Mutagenic urinary chemical exposures in dogs and people sharing the same households

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Background

• 30% of urothelial carcinoma (UCC) in people is not explained by tobacco or occupational exposures.

• UCC in both dogs and people tracks to regions of high industrial activity.

• We hypothesize that dogs with UCC may act as sentinels for non-tobacco, non-occupational urothelial carcinogen exposures in people.

• The goal of this study was to first establish whether dogs and people share household exposures to urothelial carcinogens.

Research aims

• To determine whether healthy people and their pet dogs share urinary exposures to acrolein, arsenic, or 2,4-D, which are chemicals associated with bladder cancer in people and animals.

• To evaluate whether urinary chemical exposures reached mutagenic levels.

Approach

n = 42

• 2,4-D (as 4-chlorophenol)

• Acrolein (as 3-HPMA)

• Arsenic species

• Creatinine

γ-H2AX assay for DNA damage

Canine & human urothelial cell lines

Fig 1. Urinary exposures to mutagenic chemicals in dogs and their owners 1

Fig 2. Acrolein and inorganic As exposures correlate between dogs and their owners

Acrolein exposure

r = 0.32; P = 0.04

Inorganic As exposure

r = 0.37; P = 0.02

Herbicide metabolite

4-chlorophenol: 2.8-fold higher in dogs
P < 0.0003

Dog 4-CPhOr HUMAN 4-CPhOr

Acrolein (as 3-HPMA): 4.9-fold higher in dogs
P < 0.0001

Dog 3-HPMAOr HUMAN 3-HPMAOr

Dimethylarsinic acid: 6.2-fold higher in dogs
P < 0.0001

Dog DMAOr HUMAN DMAOr

Fig 3. Urothelial mutagenicity in vitro from observed acrolein exposures

HT-1376

K9TCC

Fig 4. Urothelial mutagenicity in vitro from observed arsenic exposures

HT-1376

K9TCC

Fig 5. Acrolein and inorganic As exposures correlate between dogs and their owners

Acrolein exposure

r = 0.32; P = 0.04

Inorganic As exposure

r = 0.37; P = 0.02

Ongoing work

• Assessment of additional cell lines.

• Case-control study to compare urinary exposures to acrolein and inorganic arsenic in dogs with urothelial carcinoma and their owners, compared to control households.

Summary

• Healthy people and their pet dogs share urinary exposures to mutagenic chemicals linked to bladder cancer.

• Urinary exposures to acrolein or arsenic, but not 4-chlorophenol, reached mutagenic levels in 3 of 42 (7.1%) healthy people and 2 of 42 (4.8%) healthy dogs.

Cited work