A Toxicologic Service in a General Hospital

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The purpose of this article is to present useful information and suggestions that have been found of practical value in a general hospital in dealing with problems arising from accidental, suicidal, and industrial intoxication. This material is based on background experience gained in the laboratory of Dr. A. O. Gettler, Chief Toxicologist to the Medical Examiner of the City of New York, and in the establishment of a toxicologic service in a community hospital. As seen below, the clinical chemist can contribute materially to the cooperative effort required in the proper handling of a toxicologic problem.

Orientation of the Emergency Room

A good working relationship between the emergency room and the laboratory is critical to the efficient handling of acute poisoning cases. A series of informal discussions between the two departments concerning the contributions that each can make in poisoning cases has made for better liaison. The following points were covered in the discussions.

1. Specimen Collecting. The first gastric wash should be submitted for examination because it contains the highest concentration of toxic substance. By the third gastric wash, a toxic substance may be so dilute as to make analysis impossible. Blood specimens, when required, should be drawn as early as feasible. In carbon monoxide

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cases, for example, a specimen drawn after prolonged oxygen therapy may give misleading results. Vomitus should be regarded as a valuable specimen for analysis because it may contain the toxic substance in relatively concentrated form and thus facilitate the analytic problem.

2. Clue Collecting. There is an almost infinite number of poisonous substances with only a limited amount of biologic material and time available for analysis. Thus the emergency room is depended on for information that will help direct the analysis toward the rapid identification of the toxic substance.

Although the treatment of many poisons is symptomatic, it is important to establish a diagnosis as quickly as possible. For example, a misleading state of depression may be due to exhaustion following convulsive seizures. The following types of information are generally helpful to the analyst: the circumstances under which the patient was found, the clinical picture, the occupational history, and familial knowledge of the patient's preference for specific drugs. All natural or commercial products brought in with the patient should also be submitted to the laboratory. One must also consider the possibility that some of the cases considered at first glance as an organic disease may, in fact, be due to some toxic substance. A classic example of this is the mistaken diagnosis of a carbon tetrachloride form of hepatitis as a viral hepatitis.

3. Antidotes and Therapy. Copies of two books (1, 2) containing information on the diagnosis and treatment of poisoning were presented to the emergency room. The toxicity of some of the antidotes was pointed out and extreme caution advised in their use. A check was made of the antidotes and equipment on hand using the lists in chapter 3 of Von Oettigen's book (2) as a guide. The missing equipment was procured and the required antidotes placed in a special cabinet with written warnings concerning the use of the more dangerous ones.

4. Diagnostic Aid. An odor reference shelf was placed in the emergency room to aid in the rapid identification of those poisons with characteristic odors. Some of the chemicals on this shelf are carbon tetrachloride, cyanide, elemental phosphorus, kerosene, nitrobenzene, paraaldehyde, petroleum ether, phenol, and sodium hypochlorite. It was emphasized that the absence of odor does not eliminate the possibility of contact with any of these poisons.
GENERAL RULES OF PROCEDURE IN THE LABORATORY

1. The analyst must be aware of extreme personal danger in dealing with unknown compounds. For example, an unmarked paper bag filled with grayish granules was found near a dead man. The granules were identified as calcium cyanide, a product used in commercial exterminating, which liberates hydrogen cyanide even in neutral aqueous solution. Autopsy confirmed cyanide as the cause of death.

2. The analyst must be alert to the possibility that a toxic compound found near the patient or even in the gastric contents may not be primarily responsible for the observed clinical picture. There are numerous cases, especially among suicides, where more than one poison is involved. Sometimes this occurs because the first poison is relatively slow acting, thus giving the victim enough time to hunt up another toxic substance.

3. By preparing a master chart of many of the capsules and pills manufactured by pharmaceutical houses, the analyst may simplify the identification of proprietary drugs. Each pill or capsule is placed in a test tube labeled with the trade name and chemical composition. Fortunately, the capsules are made in a wide range of color combinations, shapes, and sizes. It is thus possible to identify an unknown capsule in a matter of seconds if it can be matched with one in the collection. A confirmatory chemical test should always be run because of the possibility of duplication of shape and color by different drug houses.

