EMERGENCIES IN GENERAL PRACTICE

CORROSIVE POISONING

BY

J. D. P. GRAHAM, M.D., F.R.F.P.S., M.R.C.P.Ed.

Lecturer in Toxicology, Welsh National School of Medicine, Cardiff

A corrosive is a substance which causes destruction of tissue at the site of application; in dilute solution many corrosives merely have an irritant effect, but irritants may corrode at certain sites. According to this definition the effects of a corrosive should be limited to its local action, but some of them produce serious effects from absorption, so the classification is a loose one. Corrosives may be defined more accurately therefore as "substances having an acute and predominantly local action involving destruction of tissue." The speed and the destructive nature of the poisoning constitute an emergency in which early and effective treatment is essential.

Incidence

According to the Registrar-General's Statistical Reviews, corrosives are an infrequent cause of death (see Table).

<i>Deaths from Violent Causes (England and Wales)</i>				
Year	Total	All Poisons	Corrosives	
1950 ..	18,889	3,274	184	
1951 ..	19,756	3,557	157	
1952 ..	18,802	3,666	129	

A survey of 4,393 reports of post-mortem examinations conducted by the Department of Pathology in the Welsh National School of Medicine during the five years 1948-53 showed that the cause of death was by poisoning in 39 persons. Of these, one was due to carbolic acid and one to ferrous sulphate. A survey of the diagnoses made on 58,540 admissions to the three principal institutions of the United Cardiff Hospitals during 1951, 1952, and 1953 reveals that 251 cases of poisoning were treated. Of these, only nine were due to the classical corrosives taken internally, of which five were due to "lysol" or carbolic. During the same period 201 patients were treated for external burns due to hot objects—fires, electrical apparatus, heating devices, scalds, friction, irradiation, or chemicals. Only four were due to corrosives. Of a total number of 25 cases of burns and chemical injuries to the eye, 15 were due to corrosives. The Annual Report of the Chief Inspector of Factories for 1949 shows that of a total of 8,787 accidents involving the eye, 235 were due to chemicals (167 lime and cement). The precise number due to corrosives is not stated. The same source states that of 569,485 accidents in 1949, 1950, and 1951, 21,595 were due to hot liquids, molten metal, and corrosives. No detailed analysis is available.

It may be deduced from these and other sources that corrosive poisoning is not a common cause of emergency.

Corrosives Likely to be Encountered

The following are the common corrosives: (1) *Acids*: (a) Inorganic—hydrochloric, sulphuric, and nitric; (b) organic—carbolic, cresol and related products, oxalic. (2) *Alkalis*: sodium and potassium hydroxides and carbonates, lime. (3) *Other corrosives*: formaldehyde, salts of certain heavy metals, bichromates.

When taken internally the majority of poisonings are due to lysol and related products, with acid (usually hydrochloric) the next most frequent. From analyses of deaths by poisoning in England and Wales during 1950, 1951, and 1952,* it is seen that of 335 cases of corrosive poisoning 175 were due to lysol, phenol, and related products, and 59 to acid. The common source of the cresols is by purchase of

disinfectant fluids. While most cases are suicidal, a few accidents occur, presumably owing to the keeping of small quantities of disinfectant in old medicine or liquor bottles (19 accidents to 156 suicides in this series). Accidents are evenly distributed between men and women, but the latter preponderate in the use of this method of self-destruction (115 women to 41 men).

Corrosive poisoning from swallowed mineral acid is much more common than that from caustic alkali, and the majority of cases are due to suicidal attempts (12 accidents to 52 suicides). Most of the accidents happen to men, and hydrochloric acid is by far the commonest agent. The same applies in the case of suicide, though the preponderance of males to females is less. The cause for this is obscure, but spirits of salts (hydrochloric acid) may be purchased from the pharmacist and kept in old bottles prior to use as a cleaning agent for glazed surfaces. Hydrochloric and sulphuric acids are widely used in industrial processes, and some may be obtained from the factory for private purposes such as soldering fluid.

Oxalic acid is less common as a corrosive agent than it used to be, but a few cases of poisoning still occur (seven suicides and one accident in the three years). The usual source is the purchase of salts of lemon, or salts of sorrel, from the pharmacist for use as a cleaning agent. The introduction of detergents may have made this poison less readily accessible.

Formalin is not a common agent, three suicides and one accident having occurred during 1950-2. It may be obtained freely for use as a hardening agent in photography, and has been used as a disinfectant for soft furnishings and other unwashable articles. It is used in the plastics and cellulose industries.

