

# Abstract

Dogs have been known to determine whether a patient suffers from a specific illness by sniffing out the volatile organic compounds present in a patient's urine. This approach has been applied for the detection of bladder cancer, particular transitional cell carcinoma (TCC), and has met with some success.

Since the mortality of TCC and the pathological stage of bladder cancer are directly correlated, early detection dramatically raises the patients' chances of cure. Furthermore, high recurrence rates require long-time surveillance. For these reasons, actions as routinely screening of individuals at high risk would be essential to improve early detection. Yet most of the traditional bladder cancer diagnostic methods are too expensive and time-consuming for mass screening.

With this in mind a project was designed that links gas chromatography-mass spectrometry (GC-MS) and electronic nose (eNose) analysis with chemometrics techniques to develop a non-invasive early diagnostic test for bladder cancer. This is the first time that pattern recognition has been applied to GC-MS data for bladder cancer detection. Headspace from urine samples sourced from both, healthy and diseased volunteers was analysed via the two analytical instruments. In order to evaluate the capabilities of GC-MS and eNose as diagnostic tools, the acquired data were subjected to classification via PLS-DA. Additional feature extraction via a t-test identified the most significant variables of each data set.

The performance of the classifier was assessed with a real-life data set of approximately 90 urine samples, provided by dermatologist Dr. Carolyn Willis (Amersham Hospital, UK). Using leave-one-out cross-validation, PLS-DA achieved a total accuracy of 84.09% on the GC-MS data, with 86.7% true positives and 82.8% true negatives. This result shows promise for the basis of a diagnostic technique. The success rate of 64.61% obtained by electronic nose however, shows that there is more work to do before this approach could substitute any traditional diagnostic method.

**Keywords:** Bladder cancer; Gas chromatography-mass spectrometry; Electronic nose; Pattern recognition; Diagnosis