

FERRUGINOUS BODIES IN THE LUNGS OF URBAN DOGS

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The aim of the study was to assess health hazards induced by environmental exposure to asbestos using urban dogs as biological indicators. Samples of the lung tissue taken from 36 randomly chosen urban dogs were examined. In the group of dogs aged up to four years (n=15) ferruginous bodies were identified in only two. In the dogs older than four years (n=21) 17 were ferruginous body positive. According to Fisher's exact test the difference between the two groups was significant ($P < 0.001$). The presence of asbestos bodies in the lungs of dogs is considered to be evidence of serious contamination of urban areas with respirable mineral fibres. The more frequent presence of asbestos bodies in the lungs of the older dogs indicates long-term accumulation of mineral fibres exceeding 10 μm in length. Continuous environmental exposure of the city's population to respirable mineral fibres may therefore pose a health risk.

Key terms: asbestos, inorganic mineral fibres, urban environment

The problem of asbestos exposure, both environmental and occupational is very well known. Health hazards due to asbestos result from the manufacture of asbestos products and their use (1) as well as from environmental asbestos pollution. The latter can be determined by the detection of ferruginous bodies in the lungs of urban residents from all over the world (2-5). However, several difficulties are encountered when planning a prospective epidemiological study. Firstly, reliable data on causes of death and prevention of respiratory diseases in the general population are hard to obtain. Secondly, the smoking habit and nutritional habits of urban dwellers should be taken into account as interfering factors (6, 7).

Laboratory experiments on animals have shown that various types of asbestos are capable of producing ferruginous bodies. However, no apparent morphological difference could be established between asbestos bodies formed by various types of asbestos fibres, in different animal species (8, 9). On the other hand, no literature data are available on spontaneous ferruginous body formation in animals following environmental exposure.

The aim of this investigation was to assess the health hazards of environmental asbestos pollution, using urban dogs as bioindicators.

Asbestos is emitted into the air as part of an agglomerated particle, which quickly falls to the ground, and therefore has limited air contamination potential (10). The lungs of urban dogs appear to be the most suitable model for detecting ferruginous bodies as evidence of asbestos exposure because they tend to extensively inhale fibrous dusts from the ground.

MATERIALS AND METHODS

The experimental material was taken during post-mortem examinations of 36 urban dogs, of no specific whereabouts, chosen at random. The post-mortems took place in the Veterinary Faculty, University of Zagreb in Zagreb. The dogs had died of natural causes - sickness and age, or in an accident. Their lungs were examined for the presence of ferruginous bodies. After incision of the lung, smears were obtained by scraping the cut surfaces of the basal segments of both lower lung lobes. The exuding fluid was smeared onto a standard microscope slide. The smears were air dried. Three hundred consecutive low power fields per slide obtained by standard light microscopy (magnification 250x) were examined. Ferruginous bodies found in many smears were photographed (Figures 1, 2) both before staining and after being submitted to Prussian blue reaction (11). The Prussian blue method stained the iron-containing coating material of the ferruginous bodies a dense blue, making them easily visible against the background of a safraninc counterstain. The exuding fluid was previously analysed by phase-contrast microscopy, total magnification 250x. Only those ferruginous bodies which developed a fine, straight, transparent central core with evenly segmented encrustations, and yellow to brown ferroprotein coating with clubbed or rounded ends, were considered to be asbestos bodies (12).

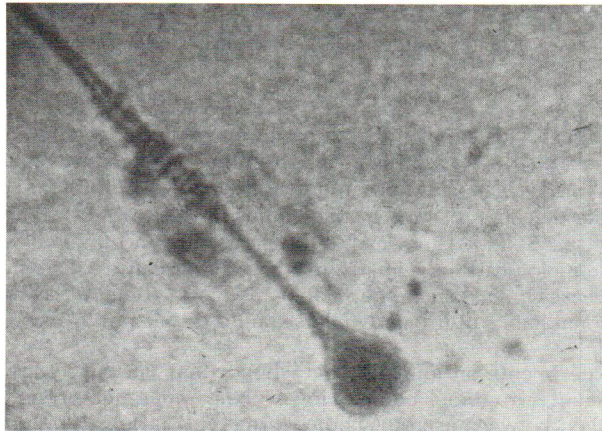


Figure 1 Ferruginous bodies in the lung smears of urban dogs

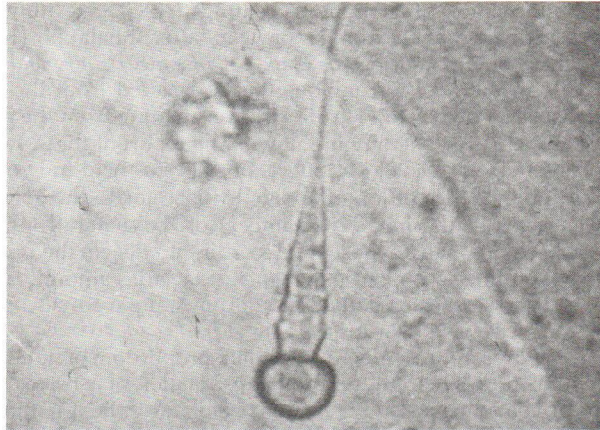


Figure 2. Ferruginous bodies in the lung smears of urban dogs

RESULTS

The occurrence of ferruginous bodies in the examined lungs is presented in Table 1.

