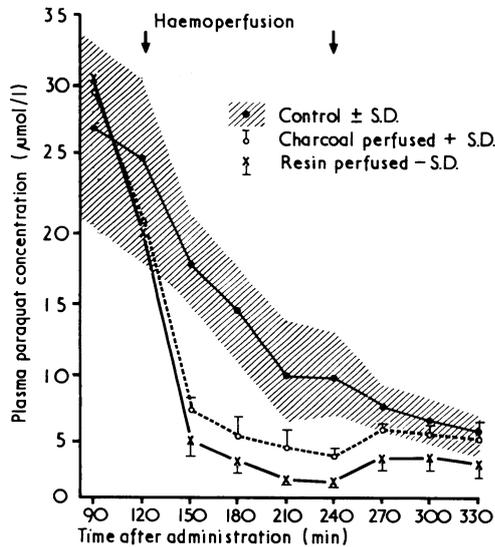


resin while three remained untreated. Anticoagulation was achieved with heparin and blood flow maintained at 200 ml/min throughout haemoperfusion (two hours).

Both forms of haemoperfusion significantly reduced plasma paraquat levels ( $P < 0.05$ ) compared with control values (see fig.), cation exchange resin being more effective than activated charcoal ( $P < 0.05$ ). Plasma paraquat clearances remained consistently high using cation exchange but were lower and more variable with activated charcoal. After haemoperfusion plasma paraquat concentrations increased in both treated groups. Paraquat concentrations approached control values 30 minutes after charcoal haemoperfusion but took 90 minutes after cation exchange haemoperfusion.



Plasma paraquat concentrations in untreated dogs (control), those treated with uncoated activated extruded charcoal, and those treated with cation exchange resin. All points represent mean of three experiments.

Conversion: SI to Traditional Units—Paraquat:  $1 \mu\text{mol/l} \approx 0.26 \text{ mg/l}$ .

Activated charcoal reduced blood platelet concentrations by 40% and cation exchange resin reduced them by 50%. The cation exchange resin was equilibrated before haemoperfusion with electrolyte solutions, and subsequently plasma calcium, magnesium, sodium, and potassium remained normal.

## Discussion

Progressive lung fibrosis leading to respiratory failure remains the most important lethal complication of paraquat poisoning in man, though renal failure is also common. Early reports suggested that paraquat exerts its toxic effect in a "hit and run" fashion.<sup>3</sup> Recently, however, paraquat has been shown in vivo to accumulate selectively in rat lung<sup>2</sup> and in vitro in rat and human lung by similar mechanisms.

After oral dosage of paraquat to rats sustained plasma paraquat concentrations of about  $3.9 \mu\text{mol/l}$  (1 mg/l) resulted in paraquat accumulating in the lung and in death.<sup>2</sup> Repeated oral doses of sorbents (bentonite, Fuller's earth) effectively reduce gastrointestinal absorption of paraquat resulting in reduced plasma paraquat concentrations and preventing lung damage and death.<sup>2</sup>

In man paraquat removal has been attempted using forced diuresis,<sup>1</sup> peritoneal dialysis,<sup>4</sup> and haemodialysis.<sup>5</sup> The treatment we propose for rapid and efficient reduction of paraquat concentrations combines the haemoperfusion methods described here with forced diuresis and repeated administration of oral sorbents. The platelet falls we saw are acceptable.

The rebound in plasma paraquat concentration after haemoperfusion may be partly due to the method of paraquat administration, but may indicate the necessity for prolonged haemoperfusion, especially when renal excretion is impaired by concomitant acute renal failure.

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<sup>1</sup> Matthew, H., *et al.*, *British Medical Journal*, 1968, 3, 759.

<sup>2</sup> Smith, L. L., *et al.*, *British Medical Journal*, 1974, 4, 569.

<sup>3</sup> Barnes, J. M., *New Scientist*, 1968, 38, 619.

<sup>4</sup> Oreopoulos, D. G., *et al.*, *British Medical Journal*, 1968, 1, 749.

<sup>5</sup> Eliahou, H. E., *et al.*, *Israel Journal of Medical Sciences*, 1973, 9, 459.