Heavy metals when ionized from dilute solutions of a salt act as astringents (blue-stone and silver-stick), but if their concentration is high they may act as corrosives. Of recent years there has been increasing concern about young children having access to ferrous sulphate tablets, which are attractive in appearance, 23 deaths from this cause being reported in the series of 335 mentioned above. Ferrous gluconate and other non-toxic iron compounds are being increasingly prescribed and the incidence of ferrous sulphate poisoning may therefore be expected to decrease. Of 6,598 children admitted as in-patients under the care of the Department of Child Health of the Welsh National School of Medicine during 1951-3, two suffered from ferrous sulphate poisoning, whereas during the seven-year period 1947-53, there were 15 cases.* A part of the syndrome results from absorption of excess iron, but a part of it is undoubtedly due to the local action on the gastro-intestinal mucosa, and perforation or late sequelae of extensive corrosion of the pyloric area of the stomach have occurred. Children who have swallowed these tablets should therefore be treated vigorously and urgently for corrosive poisoning.

When applied externally the circumstances are usually accidental, with the exception of the rare and execrable crime of vitriol throwing. Cases may be divided into two types:

(1) *Chemical Burns of the Skin*.—These are usually due to strong acid or alkali spilled or splashed at work. They are seldom severe, as the substance is easily washed off. Phenol or lysol on the skin can be removed before it does much damage. Emergencies from such causes are therefore rare.

*Pharm. J., 1953, 171, 50; 1954, 173, 284.

*Watkins, A. G., Bray, P. T., and Gray, O. P., *British Medical Journal*, 1954, 1, 335.

(2) *Severe Irritants and Corrosives in the Eye.*—By far the most common cause is lime burn in agricultural and building workers, the solid particles of calcium oxide adhering to and destroying tissue as a result of dehydration, and the hydroxide acting as an alkaline irritant. Accidents usually occur during the process of slaking the lime or while spreading it on fields, etc., or when applying it to walls and floors as a limewash. Cement contains 65% lime.

General Management

Certain principles apply to the management of all cases of poisoning. They apply no less to poisoning by corrosives than by barbiturates or other drugs.

1. The physician should consider each occasion on which the remote possibility of poisoning arises as urgent and make every effort to treat his patient promptly. Most of these occasions will prove to be false alarms, but the day will arrive when speed in giving attention is rewarding. Despite this urgency he must be calm, cool, and unhurried in procedure and obviously in control of the situation to an extent even greater than usual. Corrosive poisoning has a demoralizing effect on the patient's relatives and friends.

2. The first step is to safeguard respiration. Place the patient prone for fear of inhalation of vomitus. If there is any embarrassment to breathing, clear the airway and institute artificial respiration, at the same time requesting the presence of someone who can relieve you of this duty (many people have had training in first-aid methods; the police are expert). Fortunately, this urgent measure is seldom needed at first with corrosive poisoning, but may soon become important if oedema of the glottis develops. For this reason never delay unduly before sending the patient to hospital. Many patients who take fatal doses of corrosive fluids die of suffocation. Tracheotomy* may be necessary.

3. The next step is to remove such amounts of the corrosive as may be still active, or unabsorbed. In a case of external burns this may be the main treatment required; when dealing with a burn of the eye it is difficult but very necessary to be thorough. In the case of internal consumption of strong corrosives it is seldom advisable to use the stomach tube for fear of perforation. Details of gastric lavage will be given in next week's article on "Barbiturate and Aspirin Poisoning," should the physician decide to wash out the stomach.

4. The diagnosis of the probable nature of the corrosive should be established as soon as possible and the medico-legal aspect considered. This involves the questioning of relatives and attendants, the recovery and careful preservation of probable sources of the poison, and inspection of the patient.

5. The collection and preservation of specimens of vomitus and of any remaining portion of the presumed poison or of its container are important. This task may be temporarily delegated to a reliable attendant, but it is the physician's duty to supervise the matter closely. Specimens may be temporarily collected in any clean container—for example, glass jam-jars—but should subsequently be transferred to stoppered and labelled bottles.

6. It may be possible, depending on the probable diagnosis, to institute specific measures to neutralize acid or alkali or to counteract possible results from absorption of other substances. The measures so far taken can then be reviewed, and the degree of urgency in transferring the patient to hospital decided upon.

7. A brief general examination of the patient should be made at this stage and short notes prepared for future reference. If necessary, an analgesic may be administered now—for example, injection of morphine sulphate, $\frac{1}{4}$ gr. (15 mg.) for an adult—if respiration is adequate. Particular attention should be paid to the skin, lips, mouth, breath, vomitus, respiration and circulation, and the mental state.

*For details of the technique of tracheotomy see the article in this series on "Respiratory Obstruction," by Mr. Norman Jory (March 26, p. 781).

8. The nearest suitable hospital should be warned and transport arranged from the emergency ambulance service. The urgent nature of the case should be emphasized if necessary. Oxygen may be needed for the maintenance of respiration during the journey to hospital.

