Received: 20 January 2020 | Revised: 2 March 2020 | Accepted: 25 March 2020

DOI: 10.1111/dth.13405

ORIGINAL ARTICLE

DERMATOLOGIC THERAPY WILEY

A new medical imaging technique for diagnosing dermatologic diseases: A clue to treatment choices

Massimo Fioranelli[1] | Alireza Sepehri[1] | Maria Grazia Roccia[1] | Aracena Jahaira Carolina[1] | Iva Binic[1] | Masa Golubovic[1] | Michael Tirant[1] | Nguyen Van Thuong[1] | Julia Sigova[1] | Torello Lotti[1] | Aroonkumar Beesham[2]

[1]Department of Nuclear, Sub-Nuclear and Radiation Physics, Guglielmo Marconi University, Rome, Italy

[2]Faculty of Natural Sciences, Mangosuthu University of Technology, Jacobs, South Africa

Correspondence
Massimo Fioranelli, Department of Nuclear, Sub-Nuclear and Radiation Physics, Guglielmo Marconi University, Via Plinio, 44-00193 Rome, Italy.
Email: massimo.fioranelli@gmail.com

Funding information
National Research Foundation, Grant/Award Number: 118511; Guglielmo Marconi University

Abstract

Recently, it has been shown that DNA could emit some waves which carry main information about its evolution. Using this idea, we design a new method to image the behavior of skin cells, especially melanocytes, and diagnose their damage. In this method, we make use of a circuit which is formed from DNAs within the damaged melanocytes, a graphene sheet, DNAs within the healthy cells, and a scope. To amplify exchanged waves between hexagonal and pentagonal manifolds of DNAs, we induce some defects in the graphene sheets and replace some hexagonal molecules by pentagonal ones to build a structure similar to the structure of DNAs. We show that unprotected exposure to UVA and UVB damages the DNA in melanocyte cells, producing genetic defects, or mutations, that can lead to exchanged waves between cells and the emergence of a current in our circuit. By analyzing the evolution of this current, we can estimate the rate of destruction in melanocytes, and predict the emergence of cancer.

KEYWORDS

DNA, electromagnetic waves, melanocytes

1 | INTRODUCTION

Recently, Montagnier and his collaborators have shown that bacterial and viral DNAs could emit some frequencies of electromagnetic waves.[1] They have described the experimental conditions by which electromagnetic signals (EMSs) of low frequency can be emitted by diluted aqueous solutions of these bacterial and viral DNAs.[2] Until now, many discussions have taken place on the application of DNA waves in biology. For example, some authors have argued that EMSs are endogenously generated at different levels of the biological organization and, likely, play an active role in synchronizing internal cell function or local/systemic adaptive response. Consequently, each adaptive response can be described by its specific electromagnetic pattern and, therefore, correlates with a unique and specific electromagnetic signature.[3] In another research, it has been found that EMSs recorded from viral and bacterial DNA solutions are consistent with the gauge theory paradigm of quantum fields.

It has been argued that London dispersion forces between delocalized electrons of base pairs of DNAs are responsible for the formation of dipole modes that can be recognized by Taq polymerase in PCR.[4] In another paper, the authors have reported that 3D-A-DNA structure behaves as a fractal antenna, which can interact with the electromagnetic fields over a wide range of frequencies. Using the lattice details of human DNA, they have modeled the radiation of DNA as a helical antenna.[5] In another work, the authors have proposed that the Resonant Recognition Model is a powerful model that can computationally predict protein, DNA, and RNA electromagnetic resonances.[6] In another investigation, a mathematical model for electronic structure of DNA has been proposed and its structure has been

compared with AM and FM radio receivers/senders.[7] Also, in another article, a model for exchanging waves between DNAs and molecules of water has been proposed, and it has been shown that DNA waves could interact with pure water and change its entropy and quantum spectrum.[8] Motivated by these works, we propose a model to apply DNA waves in imaging. We test the model for prediction of changes in melanocytes, and the emergence of melanoma.

Melanoma is one of most dangerous type of skin cancer that develops from the pigment-containing cells known as melanocytes.[9,10] Melanocytes are melanin-producing neural crest-derived cells located in the bottom layer (the stratum basale) of the skin's epidermis, the middle layer of the eye (the uvea), the inner ear, vaginal epithelium, meninges, bones, and the heart.[11-19] Melanin is a dark pigment primarily responsible for skin color. Melanomas are usually caused by DNA damage resulting from exposure to ultraviolet light from the sun[20,21] or some genetic problems.[22] In this article, we show that damaged DNAs in melanocytes emit different waves with respect to normal ones, and inform us about the emergence of cancer in its early stages. This provides a unique opportunity to remove cancerous cells and cure patients.

The outline of this article as follows: In Section 2, we propose a model for using DNA waves in imaging the behavior of melanocytes. In Section 3, we describe a material and experimental method for examining the model and the use of DNA waves in the imaging of the damaged DNAs within the melanocytes. In Section 4, we show the results and discuss their origins. In Section 5, we discuss about the origin of DNA waves and their applications in diagnosing and curing dermatologic diseases. The last section is devoted to the conclusion.

