
The canine in the coal mine?

Pollutants take their toll on our dogs

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Art by Rufino Tamayo



Rufino Tamayo
Forgotten Clock (Reloj olvidado), 1986
Oil on canvas
38.25 x 51.25 inches

Collection Olga Tamayo, Mexico City, D.F., Mexico

FROM THE PESTICIDES USED IN agriculture, insecticides and cleaners used in households, and solvents used in paints to toys made of synthetic products and artificial preservatives and additives in our food, man-made chemicals and pollutants are everywhere. With so many synthetic chemicals around us, could some of these products—as well as other aspects of our environment—be causing cancer in our canine companions?

Dr. Larry Glickman, veterinarian and epidemiologist at Purdue University, has no doubt that they do. “Of course. There are many chemicals and environmental factors known to cause cancer in people, and many may also cause cancer in pets. The problem,” he observes, “is that these are far better studied in humans than in pets.”

The dearth of study is a matter of both convenience and money. Says Glickman,

“With humans, there are mandatory reporting systems for disease—such as death certificates, [which list the] immediate and underlying cause of death.” As a result, agencies can track how frequently certain diseases result in death, and thereby accumulate information as to whether there is an increase or decrease in specific cancers, for example. “With animals, we don’t have anything,” say Glickman. “We just have scattered pieces of data to look at fre-

quency of diseases.” These include hospital records or, increasingly, insurance claim records. But, Glickman emphasizes, “This is way behind what has been done in humans.”

Clear Links Exist

Despite the scarcity of studies, some research has identified clear links between cancer in dogs and environmental factors. For instance, a 1983 study by Glickman and his colleagues revealed that dogs with a mesotheliomas (a rare tumor of the chest cavity) were more likely to have lived in households where owners had exposure to asbestos, or to have gone with their owners to workplaces in which asbestos materials were handled (e.g., shipbuilding and brake repair). Additionally, chrysolite asbestos fibers were found in significantly higher amounts in the lung tissue of these dogs than in dogs with other types of lung tumors and no history of exposure to asbestos.

In another example, Glickman notes that “exposure to cigarette smoke has been shown to increase nasal cancer in dogs.” Long-nosed dogs are two times more likely to develop nasal cancer if they live with a smoker than if they are not exposed to cigarette smoke, and the inci-

dence of canine nasal cancer increases with the number of packs the human in the household smokes per day. Similarly, short-nosed dogs are twice as likely to develop lung cancer if they live in a house with cigarette smokers. In these dogs, cotinine levels (a metabolite of nicotine) in the urine are high compared to those of dogs in nonsmoking households. Taken together, these findings suggest that the longer air-filtration system of long-nosed dogs serves to protect them from lung cancer but also predisposes them to developing nasal cancer.

Glickman’s own research has revealed other environmental risks. As he reported in 1989 in the *Journal of the American Veterinary Medical Association*, female dogs exposed to insecticides in flea sprays and dips are at higher risk of developing bladder cancer than those on whom such products are not used. As with nicotine, the compounds in dips and sprays are absorbed into the bloodstream. The body gets rid of these products by excreting them into the urine. The risk is further enhanced in overweight females, most likely because the compounds, once absorbed, are retained in fat. Animals with more fat retain more of the chemicals. And finally, risk was also elevated in females

who lived close to a second potential source of insecticides—a marsh that had been sprayed for control of mosquitoes, for example. According to Glickman, “No one chemical type of flea and tick dip accounted for the increased risk; however, the active ingredients generally account for less than 5 percent of the total product. The remaining ingredients were labeled as ‘inert’ and consisted of solvents such as benzene, toluene, xylene and petroleum distillates, many of which are themselves known carcinogens [in people and lab animals].” A second study in 2004 by Glickman also looked at the spot-on flea and tick products such as Advantage® and Frontline® but found no increase in cancer. These products are minimally absorbed into the dog’s bloodstream and consequently are not excreted via the bladder.

Research also suggests a link between 2,4-D (marketed under many names, including Ded-Weed, Lawn-Keep, Weedone, Plantgard, Miracle and Demise), a phenoxyherbicide commonly used on lawns, and cancer. The findings, however, conflict. A 1991 study published in the *Journal of the National Cancer Institute* reported that pet dogs in homes where 2,4-D was applied to the lawn at least four times per

year had twice the risk of developing lymphoma, compared to dogs who lived where lawns were not treated. These findings were challenged by the Chemical Industry Task Force, and the ensuing reanalysis of the original data found no significant relationship between the herbicide and lymphoma in dogs. (Kaneene, John B. and Miller, RoseAnn. "Re-analysis of 2,4-D use and the occurrence of canine malignant lymphoma." *Veterinary and Human Toxicology*, 41, No. 3: 164-170. June 1999).

