} g_{\mu\nu} \partial_a \psi^{\mu\uparrow} \Psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \Psi^{M\uparrow} + \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu + 2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_i)}{i! \lambda}}}} \right]^{1/2}$$

Using above radius, we can obtain the area of T-cells:

$$\text{Area of T cells} = \pi l^2 =$$

$$\pi \left[ \frac{K^2}{\frac{2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_{i-1})}{i! \lambda} F_{01}}{\sqrt{\eta^{ab} g_{\mu\nu} \partial_a \psi^{\mu\uparrow} \Psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \Psi^{M\uparrow} + \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu + 2\pi\tilde{l}_h^2 \sum_{i=1}^n \frac{-(F_1 \dots F_i)}{i! \lambda}}}} \right]$$

On the other hand, we can write below relations between fermionic, scalar and photonic wave functions with their charges, masses and numbers:

$$\begin{aligned} & \partial_a \psi^{\mu\uparrow} \Psi^{M\downarrow} \partial_b \psi^{\nu\downarrow} \Psi^{M\uparrow} \\ & \approx \sum_{i=1}^I (\text{mass of coupled charges})_i^2 (\text{number of coupled charges})_i e^2 \\ & \eta^{ab} g_{\mu\nu} \partial_a \varphi^\mu \partial_b \varphi^\nu \approx \sum_{j=1}^J (\text{mass of molecules})_j^2 (\text{number of molecules})_j \\ & \sum_{l=1}^L \frac{-(F_1 \dots F_l)}{l! \lambda} \approx \sum_{l=1}^L (m)_l h(\nu)_l \end{aligned}$$

Where  $\nu$  is the photonic frequency which is exchanged between electrons. Thus, area of a T-cell could be written in terms of its electrons, photons and molecules:

$$\begin{aligned} \text{Area of T cells} &= \pi l^2 = \\ & \pi K^2 \left[ \sum_{i=1}^I (\text{mass of coupled charges})_i^2 (\text{number of coupled charges})_i e^2 \right. \\ & \quad + \sum_{j=1}^J (\text{mass of molecules})_j^2 (\text{number of molecules})_j \\ & \quad \left. + \sum_{l=1}^L (m)_l h(\nu)_l \right] \left[ 2\pi\tilde{l}_h^2 \sum_{l=1}^L (m)_l h(\nu)_{l-1} h(\nu) \right]^{-1} \end{aligned}$$



Above equation shows that the real area of a T-cell could be written in terms of numbers, charges and frequencies of molecules, electrons and photons. Using above equation, we can obtain the energy of waves:

$$\begin{aligned}
 E = T\gamma([Area\ of\ antenna] - \\
 \pi K^2 [\sum_{i=1}^I (mass\ of\ coupled\ charges)_i^2 (number\ of\ coupled\ charges)_i e^2 \\
 + \sum_{j=1}^J (mass\ of\ molecules)_j^2 (number\ of\ molecules)_j \\
 + \sum_{l=1}^L (m)_l h(\nu)_l ] [2\pi \tilde{l}_h^2 \sum_{l=1}^L (m)_l h(\nu)_{l-1} h(\nu) ]^{-1}] \times \\
 [number\ of\ T\ cells\ in\ each\ second])^\beta
 \end{aligned}$$

On the other hand, energy of waves has the relation with their numbers and frequencies:

$$E = N h f = N h \frac{c\ number\ of\ T\ cells\ in\ each\ second}{separation\ distance\ between\ cells}$$

Thus, number of emitted waves could be obtained from below equation:

$$\begin{aligned}
 N = [ \frac{c\ number\ of\ T\ cells\ in\ each\ second}{separation\ distance\ between\ cells} ]^{-1} \times \\
 T\gamma([Area\ of\ antenna] -
 \end{aligned}$$

$$\begin{aligned}
& \pi K^2 \left[ \sum_{i=1}^I (\text{mass of coupled charges})_i^2 (\text{number of coupled charges})_i e^2 \right. \\
& + \sum_{j=1}^J (\text{mass of molecules})_j^2 (\text{number of molecules})_j \\
& + \sum_{l=1}^L (m)_l h(\nu)_l \left. \left[ 2\pi \tilde{l}_h^2 \sum_{l=1}^L (m)_l h(\nu)_{l-1} h(\nu) \right]^{-1} \right] \times \\
& [\text{number of T cells in each second}]^\beta
\end{aligned}$$

Above equation shows that number of emitted waves from an antenna including T-cells depend on temperature, area of antenna, number and charges of molecules, electrons and number and frequencies of photons.

