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A Survey of Mercury Vapor Hazards in Hospitals

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The mercury hazard associated with the use of the Coulter counter, the Van Slyke apparatus, and Miller-Abbott and Cantor tubes was surveyed in forty-seven hospitals in the Commonwealth of Pennsylvania. A commercial mercury vapor detector was used in the survey. Mercury concentrations in excess of 0.1 mg/m^3 were detected in six hospitals. Accidental spills and poor housekeeping were the major causes of high mercury concentrations. Hospital personnel were, in general, unaware of the health hazards of mercury vapor. Recommended precautions are given.

Introduction

DURING THE PAST few years, the existence of a possible mercury vapor hazard in hospitals has been discussed informally at meetings of governmental industrial hygienists. Representatives from various State Health Departments have indicated an interest in this matter.

The literature is rich in its treatment of mercury and its compounds. Most are references covering its many uses in industry. There is little information available regarding the mercury vapor hazard in hospitals.[1,2] The few references which do exist indicate the definite existence of such a hazard in these institutions.

Last year in Pennsylvania an occupational health trainee made a tabulation and visual inspection of possible occupational health hazards in a number of hospitals. This was a phase of the summer training program sponsored by the Department of Health. One of the hazards indicated by this inspection was the possibility of mercury vapor poisoning.

Our interest in this subject was aroused by this report, and, after several hospital pathologists had shown an interest in ascertaining the extent of the mercury vapor hazard in their institutions, the decision to conduct a formal study of the mercury vapor hazard was made.

It was considered advisable to conduct a pilot study of several hospitals to determine the degree of the mercury vapor hazard. The results indicated the necessity for evaluating the mercury hazard in a larger number of institutions. Surveys were made in forty-seven hospitals. Although this was not a state-wide study, the hospitals chosen were a representative cross section of those in the state.

Source of Exposure

The mercury hazard arises from the use of several pieces of hospital apparatus. These are the Coulter counter, the Van Slyke apparatus, Miller-Abbott and Cantor tubes, and the reported breakage of several thousand thermometers a year.

One of the principal sources of mercury vapor in the laboratory is the use of this substance in the Coulter counter, an apparatus used in hospitals to count red and white blood cells. The instrument works on the principle that blood cells are poor electrical conductors compared with saline solution and employs an electronic gating principle to perform the actual cell count.

A 0.9% solution of sodium chloride is prepared. To obtain a red cell count a greater dilution is necessary and the white cells do not interfere in the count.

A microscope is a part of the counter. The

TABLE I
Mercury Vapor Concentrations in Six Pennsylvania Hospitals

Location	Number of Readings	Mercury (mg/m³) Range	Median	Average
Van Slyke apparatus	29	N.D.[a]–0.16	0.09	0.07
Coulter counter	18	N.D. –0.05	0.02	0.02
General air	89	N.D. –0.71	0.08	0.11
Floor	30	N.D. –0.32	0.10	0.12
Central supply	6	N.D. –0.06	0.00	0.01

[a]N.D. denotes none detected.

reflection of the particles is registered on an automatic counter.

To count the blood cells a small amount of the solution containing the blood is placed in a thimble-like cup and placed in the center of the stage. This solution enters an orifice through a 70 × 100-micron disk aperture and conducts an electrical current between platinum electrodes.

Mercury is used to create a vacuum and allow the sample to enter the electrode chamber. During the process of placing the mercury in the containers as well as in cleaning the instrument, a busy or nervous technician may spill quantities of this metal on to the floor.

Another source of mercury in hospitals arises from the use of the Van Slyke blood gas apparatus. This apparatus is used primarily to measure the carbon dioxide content of the blood. The gas is released from the serum by the action of lactic or sulfuric acid. One milliliter of the sample is placed in the apparatus, and the acid is added. Mercury is used to bring the level of the fluid in the manometer to a convenient number on the scale to measure the gas evolved. A modification of this apparatus uses the same principle, but only 0.03 milliliter of blood is needed for the sample.

The third major source of mercury vapor is the use of the Cantor and Miller-Abbott tubes. These tubes are used in the removal or reduction of intestinal obstructions. They are tubes with a balloon on one end. Mercury is placed in the balloon to convey the tube into the intestines.

