News & Views in ...

Imaging in Medicine

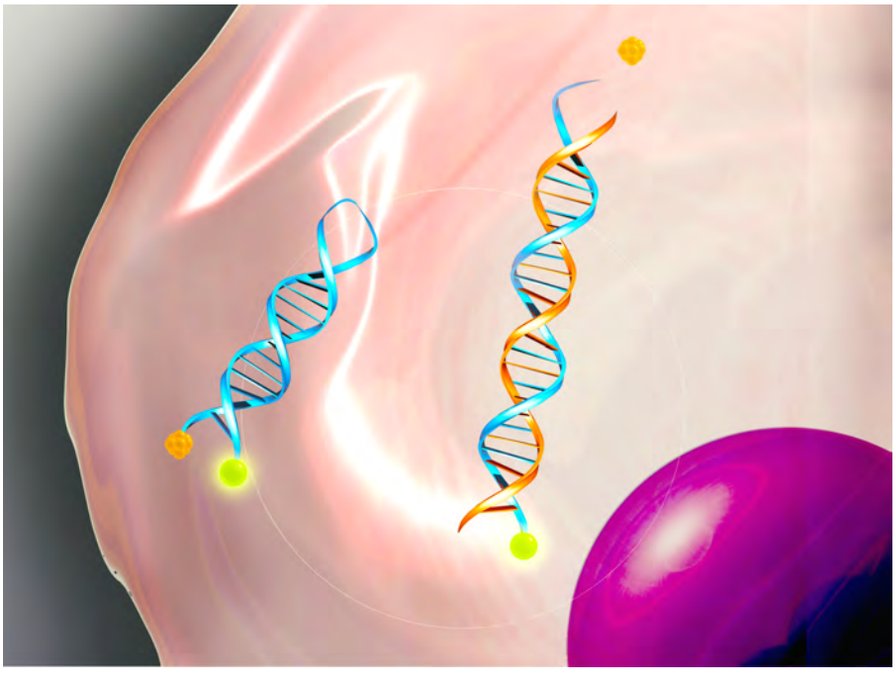
Forster resonance energy transfer microscopy using gold nanoparticles could detect cancerous cells

Research carried out at the University of Strathclyde (Glasgow, UK) has provided findings of how gold nanoparticles used in conjunction with Forster resonance energy transfer (FRET), could be used for the detection of cancerous cells.

Organic dye molecules currently used in FRET microscopy do not have high photostability as exhibited by gold nanoparticles. This attribute of gold allows the probe to be used for long distances without affecting cells in a detrimental manner. The mechanism behind FRET microscopy and gold nanoparticles lies in the principle that the gold nanoparticles are linked to a fluorescent protein by a single strand of DNA structured like a hairpin. When this single strand of DNA interacts with a complementary region of mRNA, it dissolves, leaving behind a fluorescent signal. This signal then consequently acts as a signpost, allowing mRNA associated with disease to be tracked and quantified. Yu Chen, who is part of University of Strathclyde's Physics Department, explains that "this technique could allow simultaneous detection of multiple types of RNA and may also lead to the development of techniques to study the efficacy of drugs."

Using gold nanoparticles with FRET microscopy is different from other techniques owing to the smaller amount of RNA incorporated. The technique enables studies to be carried out at a single cell level, and Chen speaks of how "only at a single-cell level can one start to understand the heterogeneous responses of individual cells and thereby sense the dynamics of RNA in the cell to a meaningful precision."

Funding by the Biotechnology and Biological Sciences Research Council has



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enabled this 18-month project to be undertaken. In correspondence with *Imaging in Medicine*, Chen expresses the hope that "successful development of gold nanoprobes may provide insight into developing bio-assays for detecting multiple types of RNA related to cancer, which would raise the possibility of scientists eventually being able to screen patients."

Source: University of Strathclyde news release: www.strath.ac.uk/press/newsreleases/headline_727847_en.html

New imaging software could reduce and control CT radiation risk in children

A study conducted at Cincinnati Children's Hospital (OH, USA) has lead to new imaging software that when used in conjunction with existing CT scanners, could determine and control the minimum radiation dose subjected to a patient.

The findings of the study were published in *Radiology* and provide radiologists with control over the quality of the images produced by the scanner, as well as the dose of radiation. The imaging software works by providing a tailored minimum radiation dose for the patient by using a mathematical algorithm. The software grants the radiologist with the correct optimum settings for the CT scanner prior to the scan, as well as monitoring the scan to ensure that the ideal dose is used. David Larson, the study leader at Cincinnati Children's Hospital, states that the study "presents a new approach to CT radiation dose management by translating the radiation dose that is 'as slow as reasonably achievable' into quantitative terms, based on image quality, and then providing a means for consistently and verifiably achieving that level."

The study involved 817 children who underwent CT examinations and radiologists were asked to score the images produced, taking into consideration the amount of image noise that would be sufficiently tolerable to enable a radiologist to make a suitable diagnosis. Larson and his team used these observations to determine the minimal dose of radiation that the patient could be subjected to, while taking image quality into consideration. The imaging software delivered impressive results, with a 37% reduction of CT scan radiation exposure.

Larson explained that "modern CT scanners adjust the dose based on the size of patient, they do not necessarily adjust it to the exact image quality radiologists need." The new imaging software, currently only in use at Cincinnati Children's Hospital, can be used to specify the image quality and an appropriate dose, as well as providing prior scanner settings, which can attain the said levels without the present trial-and-error approach to optimizing CT radiation dose.

The exciting conclusion of the study, expressed by Larson, was the ease of using the imaging software. In correspondence with *Imaging in Medicine*, he explains "we could be confident we were consistently hitting our dose and image quality targets without having to continue to pour in additional resources."

