Imperial College London

TRANSCUTANEOUS FLUORESCENCE SPECTROSCOPY TO ASSESS GUT PERMEABILITY & GASTRIC EMPTYING RATE

Summary

The present invention relates to a device and methods for non-invasive measurement of gut permeability and gastric emptying rate

Proposed use

- Rapid, non-invasive assessment of gut permeability and gastric emptying
- Monitoring of treatment/intervention responses (e.g. coeliac disease, IBD, liver disease, immunotherapy, malnutrition, etc.)
- Monitoring recovery following colorectal (and other) surgery
- Screening to identify patients with pre-cancerous conditions (e.g. IBD)
- Assessment of gastric emptying rate for gastroparesis, indigestion, stomach cancer, enteral feeding, etc.

Problem addressed

The function of the gut plays a vital role in health and disease. Increased gut permeability occurs when the intestinal barrier becomes compromised and involves the leakage of bacteria and other pathogens out of the intestine. This results in a cycle of infection and inflammation that can drive additional consequences and further exacerbate the issue of increased permeability. The condition is associated with many widespread diseases including coeliac disease, inflammatory bowel disease (IBD), HIV, liver disease, sepsis, and even malnutrition. Similarly, gastric emptying rate (the rate at which the stomach empties) is altered in conditions ranging from diabetic gastroparesis to stomach cancer. These diseases represent a huge cost burden on national healthcare systems worldwide. Importantly, in many of them, the role and impact of gut function is not well understood. Moreover, current techniques for assessing gastro-intestinal function (including permeability and gastric emptying rate) can be cumbersome, expensive, highly invasive, unreliable and difficult to perform in infants. Thus, there is a need for new technologies that can enhance understanding of gut function and provide improved means of quantification – in particular for gut permeability and gastric emptying rate.

Technology overview

This device and method rely on *Fluorescence Spectroscopy* to assess gut permeability (and gastric emptying rate) in a non-invasive manner. The subjects drink a solution of one or more fluorescent dyes, which are then detected in the blood stream by a wearable sensor. Thus, the leakage of the dyes from the gut into the blood stream can be quantified. The device is small, comfortable, and does not break the skin in any way. The current system is a portable fibre-optic spectrometer that detects the presence of the fluorescent dyes using laser excitation sources and a commercial spectrally resolved detector.

Benefits

- Non invasive
- No collection of biological samples (e.g. urine, blood, etc.)
- Time and cost effective
- Easy to operate (in future test may even be performed at home)
- Rapid dissemination of results based on automated data analysis
- Reliable

Development Stage

- Portable, trolley-mounted system currently used in clinical trial – TRL 7
- Methods of analysis being validated in clinical trial – TRL 6
- Ongoing work: miniaturisation and development of embodiments (e.g. finger clips, earlobe clips, wrist straps, skin patches, etc.) – TRL 3