In cleaning, filling, and use of Cantor and Miller-Abbott tubes, the Van Slyke apparatus, and the Coulter counter, considerable amounts of mercury may be spilled. Sometimes these instruments are mounted on impervious trays to contain and collect spilled mercury and any spillage can be caught and stored properly. However, in many instances the mercury spills on the floor and its decontamination is quite difficult.

The laboratory is the most common offender in these institutions. The Cantor and Miller-Abbott tubes are usually cleaned in the central supply room. This survey was therefore confined to the laboratories and central supply room, and the sinks and waste receptacles contained in these areas were evaluated for contamination as part of the survey.

A Kruger mercury vapor meter Model 23 was used to define the hazard. At the beginning of each survey the Kruger instrument was plugged into a convenient electrical outlet, and the instrument was calibrated. The calibration was always done in the outside atmosphere or in an uncontaminated area at the hospital. After calibration the instrument was taken to the mercury use area and the tests were begun. Readings for mercury vapor were taken on each side, in front of, and at the rear of the hospital apparatus. The floor of the room, waste receptacles, sinks, and the area above water traps of the laboratory were then scanned.

Findings of Survey

In our evaluation program of forty-seven hospitals, a total of 847 readings were recorded. About 90% of the hospitals were without mercury hazard; that is, no concentrations of mercury in excess of 0.1 mg/m³ of air were found. There were only six hospitals where mercury concentrations in excess of 0.1 mg/m³ of air were recorded.

Data in Table I are tabulated from these six hospitals. In the Van Slyke area, 29 mer-

cury vapor readings ranged from none detected to 0.16 mg/m³ with a median concentration of 0.09 and an average of 0.07. This mercury vapor resulted from spillage during manual use of the instrument, overflowing of the reservoir, and cleaning of mercury-contaminated apparatus following usage.

Eighteen mercury vapor readings were taken in the Coulter counter areas; these ranged from none detected to 0.05 mg/m³ with a median of 0.02 and an average of 0.02. The lower readings were a result of less mercury being used, since the apparatus is basically automatic. Many hospitals had the manufacturer of the instrument clean, adjust, and resupply the instrument with clean mercury.

The mercury vapor hazard in the general air was evaluated with 89 readings. The range of these was from none detected to 0.71 mg/m³ with a median of 0.08 and an average of 0.11. These measurements were at breathing zone level near other laboratory tables, instruments other than the Van Slyke or the Coulter counter, in doorways, near desks, and above sinks.

Thirty floor readings were recorded and ranged from none detected to 0.32 mg/m³ with a median of 0.10 and an average of 0.12. The higher readings were due to mercury accumulations in the cracks in the floor tile, baseboard strips around the floor, and the spread of mercury during mopping and cleaning.

Only six readings were recorded in the central supply room, ranging from none detected to 0.06 mg/m³ with a median of 0.0 and an average of 0.01.

The almost complete unawareness of hospital laboratory personnel of the health hazards involved in careless handling and spillage of mercury seemed significant. As a consequence there were many unnecessary exposures to mercury vapor. It is incongruous that people employed at tasks devoted to the restoration of health in others should be exposed to the potential health hazard of mercury poisoning.

Recommended Precautions

1. Employees associated with mercury exposure should be instructed in the health hazards of mercury.
2. All mercury containers should be kept closed when not in use.
3. Nonmetallic containers with tight-fitting lids should be used for mercury-contaminated articles.
4. The instruments should be provided with a base of such design so as to catch any spillage of mercury.
5. Every precaution should be exercised to prevent spillage of mercury.
6. Droplets of mercury may be removed by using a small-bore steel pipe connected with rubber tubing to a vacuum pump.
7. A mercury absorbent such as HgX or flowers of sulfur together with a mercury vacuum cleaner should aid in the cleaning operation.
8. Quarterly urine mercury assays should be made on potentially exposed personnel. All employees with over 0.3 mg of mercury per liter of urine should be removed from exposure and medically evaluated. With a good control program the value should be 0.1 mg or less of mercury per liter of urine.

Summary

This study was undertaken to evaluate the possible mercury vapor hazard in hospitals. The laboratories in forty-seven hospitals were monitored for mercury vapor. In only six of the hospitals was a hazard from mercury vapor found to be present. The findings in these six hospitals emphasize the fact that a possible mercury vapor hazard may be present. In general, the busier the hospital laboratory, the greater is the possibility of the existence of a mercury vapor hazard.

References

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