Diagnosis and Emergency Treatment of Individual Syndromes

The principal aid to diagnosis is the history and circumstances of the case. The clinical picture may be helpful, as follows.

Lysol, Phenol, Cresolic Preparations

The patient may have complained of a hot burning taste and severe internal pain, but not for long, as phenol produces a surface analgesia. Vomiting may not occur, or only once. The effects of absorption appear quickly—a few minutes to half an hour—with giddiness, delirium, and perhaps convulsions and coma. The patient is often found in this latter state. The breathing is stertorous, and the pupils are constricted; the mouth is burned dull white with phenol and the lips and chin are stained dark, while with lysol and other cresolic preparations the mouth is burned dark brown. There is usually a characteristic odour. If the physician has reached the case within fifteen minutes of the occurrence he may wish to pass a stomach tube and wash out. The addition of half an ounce (15 g.) of magnesium sulphate or a pint (570 ml.) of milk to the washing water is advantageous. Above all, guard the respiration by placing the patient prone and clearing the throat. Administer 100 mg. of leptazol subcutaneously, or 0.5 g. nikethamide intramuscularly, if breathing is poor; wash the external burns with soap and water, and order hot-water bottles as a simple measure to combat shock while awaiting immediate transference to hospital.

Inorganic Acids and Caustic Alkali

The patient is very collapsed, having experienced severe pain and violent vomiting almost as soon as the corrosive was swallowed. The jaw may be clenched, the mouth full of viscid mucus and shreds of tissue, white, foamy, blood-stained, or, later, coloured yellow or brown (acid). The vomitus contains altered blood and shreds of mucosa, apart from food. Hydrochloric and nitric acids produce an irritant fume and suffocation is often marked. Little can be done for it, as the air passages are affected. The skin around the mouth may be burned brown (acid) or white and soapy (alkali). The mind remains clear. Place the patient prone; clear the throat; do not use a stomach tube. For acid burns, endeavour to give sips of "milk of magnesia," if available, diluted 50% with water; chalk, or any gastric antacid, or dilute toilet soap in water; or the whites of two eggs in a pint (570 ml.) of water; or, if none of these is available, weak sodium bicarbonate (one teaspoonful to one pint (570 ml.) of water). The danger of the latter is the violent evolution of gas. For alkali give one part of domestic vinegar to three parts of water. Administer $\frac{1}{4}$ gr. (10 mg.) of morphine and 1/100 gr. (0.6 mg.) of atropine intramuscularly. If oxygen is available, administer it. Keep the patient warm, and give 0.5 g. of nikethamide intramuscularly if the circulation is failing. Send the patient to hospital as soon as possible.

External burns should be well washed with soap and water (acid) or diluted vinegar (alkali), and dressed with weak solution of bicarbonate (acid) or saline (alkali), and the patient transferred to hospital for further treatment. To prevent subsequent infection an injection of 300,000 units of procaine benzylpenicillin with 100,000 units of benzylpenicillin B.P. may be given with advantage.

Oxalic Acid and Oxalate

These have a rapid double action—immediate corrosion and subsequent depression of the heart and nervous system. A concentrated solution has similar effects to the inorganic acids, giving rise to pain, vomiting of altered blood,

suffocation, shock, and collapse. If the solution is less concentrated or salts of sorrel have been used, vomiting may be delayed, in which case the stomach should be washed out as soon as possible. Send to the nearest pharmacy for a pint (570 ml.) of lime-water; dilute it with an equal quantity of water and use it as the washing fluid, leaving the last half-pint (280 ml.) in the stomach. If a washout is not undertaken administer 4 fluid ounces (110 ml.) by mouth. If chalk is more readily available, give a teaspoonful stirred up in milk and repeat the dose three or four times. Respiratory or circulatory failure may require the injection of leptazol, 100 mg., with or without the administration of oxygen. Send the patient to hospital as soon as possible.

Formalin

Formalin causes acute pain and vomiting, and suffocation from the fumes. The stomach should be washed out with a solution of a teaspoonful of baking soda to a pint (570 ml.) of water, otherwise sodium bicarbonate should be given by mouth in warm water. Respiratory distress may require oxygen. Admit all cases to hospital, as sequelae may develop.

Ferrous Sulphate

This substance displays two actions—immediate irritation with possible corrosion, and late effects from absorption. The patient is usually a child, and the case presents with retching and vomiting, often of altered blood or mucosal shreds, pallor, tachycardia, and great drowsiness with restlessness; collapse occurs later. Hold the child upside down and tickle the fauces to promote vomiting. If gastric lavage is undertaken use a teaspoonful of sodium bicarbonate to a pint (570 ml.) of water and leave 100–250 ml. in the stomach. Guard against inhalation of vomitus, apply warmth, and send the patient to hospital.