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## Gastric Fistula after Proximal Gastric Vagotomy

Though proximal gastric vagotomy is generally regarded as a safe operation<sup>1</sup> occasional complications have occurred.<sup>2,3</sup> Of particular importance is necrosis of the lesser curve of the stomach which may be accompanied by fatal peritonitis. We describe a patient who underwent routine proximal gastric vagotomy and developed a gastric fistula—a previously unrecorded complication of this procedure.

### Case Report

A previously fit 41-year-old man was admitted for elective surgery for a chronic duodenal ulcer. He had a 15-year history of recurrent dyspepsia. Barium meal examination had shown a chronic duodenal ulcer on two occasions. Apart from old healed inactive tuberculous lesions shown on chest x-ray films no abnormalities were found. Duodenal ulceration was confirmed endoscopically and a routine proximal gastric vagotomy carried out by a surgeon (R.W.H.) familiar with the method developed by Mr. H. Burge.

Three days later the patient developed fever, which began to swing and reached a peak of  $39.2^\circ\text{C}$ . Initial clinical examination and investigations showed no abnormality. Blood cultures were taken. The wound became indurated on the fifth day after operation and the pyrexia continued. Seven days after surgery *Klebsiella* spp. and *Pseudomonas* spp. were isolated from the blood cultures and gentamicin treatment began. The next day there was a profuse purulent discharge from the upper end of the abdominal wound. The patient had remained uncomplaining but on the 10th day he remarked that he was a little worried because his morning tea had discharged through the wound. Our suspicions of a gastric fistula were confirmed by giving an oral dose of methylene blue, which appeared on the wound dressing after a short interval. The pH of the discharge from the fistula was acid.

Subsequently the discharge decreased and when a Gastrografin swallow and fistulogram were carried out on the 14th and 15th days no gastric fistula could be shown. The patient left hospital three weeks after surgery feeling well and with no further discharge from the wound.

### Discussion

Sloughing of the lesser curve of the stomach is a rare but well-recognized complication of proximal gastric vagotomy.<sup>4</sup> We believe that our patient developed necrosis of the lesser curve which remained localized and subsequently discharged through the wound, thus creating a gastric fistula.

The stomach is a difficult organ to devascularize. The creation of an avascular strip along the lesser curvature of the stomach after proximal gastric vagotomy may be related to excessive use of diathermy, division of the ascending branch of the left gastric artery, damage to the stomach wall by a closely applied ligature, or intramural haematomata. Accidental perforations at operation are usually detected and oversewn. Sloughing usually occurs four to six days after operation<sup>5</sup> whereas a "missed" operative perforation often presents earlier as localized or diffuse peritonitis. Of six "operative" perforations after selective vagotomy reported from Copenhagen<sup>3</sup> at least two seem to have been due to necrosis of the lesser curve.

As this infrequent complication of proximal gastric vagotomy causes morbidity and mortality methods for its prevention should be considered. Plication of the lesser curve to bury and reperitonealize the bared area may be effective.

We thank Mr. K. W. Reynolds for permission to study this patient, who was under his care.

<sup>1</sup> Johnson, D., *Gut*, 1974, 15, 748.

<sup>2</sup> Newcombe, J. F., *British Medical Journal*, 1973, 1, 610.

<sup>3</sup> Kalaja, E., *et al.*, *Surgery*, 1975, 77, 140.

<sup>4</sup> Kennedy, T., *et al.*, *British Medical Journal*, 1975, 2, 301.

<sup>5</sup> Wyllie, J. H., *British Medical Journal*, 1974, 2, 561.

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## Equinus Deformity and Haemangioma of Calf Muscle

The cause of equinus associated with calf pain in children can be difficult to elucidate. We report two children in whom the diagnosis was finally established, in one by arteriography and in the other by exploration. In the second child the symptoms were thought to be hysterical. Both children were found to have an haemangioma in a calf muscle.

