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III—Poisonings Common in Children

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MANY drugs and chemicals have caused poisoning in children but only the more common ones as determined by a survey of all the cases of poisoning admitted to the Hospital for Sick Children, Toronto, since 1919, will be discussed in this communication.

As shown in Table I, a large proportion of these poisoning cases, both here and in the United States, occurs in children under five years of age. The poisonings resulting in fatalities and a few of the more common poisonings with no fatalities are shown in Table II.

TABLE I

POISONING IN CHILDREN
IN THE HOSPITAL FOR SICK CHILDREN, 1919-1933

	Cases	*Deaths*
Under 5 years	135	18
5-14 years	26	3

IN THE UNITED STATES, 1929 (ILLUMINATING GAS EXCEPTED)

	Deaths
Under 5 years	930
5-9 years	47

TABLE II

HOSPITAL FOR SICK CHILDREN, 1919 TO 1933
GROUP I—POISONINGS WITH FATALITIES

	Cases	*Deaths*
Strychnine	32	6
Illuminating gas	10	2
Morphine	4	2
Oil of wintergreen	2	2
Poison oak plant	1	1
Chloral hydrate	1	1
Lemon oil furniture polish	1	1
Zinc stearate (Aspiration pneumonia)	4	2
Turpentine (Aspiration pneumonia)	7	1
Sloan's Liniment (Aspiration pneumonia)	1	1

GROUP II—OTHER COMMON POISONINGS WITHOUT FATALITIES

Atropine	10 cases	Sodium hydroxide (Lye)	5 cases
Mercury	8	Acetanilid	4
Food Poisonings	5	Arsenic (Fly poison pads)	4
Luminal	5	Aniline dye (Shoe dye)	3

STRYCHNINE

Frequency

Among the drug poisonings strychnine was responsible for the largest number of cases and the highest percentage of fatalities. It usually resulted

from the child swallowing tablets containing aloin, belladonna, strychnine and cascara (A.B.S.&C.), frequently in large numbers, sometimes as many as 80 or 90. The widespread use of these tablets in the homes and their chocolate coating are probably largely responsible for the frequency of this type of poisoning. Other tablets, such as A.B.&S., Hinkle's Cascara and Blaud Pill Compound, also contain sufficient strychnine to cause poisoning with convulsions in a child. The number of strychnine poisonings, in this hospital and in New York State,[1] in children under five years of age is compared with other poisonings in Table III. It is evident that strychnine was responsible for approximately one-third to one-half of the fatal poisonings in the pre-school children represented by these two groups.

TABLE III

POISONINGS IN CHILDREN UNDER 5 YEARS OF AGE IN THE HOSPITAL FOR SICK CHILDREN, 1919-1933

	Cases	*Deaths*
Strychnine	32	6
(A.B.S. & C. Tablets)	(28)	(5)
All others	103	12
	135	18

IN NEW YORK STATE, 1926-1932

	Deaths
Strychnine	75
All others	83

In the strychnine poisoning cases there is usually very little difficulty in diagnosis. The mother gives the history of the child having found a bottle of A.B.S.&C. tablets, swallowing a number of them. In a few hours he becomes dizzy, his face is flushed, he walks stiffly and jerkily and finally is unable to stand. If the child is induced to vomit or the stomach is washed out before the onset of convulsions the prognosis is fairly good, but otherwise the outcome is usually, although not always, fatal.

The treatment consists of gastric lavage with 1/1000 solution of potassium permanganate followed by 1 to 2 tablespoonfuls of medicinal charcoal C.F. in a glass of water. This should be given immediately. Morphine and ether may be used to control convulsions. If muscular hypertonicity persists, sodium phenobarbital may be given in a dose of not more than 4 grains for a three-year-old child, six grains for a five-year-old child and nine grains for a ten-year-old child, until convulsions are controlled.[2] Intravenous sodium amytal may be used instead of sodium phenobarbital for controlling the convulsions. The child is isolated and kept absolutely quiet.