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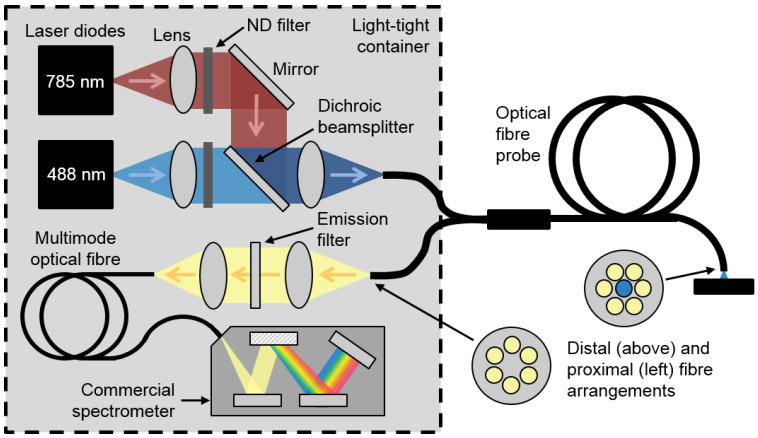
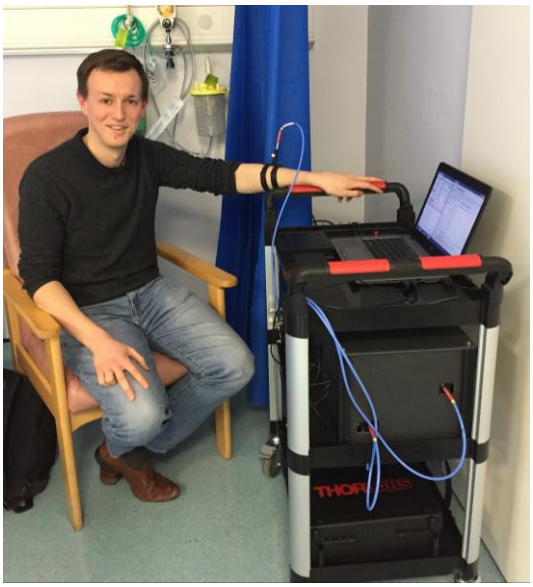
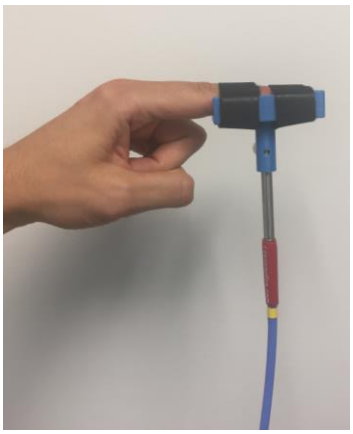
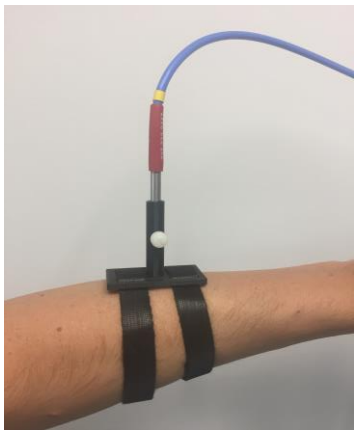
Technology reference: **8831**

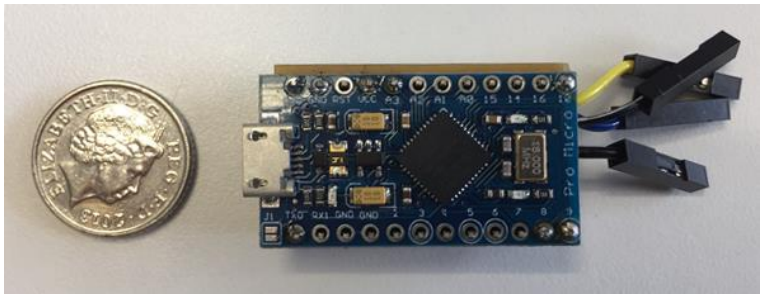
The fibre-optic probe is attached to the skin and provides transcutaneous (through the skin) detection of the fluorescent signals. The device is capable of detecting the presence of multiple dyes simultaneously and, hence, can determine gut permeability and gastric emptying rate using a variety of approaches. Importantly, through appropriate normalisation of the data (based on measurement of the reflected light intensity) it is possible to quantify permeability and gastric emptying rate using a single, clinically approved fluorescent dye (fluorescein). Moreover, multiple parameters can be used as readouts, providing the opportunity to optimise the sensor for different applications. Once collected, data can be analysed in real time using the laptop computer that controls the device hardware. Miniaturised, wireless sensors are also being developed based on smaller light sources (e.g. light emitting diodes) and detectors (e.g. photodiodes) to allow for larger scale deployment.











Intellectual Property

Priority UK patent application filed in February 2020.

Inventor

Dr Alex Thompson is a Lecturer in the Hamlyn Centre, Institute of Global Health Innovation and the Department of Surgery and Cancer, St Mary's Hospital. Dr Thompson's research involves investigating the use of optical spectroscopy as a tool for minimally- or non-invasive assessment of multiple aspects of gut health. This includes applications in conditions ranging from rectal cancer through to malnutrition and has a particular focus on the development of low-cost diagnostic devices for use in the developing world.