Multimodal recordings of intestinal motor activity

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Functional disorders of the human digestive tract cause significant societal burdens because of their impact upon quality of life and healthcare systems. While abnormal gut motility is often associated with functional disorders, monitoring such activity is difficult. A number of different techniques have recently been developed to help gain insight into these complex relationships. These techniques fall into two fundamental categories: i) measurement of transit through the gut; or ii) measurements of gut contractility.

In current clinical practice, transit through the gut is most commonly assessed by x-ray or scintigraphy. However, these techniques involve radiation exposure, and several trips, over a number of days, to specialist centres. To overcome this there has been considerable time and effort invested in the development of ingestible pill for assessing gastrointestinal transit. The wireless motility capsule (WMC: SmartPill Corporation), synchronously monitors, in ambulant patients, phasic pressure activity and pH change as it traverses the GI tract; a temperature sensor confirms expulsion from the body. This information is transmitted to a portable device worn by the patient, from which the data can be downloaded at the end of the study.

Another ingestible capsule-based technique is the magnetic tracking system (MTS: Motilis Medica SA). This works on the principle of accurately tracking a capsule containing a magnet through the digestive tract. The technique can only be used in non-ambulant patients but it does provide unique information on transit speed and direction of propagation, all recorded in real time. For the measurement of gut contractility, high resolution manometry (HRM) has become increasing popular throughout the world. The catheters contain multiple closely spaced pressure sensors and when coupled with computerized interpolation between the recording sites, continuous spatiotemporal pressure profiles, along the studied region, can be obtained. More recently, developments in fibre-optic technology has seen the emergence of a new form of manometry catheter capable of recording HRM over lengths up to 120cm. These fibre-optic catheters are currently only in use in Australia, and preliminary studies have highlighted complexities of colonic motility that have not been captured by previous low-resolution recording.

While manometry captures intraluminal pressure and force across multiple regions, Impedance Planimetry is emerging as a means of assessing the cross-sectional area of the region being studied. Impedance planimetry can be used with pressure measurements to derive information on the wall tension and wall strain, as well as measurements of contractility against a standard force or stretch. Alternatively by utilizing the increasing imaging speed coupled with the ability to capture dynamic, 3-dimensional images over a large field-of-view, magnetic resonance imaging (MRI), has been adopted by some centres as a non-invasive technique for measurement of changes in gut diameter during the movement of content.

Each of these investigative techniques has strengths and weaknesses. Their evaluation will determine the future directions of research.