MISCELLANEOUS GROUP

Cases of poisoning with *illuminating gas* are less frequent now than a few years ago, probably due to better gas fittings in the poorer communities. In the treatment of illuminating gas poisoning, oxygen with 5 per cent CO_2 to increase the depth of respiration, and external heat are used; an exsanguination

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transfusion and artificial respiration may be necessary. Coramine is given as required.

In *morphine* and *opium* poisoning the patient must be kept awake by constant attention and carbon dioxide-oxygen inhalation is given. Black coffee and caffeine or coramine are used to improve respiration. A purgative is also advisable.

The *oil of wintergreen* poisonings, both fatal, were due to drinking liniment from a bottle in the absence of the parents. The treatment consists of gastric lavage with sodium bicarbonate solution, purgation, external heat and stimulants.

In the last three poisons listed in Group I, Table II, the fatalities were the result of an aspiration pneumonia. *Zinc stearate* inhalation is particularly likely to result in pneumonia.

Atropine poisoning in the second group, Table II, with no fatalities, is usually of a mild nature because the drug is seldom dispensed for children in solutions stronger than 1 part in 500 and the child does not obtain much of the drug even though an ounce or more is swallowed. In treating these cases a gastric lavage with 1/1000 potassium permanganate solution or sodium bicarbonate solution may be given. This is followed by the administration of medicinal charcoal C.F. If excitation persists paraldehyde may be used. Caffeine may be necessary occasionally.

The early symptoms of bichloride of mercury poisoning are abdominal pain, vomiting and purging with mucous and blood. There is also muscular trembling and incoordination with scanning and explosive speech. The late symptoms are due to kidney damage, with hematuria, albuminuria, and finally uraemia. As an antidote the following mixture is recommended (Geiger[3]): 10 cc. of 10 per cent sodium hypophosphite solution in a glass of water to which 5 cc. of hydrogen peroxide is added. Administer this mixture by mouth and also by lavage. Egg white in milk may be used similarly. Later treatment consists of frequent gastric lavage with sodium bicarbonate solution and the administration of sufficient sodium acetate by mouth to keep the urine alkaline. Rosenthal[4] has recently recommended the use of sodium formaldehyde sulphoxylate in cases of mercury poisoning. Gastric lavage with a 5 per cent solution of the drug is followed by intravenous injection of 5 to 10 grams of the purified sulphoxylate in 200 cc. of normal saline.

The *food poisonings* were caused in two cases by canned sardines and in the others by canned fruits which had spoiled after the tin was opened. These are in reality intestinal infections with pathogenic organisms.

In poisonings with alkalies such as *lye* and *washing soda,* a stomach tube should not be passed because of the burning and necrosis of tissue. From 100 to 200 cc. of 0.5 per cent hydrochloric acid is given immediately, and later 8 ounces of olive oil. This may be followed by gelatin or flour in water. Stimulants are also administered.

Aniline dye poisoning occurs very infrequently in children and although the marked cyanosis is a very disturbing symptom, the poisoning is seldom of a serious nature. Recently dyed shoes, worn by the child before they are thoroughly dry, may result in poisoning by absorption through the skin. If

the case is severe, 50 cc. of 1 per cent methylene blue may be given intravenously.[5] In the usual case, however, external heat, caffeine and carbon dioxide-oxygen inhalation are sufficient.

The other types of poisonings in this group are treated along routine lines.

In prevention of these poisonings the chief drug to contend with is strychnine, and since the aloin, belladonna, strychnine and cascara (A.B.S.&C.) tablets are the principal source of this poison, it would seem advisable to control more adequately the sale of these tablets or eliminate strychnine from the formula. These measures would prevent the death of a large number of children, both in Canada and the United States, each year. As for the other drug poisonings, probably very little can be done toward prevention except in the education of parents to keep these poisons out of the reach of small children.

LEAD POISONING

The cases of lead poisoning are discussed as a separate group, as the clinical picture, the action of the poison in the body and the difficulties in diagnosis make these cases entirely different from the drug and food poisonings.