2 | THEORY OF MODEL: USING DNA WAVES TO IMAGE EVOLUTIONS OF DNAS WITHIN THE MELANOCYTES

DNA is constructed from charged particles like atoms and electrons. By the motion of these charges, some electric currents are created. These currents emit some waves which carry the main information about the evolution of the DNA. We can use these waves in imaging. To this aim, we should design a new device from DNAs and electronic devices.

In this research, we construct a circuit from DNAs within the melanocytes and graphene sheets. DNAs could play the role of inductor because they are built from charged particles within base pairs which are coiled several times around different axes. By motion of the DNAs, these charges move and produce magnetic fields (Figure 1). The magnetic field of an inductor can be obtained from the equation below:

$$B = \mu_0 NI \tag{1}$$

where N is the number of currents, and I is the measured value for each current. Now, if melanocytes are exposed to UV waves, some base pairs are broken and inductor-like DNA misses some currents and thus, we can write:

$$B_{UV} = B - B1 = \mu_0 NI - \mu_0 MI \tag{2}$$

where M is the number of damaged base pairs. Thus, damaged melanocytes have different radiation with respect to healthy ones (Figure 1).

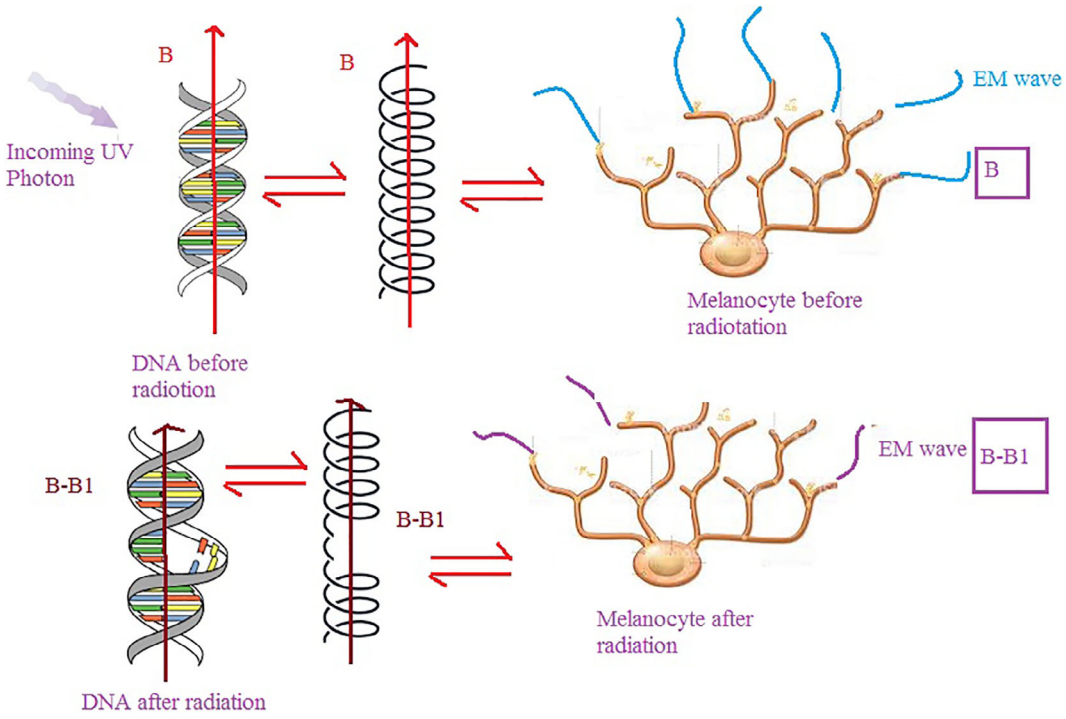

FIGURE 1 DNA waves of melanocytes are different before and after UV radiation

Now, we can take waves of melanocytes and diagnose their damaged DNAs. To do this, we need a device that could detect DNA waves. From a knowledge of electricity, it seems that the structure of graphene is closer to the structure of DNAs because graphene is built from hexagonal manifolds and has some free electrons. Similarly, DNA is also formed from hexagonal and pentagonal manifolds. To increase the similarity between DNAs and graphene, we should create some defects in graphene sheets and replace some hexagonal manifolds by pentagonal ones (Figure 2).

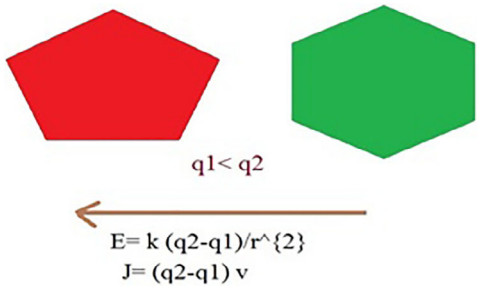

FIGURE 2 Emergence of current between hexagonal and pentagonal manifolds

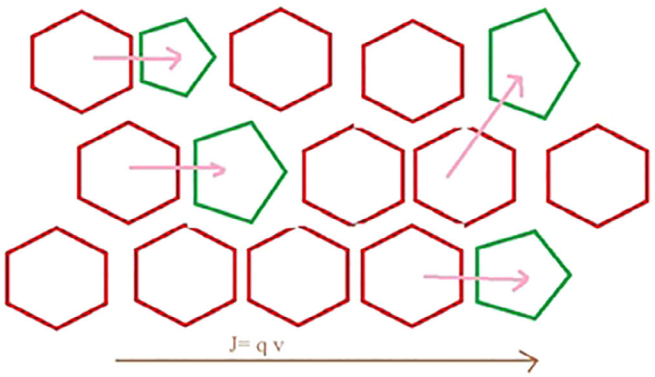

FIGURE 3 Producing defects within graphene sheets

The number of charged particles within a hexagonal manifold is greater than a pentagonal one, and consequently, an electric field emerges between these systems. This causes the motion of charges and emergence of currents (Figure 3). We can write:

