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Industrial Hygiene Forum

Franklin D. Griffith, Ph.D.
Department Editor

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Asbestos Exposure Associated with Automotive Brake Repair in Pennsylvania

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Introduction

Automobile mechanics are potentially exposed to asbestos fibers released during brake repair work in service stations, car dealerships and muffler shops nationwide. Asbestos fibers are released when service mechanics clean dust residue from contaminated drum or wheel parts. Personal samples were collected from the breathing zones of automobile mechanics to estimate their asbestos exposure while performing actual brake removal and repair work. Exposure measurements were made in thirty-one different facilities with widely diverse work practices. The estimated average asbestos exposure during actual repair work was <0.03 fiber per cubic centimeter (f/cc) based on thirty-five separate samples. If zero exposure were assumed for the unsampled portions of these shifts, the mean eight-hour, time-weighted average would have been <0.002 f/cc.

Materials and Methods

Personal samples were drawn from the breathing zones of employees performing brake service work. Sampling encompassed the entire period required to complete the assigned tasks. In most instances the assignment consisted of pulling all four wheels, visually inspecting the front disc pads, then removing and replacing both sets of rear brake shoes.

Each sample was collected on an 0.8-μm pore size, 25-mm diameter mixed cellulose ester filter mounted in an open-face, 5-cm diameter cassette. Individual filters were attached to the employees' outer garments in the breathing zone. Air was drawn through these filters using MSA Model G sampling pumps. The flow rate on each pump was set at 1.7 Lpm as established by prior calibration by a soapbubble meter. The sampling rate was checked periodically and adjusted if necessary to maintain the desired setting. At the conclusion of each survey, the individual cassette was sealed, labeled and submitted to an approved industrial hygiene laboratory.

At the laboratory, a small portion of each filter was cut and mounted on a glass slide in a medium consisting of dimethylphthalate and diethyloxalate, then covered with a glass cover slip. Each sample was subsequently counted on a Zeiss microscope equipped with phase contrast and a porton reticle. The reticle is calibrated at a magnification of 400 times with the stage micrometer from Bausch and Lomb Optical with scales of 0.10 mm and 0.01 mm.

Results and Discussion

One major finding of this study was that automobile mechanics were very well educated about the danger of using compressed air to clean dust from wheel or brake parts. Compressed air was used on a limited basis in only one of the thirty-one facilities surveyed.

The data summarized in Table I suggest that employee exposure typically falls well below the OSHA permissible exposure limit (PEL) of 0.2 f/cc. We point out that these measurements were collected during repairs on a representative number of vehicle makes and models, in a broad spectrum of repair facilities employing a wide diversity of work practices.

In 75% of the instances where exposure exceeded the mean (0.03 f/cc), poor work practices were involved. Where employees utilized good work practices — such as the use of a spray-type, aerosol liquid cleaner — seventy percent of the exposure measurements fell below the mean.

Our findings seem somewhat lower than those reported by Kauppinen and Korhonen,[1] but this may be due to less frequent use of compressed air for cleaning. In most of the Pennsylvania facilities surveyed, each employee performed an average of two or three brake repairs per week. Based on our interviews, it would be unusual for a mechanic to perform brake service work on more than one vehicle per day.

The mean length of time required to complete these brake jobs was 29 min. If one expects exposure to average <0.03 f/cc during this high risk period with zero exposure assumed for the remainder of the shift, the employee's eight-hour, time-weighted average could be predicted to average <0.002 f/cc on days when brake repairs are undertaken.

Conclusions

Appendix F to 29 CFR 1910.1001 summarizes non-mandatory work practices and engineering controls for automotive brake repair operations.[2] Our study supports OSHA's position that management in the automobile service industry can keep employee exposure below 0.1 f/cc and avoid costly compliance programs. The most readily accepted, cost-effective approach seems to be the use of spray-type, aerosol cans of brake cleaning solvents. These containers deliver a mist with considerably less force than shop air hoses fitted with a solvent delivery system. The aerosol spray approach may be equally as

TABLE I
Summary of Asbestos Exposure Monitoring

Number of Exposure Measurements	Range for Duration of Sample Period (minutes)	Asbestos Concentration^A in fiber/cc (Median)	(Mean)	(Range)
35	10 - 60	<0.02	<0.03	<0.01-0.15

^A Exposure estimates above reflect actual time-weighted averages for the sampling period during which brake service work was carried out, not the full eight-hour shift.

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effective as vacuum systems equipped with HEPA filters, provided that the contaminated liquid drippings are caught in a drip pan and disposed of in accordance with appropriate waste disposal regulations.

Other work practices which deserve management consideration include limiting the height of the car-lift or service rack so that wheel parts are not disassembled at (or above) the level of the employee's breathing zone and prohibiting employees from dumping dust residue from brake drums directly on the shop floor. Contaminated dust can be vacuumed or carefully dumped into waste liquid containers which subsequently will be used to catch aerosol drippings.

