Drug Treatment of Disease

TREATMENT OF ACUTE POISONING

BY

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Historically, acute poisoning is the classic medical emergency. The most important principle in management is *speed* in starting the appropriate treatment; initial delay may render subsequent measures ineffective, and in all cases will increase uncertainty in the prognosis. Many substances may cause poisoning in man, but the general principles of treatment are the same in all cases: remove the poison from the patient; administer the specific antidote when it is available; prevent or treat the complications which may result from the action of the poison.

GENERAL PRINCIPLES

Emptying the Stomach

As many poisons are taken by mouth, removal consists in emptying the stomach (for exception see "Corrosive Poisoning" below). This is best accomplished in the conscious patient by boldly thrusting a finger into his pharynx; he should be leaning forward or lying prone. This technique can be repeated several times, the patient drinking 500 ml. of warm water before each attempt to produce vomiting. Should direct pharyngeal stimulation fail, he should be given an emetic such as a tablespoonful of common salt, or a dessertspoonful of mustard, in a tumblerful (300 ml.) of warm water. Other irritant or reflex emetics should not be used, as they are unreliable, and, when ineffective, may themselves cause poisoning. As an alternative to reflex emetics, apomorphine hydrochloride can be given intravenously in a dose of 6 mg. This drug stimulates the vomiting centre in the medulla and emesis follows within two minutes; the patient is more likely to vomit if he is made to sit up after the injection. Apomorphine should not be used in corrosive poisoning or where there is deep narcosis; in the latter case the vomiting centre is unresponsive and apomorphine may further depress the central nervous system. In the fully conscious patient it is a valuable and reliable drug, but if the first dose does not produce vomiting a second dose should not be given.

Whether emetics are used or not, the stomach must be washed out—a procedure which calls for more skill than is generally understood. The principal contraindication is the presence of a corrosive poison which may have damaged the mucosa of the oesophagus or the stomach. In poisoning with paraffin or petrol, lavage should be avoided; inhalation of the poison into the respiratory tract greatly increases its toxicity, leading to bronchopneumonia. For an adult, a stomach tube of about 1 cm. in diameter is used—not to be confused with a Ryle's tube. Lavage should be performed even when it seems unlikely that the poison remains in the stomach; undissolved tablets may be recovered from gastric contents many hours after ingestion. The principal hazard of

gastric lavage is inhalation of gastric fluid into the trachea, especially in the drowsy, shocked, or comatose patient.

Lavage

The patient should be in a prone position with the head and shoulders below the level of the trunk. About one gallon (4.5 l.) of tepid water is needed for lavage, and the stomach is emptied repeatedly by siphonage. Not more than half a pint (300 ml.) should be poured into the funnel at a time, because large volumes of fluid entering the stomach tend to drive the gastric contents through the pylorus. The first 4 oz. (100 ml.) of vomitus or gastric washings should be carefully set aside for chemical analysis. If an antidote is available, it can be conveniently administered while the stomach is being washed out. Thus in opium or morphine poisoning, potassium permanganate* can be added to the water (a strongly pink solution). Lime water may be used to treat poisoning with oxalic acid.

It must be emphasized that the use of such antidotes does not compensate for delay in carrying out thorough lavage. Before removing the stomach tube it is advisable to run in a pint (600 ml.) of warm water containing one tablespoonful of sodium sulphate (Glauber's salt); this saline purgative ensures more rapid evacuation of any poison which has passed into the intestine. A tablespoonful of powdered activated charcoal (potent preparations are available commercially as "active carbon") should be added to the solution if the poison is one that can be adsorbed—such as the alkaloids and glycosides.