$$J = (q_2 - q_1)v \tag{3}$$

where J is the current density, q_2 is the charge of the hexagonal manifold, and q_1 is the charge of the pentagonal one. Also, v is the velocity of free electrons which move along the graphene sheet (Figures 2 and 3). These currents are very similar to currents which emerge between hexagonal and pentagonal molecules in a DNA.

Now, we can design a circuit for imaging the status of DNAs within the melanocytes. To this aim, we connect healthy melanocytes to damaged ones by using a graphene sheet. This graphene sheet includes some pentagonal and hexagonal molecules which act similar to hexagonal and pentagonal manifolds of DNAs. DNA waves of the damaged melanocytes are different with respect to DNA waves of healthy ones, and produce different currents along the graphene sheet. We can measure these currents by connecting graphene sheets to scopes (Figure 4).

3 | MATERIALS AND EXPERIMENTAL METHOD: TESTING THE MODEL FOR EXPOSED MELANOCYTES TO UV WAVES

3.1 | Materials

To build a circuit for collecting the signals of melanocytes, we need the devices below:

1. UV Lamp or UV radiation of sun
2. Sunscreen or any barrier in front of UV waves

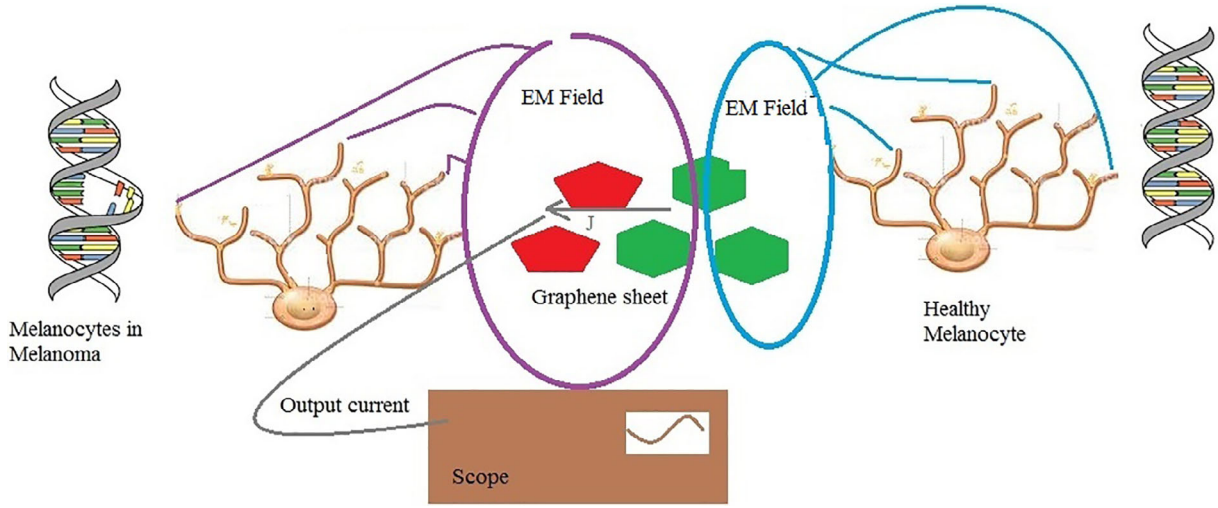

FIGURE 4 A circuit for imaging the status of melanocytes by using DNA waves

3. Oscilloscope or Radio-SkyPipe
4. Ampere-meter
5. Graphene sheets including pentagonal and hexagonal molecules.
6. Magnet
7. Gold/copper wire
8. Skin cells including melanocytes

3.2 | Experimental method

Now, we can design a circuit to take the DNA waves of melanocytes. To this aim:

1. We should isolate the waves from melanocytes from the waves of other skin cells. Totally, each cell can emit some waves. Because its DNA is built from charged particles and, according to the laws of physics, by each motion of DNA during transcription and replication, it radiates some waves. The shapes of the waves for each cell could be different from the shape of waves for other cells because the types of active genes and motions of DNAs depend on the types of activity of the cells. Thus, by analyzing the waves, we can determine their origin and source. For this reason, we can separate the waves from melanocytes from the waves of other cells.
2. We can isolate the waves of the melanocytes by considering differences between the waves of skin, before and after radiation of UV rays, because, in humans, these cells act as ultraviolet radiation filters. Also, melanocytes are responsible for skin coloration through production of melanin pigments. Specifically, when they are exposed to UV radiation, they produce more melanin. Thus, by changing the color of skin, we conclude that the activity of melanocytes increases, and consequently more waves are emitted by these cells (Figure 5). We can write:

$$B_{\text{excited melanocytes}} = B_{\text{dkin\after UV radiation}} - B_{\text{skin\before UV radiation}} \quad (4)$$

where $B_{\text{melanocytes}}$ is the magnetic field which is produced by the melanocytes after UV radiation, $B_{\text{skin\after UV radiation}}$ is the magnetic field of the skin after UV radiations and $B_{\text{skin\before UV radiation}}$ is the magnetic field of the skin before UV radiation (Figure 5).