Table 1. Ferruginous bodies in the lungs of urban dogs

Age (years)	Ferruginous (-)	bodies (+)	TOTAL
<4	13	2	15
>4	4	17	21
TOTAL	17	19	36

The dogs were classified by age into two groups, one group of 15 dogs up to four years old, and one of 21 dogs over four years old. In the younger group only two dogs had positive asbestos body findings, whereas in the older group they were 17. The chi-squared test showed a significant increase of asbestos body findings in the older group of dogs ($P < 0.001$). According to Fisher's exact test, the significance level (upper tail probability) was $P < 0.001$.

DISCUSSION

Ferruginous body formation is a phenomenon that occurs when macrophages and/or multinucleated cells meet indigestible fibres too large to be totally ingested by a single macrophage or giant cell. The asbestos body formation involves fibres 8 μm in length and longer, with a diameter greater than 0.2 μm (13). Very few non-asbestos fibres are

is necessary for the formation of ferruginous coatings (12). The coating process appears to be progressive, lasting probably months or years after inhalation (14). However, not all ferruginous bodies contain an asbestos core. For instance, *Churg and Warnock* demonstrated that the vast majority of ferruginous bodies isolated from the lungs of city inhabitants contain asbestos fibres (15). Health risks originating from the asbestos contaminated urban environment are generally unknown. The report of the Advisory Committee of the Working Conference on Biological Effects of Asbestos held in Lyon (16) stated that »there is at present no evidence of lung damage by asbestos to the general public«, and »the amount of asbestos in the lungs of members of the general public is very small compared to those occupationally exposed«. According to *Roggly* the presence of a single asbestos body in a sputum specimen is evidence of a large amount of asbestos in the lungs; the presence of one asbestos body in a sputum sample equals approximately 900 fibres per gramme of wet weight of lung tissue (17).

Although coated fibres represent only a small proportion of total fibrous mineral burden, their identification is helpful for a rough estimation of asbestos exposure. Firstly, an asbestos body or coated asbestos fibres are considered to be a hallmark of exposure, past or current. Secondly, the presence of asbestos bodies (at least two bodies in a histological slice) is still considered to be the necessary criterion for the pathological diagnosis of an asbestos-related disease, even when asbestos exposure history is positive (18).

Our results indicate that fibrous mineral particles, settled on the ground, are continuously present in the urban environment. The incidence of positive ferruginous body findings in the lungs of dogs increases with age. In the youngest dogs (up to one year old), no ferruginous bodies were found. Presumably, they had not had the chance to be exposed long enough, so exposure was slight if any, or the period of dust deposit was not sufficiently long to activate the pulmonary defence mechanism. Our results show that in the younger group of dogs (up to four year old) the proportion of those with a positive finding of ferruginous bodies was small (two out of 15), whereas in the older group the incidence of asbestos bodies was significantly greater ($P < 0.001$), thus 17 out of 21 dogs were ferruginous body positive. The positive ferruginous body findings were usually associated with anthracosis, chronic bronchitis and peribronchitis.

The results of this preliminary study present evidence of the serious contamination of urban areas with mineral fibres, mainly asbestos, as well as accumulation of fibres longer than 10 μm in the lungs of dogs, thus implying a possible health risk to the urban population.

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Sažetak

FERUGINOZNA TJELEŠCA U PLUĆIMA GRADSKIH PASA

Uzorci pluća 36 slučajno izabranih gradskih pasa pretraženi su na prisutnost feruginoznih tjelešaca s namjerom da se procijeni da li izloženost vlaknatim organskim prašinama, uglavnom azbestu, iz gradskog okoliša, nosi opasnost za zdravlje. U skupini od 15 pasa do četiri godine starosti, u dva su nađena feruginozna tjelešca. U drugoj skupini koja je sadržavala 21 psa starija od četiri godine, sedamnaest njih je imalo pozitivan nalaz. Prema Fisherovu egzaktnom testu postoji značajna statistička razlika ($P < 0.001$) između dviju skupina životinja. Prisutnost azbestnih tjelešaca u plućima pasa svjedoči da su javne gradske površine visoko kontaminirane vlaknatim mineralnim prašinama respirabilne veličine, uglavnom azbestom. Češći nalaz azbestnih tjelešaca u plućima starijih pasa upozorava na akumulaciju vlakana duljih od 10 μm tijekom duljeg vremena, a predviđive su i posljedice takve kontaminirane izloženosti vlaknatim mineralnim kontaminantima za zdravlje gradskog stanovništva.

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ključne riječi: anorganska mineralna vlakna, azbest, gradski okoliš