Treatment of Systemic Effects

In addition to removing the poison from the gastrointestinal tract, the local and systemic effects of the poison may require treatment. These symptoms and signs vary with the circumstances, but the most dangerous are dehydration, circulatory collapse, depression of respiration, and coma. In corrosive or irritant poisoning, there may be severe *pain* in the mouth, oesophagus, or

*In recent years the special value of potassium permanganate as an antidote has been doubted. It is therefore particularly important to remember that in the stomach too strong a solution of this metallic salt can do more harm than good by its corrosive action. In the emergency treatment of poisoning it is virtually impossible to prepare accurately a solution of a stated strength for immediate administration. The procedure used in making potassium permanganate mouth-wash is therefore recommended in preparing for gastric lavage. Three or four crystals of KMnO_4 are dropped into a glass tumbler, which is then filled with warm (not hot) water and the solution is gently stirred. In about half a minute the solution is strongly pink in colour and can be decanted into the lavage funnel; care must be taken to prevent the escape of solid potassium permanganate. The tumbler is then refilled (without adding more crystals). If two or three tumblers are used in this way a continuous supply of solution of appropriate strength can be made available. If this solution in the tumbler becomes too strong (reddish pink) it should be diluted further immediately before use.

abdomen. Morphine in full doses is indicated. The administration of tablespoonful doses of liquid paraffin hourly for the first few hours may give some relief by its demulcent action.

Dehydration is likely to occur when swallowing is painful or diarrhoea has been severe. Administration of tap-water by slow rectal infusion (500 ml. in four hours) may be useful as a preliminary measure, but in the majority of such cases intravenous fluids will be required; physiological saline or 5% dextrose in water are suitable.

If there has been frequent vomiting (as in some cases of irritant poisoning) and also when the absorbed poison upsets the level of serum electrolytes, expert biochemical advice is necessary in order that the appropriate fluids may be given intravenously. For practical purposes the surest indication that fluid intake is adequate for the individual patient is that his *urinary output is maintained*; the volume of urine should be not less than 1,500 ml. per day.

Shock should be treated by laying the patient prone, with the foot of the bed elevated; this position is helpful because it assists the cerebral blood flow and helps to ensure that the airway remains patent. The normal body temperature should be maintained by covering the patient with blankets, but overheating—for example, with hot-water bottles—is to be avoided. For all but the mildest cases, intravenous plasma will be required.

Respiratory depression should be combated by means of artificial respiration, the Holger Nielsen method being preferred; a mechanical respirator may be required. Stimulants of the respiratory centre may be administered, the most useful being nalorphine hydrobromide which specifically antagonizes the action of morphine and related drugs (see below). Other non-specific stimulants are available, including amphetamine, leptazole, and nikethamide; each is administered by the intravenous route, the duration of action is short, and the dose varies with the response of the individual patient. Infection of the respiratory tract is an important complication of poisoning, and soluble penicillin should be given intramuscularly in a dose of 500,000 units initially, followed by 100,000 units six-hourly, to all patients with respiratory depression.

In addition to the application of these general principles, treatment of individual cases of acute poisoning may require the use of specific antidotes; those available for the more common forms of poison can now be discussed.

SPECIFIC ANTIDOTES

Corrosive Poisoning

This should not be treated by induced vomiting or gastric lavage; for these procedures may spread the corrosive, cause perforation of the stomach, or lead to subsequent strictures of the oesophagus. In the case of *strong acids*, the antidote is magnesium oxide (magnesia) as one teaspoonful (4 g.) moistened with cold water; failing this any antacid may be used, but sodium bicarbonate should probably be avoided because of the danger of releasing large amounts of carbon dioxide in a damaged stomach. When the corrosive is a *strong alkali*, vinegar or dilute acetic acid should be given in teaspoonful (4-g.) doses diluted with cold water. *Phenol* and coal-tar disinfectants may also produce severe corrosion, and olive oil in tablespoonful (16-ml.) doses

at hourly intervals should be given; a dessertspoonful (8 g.) of Epsom Salts (magnesium sulphate) in a tumblerful (300 ml.) of water may be taken after the first dose of olive oil. Phenol burns of the skin and mucosa should be repeatedly swabbed with olive oil—which acts both as a protective to the tissues and a solvent for the available phenol.

Aspirin

When poisoning is due to *acetylsalicylic acid* (aspirin), sodium bicarbonate in a dose of two teaspoonfuls (8 g.) is indicated, given either via the stomach tube after lavage or in divided doses by mouth during the first two hours of treatment. In the severe case M/6 sodium lactate intravenously may be required to combat the metabolic acidosis; one pint (600 ml.) can be given in the first hour, a second in the next two hours, and thereafter one pint every four hours.