3. To produce UV waves, we can make use of the ultraviolet waves of the sun or some artificial source like UV lamps. In this experiment, we make use of both sources. The results are approximately the same.
4. To collect the waves of the melanocytes, we can make use of graphene sheets (or gold and copper) to amplify the DNA waves and measure their currents. These graphene sheets should have some defects including pentagonal molecules. Graphene sheets could be replaced by metals like copper and gold. These metals should be coiled around several axes to become more sensitive to extra waves.
5. Another way is by using two magnets with opposite magnetic poles at two ends of some copper wire. These magnets produce two opposite magnetic fields, and the direction of spin of the electrons at one end is opposite to the direction of spin at the other end. This causes the electrons along the wire to become coupled, and a magnetic diode appears. DNA waves could break this pairing and produce a current. We can measure this current by a scope like Radio-Sky-Pipe
6. We connect a graphene sheet or magnetic diode to two different parts of the skin. We expose one part of the skin to UV waves

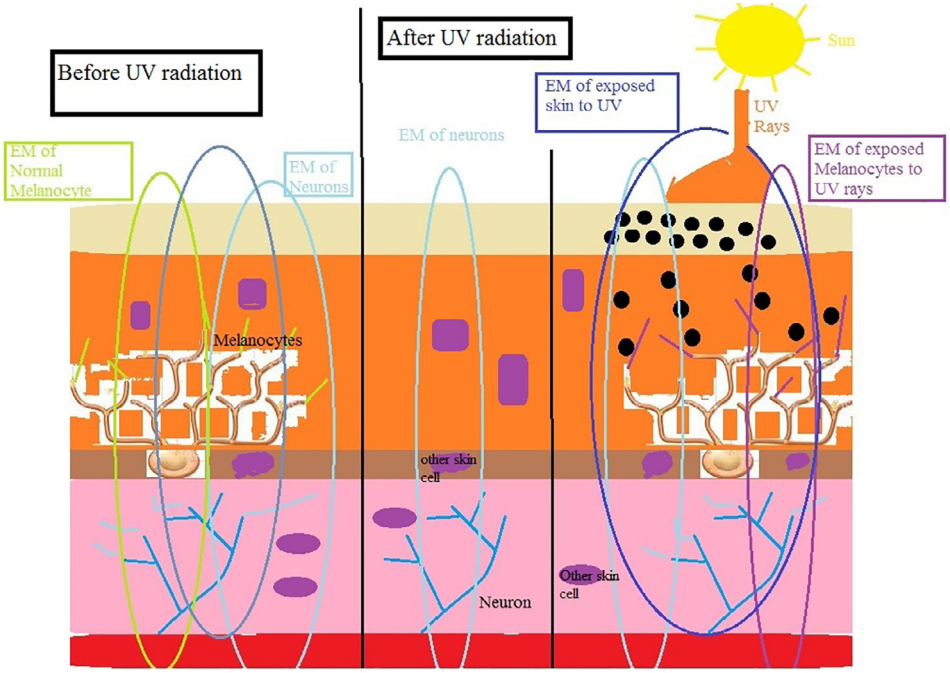

FIGURE 5 A change in waves of skin before and after UV radiation

from the sun or UV lamp, and protect the other part from the UV rays by putting a barrier or sunscreen on it (Figure 6).

7. The emitted waves from the two parts of the skin produce two different currents, one related to (normal cells + excited melanocytes) and the other related to (normal cells). Thus, we can write:

$$J_{\text{excited melanocytes}} = J_{\text{normal cells + excited melanocytes}} - J_{\text{normal cells}} \quad (5)$$

where $J_{\text{excited melanocytes}}$ is the current which is produced by excited melanocytes, $J_{\text{normal cells + excited melanocytes}}$ is the current which is