A subsequent 1994 study in the scientific journal *Cancer, Epidemiology, Biomarkers and Prevention* did, however, show that dogs living around residences recently treated with 2,4-D absorbed measurable amounts of the herbicide for several days after application. Dogs exposed to lawns within seven days of treatment were 50 times more likely to have high levels of the herbicide than those exposed to lawns treated more than seven days previously. The highest concentration of 2,4-D was found in dogs walking on lawns within two days after the lawn had been treated. Despite these higher herbicide concentrations, Dr. Antony Moore, veterinary oncologist at Veterinary Oncology Consultants in New South Wales, Australia (vetoncologyconsults.com), states, "This is not sufficient to say that use of the herbicides causes a high risk for cancer. However, if you're an owner and have a dog, why use 2,4-D when there are other equally good herbicides available?"

The link between herbicides and cancer in the general dog population may be debatable, but when one considers a specific breed, the Scottish Terrier, the link is clear. Overall, Scottish Terriers are at 18 times increased risk of transitional cell carcinoma (bladder cancer) when compared to mixed-breed dogs. When exposed to lawns treated with phenoxyherbicides four or more times a year, Scottish Terriers had a four times higher risk of developing bladder cancer than those who were not exposed to herbicide. That risk increased to seven times if they were exposed to both herbicides and insecticides.

This suggests a question: If these chemicals are carcinogenic, why are they still

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around? Well, says Dr. Moore, "It's very hard to show that a factor causes cancer. We can only show that it increases the risk of getting cancer. For example, a study out of Italy showed that dogs who lived with people who used paints and solvents were at 4.6 [percent] higher risk of developing lymphoma. This finding does not tell you that because you spill solvent on the ground and a dog walks through it one time, the individual dog's risk is higher."

Other studies have shown that area of residence can increase the cancer risk. "The same study out of Italy showed that dogs that lived in the industrial areas had an 8.5 times higher risk of developing lymphoma than those living in urban areas," says Moore. Similarly, a study published in 1971 in *Archives of Environmental Health* found that tonsillar squamous cell carcinoma was 10 times more common in animals living in cities than in those living in more rural environments. Both findings imply that urban living exposes animals to more environmental pollutants; however, they do not quantify an amount of urbanization or industrialization that significantly increases risk, or which anatomical characteristics put some individual dogs at greater risk than others. As Moore explains, other factors come into play, including long-nosed vs. short-nosed, or Scottish Terrier vs. other breeds, amount of exposure, and obesity.

The Biology of Cancer

This interplay of factors can in part be explained by the mechanism of cancer. Normally, cells have a set lifespan. They die and are replaced by new cells. During the cells' lifespan, mutations in their DNA commonly occur, and though many are repaired, others are not, which often leads to early programmed cell death (apoptosis). Some mutations, however, result in prolonged cell survival, because mutations in the cell repair mechanisms or in the mechanisms that normally lead to programmed cell death have already taken place. In other words, these cells avoid apoptosis and divide in an uncontrolled manner. As they do so, they form an enlarging mass of cells that can invade local tissues as well as spread to other locations. Thus, cancerous cells are the result of multiple mutations occurring in the right combinations.

Because of these interactions, it can be difficult to appreciate some cancer risks. "Everyone knows about a 90-year-old guy who smoked all his life," Moore says. "While smoking increases the risk of cancer, it may be that this person just doesn't have the changes in his cells that can combine with the mutations caused by smoking to result in cancer." More information is necessary. "It's possible that the genome project will help identify genes related to getting cancer or being more at risk for getting cancer, but the risk may not present until the animal is exposed to the right environmental factors, such as herbicides, or becomes obese."

Genes Play a Role

Clearly there are genetic factors. Says Glickman, "In the average breed, 20 to 30 percent of dogs die of cancer, but in other breeds, such as Golden Retrievers, it is probably 60 percent." In some animals, the very traits that make them desirable as pets or especially skilled at certain tasks make them prone to certain cancers. For instance, Irish Wolfhounds and other large sighthounds bred for exceptional speed and ability to capture agile prey such as deer or rabbits are also prone to developing osteosarcoma (bone cancer). In fact, in general, dogs with legs

longer than 50 cm (or a little less than 20 inches) are at risk for this cancer of the leg bones. Similarly, as noted earlier, the same trait that protects long-nosed dogs against lung cancer predisposes them to cigarette-related nasal cancers.

Information on genetic predispositions can be used to help decrease cancer risk. In the case of Scottish Terriers, Glickman is working with the National Cancer Institute to identify those at highest risk for bladder cancer and to establish the genetic basis for that predisposition. Says Glickman, "The goal is to screen all Scottish Terriers as puppies and identify those with higher risk of bladder cancer. Those that [have this risk] can have twice-yearly evaluations of urine to look for early signs, or can have an ultrasound performed every six months." If the cancer is detected early on, it might be possible to remove it. But even more valuable is that with these predisposed dogs, exposure to lawn chemicals can be eliminated and diet can be changed. Consumption of vegetables—specifically leafy greens and yellow-orange vegetables—three or more times a week was associated with a 70 to 90 percent reduction in risk of developing transitional cell carcinomas in Scottish Terriers.