Hypnotic Poisoning

This is most commonly due to a barbiturate and may cause deep coma, in which case an analeptic should be given. Bemegride, when introduced, was thought to be a specific antagonist to the barbiturates, but there are now numerous reports of its stimulant activity in many other types of hypnotic and sedative poisoning. The dose is 50 mg. in 10 ml. solution, injected intravenously at intervals of 5 minutes until the pharyngeal and laryngeal reflexes return and the blood pressure approaches normal. Should the depth of coma make it seem likely that prolonged medication will be necessary, bemegride can be conveniently injected (in the same dose) into the rubber tubing during intravenous infusion of physiological saline or 5% dextrose solution. Excessive dosage with bemegride may produce convulsions, and over-enthusiastic medication is to be deprecated. An alternative stimulant in hypnotic coma is amphetamine sulphate; it is given intravenously in a dose of 50 mg., repeated in one hour if there is no clinical improvement, and thereafter 25 mg. hourly.

In cases of *morphine poisoning*, in addition to the use of potassium permanganate for gastric lavage, nalorphine hydrobromide is indicated as the specific antidote. The dose is 10 mg. intravenously, and this may be repeated three times in the course of the next four hours. Within a few seconds of injection in appropriate dose, it produces a dramatic stimulation of respiration, increasing both the rate and the minute volume; hypotension is also relieved. Nalorphine is an active antagonist to the other opiates and also to *methadone* and *pethidine*. A word of caution is necessary: when narcosis or respiratory depression is not due to these drugs, nalorphine itself may cause respiratory depression.

Iron

Ferrous sulphate poisoning is not uncommon, especially in children, who are apt to mistake the coloured tablets for sweets. Vomiting usually results from the gastric irritation, but lavage should be performed with a solution of sodium bicarbonate (one teaspoonful (4 g.) to one pint or 600 ml.). 300 ml. of this solution should be left in the stomach after lavage; a dessertspoonful (8 g.) of magnesium sulphate may also be added.

Other Poisons

The appropriate antidotes for some of the less common types of ingested poisons are listed below. It

must be emphasized again that *the use of antidote is only supplementary to gastric lavage and should not replace it.*

Poison	Antidote
Antimony compounds	Tannic acid, one teaspoonful (4 g.) in a cupful of cold water. Failing tannic acid, magnesium oxide or calcium hydroxide.
Arsenic compounds	(1) Ferric hydroxide (freshly prepared by nearest pharmacist while gastric lavage is proceeding).† (2) Dimercaprol (B.A.L.) 3 mg./kg. body weight 4-hourly intramuscularly.
Atropine and belladonna	(1) Potassium permanganate (strongly pink solution for gastric lavage). (2) Phenobarbitone sodium (0.1 g. intravenously) to combat early phase of excitement.
Heavy metals (As, Bi, Hg, Au, Sb)	Dimercaprol. See "Arsenic" above. Ineffective against selenium and uranium, and of doubtful value in cadmium poisoning.
Hydrocyanic acid and cyanides	(1) Amyl nitrite inhalations. (2) Sodium nitrite solution 3%, 10 ml. in three minutes intravenously. (3) Sodium thiosulphate solution (50%), 25 ml. intravenously.
Iodine	Starch cream, or sodium bicarbonate, or magnesium oxide.
Lead salts	(1) Epsom salts (magnesium sulphate) or Glauber's salts (sodium sulphate). (2) Calcium gluconate solution 10%, 10 ml. intravenously gives early symptomatic relief. (3) Sodium calciumedetate intravenously may be given later in the de-leading technique.
Oxalic acid	Magnesium oxide or calcium hydroxide.
Silver nitrate	Common salt, a dessertspoonful (8 g.) to a pint (600 ml.) of water.
Strychnine	Thiopentone sodium intravenously.

†The dose consists of a freshly prepared mixture of light magnesium oxide 24 gr. (1.6 g.), triturated to a smooth paste with water, diluted to 4 oz. (115 ml.) and added in a thin stream to a strong solution of ferric chloride 85 minims (4.8 ml.) diluted with 340 minims of water (20 ml.) (Martindale: *The Extra Pharmacopoeia*).