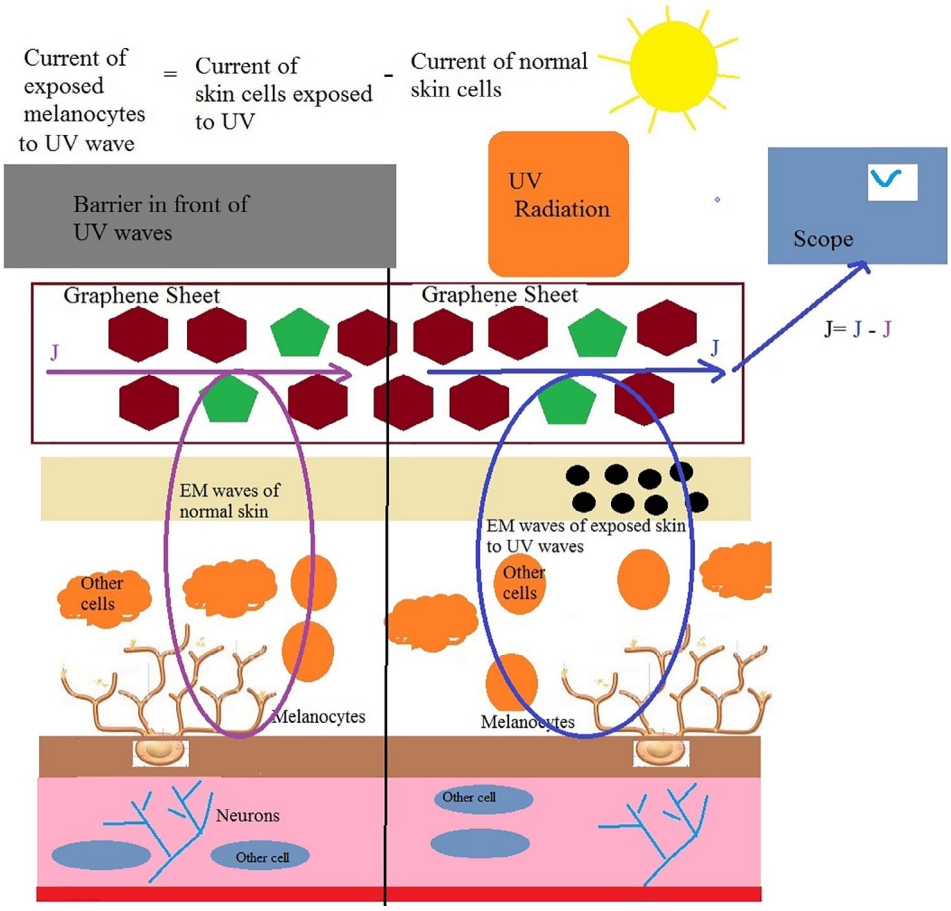

FIGURE 6 A method for taking waves from excited melanocytes

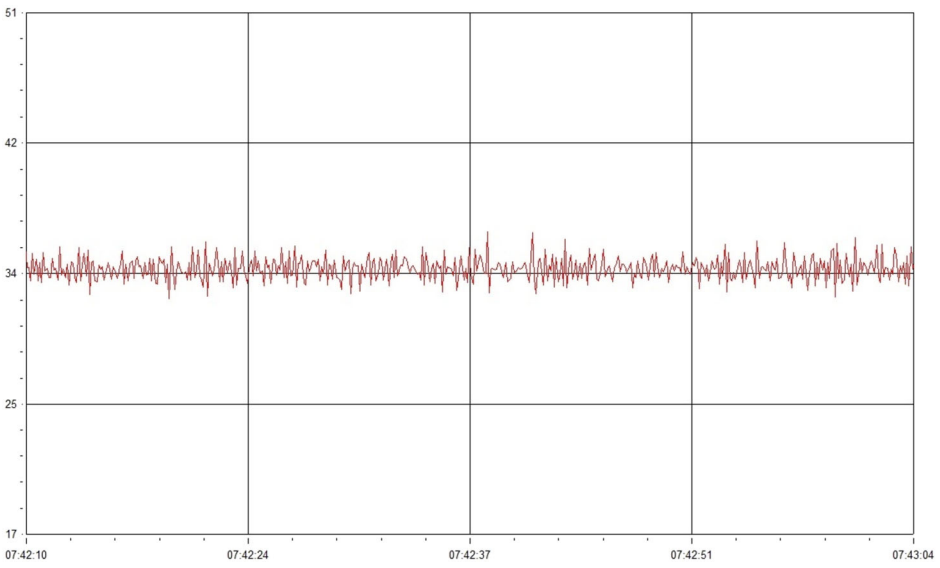

FIGURE 7 Background waves in medium before experiment

produced by normal cells + excited melanocytes, and $J_{\text{normal cells}}$ is the current which is produced by normal cells.

8. The current from the excited melanocytes is taken by some scopes like a Radio-Sky-Pipe or Ampere-meter (Figure 6).

4 | RESULTS

To examine the model, we compare DNA waves of the exposed melanocytes to UV waves with normal ones. In this experiment, we use Radio-Sky-Pipe as a scope for observing the waves. Under normal conditions, this scope measures the values of cosmic waves in a medium. We measure the amount of background waves to determine their effects on our circuit (Figure 7). We also use of an Ampere-meter to measure the values of the currents in graphene sheets or magnetic diodes. Now, we connect two healthy parts of the skin including melanocytes to our circuit. We observe that exchanged DNA waves lead to the motion of free electrons in the circuit and produce extra currents (Figure 8). At this stage, we expose the skin's cells to UV waves from the sun for some hours, connect them to the circuit and wait to observe some signatures of melanin on the skin. We show that the DNA waves become different and evolve more with respect to normal conditions (Figure 9). In Figure 10, we compare currents which are produced by waves of normal melanocytes (blue color) with currents which emerge by the waves of exposed cells to UV radiation (red color). We show that the current of normal melanocytes increase and tend to a constant value. However, the currents of the exposed melanocytes to UV grow and accelerate to large values. This is because UV waves damage melanocytes and produce extra free electric charges. These charges produce extra currents and emit extra waves with respect to normal conditions. Analyzing these currents may help us to predict the emergence of cancer in its early stages.