Risks Not Limited to Chemicals

Clearly, another reason why just banning all carcinogens known to man would not solve the problem is that environmental risks of cancer are not limited to chemicals. A 1995 study in the *American Journal of Epidemiology* found that dogs living in houses with high magnetic fields, as measured by the current configuration wire code, were nearly seven times more likely to develop lymphosarcoma. This included both cables above and below ground. Interestingly, Moore states that these findings have never been shown in humans. Another non-chemical risk factor for cancer in dogs is the failure of the owner to have the dog spayed. This is one of the most common and well-documented risk factors for cancer in female dogs. Says Moore, "Female dogs who are intact are much more likely to develop mammary cancer than those who are spayed. Spaying before the first heat cycle reduces the risk to almost zero." This risk steadily increases with each heat, up to about 6 to 8 percent risk of mammary cancer after the dog has gone through two to three cycles. Once the dog hits about two and a half years of age, 40 percent will develop mammary cancer. Says Moore, "This is a disease we can practically eliminate by

spaying dogs early."

Additionally, diet can further reduce the risk of mammary cancer. One research study looked at the diet of dogs the year before they had surgery for mammary cancer. For dogs on a low-fat diet, the level of protein (measured on a dry-matter basis, not based on the crude analysis number reported on the bag) was strongly predictive for how long they would live. Protein greater than 27 percent on a dry-matter basis correlated with survival past three years of age. Those dogs on a low-fat diet with less than 23 percent protein survived less than six months. Protein levels made no difference or had no effect if the dog was on a high-fat diet. In addition to diet composition, the researchers also found those dogs that were overweight at one year of age were three times as likely to develop mammary cancer.

More Studies, Better Answers

So should you just avoid all possible carcinogens?

"That's fine if you don't drink or eat," says Glickman, "but they are everywhere." Even environmental factors as ubiquitous as sunlight can increase risk of cancer, especially in light-skinned pets. It's a matter of exposure levels combined with genetics.

ONLINE ASSISTANCE

CanineCancer.com

Extensive resource list and links.
caninecancer.com

Colorado State University

Complementary therapies & nutrition.
csuanimalcancercenter.org

National Canine Cancer Foundation

Click on "Facts on Cancer."
wearethecure.org

Perseus Foundation

Nationwide list of open clinical trials.
perseusfoundation.org

How high does the risk have to be to be important? Glickman recommends that we consider how likely the animal is to be exposed. A 20 percent increased risk may be important for dogs who are exposed a lot, whereas a twofold increased risk is less worrisome if the animal will not receive much exposure. Thus, for Scottish Terriers, a breed in which it is calculated that 75 percent of bladder cancers are related to chemical exposure, it is best to avoid phenoxyherbicides and insecticides, whereas a moderate exposure is much less likely to cause a problem for other dogs.

In defining "a lot" and "not much," Glickman notes that "this speaks to the

concept of attributable risk, which is the proportion of a specific type of cancer that can be attributed to a specific exposure such as insecticides. Attributable risk is a function of how many individuals in a population are exposed to insecticides plus the risk of cancer associated with insecticides. Thus, a chemical associated with a small increased risk of bladder cancer is important if a high proportion of dogs are exposed. In contrast, a chemical like asbestos is associated with a very high risk of mesothelioma, but very few dogs are exposed, and the attributable risk is thought to be low in people (about 5 percent of all lung cancers). In contrast, the attributable risk for lung cancer (90 percent) associated with smoking is very high even though the risk of lung cancer associated with smoking is relatively low, since so many people smoke."

Both Glickman and Moore stress the need for more studies. It's not accurate to assume that if an individual pet gets cancer, it must be due to some factor noticed to be different in the environment—many factors may change simultaneously. For instance, says Moore, "When people were first looking at causes of Down syndrome in humans, they found that the sixth child was much more likely to have Down syn-

drome. So that was thought to be a risk factor. But it was really the age of the mother at birth."

Clearly, careful studies that take a myriad of potential risk factors into consideration are needed—for example, comparing dogs who develop a specific cancer to similar groups of cancer-free dogs, and even similar groups with other types of cancer—in order to identify potential correlations. This sort of research, which involves a multitude of animals who are followed throughout their lifetimes, is expensive, often running into millions of dollars. The adage "forewarned is forearmed" applies here, however; understanding the connections between genetic predispositions and environmental risk factors gives us the information we need to make better decisions about the dogs we love and care for—decisions that could potentially improve the quality and length of their lives. And that benefit is priceless. ☹

The Morris Animal Foundation has recently launched "Canine Cancer Cure," a \$30 million effort to cure canine cancer. This effort involves fundraising and managing and administering research grants to veterinary colleges and research organizations.

morrisanimalfoundation.org/k9_cancer