Synopsis of "Microchip-Induced Tumors in Laboratory Rodents and Dogs: A Review of the Literature 1990–2006"

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Overview

This document summarizes a paper titled "Microchip-Induced Tumors in Laboratory Rodents and Dogs: A Review of the Literature 1990–2006." The full, 48-page paper provides a detailed review of literature published in toxicology and pathology journals showing a causal link between implanted radio-frequency (RFID) microchip transponders and cancer in laboratory rodents and dogs.

This work was first inspired by Leon, the French bulldog who developed cancer from a microchip implant. Leon's owner made heroic efforts to publicize his story and help other dogs avoid his fate. Her work was carried forward by Associated Press reporter Todd Lewan, who brought the research to the attention of the public in September 2007 in a feature-length AP article.

Revelations of a causal link between microchipping and cancer in animals have since prompted widespread public concern over the safety of implantable microchips for use in pets and human beings. The current report aims to inform the debate with an in-depth analysis of the relevant animal studies.

Cancer in Animals

Eleven journal articles published between 1990 and 2006 addressed tissue reactions to microchip implants in laboratory animals and dogs. In six of the articles, it was reported that between 0.8% and 10.2% of laboratory mice and rats developed malignant tumors around or adjacent to implanted microchips. Two additional articles reported microchip-related cancer in dogs. A summary of these findings is presented below in Table 1.

Table 1. Studies in which microchip-induced cancer was found (in reverse chronological order)

Author(s)	Species	# of animals	Length of Implant Exposure	Developed Cancer
Le Calvez 2006	mice	1,260	2 years	4.1%
Vascellari 2006	dog	N/A	7 months (at age 9)	1 dog
Vascellari 2004	dog	N/A	18 months (at age 11)	1 dog
Elcock 2001	rats	1,040	2 years	0.8%
Blanchard 1999	mice	177	6 months	10.2%
Palmer 1998	mice	800	2 years	2.0%
Tillmann 1997	mice	4,279	lifespan	0.8%
Johnson 1996	mice	2,000	2 years	~1.0%

In almost all cases, the malignant tumors, typically sarcomas, arose at the site of the implants and grew to surround and fully encase the devices. In several cases the tumors also metastasized or spread to other parts of the animals. The tumors generally occurred in the second year of the studies, during middle age or older for the animals. The exception to this was a single study in which 10.2% of genetically modified mice developed fast-growing cancers before six months of age.

Studies that did not Find Cancer

Three additional microchip implant studies were reviewed in which researchers did not find cancer. These include two early studies conducted in 1990 and 1991 when implants were first being introduced, and a 2003 study involving nine dogs. These studies are deeply flawed. Unlike the other articles which typically looked at thousands of animals over a two-year period, these studies involved very small samples and/or short exposure times to the microchips.

Studies with small sample sizes lack valid predictive ability as they are unlikely to detect outcomes that occur only a small percentage of the time. Small effects require large samples to achieve statistical power. In other words, concluding that the microchip does *not* cause cancer would require a sample of many hundreds or even thousands of animals in which no cancers were found. As statisticians put it, "Absence of evidence is not evidence of absence."

Length of exposure time and the age of the animal also appear to be important considerations in the development of microchip-induced tumors. In mouse and rat studies, the onset of malignancies typically occurred during the second year after implantation, when the animals were middle-aged and older. Younger animals with short exposure times such as the ones used in these studies would not be expected to develop cancer under this model.

A summary of the studies appears in Table 2 below. Concerns over the validity of these studies are discussed in greater depth in the full report.

Table 2. Studies in which microchip-induced cancer was not found (In reverse chronological order)

Author(s)	Species	# of animals	Length of Implant Exposure	Developed Cancer
Murasugi 2003	dogs	2	3 days	none observed
		2	3 months	
		2	1 year	
		2	3 years	
		1	6 years	
Ball 1991	rats	10	2 weeks	none observed
		10	3 months	
		10	6 months	
		10	1 year	
Rao & Edmondson 1990	mice	10	3 months	none observed
		10	15 months	
		74	2 years	
		39	< 2 years	

Details of the Studies

A one- to three-page detailed writeup on each of the 11 studies is provided in the full report.

Animals and Microchips Used in the Research

Common breeds of laboratory mice and rats were used in the rodent studies, and are identified in the full paper. Only one study used a genetically-modified mouse, the p53+/- mouse, which has an increased susceptibility to cancer caused by genotoxins, or substances that damage genetic material. The high rate of cancer development in these mice (10.2%) suggests that implanted microchips may have genotoxic attributes or give rise to the production of genotoxins in the host.

The microchips used in at least 10 of the 11 studies[1] were industry-standard, passive implantable RFID transponders, encapsulated in medical-grade glass and partially coated in an anti-migration polymer sheath. The implanted devices are designed to respond with an identification code when stimulated by radio-frequency energy emitted from a reader. The microchips used in these studies were obtained from BioMedic Data Systems, Inc., Destron Fearing[2], and Merial.[3]

Explanations for the Tumors

The following proposed explanations for microchip-induced tumors are discussed at length in the full report:

(1) ***Foreign-Body Tumorigenesis:*** The presence of the microchip, a subcutaneous foreign body, may cause cellular changes that can lead to cancer.

(2) ***Post-Injection Sarcoma:*** Inflammation from the chip-injection procedure may cause cellular changes that can lead to cancer.

