BLADDER CANCER

Getting into the right (urine) headspace

Researchers from the University of Liverpool, UK, and the University of the West of England, Bristol, UK, have built a device that can detect the early signs of bladder cancer from urine 'headspace' (the gas or empty space above the contents of a sealed container) in less than 30 min.

The device, called ODOREADER, is about twice the size of a payment card reader and contains a metal oxide sensor that analyses chemicals in the gas emitted from heated urine samples, creating an 'odour profile'. Volatile organic compounds (VOCs) such as formaldehyde—which are produced when malignant cells undergo metabolic changes—are separated according to their chemical properties in a gas chromatography oven and eluted from a capillary column.

To assess the efficacy of ODOREADER for detecting bladder cancer, Khalid *et al.* studied urine samples from 98 male patients, aged 27–91 years, who presented to urology clinics in Bristol, UK, with bladder outflow obstruction symptoms or haematuria (or both). Bladder tumours were later identified in 24 of these patients and the device detected cancer in all of them, as well as correctly assigning 70 of the 74 controls (men with urological symptoms but no cancer).

Analysis of the chromatograms showed that 20 of 24 bladder cancer samples had a measurable peak at circa 3200 (half seconds), whereas peaks in this region of the spectra were predominantly absent in controls. Although the identities of the

VOCs that contribute to this biomarker profile have yet to be determined, the team plan to investigate these compounds further using gas chromatography mass spectrometry techniques.

As well as providing results that are comparable to, or better than, currently available urine biomarkers for bladder cancer, the ODOREADER is inexpensive to build and run. The NHS spends £33.5 million a year on negative cystoscopies in patients without bladder cancer, highlighting the need for a cheaper alternative. In addition, the device is durable, with a lifetime that is likely to be far in excess of 100 analyses, can be used by semi-skilled personnel, and contains components that can be miniaturized further to produce a point-of-care device.

"We are very pleased with the results," remarks Chris Probert, lead investigator at the University of Liverpool Institute of Translational Medicine. "Our data show great promise for the identification of bladder cancer—a disease for which there is no accepted biomarker."

Despite the fact that bladder cancer is much more prevalent in women than in men (ratio of 2.5:1), only men were recruited for this stage of the study because the team were concerned that menstruation and cystitis might be confounding factors (as both can add blood to urine samples). Other limitations of the study were the relatively small sample size, single-centre design, and lack of external validation. However, the investigators now plan to study larger cohorts of both male and female patients.

Although the device was originally designed with support from the Wellcome Trust for the diagnosis of *Clostridium difficile*, its potential applications extend far beyond this. In addition to its proven role in detecting bladder cancer, "the same device is being studied for the diagnosis of prostate cancer and shows promise there too, although the results are not ready to be shared yet," Probert reveals.

Melanie Clyne

Original article Khalid, T. *et al.* A pilot study combining a GC-sensor device with a statistical model for the identification of bladder cancer from urine headspace cancer. *PLoS ONE* doi:10.1371/journal.pone.0069602

© iStockphoto/Thinkstock