Current Practice

Gastrointestinal Helminthiasis

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Most of the worms that affect man live unobtrusively in the gut and do little to impair the health of their host. Symptoms and signs usually only appear with heavy infections. Of the many intestinal worms likely to be brought into Britain by immigrants and travellers the ones most likely to be encountered by practitioners are hookworms, ascaris, strongyloides, whipworms, and cestodes. Adult schistosomes live in the portal blood vessels, but since the ova of *Schistosoma mansoni* and *S. japonicum* are found in the faeces a short account of intestinal schistosomiasis will be given.

Hookworm Infection

Two types of human hookworm are known, *Ancylostoma duodenale* and *Necator americanus*. The former is predominantly found in southern Europe, the Middle and Far East, and the latter in the New World and tropical Africa. Mixed infections are not uncommon. When a parasite is universally distributed it is not always easy to be sure to what extent it is responsible for disease in the community, and what significance to attach to its presence in an individual. Failure to appreciate this point has in some instances led on the one hand to an uncritical diagnosis of hookworm anaemia, and on the other to a reluctance to accept a causal relationship between hookworm infection and anaemia.

The adult worms (8-10 mm. long) live in the upper part of the small intestine attached by their mouths to the mucosa, from which they suck blood. The site of entrance of the worm larvae through the skin is sometimes characterized by itchy dermatitis. When a patient is first infected there may be abdominal pain, diarrhoea with blood in the stools, and an associated eosinophilia. In chronic infections these gastrointestinal manifestations are vague and inconstant, and eosinophilia is not usually present. The most important manifestations of severe hookworm infection are anaemia, hypoalbuminaemia, and possibly malabsorption.¹

The anaemia is a classical iron deficiency anaemia with low haemoglobin, low mean cell haemoglobin concentration, low serum iron, high iron binding capacity, and the appearance of hypochromic red cells in thin blood films. In some areas of the tropics there occurs a superadded folic-acid-deficient megaloblastic anaemia which is initially often masked by the severe iron deficiency anaemia.

The pathogenesis of the anaemia caused by hookworm is essentially loss of blood into the gut and is dependent on three factors—the iron content of the diet, the state of the iron reserves, and the intensity and duration of infection. These factors vary in different areas and must be taken into account for a correct evaluation in each individual patient.²

In addition to anaemia loss of protein is another important manifestation of hookworm infection, while a malabsorption

syndrome occasionally also occurs. The majority of patients with hookworm anaemia present with lassitude, shortness of breath, swelling of the legs, and anorexia. Some patients have angina pectoris, while many complain of pain in their thighs or calves on walking. Virtually none complain of dysphagia despite the pronounced anaemia (haemoglobin 1.5 to 6.0 g./100 ml.). Most patients have an increased pulse pressure, peripheral vasodilatation, and a raised venous pressure. A few have a small pulse, collapsed veins, severe generalized oedema, and ascites; these patients are very ill and complain continually of feeling cold.

The most satisfactory treatment for hookworm infection is a combination of tetrachlorethylene and bephenium hydroxynaphthoate (Alcopar). No purgative is given before or after treatment. A single dose of tetrachlorethylene (0.1 ml./kg.), maximum dose 4-6 ml., is given in the morning on an empty stomach, and food is withheld for two hours afterwards; at the same time 5 g. of bephenium hydroxynaphthoate (2.5 g. base) regardless of age or weight is also administered; after which a course of iron orally or parenterally will correct the anaemia. Folic acid will be required if a megaloblastic anaemia is also present.

Ascaris Infection

Ascaris lumbricoides has a world-wide distribution, with the highest prevalence in the hot humid tropics. Infection is acquired by ingestion of eggs contaminating food or drink. The larval stages during the migratory phase may give rise to a pneumonitis 4 to 16 days after infection with fever, cough, expectoration, eosinophilia, and pulmonary infiltration. The larvae may be found in the sputum.

The adult worms (about 20 cm. long) live in the small intestine and cause a variety of abdominal symptoms, such as gastrointestinal discomfort and vomiting. The most important manifestation of a heavy ascaris infection is intestinal obstruction in children. Volvulus and gangrene of the bowel, intussusception, and appendicitis also occur. Pancreatitis has been described in childhood, while cholangitis, acute cholecystitis, and perforation of the bile ducts are uncommon complications. The adult worms may enter the common bile duct or intrahepatic ducts leading to the development of obstructive jaundice.

Piperazine citrate (Antepar) is the drug of choice for the treatment of children and adults. The dosage is 150 mg. per kg., with a maximum dose of 4 g. The drug is given at bedtime in one single dose without fasting or purgation, and can be repeated a week later if necessary.

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Strongyloidiasis

Strongyloides stercoralis has a geographical distribution similar to that of hookworms, and a complicated life cycle. The females (about 2 mm. long) live in the duodenal and jejunal mucosa. Human infection is usually acquired through the skin from contaminated soil, but in addition infective forms can also penetrate the bowel or the perianal skin producing autoinfection. *S. stercoralis* infection can be very chronic, and indeed can persist for as long as 40 years.

