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Abigail studied at Middlesex University for four years for a degree in Veterinary Nursing, and qualified as a registered veterinary nurse in June 2013. She has always wanted to nurse, so getting her degree was a real achievement, and she considers it to be a very rewarding career. She has a particular interest in animal welfare, in-patient care and the business aspect of the veterinary world. She has a three-year-old Dachshund called Slinky who is quite a character!

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Canine scent detection of human cancers

Is this a viable technique for detection?

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ABSTRACT: A review of literature published between January and July 2013 was undertaken to explore the findings relating to the viability of the use of dogs to detect the presence of cancer in human subjects. It was found that a significant percentage of the dogs used in the studies could successfully detect the presence of cancer biomarkers in urine or exhaled breath. The review explores and discusses the methodology of training the dogs, the viability of the cancer research, ethics and the types of cancer that dogs are being trained to detect.

Introduction

In recent years, interest has developed in the theory that dogs can detect cancer. This theory has been reviewed and discussed in the media. Non-communicable diseases are responsible for over two-thirds of all human deaths, and cancer is one of the four major killers (Marcus 2007.) Olfaction, the act of processing scents in the environment, is the dog's primary sense. A dog's sense of smell is more acute than many other animals and over a thousand times more sensitive than that of humans. It has been found that dogs are able to recognise people and animal pheromones, and research has demonstrated that they have the ability to detect cancer cells through cancer biomarkers (Correa 2011).

Detection of cancer, particularly in the early stages, can potentially lead to additional health risks. For example, radiation, used to image the body for the presence of cancer, may have somatic and genetic effects, or the patient may have an allergic reaction to the contrast media used in imaging. Detection of cancer can also be costly and difficult to achieve.

Interest has recently developed in the hypothesis that dogs can detect cancer. In general it is viewed in a positive light among medical and veterinary practitioners, and there would appear to be no strong ethical objections to it.

The first study discussing this hypothesis was published by Williams and Pembroke in 1989 in an article published in *The Lancet* discussing a patient whose dog had been persistently licking and even biting at a mole on her leg. The behaviour was so persistent that the woman decided to have the mole examined and subsequently the lesion proved to be a malignant melanoma. Before the technique can be clinically useful, however, dogs have to be able to detect human cancers with enough sensitivity and specificity to be clinically viable (McCulloch *et al.* 2006.)

Methods of training dogs to detect cancer

The method of training the dogs has to be precise and accurate to gain the best results (Babineau 2006.) In a study by Willis *et al.* (2004) the preferred technique was a 'clicker method', an operant conditioning method involving using a clicker to indicate success to the dog, with food as a reward (Pryor 2009).

The dogs were trained to smell a urine sample and also trained to be able to distinguish between a cancerous and a non-cancerous urine sample. If the dogs were correct, the trainer would click a clicker and give the dog a treat. The authors noted that training was efficient and cancer identification was accurate. Other studies using the clicker method were published by Cornu *et al.* (2011)

and Gordan *et al.* (2008), again with positive results. The authors did not note any negative aspects of the training method on the part of the dogs, which appeared to pick it up easily.

Pickel *et al.* (2004) explored whether dogs could detect and indicate a melanoma by smelling lesions placed on living subjects. The human subjects were unaware which of them had the positive sample, as were the handlers of the dogs, so this was a double-blind test. The research suggested that this was a good method of testing the hypothesis that dogs can detect cancer through scenting lesions on living subjects, but it was time-consuming and the research took several months to complete.

Types of cancer that can be identified by dogs

Different types of cancer have been identified by dogs in various studies. In the study by Willis *et al.* (2004) the dogs correctly selected urine from patients with bladder cancer on 22 out of 54 occasions, giving a mean success rate of 41%, compared with the 14% that would have been expected by chance alone. Analysis suggested that the dogs' capacity to recognise a characteristic bladder-cancer odour was independent of other chemical aspects of the bladder biomarkers. Dogs are believed to be able to detect pheromones and biomarkers of cancer in urine, breath and even the skin (Correa 2011).

When the urine samples were dried, the results were significantly worse (22% success) compared to when the urine was fresh (41% success). This decline in performance by the dogs could be due to loss of volatile molecules during the drying process (Willis *et al.* 2004). The results suggest that tumour-related volatile organic compounds (VOCs) are present in urine, creating a characteristic odour signature distinct from those associated with secondary effects of the tumour, such as bleeding, and that dogs can be trained to recognise this (Matsumura *et al.* 2010).