(3) ***Possible Genotoxic Properties of the Implant:*** The glass capsule or polypropylene sheath surrounding it may have carcinogenic or genotoxic properties, or its presence within the host may give rise to genotoxic byproducts.

(4) ***Radio-Frequency Energy Emissions from the Transponder or Reader:*** The radio-frequency energy involved with the transponder may somehow contribute to tumor formation.

Additional Adverse Events

In addition to malignant tumors, researchers described other adverse events associated with implanted microchips, including migration, incorrect insertion, loss from the body, and failure to function.

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1 In one study (Palmer et al, 1998), the microchips were identified only as "passive integrated transponder implants used for identification." It is likely they were the same, industry-standard chips as those used in other studies.

2 Destron Fearing is a subsidiary of Digital Angel, part of the family of companies that markets the VeriChip human implant. It is the exclusive manufacturer of RFID microchips for Schering Plough's Home Again pet recovery program.

3 Merial is a European distributor for Digital Angel's implantable microchip products.

These adverse events occurred in studies that found cancer and those that did not. The migration issue was particularly acute, as even with the anti-migration sheath, many of the implants migrated from the original implantation site on the backs of the mice to cause cancer at other locations in the body. In one study, nineteen percent of the cancers found encased microchips that had migrated to the limbs, abdomens, or heads of the mice.

Relevance for Humans

The fact that rodents and dogs have developed cancer in response to implants does not necessarily mean that humans will do the same. However, prior research indicates that humans are subject to malignant tumors in response to foreign-body implants. In a small number of cases, highly aggressive sarcomas and carcinomas have developed in humans around pacemakers and other implants.

Most of the malignant, microchip-induced tumors in rodents were classified as sarcomas – soft tissue cancers. Although soft tissue sarcomas are rare in humans, they are responsible for more deaths than testicular cancer, Hodgkin's disease, and thyroid cancer combined. They are also notorious for recurring and metastasizing—often with devastating results.

Since the microchip implant procedure has only been performed since 2001 on a small number of individuals—and there is no formal follow-up procedure in most cases—very little is known about the long-term response to the implant in human beings.

Relevance for Pets

Foreign-body-induced tumors can pose serious threats to animal health. Researchers report that most tumors arising from foreign bodies are malignant mesenchymal neoplasms with a rapid growth rate, killing the animal in a matter of weeks. Many of the study animals with microchip-associated tumors died prematurely due to the masses. In addition, many of the tumors metastasized, spreading cancer to the lungs, liver, stomach, pancreas, and other organs. Further research is needed to determine whether and to what extent the microchip implants give rise to cancer in pets.

Recommendations for Humans

The following recommendations are made for policy makers, physicians, and patients in light of the research findings:

- Further microchipping of humans should be discontinued.
- Implanted patients should be informed in writing of the research findings and offered a procedure for microchip removal.
- Patients choosing to retain the microchips should be routinely checked for abnormalities.

Recommendations for Pets

The following recommendations are made for policy-makers, pet owners, and veterinary researchers:

- In light of research linking the microchip to cancer in animals, policy makers should reverse all mandatory animal microchipping statutes and policies.
- Veterinarians should familiarize themselves with the research findings and carefully consider the potential for adverse reactions before recommending implants for pets.
- Pet owners seeking microchip implants should be advised of the research linking the device to cancer in rodents and dogs.
- Owners of implanted pets should regularly examine the area surrounding the microchip and immediately report abnormalities to a veterinarian.
- No vaccinations or injections should be administered near the site of an implanted microchip.
- Chip-removal is likely to be costly and invasive, therefore pet owners may wish to leave the implanted microchips in place unless specific problems arise.
- Unchipped pets should be fitted with a well-made collar and a clear, legible tag with the owner's contact information.

Recommendations for Researchers

- A national registry should be created to record adverse reactions from implanted microchips.
- Directions for additional research are suggested.

Conclusion

The body of research reviewed in this report indicates a clear causal link between microchip implants and cancer in mice and rats. It also appears that microchips can cause cancer in dogs, as they have done so in at least one case, and quite likely in two. These findings raise a red flag about the continued use of microchips in both dogs and human beings.

As the Associated Press reported, concern over the safety of microchip implants is shared by some of the nation's most respected cancer researchers.

"There's no way in the world, having read this information, that I would have one of those chips implanted in my skin, or in one of my family members," said Dr. Robert Benezra, head of the Cancer Biology Genetics Program at the Memorial Sloan-Kettering Cancer Center in New York. He added, "Given the preliminary animal data, it looks to me that there's definitely cause for concern."

Dr. George Demetri, director of the Center for Sarcoma and Bone Oncology at the Dana-Farber Cancer Institute in Boston, agreed. Even though the tumor incidences were "reasonably small," in his view, the research underscored "certainly real risks" in RFID implants, adding that the tumors can be "incredibly aggressive and can kill people in three to six months."

Dr. Chand Khanna, a veterinary oncologist at the National Cancer Institute, said that the evidence "does suggest some reason to be concerned about tumor formations." All of the cancer specialists agreed the animal study findings should be disclosed to anyone considering a chip implant.

On the basis of these findings, physicians, patients, veterinarians, and pet owners may wish to avoid implants due to the potential health risks such devices may pose. It is the opinion of this researcher that further microchipping of pets or human beings should be immediately discontinued.

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For a copy of the full report, "Microchip-Induced Tumors in Laboratory Rodents and Dogs: A Review of the Literature 1990–2006, please visit CASPIAN'S human chipping website at http://www.antichips.com/cancer.

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