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Nano imaging: A novel era of cancer Nano medicine in 21st century

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EDITORIAL

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The beginning of structural imaging has been traced since 1895, when Wilhelm Röntgen discovered the X-ray. It produces photons, a quantum of visible light that owns energy, to measure the density of different tissues. X-ray was the clinician's core imaging diagnostic tool for more than half-done of the past century. In 1970s it was transformed to a new subject, computerization. When X-ray computed tomography (CT) was developed.[1] Cormack and Hounsfield invented it in 1971. Computed tomography uses distinct X-ray instrument to take 3-dimensional structural images of bone, soft tissues and air in whole body. It is particularly suitable in emergency trauma since it could be done fast.

During 1930's-40a new technique, ultrasound, constructed. It was first practical to the human body by Ludwig at the Naval Medical Research Institute in 1940s. In Obstetrics and Gynaecology it has a very definite beginning with the 1958 classic Lancet paper "The investigation of abdominal masses by pulsed ultrasound" by Donald, McVicar, and Brown in 1958.[2] It is an oscillating sound pressure wave. It frequency is higher than the upper limit of the human hearing domain. It processes sound waves to determine the positions of surfaces inside tissues, and differentiates surfaces from fluids. It measures the time that transits between the making of an ultrasonic pulse and the echo created when the surface reproduces the pulse. Up to the 1960s when scientists attempt to diagnose brain tumours it was mostly used neurologically. When experts determined that the skull considerably changes the signals, its use for this determination stopped whiles its use in obstetrics and gynaecology widespread.

The concept of positron emission tomography (PET) was introduced by Kuhl, Chapman and Edwards in the late 1950s. Their work later led to the design and construction of several tomographic instruments at Pennsylvania University. Tomographic imaging techniques were further developed by Ter-Pogossian, Phelps, Hoffman and their colleagues at the University of Washington.

Magnetic Resonance Imaging (MRI) first introduced by Paul Lauterbur in living mouse at University of Illinois in 1974. Then it is developed by Peter Mansfield at University of Nottingham as the first MRI image in human demonstrated in 1977.

Today, nanotechnology-based chemotherapeutics and imaging compounds signify a novel era of "cancer nanomedicine".[3-5] It is employed to deliver multipurpose contents with promising pharmacokinetics and capitalize on molecular and cellular targeting for enhanced efficacy, specificity, and safety. In cancer preclinical investigations and readings Optical Imaging Systems (OISs) have conventionally played a central part in molecular imaging of gene reporters, molecular targets and receptors.[5] Nano medicines are sub-micrometre-sized carrier materials envisioned to advance the bio-distribution of intravenous administered (chemo-) therapeutic agents. Now ever more hard work in this field has employed OISs to screen bio-distribution and target site accumulation.

Optical imaging systems have obvious advantages over standard MRI or CT scans. They are performed during surgery; they spare patients repeat surgeries; and unlike CT scans, they do not expose patients to radiation. Optical imaging systems can also scan a larger tissue area for tumour cells than pathologists can assess with the microscope. The others advantages of OISs are: a) Imaging of near surface abnormalities, b) No labelling, c) Microscopic information of tissue anatomy, d) High spatial

resolution (~10µm) and finally e) Cost effective. Within the next few years it is anticipated that the results of today's molecular imaging research will have a direct effect on patient care.[6,7]

Use of current imaging technology for molecular imaging Nano sensor refers to the use of semiconductor micro fabrication technology to create sensors sensitive to a biologic change and of course it has limitations.[8] Limited depth detection ability (<1cm) and currently, limited in vivo application are important issues. In addition, subtle differences between tumour and normal tissue combined with weak signalling could make it hard to see tumour's margins.

The hope is that the nanotechnology-based contrast agents will overcome these problems and send strong, easily detectable signals from tumour cells. Translating imaging agents to the clinic is costly and frequently hampered by regulatory hurdles because of versatility of several Nano medicine-based platforms, Therefore, translating cancer Nano medicine might largely be application-defined, where agents are adapted only in the direction of specific indications where their properties confer inimitable and unique advantages. This approach might also realize therapies that could enhance clinical impact through combinatorial Nano medicine.

In the 21st century, the use of in vivo OISs has increased exponentially. Besides for molecular imaging purposes, optical imaging has also been more and more used for monitoring the bio-distribution and target site accumulation of Nano medicine formulations. To overcome some of the shortcomings associated with optical imaging of Nano medicine bio-distribution, in particular those related to the lack of anatomical information, Junjachan and his co-workers developed a hybrid CT-FMT-based imaging protocol to enable more meaningful and more quantitative in vivo analyses. Consequently, these initial proof-of-principle protocols persuasively show that combining anatomical µCT with Fluorescence Molecular Tomography (FMT) facilitates the non-invasive assessment of Nano medicine bio-distribution.
The future of in vivo Nano imaging would be highly progressive. It will shine with advances in discovery and revealing technology matching with the development of an array of suitable sensors and techniques to progress biocompatibility and safety. Therefore optimization and translation of the sensors and new techniques for everything from cancer to cardiac arrest will necessitate multidisciplinary hard works between biologists, engineers and clinical practitioners from cell biology and chemistry to engineering and radiology.[8]

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PEER REVIEW

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CONFLICTS OF INTEREST

The author declares that he has no competing interests.