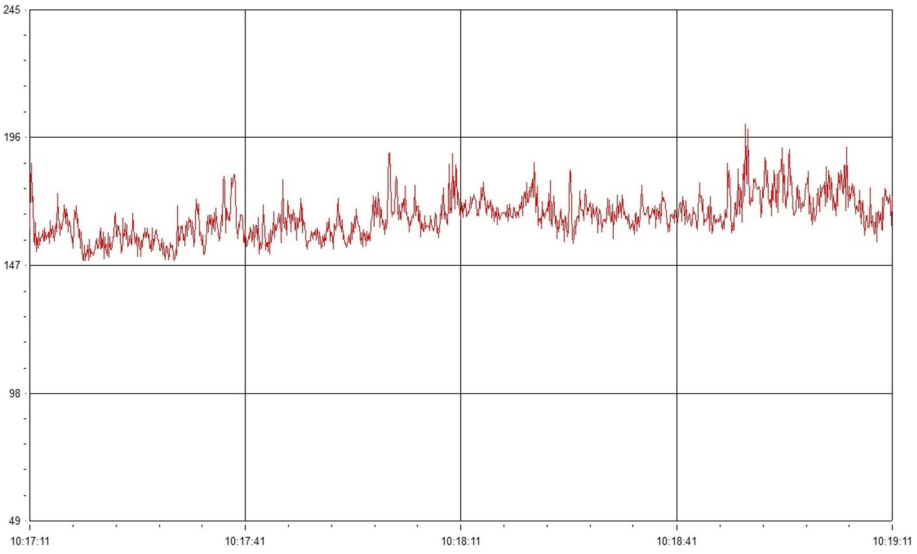

FIGURE 8 DNA waves of healthy melanocytes of skin connected to the circuit

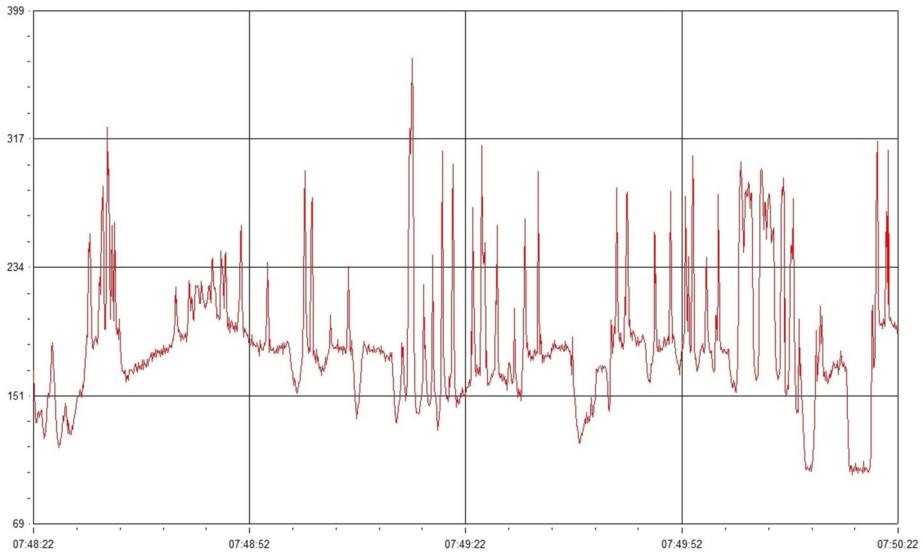

FIGURE 9 DNA waves of melanocytes of skin exposed to UV

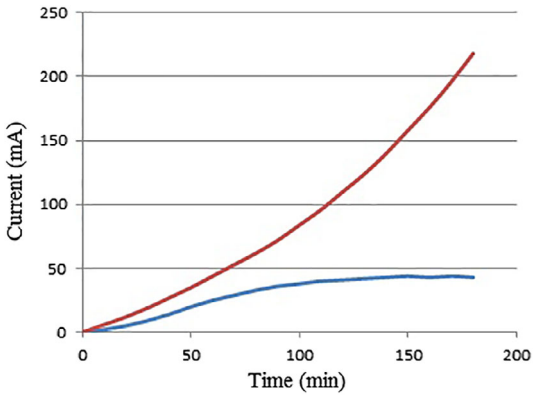

FIGURE 10 Comparing currents of melanocytes in healthy skin with currents of cells in exposed skin to UV

5 | DISCUSSION

Our experiments show that DNAs within the melanocytes and other skin cells emit some waves. These waves carry key information about the evolution of DNAs within cells. Any change in the structure of DNA could cause significant changes in its waves, because each DNA is built from hexagonal and pentagonal base pairs. These bases are formed from charged particles like electrons and atoms. By the motion of the DNAs within the cells, charged particles move and according to the laws of physics, any motion of charged particles causes the production of some special waves. The frequency and intensity of these waves depend on the number of charged particles and the structure of the DNA. Any damage in a DNA could cause a decrease or increase in the number of charged particles, and change in the electronic structure of a DNA. Consequently, this new electronic structure of a damaged DNA includes more or less charged particles, and emits waves with different frequency and intensity. By analyzing changes in the emitted waves from a DNA, we could determine the type and amount of change in its structure. These waves could be detected by free electrons on the graphene sheets or metals and observed on the scope. Specifically, if we create some defects like the hexagonal and pentagonal structures of base pairs within the graphene sheets, we can predict the type of change in the structure of DNAs better.

