Laser scanner to detect cancer in less than 30 seconds

A team of European scientists has developed the world's first cancer scanner that detects blood vessels grown by a malignant melanoma with an infrared laser beam in 30 seconds.

Current skin cancer diagnosis can last a number of weeks and be very upsetting.

Multiple stages can involve visiting a GP, being sent to a dermatologist for a skin biopsy, waiting for laboratory analysis, having a sentinel lymph node biopsy under general anaesthetic, and then having more tests if the cancer has spread.

However, a new imaging system developed by a group of European scientists could dramatically speed up the process and reduce the need for debilitating sentinel-lymph node biopsies by placing real-time diagnosis in the hands of a dermatologist.

Using a handheld laser, a specialist can actually see under your skin at depths of 1 mm by creating a 3D colour image of the microscopic blood vessels in a process that takes around 30 seconds.

Employing a new and advanced version of Optical Coherence Tomography (OCT), a photonics technique more commonly used in retina scans, the scanner captures 3D images of the micro structures under the skin with a harmless infrared laser beam.

Since melanomas need oxygen to grow and survive, they grow their own blood vessels. As the cancer develops and becomes more malignant, they become increasingly distorted and malformed, differing in appearance from healthy vessels.

Being able to detect and see these vessels in a suspicious lesion in real time has never been possible, until now, opening the possibility for dermatologists to make treatment decisions in an unrivalled timeframe.

Shining a Light on Cancer

Melanoma is one of the most dangerous forms of skin cancer. Over 55,500 people in the world (12,000 European) died from malignant melanoma of the skin in 2012 alone. While 2,459 deaths from melanoma skin cancer were recorded in the UK in 2014, an estimated 9,730 people will die of melanoma in the United States in 2017.

Melanomas produce their own blood vessels to feed and grow the tumour, so by revealing the microstructures in 3D pictures the scanner show doctors how the cancer has developed.

A specialist can potentially determine on the spot, whether simply cutting it out is sufficient for a cure or whether further treatment with cancer drugs will be needed.

With their new device, called 'VivoSight' on the market, the European team 'ADVANCE' (or '*Automatic Detection of VAscular Networks for Cancer Evaluation*') is aiming to reduce the time for treatment decision from a number of weeks to a matter of seconds, while removing

the invasive nature of the appointment. UK project leader, Jon Holmes of Michelson Diagnostics Ltd, a key partner in the ADVANCE consortium, explains:

“Every melanoma above a certain thickness could have spread to other parts of the body. At present, all patients with such melanomas have to wait for a sentinel lymph node biopsy performed in a hospital under general anaesthesia to find out if it is spreading. This can take weeks to perform, is very expensive and can be debilitating for the patient.

“About 80% of the time, the biopsy produces a negative result with no sign of the cancer spreading. There has to be a better way: our scanner may radically improve the abilities of dermatologists to decide whether a melanoma is in the less malignant, non-spreading, early stage, or if it has already developed and requires immediate aggressive therapy. Further clinical trials will be needed to conclusively prove the technology.”

Speckle Variance OCT

The ADVANCE team has employed a variant of OCT in its scanner called ‘Speckle-Variance’ OCT or dynamic OCT (D-OCT), an advancement of OCT that is ideal for capturing movement.

Studying the ‘speckle’ or flicker of light patterns created by moving blood cells, the imaging device takes around four frames per second and compiles the images so that a clinician may tell where something has moved on the image from frame to frame.

“Using D-OCT we can see movement of blood against the solid tissue structures, something we have never been able to do before in a clinical setting. It’s like looking out at night and seeing cars’ headlights flowing along a motorway, only at depths of nanometers under the skin.”

“But it appears cancers don’t take the direct route! Their vessels are like twisty, branching country lanes that get narrower and wider. Our clinical team thinks that these ‘shapes’ are key to understanding the cancer. Our scanner shows these vessels in gorgeous detail,” Mr Holmes explained.

While a sentinel node biopsy can cost in excess of €10,000, and with many hospitals performing hundreds per year, there is a growing concern and a need to find an alternative when over 80% of these operations turn out to be clear of any malignant growth.

Wounds, Ulcers, Burns

As well as the profound use in skin cancer diagnosis, the ability to see blood vessel networks with the ADVANCE technology has created a number of useful spin-off benefits.

“The scanner can image the blood vessels in healing wounds. This may have application for treatment of leg and foot chronic ulcers, when doctors want to know whether a wound is healing or requires a change in treatment, potentially reducing the number of amputations.”

“ADVANCE technology may also help with burn victims, being able to give a doctor a quicker response time than the standard 15 days to determine whether a patient’s skin is healing and whether or not to give a skin graft”.

“Ultimately with the ADVANCE scanner, not only can thousands of lives be saved and many millions of Euros in cost savings be made annually worldwide, but there is no price we can put on a patient not having to go through an unnecessary operation with potential long term debilitating side effects or wait an unnecessary amount of time for treatment.”

Coordinated in the UK, the ADVANCE project received a grant of € 2,282,143 from the European Commission’s FP7 programme.

Participants from five European countries are: (United Kingdom) Michelson Diagnostics Ltd (manufacturer of VivoSight) and EG Technology Limited; (Germany) CMB Collegium Medicum Berlin GMBH, and Klinikum Augsburg Kommunalunternehmen; (Denmark) Region Sjaelland; (Italy) Università degli Studi di Modena e Reggio Emilia; (Serbia) Tehnološko partnerstvo d.o.o. Beograd (Stari Grad).

About Photonics21

Photonics21 is the European Technology Platform (ETP) for photonics, a technology encompassing all of the products and processes around the emission, manipulation and detection of light. Photonics is integral to a wide range of industries that include the medical, healthcare, transport, manufacturing, and telecommunications sectors.

"Photonics21" was set up in December 2005 to bring the community of photonics researchers and industries together. The European Commission defined photonics as one of five European Key Enabling Technologies (KET's) in September 2009. Shortly after, the European Research & Innovation Program "Horizon 2020" invited Photonics21 to become a "Public Private Partnership" (PPP). The "Photonics 21 Association", a legal entity under Belgium law, became the private contract partner in November 2013 in a Public Private Partnership (PPP) in conjunction with the EU Commission.

Today Photonics21 represents more than 3000 personal members from across Europe and abroad. Our members are experts in the photonics industry, research organisations and universities who actively engage with us to develop a joint photonics strategy for future research and innovation in Europe.

With the global photonics market growing from €350 Billion in 2011 to €447 Billion in 2015, Photonics remains a strong industry. The European photonics industry, estimated to be worth €70 billion, has considerable global leadership positions and employs over 300,000 people directly.

With positive growth forecast, current industry trends like digitalisation, resource efficiency, individual and zero failure production will drive the photonics industry further.

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