The execution of controlling CT radiation doses using the software had lead to a decrease in image noise variation as well as radiation dose, which was estimated by patient size. The team has provided a method that in the future could potentially be used widely in clinical practice in all hospitals. Larson speaks of this unique imaging software providing better control of CT scanners consequently leading to a "better way to confirm to ourselves, regulators and our patients that the doses we are using are, in fact, as low as reasonably achievable."

Sources: Larson DB, Wang LL, Podberesky DJ, Goske MJ. System for verifiable CT radiation dose optimization based on image quality. Part I. Optimization model. Radiology *doi:10.1148/radiol.13122320 (2013) (Epub ahead of print); Cincinnati Children's Hospital news release: www.eurekalert.org/pub_releases/2013–06/cchm-ntr061713.php*

Visualizing the brains of children with learning difficulties with the help of an engineered ballpoint pen

A new computer-interfaced drawing pen and pad has been designed at the University of Washington (WA, USA) to help researchers to visualize the brains of children who suffer from learning difficulties such as dyslexia.

Thomas Lewis and his team presented the device at the 19th Annual Meeting of the Organization for Human Brain Mapping held in Seattle (WA, USA). The device, which allows handwriting to be tracked by using a fiber optic pen, provides an insight into brain function while the patient undergoes functional MRI. Frederick Reitz and Kelvin Wu, members of Lewis' team, had inventively placed optic fibers inside a ballpoint pen, in turn allowing movement of the pen to be recorded. This was performed by asking the patient to use the pen to write on a piece of paper that had a series of colored gradients.

The simple components, fiber optics, pens and colored gradient paper, are all accessible to those working in laboratories.

Reitz speaks highly of the cost-effective device in comparison to others available on the market. He expresses how the engineered device 'does something similar for a tenth of the cost'. By analyzing the behavior and style associated with exhibited handwriting patterns, the device would provide an insight into the neural connections and pathways in children with learning difficulties.

The research conducted involved children aged between 11 and 14 years. They were divided into groups; a group of children who had learning difficulties, such as dysgraphia, and a control group who exhibited no learning difficulties. Each child was provided with a variety of reading and writing tasks that each took 4 min. By analyzing the brain activity of the children during these tasks, certain unexpected pathways and brain areas were found to be activated. Lewis spoke of the minimal knowledge surrounding pathways associated with handwriting; he explained that "there are other motor pathways that allow you to move your hand. But how it all connects to the hand and motion is still being understood."

The idea of using a simple ball point pen engineered with fiber optics used alongside a pad could, in the future, be used to understand movement disorders exhibited by adults such as Parkinson's disease. Analysis of hand movements could help researchers to understand the neural pathways that are perturbed in such disorders. Todd Richards, principle investigator of the University of Washington Integrated Brain Imaging Center, expressed his hope that "the MRI-compatible pen will allow us to make new discoveries about the functional brain activity."

Source: Fiber-optic pen helps see inside brains of children with learning disabilities: www.washington.edu/news/2013/06/17/fiber-optic-pen-helps-see-inside-brains-of-children-with-learning-disabilities

Identification of spinal infections caused by contaminated injections using MRI screening

A study conducted by a team at St Joseph Mercy Ann Arbor Hospital (MI, USA) has provided details of how MRI at the site of a contaminated drug injection led to the discovery that some patients despite no medical complaints had a fungal spinal infection. The study was published in a recent issue of the journal *JAMA*.

The steroid drug, methylprednisolone, originated from a batch at the New England Compounding Center (NECC; MA, USA). The anti-inflammatory drug is thought to have been contaminated at the NECC with either a fungus or meningitis. The contaminated batch was responsible for over 58 deaths in the autumn of 2012, while other receivers of the injection had cases of meningitis. An interesting aspect of the outbreak was that the prevalence of meningitis had decreased while there was an increase in the amount of patients with spinal infections.

Anurag Malani and colleagues analyzed the link between contaminated steroids and the spinal infection at the site of injection using contrast-enhanced MRI at the regions of injection. The team decided to focus on 172 patients who had no complaints of meningitis and spinal infection. The results of the study demonstrated that 36 out of 172 patients had abnormal results including fluid build up, which suggested that there was a probable infection. Further investigation, using categorization by the CDC, showed that 17 out of the 36 patients had a high chance that they had a fungal infection, while 18 patients had a definite fungal spinal infection. Suitable medical care was provided to those with the infection.

An interesting finding of this study was that MRI aided identification of spinal infections in patients who had no complaints of feeling unwell after contaminated methylprednisolone injections. This finding is effective for screening receivers of the injections for infection prior to the onset of symptoms.

Using contrast-enhanced MRI screening may provide answers to patients who have spinal infections but are unaware of the cause. However, there are concerns that the injection itself may have been the reason behind back pain suffered by patients and whether the injections should have been administered in the first place is being questionned. The authors of the paper spoke highly of using MRI as an infection screening tool for this outbreak of spinal infections. They said it could lead to a more "efffacious medical and surgical treatment and improved outcome."

Source: Koch S, Vandenberg DM, Halasyamani L et al. *Magnetic resonance imaging screening to identify spinal and paraspinal infections associated with injections of contaminated methylprednisolone acetate.* JAMA *309(23), 2465–2472 (2013).*

– All stories written by Simi Thankaraj

About the News

The News highlights some of the most important events and research in the field of imaging in medicine. If you have newsworthy information, please contact: Sarah Miller, Commissioning Editor, *Imaging in Medicine,* s.miller@futuremedicine.com