

Diagnostic Accuracy of Canine Scent Detection in Early- and Late-Stage Lung and Breast Cancers

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Background: Lung and breast cancers are leading causes of cancer death worldwide. Prior exploratory work has shown that patterns of biochemical markers have been found in the exhaled breath of patients with lung and breast cancers that are distinguishable from those of controls. However, chemical analysis of exhaled breath has not shown suitability for individual clinical diagnosis. **Methods:** The authors used a food reward-based method of training 5 ordinary household dogs to distinguish, by scent alone, exhaled breath samples of 55 lung and 31 breast cancer patients from those of 83 healthy controls. A correct indication of cancer samples by the dogs was sitting/lying in front of the sample. A correct response to control samples was to ignore the sample. The authors first trained the dogs in a 3-phase sequential process with gradually increasing levels of challenge. Once trained, the dogs' ability to distinguish cancer patients from controls was then tested using breath samples from subjects not previously encountered by the dogs. The researchers blinded both dog handlers and experimental observers to the identity of breath samples. The diagnostic accuracy data reported were obtained solely from the dogs' sniffing, in double-blinded conditions, of these breath samples obtained from subjects not previously encountered by the dogs during the training period. **Results:** Among lung cancer patients and controls, overall sensitivity of canine scent detection compared to biopsy-confirmed conventional diagnosis was 0.99 (95% confidence interval [CI], 0.99, 1.00) and overall specificity 0.99 (95% CI, 0.96, 1.00). Among breast cancer patients and controls, sensitivity was 0.88 (95% CI, 0.75, 1.00) and specificity 0.98 (95% CI, 0.90, 0.99). Sensitivity and specificity were remarkably similar across all 4 stages of both diseases. **Conclusion:** Training was efficient and cancer identification was accurate; in a matter of weeks, ordinary household dogs with only basic behavioral "puppy training" were trained to accurately distinguish breath samples of lung and breast cancer patients from those of controls. This pilot work using canine scent detection demonstrates the validity of using a biological system to examine exhaled breath in the diagnostic identification of lung and breast cancers. Future work should closely examine the chemistry of exhaled breath to identify which chemical compounds can most accurately identify the presence of cancer.

Key Words: dogs • canine scent detection • breast cancer • diagnosis • lung cancer, diagnosis