Voltage-based method to detect cancerous cells

Background
Real-time diagnostics during surgery and in vivo monitoring of chemotherapy-induced tissue changes in the neoadjuvant and adjuvant situation are two critical technologies in cancer treatments, which would enable individualized surgical treatment. It has been established that abnormal proliferation of a single cell caused by cancer can lead to cell depolarisation. Current surgical techniques such as “iKnife”, uses rapid evaporation ionization mass spectroscopy (REMIS) to detect tumours real-time. Another technique, Fluorescent bioelectricity reporter (FBR) has been used to monitor a large number of cell in vivo. However, none of these techniques have been used in clinical setting, as iKnife requires a detailed chemical spectrum database, while FBR is not designed for clinical applications. Hence, there is a need for a technology that can detect cancerous tissue real-time. These challenges have been overcome by a technology developed by a team in Imperial college London. This novel system measures voltage in tissue and differentiates cancerous from non-cancerous tissue. This paves way for the development of predictive and prognostic biomarkers based on the biopotential properties of cancerous tissue.

Technology
A team at Imperial College London, led by Professor Emmanuel Drakakis, has developed a novel technology detects cancerous tissue by means of differential voltage measurements. The key features of this technology are:

- The technology comprises of an instrumentation amplifier (IA) that is connected to two electrodes; tungsten and silver/silver chloride electrode.
- The FHC D.ZAP tungsten electrode with a metal-tip is in contact with the tissue sample suspended in media.
- The silver/silver chloride (Ag/AgCl) electrode typically acts as a reference electrode in the system and it is contact with media containing cancerous/non-cancerous omentum.
- The IA records and amplifies potential differences between its terminals when the system is in equilibrium.

Quick Info
Benefits
- Real-time detection of cancerous tissue
- Measures voltage and differentiates cancerous from non-cancerous tissue

Applications:
- Portable device used to detect wide range of cancerous tissue during surgery
- It can be used in electrically noisy hospital wards because it possesses high signal to noise ratio

Dr Andrew Tingey
Director of Healthcare Licensing
e: andrew.tingey@imperialinnovations.co.uk
t: +44 (0)20 3053 8813
Technology reference number: 7550
The potential difference between cancerous and non-cancerous tissue are recorded.

A decreased absolute valued voltage of the tissue sample compared to the control sample is indicative of cancer.

Applications
The novel technology can be used for real-time detection of cancerous tissue. It could potentially be used as a portable theatre instrument or a handheld device that enable testing of wide range of cancerous tissue samples (ovarian, rectal sigmoid, spleen, para-aortic lymph node or pelvic side wall) during operation. It removes the common-mode noise from the input signal, so the output amplified signal has a higher signal-to-noise ratio (SNR). As a result, the voltage signals recorded are less susceptible to noise.

Market Research
The global cancer/tumour profiling market was valued at USD $13.30 billion in 2012. At the end of 2013, the market is estimated to be USD $14.99 billion and is poised to reach around USD $35 billion by 2018, growing at a CAGR of 18.50% from 2013 to 2018.

Team
Professor Emmanuel (Manos) Mic. Drakakis:
Academic member of staff of the Department of Bioengineering at Imperial College London.

Professor Hani Gabra:
Professor of Medical Oncology and Deputy Head of the Division of Cancer (Clinical). He is Head of the Molecular Therapeutics Unit and Director of the Ovarian Cancer Action Research Centre at Imperial College. Within Imperial College Healthcare NHS Trust he is Head of Medical Oncology, Chair of the Cancer Research Committee and is Honorary Consultant Medical Oncologist.

Professor Christina Fotopoulou:
Consultant gynaecological oncologist at Queen Charlotte’s & Chelsea Hospital.

Professor Martyn Boutelle:
Professor of Biomedical Sensors Engineering at Imperial college London

Intellectual property
The PCT application and provisional patent for UK is pending for the novel tumour detecting technology. The technology is available for licensing.