Some of the DNA damage can produce some errors during replication. These errors could lead to some gene mutations and genetic disorders. Some of these mutations can cause the cell to become malignant, and cancer emerges. These cancerous cells emit different waves with respect to healthy ones. Genetic disorders and mutations change the electronic structure of DNAs and consequently, the number of charged particles change, which leads to some differences in the radiated waves. By analyzing these changes in the emitted waves, we can diagnose mutations and determine their location. To remove the effects of harmful waves, some special waves are emitted and stop communication of the damaged DNAs with the healthy ones. Also, the damaged DNAs are diagnosed and removed or repaired. Some of the damages has a direct effect on binding sites, promoters and terminators. Consequently, some RNAs and proteins are repelled or attracted by the DNAs. This causes the processes of production of some helpful RNAs and protein to stop, and in turn, some extra harmless proteins are produced. These extra biological matters are formed from charged particles like electrons and atoms. Consequently, by motion of these extra biological products, some extra waves emerge which could be detected by free electrons on metal or graphene sheets and observed on scopes. By analyzing these waves, we can detect the location of damaged DNAs and cells, and remove or repair them.

6 | CONCLUSION

Recently, Montagnier and his colleagues have shown that bacterial DNAs could emit some low frequency waves. This could be a base for designing new medical imaging technique because DNA waves could transform key information about evolution within the cell to outside of it. Thus, by analyzing these waves, we can image all activities of DNAs within the cell. To show this, we have put two DNAs, one interior a damaged melanocyte, and another exterior of it and connected them by a graphene sheet. We have used some defects in graphene sheets to make the exchanged wave signals between the DNAs stronger. For example, we replace some hexagonal molecules by pentagonal ones, which help to free electrons for moving along the graphene sheet and the emergence of a current. We have compared the emerged current for exposed melanocytes to UV with normal ones, and shown that by increasing radiation, the emitted DNA waves become different. Thus, we could image the evolutions of DNAs within damaged melanocytes through their exchanged waves with DNAs within the healthy cells. In future, this will represent a useful clue to treatment choices.

These findings could be useful in clinical aspects—both diagnostic or therapeutic. This is because each type of damage causes a special change in DNA waves, and by analyzing the DNA waves, we could determine the type and amount of damages. Also, we can find the location of the damage, and try to repair or remove the damaged DNAs. A DNA is formed from hexagonal and pentagonal base pairs. These bases are built from charged particles like electrons and atoms. By the motion of DNAs within the cells, their charges move and, according to the laws of physics, some waves are emitted. Any change in the structure of a DNA could increase or decrease the number of charged particles and consequently, the frequency and intensity of the DNA waves changes. For example, some DNA damage can cause some errors during DNA replication, and these errors of replication can cause some gene mutations that, in turn, could cause some genetic disorders. Some mutations may happen in some somatic cells of an organism. Such mutations will be present in all descendants of these cells within the same organism, and some mutations can cause cells to become malignant, and, thus, some cancerous cells are produced. These mutations and genetic disorders change the DNA waves. Any change in DNA waves could be detected by free electrons in graphene sheets and produce different currents with respect to normal conditions. By analyzing these changes in waves and currents,

we can diagnose the occurrence of genetic disorders, mutation and even cancer. We also could determine the location of genetic disorders, and damage to a special DNA in a special cell. Then, we can emit some waves to cancel the effects of the harmful waves, and prevent the progression of the cancer. Also, we could remove cancerous cells or cure them. As another example, a change in the structure of DNA may cause some changes in binding sites for proteins. These changes may lead to some factors in replication like helicase and DNA polymerase being attracted to or repelled by the binding sites, and replication occurring more or less depending on the type of DNA damage. These changes in binding sites could be diagnosed by analyzing DNA waves and becoming repaired by some methods in genetic engineering. Also, DNA damage may cause the destruction of promoters or terminators and cause that some genes become active or turn off. Consequently, productions of some helpful RNAs and proteins are stopped or, some harmful proteins and RNAs emerge. Any extra products could emit some extra waves that we could detect them. These waves carry key information about the type of destruction and amount of extra products within the nucleus. Considering these waves, we determine the location of damaged DNAs and extra products, remove or cure them.

ACKNOWLEDGMENTS

The work of M.F., A.S., M.G.R., A.J.C., I.B., M.G., M.T., N.V.T., J.S., and T.L. has been supported financially by Guglielmo Marconi University in Italy. Also, the work of A. Beesham has been supported financially by the National Research Foundation of South Africa (grant number: 118511).