Twenty-three cases of lead poisoning were treated at the Hospital for Sick Children during the past two years. It would thus appear that lead, rather than strychnine or illuminating gas as was previously thought, is probably the most common single cause of poisoning in children. Of these 23 cases, 10 had cerebral symptoms on admission and 5 of these died. One case has resulted in a cerebral sclerosis with mental retardation. The remaining 13 were cases of latent lead poisoning.

The symptoms of lead poisoning may for convenience be divided into early and late. It usually requires from 2 to 4 months or longer of nibbling paint before any acute symptoms arise. The duration of this early period, called by McKhann "latent lead poisoning"[6], depends not only on the amount of lead ingested but to some extent on the amount of calcium and vitamin D in the diet. During this period the mother may notice a change in the child's disposition. The child will become cross and very irritable, and if old enough there will be complaints of abdominal pain. Anorexia soon develops and this is usually associated with constipation and occasional vomiting. A decrease in the child's activity is often noted about this time, and either a loss or a delay in the ability to pronounce words, and form sentences, may be observed by the mother.

The late symptoms are characterized by the onset of convulsions. These may occur either following a slight acidosis from diarrhoea or other causes, or simply when there is sufficient concentration of lead in the brain to produce cerebral oedema. The convulsions may be more or less continuous for a period of 12 to 36 hours or may occur at intervals over a period of weeks. From this it will be seen that the symptoms of lead poisoning in children are somewhat different from those found in the adult. Abdominal cramps, wrist drop and blue lines on the gums occur very rarely in children.

Previous to 1923 cases of lead poisoning in children were considered to be of very rare occurrence. It was not until 1930 when Park et al.[7] of Baltimore

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and Vogt[8] of Boston independently reported the fact that lead produced a characteristic band of density at the growing ends of all the long bones, which may be seen on X-ray, that these cases came to be more frequently recognized. More recently the introduction of micro methods for the determination of lead in the urine[9] and blood[10] of children and the more careful staining of blood smears for stippled cells have greatly assisted in the diagnosis of these cases.

Sources of Lead in Lead Poisoning in Children

A child who has a natural tendency to pica may ingest sufficient lead from many different sources to cause symptoms. Metal or wooden cots which have been repainted at home are probably the most common source. New metal cots and cribs as purchased do not appear to be in any way dangerous because lead-free enamel is usually used in manufacture. Play pens, however, which are made of wood, may easily have the paint scraped off by the child's teeth, and if lead is used in the paint, as is sometimes the case, they constitute a considerable source of danger. Kitchen chairs and tables, window sills and verandah railings are frequently repainted many times in the poorer districts, and the paint used in some cases contains 30 per cent or more of lead carbonate. This thick layer of soft paint is easily nibbled off. Crayons and painted toys may add to the lead intake to a minor extent. The lead from these sources has a cumulative effect in the body due to the fact that it is normally excreted very slowly.

Age Distribution

In nursing infants, lead poisoning has occurred following the use of lead-containing powders or lead lotions on the breasts, but these cases are now very rare. The poisoning occurs in the large majority of cases between one and two and a half years of age, or during the "teething period". When the four central incisors have erupted the child may begin to nibble the paint from anything within reach, and this habit may persist or may terminate at any time. The cases occurring in older children may be due to pica, but more frequently to other modes of lead ingestion, such as those which occasionally occur in families of painters and decorators, where the child may play with tins of liquid paint and get a certain amount of it in its mouth.

Treatment

Cases which are recognized before the onset of convulsions are treated by the administration of fairly large doses of calcium, either in the form of lactate or phosphate, together with vitamin D to increase the absorption of the calcium. Children of this age group are usually on a high milk diet which will also supply large amounts of both phosphorus and calcium, and in the milder cases the avoidance of an acidosis may be the only factor that is essential in treatment.

