degree of protein binding is predictable from the highly ionized state of the molecule.

The lethal dose seems to be variable. In the past death has occurred after ingestion of 1 ml of Gramoxone W and after spitting out a mouthful ingested accidentally. In the present case the amount ingested and the concentration in the blood were high compared with other fatal cases.

Paraquat is remarkable for the distinctive lung changes it causes and for the 'hit and run' manner in which it appears to act (Clark, McElligott & Hurst, 1966). In this case even though death occurred within 48 hr early proliferative changes were found in the lungs; and it seems highly probable that he would have succumbed to respiratory failure if he had survived long enough. It follows that if treatment designed to inhibit cellular proliferation is to have any chance of success it should be started as soon as possible after ingestion of the poison.

Jaundice and raised serum transaminase concentrations were interpreted as evidence of liver damage although histologically the liver was normal. In accord with previous reports the renal changes were predominantly those of tubular damage affecting the loops of Henle more than the convoluted tubules.

The mode of death was not typical. In most reported cases death has resulted from respiratory failure some 10–20 days after taking paraquat. In this case death occurred from circulatory failure within 48 hr: whether this represented a direct toxic affect of paraquat on the myocardium or the effects of severe metabolic disturbance is uncertain. Paraldehyde may have been a contributory cause since the drug has been reported as a cause of metabolic acidosis (Hiemcke, 1964) particularly in the presence of liver damage.

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Diquat poisoning

D. G. OREOPOULOS
M.D.

The Renal Unit,
Belfast City Hospital

J. MCEVOY
M.D., M.R.C.P.

The Renal Unit, Belfast City Hospital, and
The Department of Physiology,
The Queen's University of Belfast

DIQUAT, like paraquat, is a dipyridilium compound used as a herbicide, and sold under the trade name of 'Reglone'. The severe toxic effects of paraquat have been well documented (Oreopoulos *et al.*, 1968; Matthew *et al.*, 1968; Kerr *et al.*, 1968), but there is little known as yet of the effects of diquat ingestion.

Correspondence: Dr J. McEvoy, Renal Unit, Belfast City Hospital, Lisburn Road, Belfast BT9 7AB.

We present here what we believe to be the first case of diquat poisoning The patient recovered after treatment with forced diuresis.

Case report

An 18-year-old man accidentally took a mouthful of undiluted 'Reglone', from a Coca Cola bottle at 08.00 hours on the 7 September 1968. Although he

spat most of it out, he is quite certain that he swallowed a small quantity. He was seen by his family doctor a short time afterwards, but, since he was feeling well, was sent home and advised to report back if he should develop any symptoms. Over the next 10 hr he felt progressively more unwell and had five or six episodes of diarrhoea. His doctor referred him to the local hospital. There he was treated by gastric lavage and bedrest, until his transfer to our unit 56 hr after ingesting the diquat.

On admission here he had no complaints, apart from some difficulty in swallowing which had been present from the time he had taken the poison. On examination there was a small ulcer on the upper surface of the tongue and another on the right side of his pharynx. He was not cyanosed and there were no abnormal physical signs in the chest. The pulse rate was 82/min in sinus rhythm, and the heart sounds were normal. The blood pressure was 160/80 mmHg. The abdomen was not tender and there was no clinical enlargement of any organ. Central nervous system examination revealed no abnormality.

Because of our previous experience with paraquat poisoning he was immediately started on forced diuresis, despite his lack of symptoms and general well being. One litre of normal saline was alternated with 1 litre of 5% dextrose intravenously every 3 hr, and 500 ml of 10% mannitol were given every 6 hr by the same route. A good diuretic response was obtained and continued for 11 days, with slight variations in the intravenous fluids and their potassium content as indicated by the electrolyte composition of his blood. Over the first 10 days his average daily fluid intake from all sources was 11,262 ml, and the mean 24-hr urinary output was 9739 ml. Thereafter, the diuresis was slowly tailed off over a further period of 6 days. His urine remained free from albumin and the chest X-ray was reported as normal on seven different occasions during his stay in this unit. Haemoglobin on admission was 12·3 g/100 ml and on discharge was 11·9 g/100 ml. White cell count varied between 5000 and 7100/mm^3. ESR was 4 mm in the 1st hr on admission and 14 mm in the 1st hr on the day of discharge. Stools were consistently negative for occult blood and four ECG tracings at different times showed no abnormality. The pulse rate varied between 78 and 92/min, with one observation of 110/min on the 10th day in association with a spike of temperature to 102·3°F, probably due to infection at the site of insertion of the intravenous drip. Antibiotics were given and the temperature settled after 3 days. The Wright reaction which had been positive on two occasions during this episode was normal on his last day in hospital. Daily estimations of blood urea, serum sodium, potassium, chloride, plasma specific gravity, total bilirubin, thymol turbidity, alkaline phosphatase, SGPT and Astrup were always within normal limits. The vital capacity ranged from 3·9 to 4·9 litres and the FEV_1 from 3·7 to 4·45 litres. His urine was tested for diquat daily, and since the qualitative results indicated that he continued to excrete diquat in the urine until the 9th day diuresis was prolonged for a further 2 days. He left hospital on the 22nd day in very good condition.