4. The analyst may have to rely on many sources of information in obtaining a lead on the chemical composition of commercial and natural products. Several books have been found to be especially helpful (3, 4, 5). A careful reading of the label may also give valuable information. The nearest Poison Control Center (5) may have the desired information in its files. As a final recourse one may contact the manufacturer directly.

ANALYTIC PREPARATIONS

Although the total number of poisons is enormous, only about 19 compounds or their analogs are involved in the majority of cases. These are antimony, arsenic, barbiturates, carbon monoxide, chlorinated hydrocarbons, cyanide, ethyl alcohol, fluoride, formaldehyde, iodine, lead, mercury, methyl alcohol, morphine, paraldehyde, phenols, phosphorus, salicylate, and strychnine. Prior preparation of methods, apparatus, and reagents to detect and to determine quan-
titatively these poisons in biologic fluids is to be considered as an initial step in adequately handling most cases of acute and chronic toxicity encountered by the laboratory.

Simple methods may sometimes be selected (6, 7, 8) which are not a burden to a laboratory with limited space and equipment. More than half the poisons mentioned can be detected with the aid of glass flanges, Conway dishes, and a copper coil. For example, the aeration of 1 μg. of cyanide (9) through an alkali-ferrous sulfate-treated disc of filter paper supported by two glass flanges will produce a blue color in 5 minutes. There are similar methods for the determination of carbon monoxide (10) using a palladious chloride-impregnated filter-paper disc, and for elemental phosphorus (11) using a silver nitrate-treated disc. These methods may be used quantitatively by comparing the color produced with the colors of standards run under identical conditions.

Conway methods have been developed for the major toxic volatile compounds (12). Although they usually require more time than the aeration methods to produce an analytic result, their simplicity is a compensating factor. This liability has been overcome in a blood-alcohol method (13) by incubating the Conway dish at 90° for 20 minutes.

The utility of the Reinsch test (14) has been increased by a scheme of analysis able to detect amounts of mercury, bismuth, arsenic, antimony, selenium, and tellurium that are invisible on the copper collector.

The frequency of encounter with salicylates and barbiturates is responsible for methods (15, 16) of their analysis being generally available in the clinical laboratory. The determination of other nonvolatile poisons may require more complex methods (17, 18, 19). Newer technics involving the use of filter-paper chromatography, ion exchange resins, and both ultraviolet and infrared absorption have been applied to the determination of nonvolatile poisons (20).

Sometimes a method is too recent to have gained access to published volumes. This is found to be especially true in attempts to analyze some of the newer pharmaceutical preparations. One may contact the pharmaceutical firm directly for aid or consult the current literature. It has occurred that a firm was unable to suggest an adequate method for the analysis of their product in a biologic system, yet a method was located in Chemical Abstracts.
PARTICIPATION IN PUBLIC HEALTH PROGRAMS

The hospital may help attack the problem of accidental poisoning in the home at its source by participating in a variety of public-health education programs. This may range from talks to parent-teacher associations or other interested groups to the preparation of exhibits at community fairs. At a recent local fair an exhibit was prepared with the theme, “Poisoning in the Home.” The central poster was of a child reaching into a medicine chest with the caption, “Don’t let your child become a statistic!” Figures for injury and death due to accidental poisoning in children, lists of common dangerous household items, and a method for the conversion of common kitchen items into universal antidotes were exhibited. In addition, there were several case histories of child poisoning with a demonstration of the chemical methods involved. In this area, efforts in the direction of public awareness are as important as technical preparation to handle the most complex toxicologic problem.

SUMMARY

Information and suggestions found of value in a general hospital in dealing with toxicologic problems are presented. Relevant problems such as good liaison between the emergency room and the laboratory, sources of information on product composition, the preparation of an odor reference shelf, and selection of methods to help meet the majority of situations encountered have been discussed. The importance of participation in public-health education programs has also been indicated.

REFERENCES