Treatment of cases which have convulsions as the result of cerebral oedema is first directed toward decreasing the cerebral oedema by the subcutaneous injection of 20 to 30 cc. of magnesium sulphate in 8 per cent solution or 30 to 50 cc. of 50 per cent glucose intravenously. Magnesium sulphate is also given

by mouth. When the convulsions have been controlled large doses of calcium are administered. Calcium gluconate is very readily absorbed and repeated intramuscular injections may be given. Calcium phosphate and vitamin D therapy is then begun and continued for two or three months after discharge from hospital. Iron is also given for the anaemia.

We have not attempted gradually to delead any of the cases by the therapeutic production of an acidosis, because there is considerable danger of causing a recurrence of cerebral symptoms when more lead is allowed to circulate in the blood. The risk of this procedure is probably greater than the advantage gained. Moreover, the lead is normally excreted over a period of months. This gradual elimination is the result of normal exchange of the inorganic salt content of bone.

Mortality

Previous figures on mortality are extremely high in children showing cerebral symptoms. Stewart[11] reports 1 recovery out of 7 cases. Blackfan[12] reports 1 recovery out of 4 cases; and Holt and Howland[13] report 1 recovery out of 8 cases. These cases died with so-called "lead encephalitis". The later statistics of McKhann and Vogt[14] show that one-quarter of their encephalitis cases died and one-quarter of the remainder had permanent sequelae, such as mental retardation, muscular weakness, cerebral atrophy, blindness, etc.

The Prevention of Lead Poisoning

Lead poisoning is a preventable disease in children and lead-containing paints are the chief source of the poison. In order to adequately prevent this condition, the elimination of these paints from the immediate environment of the child during the second and third years of life is essential. Lead-free paints are readily available, and throughout Ontario most of the manufacturers of children's cots, play pens and toys are using these paints almost exclusively. For the past 3 years factory legislation requires all lead-containing paints supplied to these manufacturing plants to be so labelled. Thus the lead hazard from factory-painted articles of children's furniture is probably very small. Definite information may, however, be obtained from the manufacturer concerning the lead content of paints used on furniture. The principal hazard occurs from repainted furniture in the poorer class homes, and we would suggest that if repainting is necessary consideration should be given to the following points. Exterior house paints contain from 20 to 60 per cent of lead carbonate, all the higher grade paints containing at least 30 per cent. This type of paint should never be used for repainting woodwork or furniture in a home where there are children. In fact it would be advisable to use lead-free paint for all interior work, but unfortunately a number of companies sell and recommend interior paints with a high lead content, and these are not required to be labeled as to the presence of lead. Also, contractors frequently mix their own paints and use large amounts of lead carbonate as a base even for interior work. Interior enamels are lead-free with the exception of the green, yellow and orange colors, which usually contain lead chromates as pigments; and it

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would be advisable therefore not to use these colors in repainting. The other enamels may be used on any of the child's furniture. Lacquers and varnishes are lead-free except for the addition of about 3 per cent of lead containing dryer. The amount of lead per unit of painted surface has recently been estimated.[15] On one square foot of surface painted with ordinary house paint of the lead-zinc oxide type there would be 5.8 grams of metallic lead, while on a similar area painted with yellow toy enamel (lead chromate) there would be 1.86 grams Pb. A fatal case of lead poisoning in our series was found to have ingested not more than two-thirds of a gram of metallic lead.

In view of the above considerations it would seem advisable to prohibit the use of lead containing paints for toys, children's furniture, and for interior work. Such regulations have been in force in France since about 1915.

SUMMARY

The cases of poisoning admitted to the Hospital for Sick Children, Toronto, over a fifteen-year period are represented. Many drugs and chemical irritants are responsible for the poisoning. Fourteen per cent of the cases resulted fatally.

Poisonings due to lead appear to be more common than any other single group. Preventive measures are suggested.

Strychnine poisoning is the second largest group; it usually affects children of pre-school age. In the majority of cases it is due to the ingestion of large numbers of A.B.S.&C. tablets.

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