References

1. **Kauppinen, T. and K. Korhenon:** Exposure to Asbestos During Brake Maintenance of Automotive Vehicles by Different Methods. *Am. Ind. Hyg. Assoc. J. 48(5):*499-504 (1987).
2. "Asbestos, Tremolite, Anthophyllite and Antinolite," *Code of Federal Regulations,* Title 29, Subtitle B, Part 1910, Subpart Z. June 20, 1986.

Ribavirin — Exposure to Health Care Workers

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Introduction

Ribavirin (1-beta-D-ribofuranosyl-1,2,4 triazole-3-carboxamide), an antiviral drug, has the Food and Drug Administration (FDA) approval for administration as an aerosol to selected infants and young children with severe lower-respiratory tract infections due to respiratory syncytial virus (RSV).[1]

Ribavirin (Virazole™) has been sold in Mexico for almost twenty years under the brand name Vilona as an orally administered remedy for viral infections. It is noteworthy as one of several drugs being tested for treatment of AIDS and AIDS related complex (ARC).[2]

Warnings, contraindications, precautions and a description of adverse reactions are given in the product monograph, as they might affect the patient and the treatment of the disease.

Some of the potential adverse health effects for health care workers administering ribavirin may be carcinogenesis, fertility impairment and fetotoxicity. Use of the drug is contraindicated in women or girls who are pregnant or may become pregnant during exposure to ribavirin. Ribavirin has been found to be teratolethal and/or embryolethal in nearly all animal species in which it has been tested. It has shown structural and metabolic similarity to other cytotoxic agents, is mutagenic in mammalian cell culture and has caused cell transformation in an *in vitro* mammalian system.

The purpose of this paper is as follows:

- to describe the method of administration of aerosolized ribavirin as the source of occupational exposure to the drug;
- to describe policies and procedures developed by one hospital in the absence of any data on the level of exposure, given employee complaints of irritation and concerns about reproductive toxicity;
- to report results of environmental monitoring for airborne ribavirin.

Administration of Ribavirin

A sterile dilution of lyophilized ribavirin is prepared such that the concentration of the solution is 20 mg/mL. The small-particle aerosol generator (SPAG-2) delivers the solution as a small, uniform size aerosol (95% of particles $< 5\ \mu$ diam)[3] which is "contained" inside a hood or tent around the patient's breathing zone. The average aerosol concentration for a 12 hr period would be 190 μg/L (0.19 mg/L) of air. The aerosol is administered for 20 of 24 hr for five consecutive days.

Occupational Exposure

Direct exposure occurs when nurses, respiratory therapists, doctors or others actually enter the tent to care for the patient. Because these patients are usually very young and quite ill, the tasks involved in caring for them may be quite frequent and of relatively long duration (15 min to 1 hr at a time). It should be noted that the care is to a "babe in arms," and this exposure is in the employee's breathing zone.

Indirect exposure may occur because the tent or hood is not an airtight filtered system. The pressure inside the tent is positive with respect to the room, and, therefore, the airborne ribavirin particles may leak into the room creating potential for inhalation to anyone entering the room. Direct caregivers who may enter and leave the room to check on the patient's status, without entering the tent, may be exposed in this way. The greater concern of indirect exposure is to the parents, who may visit anytime day or night and who may spend the entire night in the patient's room.

Employees' complaints of headaches, burning and dryness of the eyes, coughing and dryness of the upper respiratory tract resulted in the Safety Office's becoming involved in investigating the matter of occupational exposure to ribavirin. Since the majority of the exposed health care workers are women in their childbearing years, the potential for fetal death or damage was of even higher concern than the above-mentioned acute symptoms.

Method and Results

In the absence of any data on the level of exposure and to most prudently address the potential hazard to unborn children of staff members, it was recommended that pregnant workers (or those attempting to become pregnant) be excluded from any exposure by not caring for patients on ribavirin.

In response to the acute symptoms described above, an industrial hygiene survey was conducted using a calibrated Bendix pump, open-face, 37 mm cassettes and 0.8 μMCEF. Preliminary results showed ambient exposure levels of 2.35 to 2.80 mg/m^3 airborne dust. Based on these results and assuming the "dust" was ribavirin, the Safety Office required the following protection for staff who enter the room while ribavirin aerosol was being administered:

- to prevent eye irritation — tight-fitting goggles;
- to prevent inhalation — approved dust/mist respirators (3M Company 8710, or equivalent) properly worn and fitted;
- to prevent inadvertent ingestion — use of long-sleeved gowns and latex gloves, scrupulous personal hygiene, hand and any exposed skin surface washing;
- to assure employees understand potential hazards, routes of entry and limitations of protective measures — dissemination of product literature and training sessions.

Using an identical method and collecting five additional samples, we (at the Children's Hospital) were unable to confirm the airborne dust concentration seen in the first two samples. All other samples were below the limit of detection in exposed and non-exposed areas.

Based on these results, the requirement for strict use of personal protective equipment was limited to the occasions when employees enter the tent.

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