A study by McCulloch *et al.* (2006) explored whether dogs can detect and indicate lung and breast cancer by smelling samples of a patient's exhaled breath. During the double-blind test, the dogs correctly indicated the target breast cancer breath with a specificity of 98% and a sensitivity of 88%; the same dogs also indicated the target lung cancer breath with a specificity of 99% and sensitivity of 99%. However, the percentage of subjects who were correctly identified as having cancer may have been overestimated, as only healthy controls were used. The authors suggested that future work should closely examine the chemistry of exhaled breath to identify which chemical compounds most accurately identify the presence of cancer.

A study by Gordan *et al.* (2008) explored whether dogs could detect breast and prostate cancer via urine. Six dogs were trained to indicate the presence of breast cancer, and only two performed better than chance in specificity while none was more sensitive than chance. For the prostate sample testing, four dogs were used. Two performed significantly better than chance in specificity and none in sensitivity.

Although most of the studies gave positive results, they were based on samples that are too small to provide significant results. All of the different types of cancer in the studies were identified by the dogs, but Pickel *et al.* (2004) highlighted the necessity of clearly identifying the chemical in the biomarker that the dogs were reacting to and thus the requirement of creating other ways of identifying it.

Validity of canine cancer detection

Although Willis *et al.* (2004) stated that their results were viable, there were insufficient dogs and samples to support the evidence fully. Comparing the Willis *et al.* (2004) and the McCulloch (2006) studies, the results appear to demonstrate that dogs are more successful at detecting the presence of cancer when scenting the breath than when scenting the urine. This would indicate that a comparative study would be appropriate in order to understand why this may be the case (e.g. whether there is a greater concentration of cancer biomarkers in the breath than in urine).

Cornu *et al.* (2011) concluded that dogs can be trained to detect prostate cancer by smelling urine with a significant success rate. The authors showed that prostate cancer gives an odour signature to urine; identification of the VOCs involved could lead to a potentially useful screening tool for prostate cancer in veterinary and human medicine.

All the authors suggested that a greater number of patients and dogs should be used in order to provide more reliable results.

Ethical implications

All of the ethical standards in each study were reviewed, and no ethical boundaries were broken. Both the human controls and participants gave informed consent and, if they had been diagnosed with cancer and they had not been informed by their own healthcare team, they received counselling and were sent to hospital straight away to see if the dogs were correct (Legood 2000). Every study discussed the support provided for the dogs that were participating in the studies: they received an appropriate amount of rest, were allowed to stop if they needed to, and checks were put in place to ensure that they were being looked after in a humane manner (Armstrong 2003).

Conclusion

Several areas for development are suggested from a review of the literature. First, the research needs to be more robust and further research should aim to use larger sample sizes in an attempt to establish the credibility of the method and to promote its use. Second, it would appear from the evidence that clicker training has been shown to be an effective approach so training staff and researchers in the use of this method should be encouraged and implemented (Babineau 2006).

Third, if conclusive evidence establishes the use of this approach to cancer detection, further work will be needed to facilitate the transition to the presence of dogs in a clinical setting. In this context, it remains uncertain whether the method is sufficiently reliable to be used as an exclusive diagnostic test. The Insitu Foundation (Los Angeles, California) has already started using and developing the technique, but it requires further funding to continue research to help deploy dogs in the hospital environment. It will be necessary to raise public awareness of the method, and to counter doubts and discomfort about using dogs in a clinical setting. This could take place in a hospital environment in order for the public to become aware of the potential of the research.

Fourth, research does seem to have established that canine detection of breast cancer is more successful when the dog scents the patient's breath compared to scenting the patient's urine (McCulloch 2006), suggesting the need for further research to discover whether the breath contains more biomarkers than urine.

Fifth, it is evident that using dogs to detect cancer could have considerable financial benefits over laboratory-based methods. Thus, the promotion of canine detection methods could be of immense benefit in countries with limited resources for healthcare provision (Simone 2005).

In undertaking this study the author has gained in confidence and acquired an insight into an area of medical research that is of particular interest to the veterinary world as veterinary professionals could help with research, raising awareness and training the dogs. As a result, the author would strongly recommend that the veterinary profession should strive to develop their professional knowledge of canine cancer detection by scent and foster debate, possibly in the form of practice meetings, to raise awareness of this exciting area of research. vnj

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