### Case Reports

**Case 1.**—A 9-year-old girl presented with a year's history of pain in the right shin. This had begun three weeks after a spiral fracture of the opposite tibia had been treated successfully by immobilization. Examination showed a fit girl who walked with a limp. Her right calf was wasted (by 2 cm) and there was a slight swelling just behind the subcutaneous border of the middle third of the tibia. Firm pressure produced severe pain at this site. There was a fixed equinus deformity which did not correct when the knee was flexed. She showed no neurological abnormalities. Plain radiographs showed no abnormality and her erythrocyte sedimentation rate was 4 mm in one hour. In view of the marked local tenderness a diagnosis of glomus tumour was entertained and an arteriogram performed which showed a small vascular mass (see fig.). At operation a swelling was palpable within the substance of the lower muscle bulk of the soleus. This was removed with a clear margin of normal muscle. The child recovered uneventfully, full dorsiflexion of the ankle returned, and she could walk normally. Histological examination showed the lesion to be a cavernous haemangioma infiltrating muscle.

**Case 2.**—A 9-year-old girl presented with pain behind her right knee and an 18-month history of difficulty in walking. Several months previously at



Femoral arteriogram showing vascular mass in middle of calf in direct relation to shot marker at site of tenderness

another hospital popliteal cyst had been diagnosed, but surgical exploration found nothing. Examination showed wasting of the right calf and an equinus deformity which was largely corrected by knee flexion. She was locally tender deep to the operation scar in the popliteal fossa. Neurological examination, including lumbar puncture and electromyography, and plain radiographs showed no abnormalities. Hysteria was then suspected until the equinus was found to persist under general anaesthesia. The popliteal fossa was re-explored, and a small dark vascular tumour was found deep in the medial head of the gastrocnemius. This was removed. After the operation the equinus deformity was corrected immediately and the child recovered uneventfully. Histological examination showed the tumour to be an hamartomatous haemangioma.

### Discussion

Equinus associated with calf pain is unusual and the possibility of an intramuscular haemangioma should always be considered. Discrete tenderness and an equinus which persists under general anaesthesia are important signs, and arteriography is a valuable investigation. Exploration and excision may be both curative and diagnostic.

We thank Mr. G. Lloyd-Roberts and Mr. Geoffrey Walker for permission to report their cases.

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## Inhibitory Effect of Oral Doxantrazole on Asthma Induced by Allergen Inhalation

Sodium cromoglycate (Intal) has proved valuable in the prophylaxis of asthma, but must be given by inhalation because of poor intestinal absorption. Some patients find it difficult to use the Spinhaler so that an orally active compound would be advantageous. A new compound 3-(5-tetrazolyl)thioxanthone 10,10-dioxide (proposed approved name doxantrazole) has this potential. The compound is active in several systems in a similar way to cromoglycate; for example, it suppresses the passive cutaneous anaphylaxis reaction and allergic bronchoconstriction in rats *in vitro* and inhibits the release of histamine from passively sensitized chopped human lung challenged with an extract of grass pollen.<sup>1</sup>

### Patients, Methods, and Results

The effect of the drug was tested on eight asthmatic patients allergic to house dust mite (*Dermatophagoides pteronyssinus*); all were positive on skin tests. Inhalation challenge tests had indicated the dose of allergen that would produce a 20-30% fall in forced expiratory volume in one second (FEV<sub>1</sub>). Using the same challenge technique<sup>2</sup> challenges were performed at least one week apart. The patients were pretreated with either doxantrazole (as 200 mg of the sodium salt in a freshly made up solution in 100 ml of water) or placebo (200 mg of lactose) one hour before the challenge. The two treatments were given double-blind and in random order. Vital capacity (VC) FEV<sub>1</sub>, peak expiratory flow rate (PEFR), pulse rate, and blood pressure were measured on arrival at the laboratory and an hour later when the drug was given. These were repeated immediately before the challenge, and further measurements were made 5, 15, 30, and 60 minutes after challenge and then every hour for four hours. The patients left the laboratory with instructions to record their peak flow rates every hour. Cromoglycate was discontinued for 24 hours before the challenge procedure and all other anti-asthma drugs for 12 hours.

The table shows mean falls in VC, FEV<sub>1</sub>, and PEFR after inhalation challenge after doxantrazole and placebo. There was a significant difference between drug and placebo in the immediate reactions of FEV<sub>1</sub> and PEFR. Six patients showed delayed reactions which started five hours or more after inhalation challenge. There was no difference in the maximum reduction of PEFR during this period but this might have resulted from the greater use