Microwaves for cancer treatment

Lifestyle Science

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The Vector Network Analyser (VNA) that is currently housed at the University of Malta. This VNA is normally used to perform reflection measurements on biological samples to measure the dielectric properties. Photo: Julian Bonello

The applications of microwaves are vast, ranging from the most known one of warming food to satellite communication; they are now even found in hospitals. Microwaves have proven to be useful both for therapeutic and diagnostic purposes.

The first attempts to use microwaves in clinical applications started in the 1980s. There are three ways to use microwaves: for diagnosis; to achieve hyperthermic temperatures (up to 45°C) in conjunction with other medical interventions such as chemotherapy and radiotherapy; and to cause microwave thermal ablation (over 45°C) to cause complete destruction of the tissue under effect.

The use of microwaves for diagnosis has shown promise in two aspects, mainly for breast cancer detection and brain stroke detection. In the latter, microwaves show promise for stroke detection as the apparatus used for diagnosis is compact and can fit in an ambulance. This will allow quicker diagnosis, which in stroke patients is crucial, as it will allow for faster treatment and reduce complications.

Presently, microwave thermal ablation is available in Malta at Mater Dei Hospital. Microwave thermal ablation is available to patients who have been diagnosed with cancer in the kidney, liver, lung, and rarely in bone and adrenal gland. When microwave ablation is performed this is done through a small incision through the skin, and provided no complications occur, this intervention can be carried out in approximately 10 minutes. The team behind these interventions in Malta is currently composed of Dr Kelvin Cortis, Dr Sarah Degiorgio, and soon Dr Christine Cannataci.

For microwave hyperthermia and ablation to function with a high level of accuracy and reliability one requires a good understanding of how microwaves interact with the patient.

The most common way of explaining how microwaves interact with human tissues is through their dielectric properties, that is, how the electric field interacts with matter, in this case, human tissues.

The University of Malta has become a centre of expertise in the measurement of dielectric properties of biological samples. Through the measurements conducted at the Electromagnetics Research Laboratory (EMRG), this group has addressed numerous lacunas in data and have made microwave devices far more reliable.

Dr Lourdes Farrugia, who is one of the academic members of EMRG, is also at present leading an EU based research initiative to further address the gaps in data. The MyWave COST Action will run for a total of three years and is aimed to improve the medical applications using microwaves and making electromagnetic hyperthermic therapies more effective so as to bring these technologies closer to patients' bedside.

Julian Bonello and Dr Iman Farhat are working on hyperthermic technologies for better treatment of cancerous tissues as part of the Electromagnetics Research Group at the University of Malta's Faculty of Science.

Sound bites

• A research team that was made up of engineers and cancer biologists found that cancer cells appeared to respond to low intensity electromagnetic fields that hindered the mobility of specific breast cancer cells. To study the effects that cancer cells seemed to sense both the presence of electromagnetic fields and the direction from which the fields were coming from, the researchers built an instrument called a Helmolz coil. The instrument allowed the researchers to apply a uniform electromagnetic energy to different types of breast cancer cells. The research was conducted on cells in a lab and has not yet proceeded to clinical trials. However the study, which was published in the journal Communications Biology, is a significant step for future researchers working to isolate the ways cancer cells couple with others and spread.

https://www.sciencedaily.com/releases/2019/08/190808111440.htm

• Researchers advanced on the notion of using nanoparticles, specifically titanium dioxide, to stimulate microwaves in order to trigger the death of cancer cells without damaging the surrounding cells. While research on these kind of nanoparticles activated by light and ultrasound in cancer treatments has been studied quite extensively, this is the first time researchers have used microwaves for cancer cell destruction. This could potentially open more opportunities for treatments for cancer patients. While the method is still under development and its limitations still need to be explored, it provides a promising approach to cancer treatment.

https://www.sciencedaily.com/releases/2019/06/190604162534.htm

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Did you know?

• The microwave region in the electromagnetic spectrum extends from 1,000 to 300,000 MegaHertz.

• Microwaves are non-ionising, which means they do not have enough energy to completely remove the negative part from an atom.

• Microwaves are also used to map meteorological disturbances in weather forecasting.

• Practical applications of microwaves had to await the invention of suitable generators such as the magnetron and klystron.

• In a microwave oven, microwaves are absorbed by water and fat in food, such as in the tissue of meats.

• Microwaves are the principal carriers of high-speed data transmissions between stations on Earth as well as those between ground-based stations, satellites and space probes.

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