On the other hand, we know that energy has the below relation with potential and charges:

$$E = Q V = (\text{Number of electrons} \times \text{Charge of electrons} - \text{Charge of T-cells}) V$$

Thus, potential of system could be obtained from below equation:

$$\begin{aligned}
V = & [\text{Number of electrons} \times \text{Charge of electrons} - \text{Charge of T} - \\
& \text{cells}]^{-1} \times \\
& T\gamma([[\text{Area of antenna}] - \\
& \pi K^2 \left[ \sum_{i=1}^I (\text{mass of coupled charges})_i^2 (\text{number of coupled charges})_i e^2 \right. \\
& + \sum_{j=1}^J (\text{mass of molecules})_j^2 (\text{number of molecules})_j \\
& + \sum_{l=1}^L (m)_l h(\nu)_l \left. \left[ 2\pi \tilde{l}_h^2 \sum_{l=1}^L (m)_l h(\nu)_{l-1} h(\nu) \right]^{-1} \right] \times
\end{aligned}$$

$$[number\ of\ T\ cells\ in\ each\ second])^\beta$$

We can use of below relations between number of charges with currents and resistance of system or antenna:

$$\text{Number of electrons} \times \text{Charge of electrons} \approx (\text{Current}) (\text{velocity of charges})^{-1}$$

$$\text{velocity of charges} \approx (\text{Resistance})^{-1}$$

$$\text{Resistance} \approx (\rho_{\text{Genus of antenna}}) (\text{length of antenna}) (\text{area of antenna})^{-1}$$

Using above relation, we can re-write potential of antenna:

$$\begin{aligned} V = & [(\rho_{\text{Genus of antenna}}) (\text{length of antenna}) (\text{area of antenna})^{-1} \times \\ & (\text{Current}) - \text{Charge of T cells}]^{-1} \times \\ & T\gamma([[\text{Area of antenna}] - \\ & \pi K^2 [\sum_{i=1}^I (\text{mass of coupled charges})_i^2 (\text{number of coupled charges})_i e^2 \\ & + \sum_{j=1}^J (\text{mass of molecule})_j^2 (\text{number of molecule})_j \\ & + \sum_{l=1}^L (m)_l h(v)_l][2\pi \tilde{l}_h^2 \sum_{l=1}^L (m)_l h(v)_{l-1} h(v)]^{-1}] \times \\ & [number\ of\ T\ cells\ in\ each\ seconds])^\beta \end{aligned}$$

Above equation shows that for inducing T-Cells within the blood vessels, we should design an antenna with the size of inter-cellular separation distance and a potential which depends on the genus of system, length of antenna, area of antenna, mass of molecules and electrons within T-cells, frequency of inter-particle waves, number of photons, electrons and T-cells. If genus of metal and blood vessels be the same, we can obtain the better potential.

This potential produces an oscillating current. This current includes current of electrons and T-cells. By motion of these charges, some waves are emerged that their shapes depend on the shape of antenna and T-cells. In fact, T-cells are like some holes within antenna waves. These waves are absorbed by the blood liquid and some T-cell holes are emerged within them. Cancer cells make a mistake in diagnosing real T-cells from virtual ones and try to vanish them. Consequently, real T-cells could be saved from PD-1/PD-L1 interactions and induce death factors into cancer cells and cause to their disappearance.

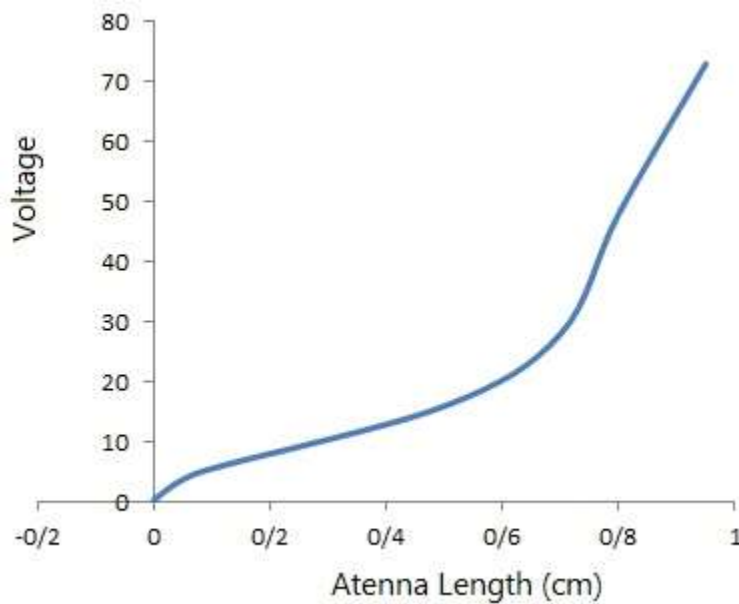


Figure 5. Voltage in terms of antenna length

To design an antenna, we put T-cells on a metal like iron and connect it to an oscillating voltage. Figure 5 considers the dependency of voltage to the antenna length. It is clear that for the smaller antennas, the resistance is smaller and the needed voltage and potential for producing the current and the wave has lower values. By increasing the length of antenna, the resistance increases and the needed voltage grows. This potential oscillates between negative and positive maximum and produce an oscillating current of T-cells and electrons. This current emits a wave which its shape depends on the shape of antenna and T-cells. This wave induce T-cells within the blood vessels.

## Conclusion:

When a tumor or cancer tissue is emerged, T-cells move within blood vessels, reach its place and induce death factors within cancer cells.

However, cancer cells also make some PD1/PD-L1 connections with T-cells and kill them. We suggest that by using electromagnetic waves, some virtual or photonic T-cells are induced within the blood vessels. These virtual T-cells make some non-real PD1/PD-L1 connections with tumor cells and make them busy. Consequently, real T-cells could be rescued and cause to a reduction in number of tumor cells.

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