Food which has been contaminated by bacteria may produce signs of acute gastro-intestinal irritation and constitutional upset. Treatment consists in administering castor-oil in a single dose of 30 ml. (two tablespoonfuls) for an adult or 15 ml. for a child; the resulting purgation removes the poison from the alimentary tract.

Inhalation

Acute poisoning by inhalation is most commonly due to carbon monoxide. In addition to its well-known sources such as coal gas and the exhaust fumes from car engines and coke ovens, carbon monoxide may also accumulate when there is incomplete combustion of butane ("calor gas") in confined, ill-ventilated spaces. The treatment of poisoning consists in promptly removing the patient to fresh air and ensuring an adequate supply of oxygen to the tissues.

Before entering a gas-filled room the rescuer should take about half a dozen deep breaths to oxygenate his own tissues and to allow him to hold his breath as long as possible: he then drags the patient out. A second visit to the room may be justified to deal with the gas leak and to open doors and windows—if this can be done easily and rapidly—but the needs of the patient demand first priority. Ideally also, the rescuer has a life-line attached to him.

As soon as the patient is in a clean atmosphere, he is laid prone, and the airway is cleared by pulling the

tongue forward, removing dentures (if any), and swabbing out secretions if necessary. If breathing is depressed, the Holger Nielsen method of artificial respiration should be adopted; respiration may cease fully ten minutes before cardiac arrest occurs. Warmth is ensured by the use of blankets. Oxygen and carbon dioxide (5 or 7%—whichever is available) should be administered as soon as possible, at a rate of 4 to 6 litres per minute through a close-fitting mask. On recovery, the patient should be advised to remain in bed for a further 48 hours; this reduces the risk of sudden circulatory collapse, which may be fatal.

Poisons Bag

There are many other substances found in the home and in industry which may produce acute poisoning, and for these the general principles of treatment outlined above should be applied. In some industries, newly discovered chemical compounds may cause acute toxicity, but in such circumstances the nature of the specific antidote—if one is available—can be obtained from the laboratory concerned.

In all cases of acute poisoning, immediate institution of therapy is of prime importance. To make this possible the medical practitioner should have available for emergency use a "Poisons Bag," which contains all the essential equipment and drugs which he will require in the treatment of the common types of poisoning. Such a bag should have: two stomach tubes (one suitable for an adult and one for a child); a funnel with a diameter of 4½ in. (11.5 cm.); two 10-ml. syringes and a selection of needles; a disposable plastic oxygen mask. Drugs should include: apomorphine hydrochloride, morphine hydrochloride, nalorphine hydrobromide, soluble penicillin, bemegride, amphetamine sulphate, dimercaprol, thiopentone sodium, 5% dextrose solution in a pint (600-ml.) bottle, M/6 sodium lactate, and Water for Injection B.P.; these may be required for parenteral administration. Drugs to be given orally should include sodium sulphate, magnesium sulphate, liquid paraffin, magnesium oxide, sodium bicarbonate, castor-oil, activated charcoal, and potassium permanganate. Vitellae of amyl nitrite should also be available.

A number of local health authorities have opened centres where travellers can be vaccinated against yellow fever. Until now this type of vaccination has been confined to regional blood transfusion centres and certain hospitals in Britain because the vaccine used needed special storage facilities and knowledge of laboratory techniques. This no longer applies, as the vaccine is now prepared in dried form and can be stored in an ordinary domestic refrigerator. The centres now open are Barnsley, Birmingham, Blackburn, Bournemouth, Bradford, Brighton, Bristol, Cambridge C.C., Cardiff, Carlisle, Derby C.C., Doncaster, Essex C.C., Exeter, Gloucester, Kent C.C., Kingston-upon-Hull, Lancashire C.C., Leeds, Leicester, Lincoln, Liverpool, Middlesbrough, Newcastle-upon-Tyne, Northampton C.C., Norwich, Nottingham, Plymouth, Salop C.C., Sheffield, Southampton, Somerset C.C., Surrey C.C., and York. The County Borough Councils of Manchester, Oxford, Southend-on-Sea, and Swansea will also be providing centres shortly. So far as London is concerned, the Hospital for Tropical Diseases, the Unilever Centre, and the West London Designated Vaccinating Centre will continue to provide a vaccination service by acting as agents for the London County Council.