Lime Burn of the Eye

Immediate treatment consists in vigorous washing with water poured from a jug, kettle, or tap. As blepharospasm is severe try to introduce cocaine eye-drops to facilitate this. Continue the washing for half an hour, and when the conjunctiva is cocaineized inspect it carefully, everting the upper lid, and remove any adherent particles. Forceps or even fine scissors may be needed. Particularly effective in removing lime from the cornea is a solution of 2 oz. (57 g.) of ammonium tartrate in one pint (570 ml.) of distilled water, which should be kept in all first-aid rooms in work-places where lime or cement is used. Unfortunately this solution must be used fresh. It is therefore necessary to keep the ingredients in separate bottles and to mix them immediately before use as an eyewash. When the eye has been cleaned, instil homatropine eye-drops, followed in a few minutes with liquid paraffin, cover the eye with a pad, and send the patient to an ophthalmic centre. Time spent by the practitioner on this treatment is more important than hasty evacuation of a patient who may still have lime particles in the eye.

Medico-Legal Aspects of Poisoning

If the patient dies before the arrival of the doctor or before removal to hospital, report the matter to the coroner or fiscal, who will in due course decide on the cause of death. If the patient is alive on arrival a decision must be reached whether the cause of the poisoning was accident, attempted suicide, or attempted homicide.

(a) If the poisoning is due to accident there is no obligation to report the matter unless the poisonous agent is one referred to in the Factories Act, 1937, administered while the patient was at work. The common corrosives are not included in the list of notifiable conditions.

(b) If the case is one of attempted suicide the practitioner should, in law, notify the police. However, this is an obligation which is more honoured in the breach than in the observance, and I have no knowledge of any practitioner having ever been prosecuted for failure so to do.

(c) If there are reasons to suspect foul play it is essential to supervise the removal of the patient to hospital. If suspicion is strong, notify the police as quickly as possible; if weak, consult the hospital authorities and let them confirm or refute. If the patient is *in extremis* and there is any reason to suspect a homicidal attempt, a dying deposition should be taken before removal. Disturb the scene as little as possible, and endeavour to ensure that no one else does so, if possible by locking up the place of death.

When the patient is transferred alive to hospital, all relevant details should be communicated by sealed letter to the medical man in attendance, especially the diagnosis of corrosive used and the treatment already given. Secure the poison container and any residues, and remove and label them. The specimens of vomitus, stomach washout, urine, etc., should be taken away in clean jars and transferred to bottles with screw tops, fixed with adhesive, and labelled with the patient's name and address, date, and nature of specimen. Lock them up in the surgery with an inventory so that they can be produced and identified if needed. Take notes at the time of the occurrence or immediately after, paying attention to the chief symptoms, the stated history, the time at which one was summoned, and the time of arrival, the alleged time at which the poison was taken, the time of death if that has occurred and is known, and any relevant statement made by the patient (in his own words). Consult the patient's medical record and make a note of any previous illness which might have some bearing on the present problem.

In the case of an external burn fairly full notes should also be taken in case of subsequent proceedings for compensation. If an accident has occurred at work, advise the patient to have the matter recorded in the "accidents book" if that has not already been done. Should death occur subsequently these notes will be needed in connexion with the inevitable coroner's or fiscal's inquiry; should the patient recover and no public inquiry ensue, the specimens may be destroyed and the notes filed with the case sheet for reference should late sequelae develop.

Next article on Emergencies in General Practice.—
"Barbiturate and Aspirin Poisoning," by Dr. T. J. Thomson
and Professor S. Alstead.

MODERN ASPECTS OF LIVER AND BILIARY DISEASE

[FROM A SPECIAL CORRESPONDENT]

A highly successful symposium on "Modern Aspects of Liver and Biliary Disease" was held for consultants at the Postgraduate Medical School, Hammersmith Hospital, London, from March 28 to April 1. The programme consisted of lectures, discussions, case demonstrations, films, and the demonstration of techniques used in the investigation of liver disease. It is possible to pick out only a few of the topics discussed.

Management of Jaundice

Professor N. F. MACLAGAN (Westminster Hospital) outlined the biochemical methods used in the diagnosis of liver disease. As a routine, the urine—preferably passed in the afternoon—should be examined for bilirubin, urobilinogen, and bile salts. In addition, serum bilirubin, alkaline phosphatase, and one or two of the flocculation tests should be done: he favoured the thymol turbidity and colloidal gold tests. Estimation of serum proteins and bromsulphalein excretion might give useful evidence of liver cell function. In the majority of cases these biochemical tests would confirm the clinical diagnosis.

Dr. SHEILA SHERLOCK (Postgraduate Medical School) stressed the importance of pain and pruritus, together with deep jaundice, as features of obstructive jaundice. Pruritus