Clinically there may be an itchy erythematous rash at the site of penetration of the infective larvae. As the larvae migrate through the lungs pulmonary symptoms of varying severity occur and larvae may be detected in the sputum. The infection in the gut may produce mild abdominal symptoms, diarrhoea, and blood loss; with very heavy infections a severe and even fatal illness may occur. A malabsorption syndrome akin to sprue has been described, and absorption tests have revealed abnormalities in glucose tolerance and in ^{131}I -oleic acid excretion. Irritability or deformity of the duodenum has been reported on radiological examination, while changes in the ileum and jejunum with atrophy of villi have been found on intestinal biopsy. A chronic and recurrent serpentine urticarial rash associated with eosinophilia may persist for many years, and is still not uncommonly seen in this country in former prisoners of war of the Japanese.

Thiabendazole 25 mg./kg. twice daily for three days is the best available treatment for strongyloides infection. No starvation or purgation is necessary.

Trichuriasis

The whipworm, *Trichuris trichiura*, has a cosmopolitan distribution but is more prevalent in the warm humid tropics. As with most of the intestinal worms the infection is symptomless unless a heavy worm burden occurs, which is extremely seldom. The mature worms (about 5 cm. long) have a whip-like shape and live in the caecum and upper colon. Human infection results from the ingestion of infective ova from contaminated hands, food, or drink.

Heavy infections of over 1,000 worms may cause bloody diarrhoea, anaemia, and prolapse of the rectum, especially in malnourished children. Treatment is unsatisfactory. Thiabendazole in the same dosage as for strongyloidiasis is stated to clear the infection in about 50% of patients treated.

Cestode Infections

The cestodes or tapeworms give rise to a variety of diseases, among which are taeniasis, cysticercosis, hydatid disease, and diphyllorhynchiasis. They have a world-wide distribution.

Taeniasis

Taenia saginata, the beef tapeworm, is large, white, segmented, and ribbon-like. The head is provided with four sucking discs and adheres to the mucosa of the small intestine. Man is infected by eating raw or insufficiently cooked beef containing a living cysticercus. The presence of *T. saginata* gives rise to minor symptoms, which vary from slight abdominal discomfort to social embarrassment when gravid segments are passed.

Taenia solium, the pork tapeworm, is potentially highly dangerous. The adult worm, as with *T. saginata*, is a strict parasite of man, but unlike *T. saginata* the larval cysticercus stage, though it normally occurs in the pig, unfortunately also can develop in man and give rise to cysticercosis (see below).

The head of the adult worm is armed with hooks as well as suckers; it attaches itself to the mucosa of the small bowel and segments continuously develop from the neck. Man is infected by eating raw or partially cooked pork containing viable cysticerci.

The first indication of taeniasis is usually the passage of segments in the stools. Symptoms vary from vague abdominal discomfort to occasional diarrhoea and loss of weight. Infection with the dwarf tapeworms *Hymenolepis nana* and *H. diminuta* are of little clinical significance.

Two drugs are available for the expulsion of adult tapeworms. Niclosamide (Yomesan) is given in a single dose of 2 g.; while the dose of dichlorophen (Anthiphen) is 6 g. on each of two successive days. No starvation or purgation is necessary. The hypothesis that these two drugs might increase the risk of autoinfection of the host in *T. solium* infections is not borne out by practical experience. Patients should be re-examined three months after treatment, and if no further segments are passed a cure can be presumed.

Cysticercosis

This condition results when man becomes infected with the larval stages or cysticerci of *T. solium* either by the chance swallowing of eggs on contaminated food or by autoinfection from the eggs of an adult worm in his own bowel. The larvae penetrate the intestinal mucosa and are then carried by the blood stream to the subcutaneous tissues, skeletal muscles, and the brain, where they may provoke epilepsy. Treatment is usually palliative with anticonvulsant drugs.

Hydatid Disease

The adult *Echinococcus granulosus* is a small tapeworm (5 mm. long) which inhabits chiefly the small intestine of dogs. When the ova, which are passed in the dog's faeces, are swallowed by man the enclosed embryo is liberated in the duodenum. It penetrates the intestinal mucosa, reaches the portal circulation, and is usually held up in the liver to develop into a hydatid cyst. If the embryo passes the liver filter it enters the general circulation, and thus reaches the lungs and other parts of the body to develop into a hydatid cyst wherever it eventually comes to rest. In order of frequency the following organs may be affected: lungs, brain, muscular tissues, spleen, kidneys, other abdominal organs, and occasionally the heart. The cysts produce pressure symptoms according to their situation. Rupture of the cysts may cause a severe allergic reaction, with urticarial lesions, pruritus, fever, abdominal pain, dyspnoea, cyanosis, delirium, syncope, and a marked eosinophilia.

Treatment is a matter of surgical judgement and technique.