ORCID

Massimo Fioranelli https://orcid.org/0000-0002-1319-8779
Torello Lotti https://orcid.org/0000-0003-0840-1936

REFERENCES

1. Luc M, Jamal A, Emilio DG, Lavallee C, Tedeschi A, Giuseppe V. DNA waves and water. *J Phys Conf Ser*. 2011;306(1):1-10. https://doi.org/10.1088/1742-6596/306/1/012007.
2. Luc M, Emilio DG, Jamal A, et al. Transduction of DNA information through water and electromagnetic waves. *Electromagn Biol Med*. 2015;34:106-112. https://doi.org/10.3109/15368378.2015.1036072.
3. Alberto F, Mario L, Maria GL, Settimio G, Antonella L. Electromagnetic information transfer through aqueous system. *Electromagn Biol Med*. 2017;36(3):289-294. https://doi.org/10.1080/15368378.2017.1347882.
4. Montagnier L, Aïssa J, Capolupo A, et al. Water bridging dynamics of polymerase chain reaction in the gauge theory paradigm of quantum fields. *Water*. 2017;9(5):339. https://doi.org/10.3390/w905033.
5. Singh P, Doti R, Lugo JE, et al. DNA as an electromagnetic fractal cavity resonator: its universal sensing and fractal antenna behavior. In: Pant M, Ray K, Sharma T, Rawat S, Bandyopadhyay A, eds. *Soft Computing: Theories and Applications. Advances in Intelligent Systems and Computing*. Vol 584. Singapore: Springer; 2018.
6. Cosic I, Cosic D, Lazar K. Is it possible to predict electromagnetic resonances in proteins, DNA and RNA? *EPJ Nonlinear Biomed Phys*. 2015;3:5. https://doi.org/10.1140/epjnbp/s40366-015-0020-6.
7. Alireza S. A mathematical model for DNA. *Int J Geomet Methods Mod Phys*. 2017;14(11):1750152.
8. Fioranelli M, Roccia. A Bionic model for exchanging waves between water and DNA. *Int J Geomet Methods Mod Phys*. 2019;16(4):1950051.
9. Goldstein BG, Goldstein AO. Diagnosis and management of malignant melanoma. *Am Fam Physician*. 2001;63(7):1359-1368. 1374.
10. Azoury SC, Lange JR. Epidemiology, risk factors, prevention, and early detection of melanoma. *Surg Clin North Am*. 2014;94(5):945-962, vii. https://doi.org/10.1016/j.suc.2014.07.0132.
11. Plonka PM, Passeron T, Brenner M, et al. What are melanocytes really doing all day long…? *Exp Dermatol*. 2009;18(9):799-819. https://doi.org/10.1111/j.1600-0625.2009.00912.x.
12. Cramer SF. The origin of epidermal melanocytes. Implications for the histogenesis of nevi and melanomas. *Arch Pathol Lab Med*. 1991;115(2):115-119.
13. Barden H, Levine S. Histochemical observations on rodent brain melanin. *Brain Res Bull*. 1983;10(6):847-851. https://doi.org/10.1016/0361-9230(83)90218-6.
14. Markert CL, Silvers WK. The effects of genotype and cell environment on melanoblast differentiation in the house mouse. *Genetics*. 1956;41(3):429-450.
15. Mackintosh JA. The antimicrobial properties of melanocytes, melanosomes and melanin and the evolution of black skin. *J Theor Biol*. 2001;211(2):101-113. https://doi.org/10.1006/jtbi.2001.2331.
16. Mayeaux EJ, Cox JT, eds. *Modern Colposcopy Textbook and Atlas*. Lippincott Williams & Wilkins (Philadelphia: American Society for Colposcopy and Cervical Pathology); 2011 ISBN 9781451153835.
17. Mintz B. Clonal basis of mammalian differentiation. *Symp Soc Exp Biol*. 1971;25:345-370.
18. Nichols SE, Reams WM. The occurrence and morphogenesis of melanocytes in the connective tissues of the PET/MCV mouse strain. *J Embryol Exp Morphol*. 1960;8:24-32.
19. Theriault LL, Hurley LS. Ultrastructure of developing melanosomes in C57 black and pallid mice. *Dev Biol*. 1970;23(2):261-275. https://doi.org/10.1016/0012-1606(70)90098-9.
20. Kanavy HE, Gerstenblith MR. Ultraviolet radiation and melanoma. *Semin Cutan Med Surg*. 2011;30(4):222-228. https://doi.org/10.1016/j.sder.2011.08.003.
21. Rünger TM, Farahvash B, Hatvani Z, Rees A. Comparison of DNA damage responses following equimutagenic doses of UVA and UVB: a less effective cell cycle arrest with UVA may render UVA-induced pyrimidine dimers more mutagenic than UVB-induced ones. *Photochem Photobiol Sci*. 2012;11(1):207-215. https://doi.org/10.1039/c1pp05232b.
22. Greene MH. The genetics of hereditary melanoma and nevi. 1998 update. *Cancer*. 1999;86(11 suppl):2464-2477. https://doi.org/10.1002/(SICI)1097-0142(19991201)86:11+<2464::AID-CNCR3>3.0.CO;2-F.

How to cite this article: Fioranelli M, Sepehri A, Roccia MG, et al. A new medical imaging technique for diagnosing dermatologic diseases: A clue to treatment choices. *Dermatologic Therapy*. 2020;33:e13405. https://doi.org/10.1111/dth.13405