Quantitative estimates of diquat excretion cannot be given at present because, though the absorption spectra of pure diquat and paraquat are quite distinct, the metabolic end product of diquat excreted in this patient's urine had similar characteristics on absorptiometry to that found in paraquat poisoning. This matter is being looked into further elsewhere.

Discussion

It is known from experimental work in rats that orally administered diquat or paraquat is poorly absorbed and is excreted mainly in the faeces (Daniel & Gage, 1968). Absorption ranges from 11 to 22% of the administered dose, depending on the strain of rats, and this appears in the urine over the next 2 or 3 days. Lesions due to paraquat manifest themselves much later, at a time when most of the poison has been excreted by the experimental animal. This led Barnes (1968) to suggest that they are initiated immediately after ingestion of the paraquat, but continue to progress in spite of its subsequent removal from the body, i.e. a 'hit and run' poison.

In our case, however, diquat excretion in the urine lasted for 11 days after ingestion. In the case reported by Campbell (1968) paraquat was found in the liver 8 days after ingestion. The patient described by Matthew *et al.* (1968) had detectable paraquat in his blood up to the 15th day, and lesions developed in the lung which was transplanted as an attempt at therapy. This discrepancy between the experimental findings and the reported human cases of poisoning could be explained by damage to the kidneys in the early stages with subsequent difficulty in excretion (Oreopoulos *et al.*, 1968). However, since there was no evidence of renal damage in the case reported here, that explanation appears rather inadequate. It seems more probable that there is a species difference in absorption and excretion of these substances between man and other animals. It may be that in man there is storage in the tissues with a gradual liberation into the blood stream and excretion by the kidneys.

The absence of clinical and radiological evidence of pulmonary complications correlates with the information supplied by I.C.I., the makers of 'Reglone' (Swan, personal communication), that diquat does not produce the proliferative lung lesions so characteristic of paraquat.

The LD50 of diquat is only half of that of paraquat, but nevertheless, the occurrence of diarrhoea, and the persistence of the poison for such a long period in the patient's urine would suggest that a considerable amount of diquat had been swallowed, rather more perhaps than the quantities of paraquat involved in those cases which have been reported to date. One case of paraquat poisoning has already been reported with successful treatment by forced diuresis (Kerr *et al.*, 1968) so that it is not improbable that this form of treatment may have contributed materially to the outcome of our case. Steroids were not given since there is no strong evidence to support their effectiveness in these patients. Both peritoneal and haemodialysis have been suggested as methods of removing paraquat from the body, but in view of the evidence that this patient was excreting diquat in the urine and the ease with which he maintained such an enormous diuresis, it was decided to persist with this single form of treatment.

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Congenital, sporadic dysgammaglobulinaemia (absence of IgA and partial deficit in IgG and IgM)

L. A. SCURO M.D.

G. PREVIATO M.D.

S. TODESCO M.D.

B. PERNIS M.D.

Institute of Medical Pathology of the University of Padua; and Institute of Laboratory Medicine of the University of Genoa, Italy

CLINICAL syndromes associated with immunoglobulin deficiency (hypogammaglobulinaemia) are being observed more and more often (Marie *et al.*, 1965; Andolfatto Zaglia & Gasparotto, 1966; Israel Asselain *et al.*, 1966). On the other hand, a selective deficit in a single immunoglobulin fraction (dissociated deficiency) is rarely found (Werner *et al.*, 1965; Leveque, 1965; Israel Asselain *et al.*, 1966).

Recently we have observed a young woman afflicted with repeated respiratory infections from the age of 6 months. Examination of the immunoglobulins showed an absence of IgA accompanied by a partial deficit in IgG and IgM. We believe the case merits mention not only for its rarity, but also because it affords a basis for consideration of the biological significance of the γA-immunoglobulins.

Case report

F.B., 12 years of age. Family history: a maternal aunt was affected with pulmonary tuberculosis. The parents and five siblings are healthy. The patient was breast-fed for 3 months and appeared to have had a normal psychosomatic development. Menstruation began several days after her first recovery in our Institute in October 1965.

From the first weeks of life the patient was affected with a persistent cough and at 9 months underwent her first of eleven subsequent hospitalizations for bronchopneumonia. After several months she was transferred to a sanatorium where she remained until 4 years of age, frequently suffering from highly febrile bouts of non-tuberculous bronchopneumonia. In the following years the same pattern recurred, with infections always exclusively involving the respiratory system. During these febrile bouts the sputum was frequently mucopurulent. Morning vomiting was common.

At 8 years of age the patient had a negative Mantoux reaction and a normal blood picture. At 9 years old, during one of her numerous hospitaliza-