Diphyllorhynchiasis

Infection by the fish tapeworm *Diphyllorhynchium latum* is more common in the Scandinavian countries than in the tropics. The adults live in the ileum and may be 10 m. long. The gravid segments disintegrate and the ova are passed in the faeces. Man is infected by eating raw or insufficiently cooked freshwater fish. In a small proportion of patients functional and mild nonspecific gastrointestinal disturbances occur, while in less than 1% of infected patients a megaloblastic anaemia may develop owing to the presence of the worm. *D. latum* abstracts cyanocobalamin from the intestinal contents. The anaemia resembles pernicious anaemia both clinically and haematologically, but tends to occur in a younger age group with both intrinsic factor and free hydrochloric acid present.

Treatment is with niclosamide or dichlorophen as previously described.

Intestinal Schistosomiasis

Heavy infections with the schistosomes *S. mansoni* or *S. japonicum* may produce dysenteric symptoms in man.

S. mansoni predominantly occurs in Africa, the Caribbean, and in Central and South America, while *S. japonicum* is confined to the Far East and parts of south-east Asia. The adult female worms (about 25 mm. long) live in the mesenteric vessels and deposit eggs which pass through the vessel walls and enter the large intestine (*S. mansoni*), and the small and large bowel (*S. japonicum*), where they are then passed to the exterior in the faeces. Man is usually infected while wading or bathing in infected waters.

The patient may have a localized itching erythematous or papular rash at the site of entry of the parasite (swimmer's itch); followed by bronchitic symptoms, pyrexia, eosinophilia, chills, headache, and generalized lymphadenopathy with enlargement of the spleen and liver. Urticarial rashes and angioneurotic oedema may occur. These early clinical manifestations are more severe in infections with *S. japonicum* than with *S. mansoni*. There then follows the stage of established infection characterized by intensive oviposition and the development of chronic disease. It is these two later phases that are usually seen in Britain.

The patient may present with fatigue, fever, headache, and bloody diarrhoea.³ An eosinophilia is usual and the liver and spleen may be enlarged and tender. On sigmoidoscopy the mucosa is found to be reddened and granular with pinpoint yellowish elevations surrounded by a hyperaemic zone. Shallow ulcers and polypi may be seen which are more extensive in *japonicum* than in *mansoni* infections. In most severe infections a pipe-stem fibrosis of the liver is produced,⁴ which can lead to portal hypertension, ascites, and hypoalbuminaemia. Haematemesis from oesophageal varices may occur. On biopsy of the liver numerous characteristic ova may be seen. The spleen becomes grossly enlarged with signs of "hypersplenism"—anaemia, leucopenia, and thrombocytopenia. In the late stages cor pulmonale develops. The central nervous system may be affected. Cerebral symptoms are more common in *japonicum* infection and cord symptoms in *mansoni*. The protein and cells in the cerebrospinal fluid are increased, and eosinophils if present are a suggestive diagnostic sign. Any organ or tissue in the body can be involved.

Treatment of *S. mansoni* and *S. japonicum* should be carried out however scanty the infection, and it is well worth remembering that the infection can persist for many years after the patient has left an endemic area. Two drugs commonly used are niridazole and stibocaptate.

Niridazole (Ambilhar) is given orally, in two divided doses, preferably at 12-hourly intervals, at a dosage of 25 mg./kg. daily for 7 to 10 days. Side-effects are common if the liver is affected, and such patients should be admitted to hospital and carefully supervised.⁵

Stibocaptate (Astiban) is given intramuscularly in one weekly injection of 6 to 10 mg./kg. for five weeks. A short course of three to five daily injections can also be used, but the toxicity of the drug is greater with this regimen. The usual complications of antimonial therapy may occur, and the appropriate precautions must be observed.

Other Infections

Many other helminth eggs may be found on routine examination of the faeces, such as ova of *Fasciolopsis buski*, *Heterophyes heterophyes*, *Clonorchis sinensis*, *Opisthorchis felinus* or *O. viverrini*, and *Fasciola hepatica*. Infections with these worms are, however, relatively uncommon in Britain, and adequate descriptions should be sought in specialized textbooks of tropical medicine.⁶ On the other hand, threadworms are sufficiently familiar to practitioners to be outside the scope of this article.

Diagnosis

Diagnosis of gastrointestinal helminthiasis depends on the demonstration of the characteristic eggs in the stool or the recovery of adult worms or segments of worms. A direct saline smear of faeces is often successful in establishing a diagnosis; alternatively various concentration techniques are available. In some instances ancillary methods such as radiology, sigmoidoscopy, serology, or other specialized techniques are required.

REFERENCES

- Gilles, H. M., Watson-Williams, E. J., and Ball, P. A. J., *Quart. J. Med.*, 1964, 33, 1.
- Roche, M., and Layrisse, M., *Amer. J. trop. Med. Hyg.*, 1966, 15, 1032.
- Gelfand, M., *A Clinical Study of Intestinal Bilharziasis (Schistosoma mansoni) in Africa*, 1967. London.
- Cheever, A. W., and Andrade, Z. A., *Trans. roy. Soc. trop. Med. Hyg.*, 1967, 61, 626.
- Gilles, H. M., *Practitioner*, 1968, 200, 451.
- Adams, A. R. D., and Macgregor, B. G., *Clinical Tropical Diseases*, 4th ed., 1966. Oxford.

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