and about 5 per cent. for the other fingers. Amputations at the proximal interphalangeal joint are best performed by a steam hammer, for then the balance between the flexors and the extensors is maintained from the outset by these tissues being crushed into the bone. Surgically we do not obtain such good results, and a lagging finger stump, especially of the middle finger, is a serious disability demanding re-amputation.

In performing amputations at the proximal interphalangeal joint a towel clip should be forced through the

FIG. 4.—Use for a towel clip to prevent retraction of the flexor tendon during amputation of a finger at the interphalangeal joint.

flexor and extensor tendons down to the bone with the finger held in a position of rest—that is, 45 degrees flexed at the metacarpo-interphalangeal joint. This will prevent retraction of the flexor tendon during the amputation, and enable the operator to suture the tendons over the bone end in a correctly balanced posture (Fig. 4). The advantage of a successful proximal interphalangeal amputation to the patient is great, for with the hand at rest he can successfully hide his deformity.

To the writers of textbooks, especially those dealing with practical surgery, I would appeal for more careful illustrations of finger amputations (Fig. 5). The incision should start at the metacarpo-phalangeal joint, which is half an inch above the web of the finger, and not, as so

FIG. 5.—Incisions for amputation of a finger at the metacarpo-phalangeal joint, by the Racquet method.

often illustrated, somewhere near the base of the metacarpal bone. It should be carried in the axis of the finger as far as the middle of the proximal phalanx; it may, with advantage, be placed nearer the mid-line of the hand in the case of the index or little fingers. From the middle of the phalanx the incision should pass horizontally round the finger almost at right angles to the vertical incision, and never so obliquely that it skirts the web, and would, in the case of the index finger, thus give rise to difficulty in covering the bone end, and, on occasion, to the serious mistake of removing the head of the first metacarpal bone, which ruins the grip.

Summary

The problem of the septic hand involves careful consideration of the mechanical, chemical, and thermal factors in treatment, which may delay healing of a non-infected wound. Adequate incisions under a tourniquet and general anaesthetic are necessary. Uninfected wounds should be splinted and kept dry; infected wounds require moist dressings. No drainage material should be used on the fingers. Stiffness may be minimized by careful judgement in each case of the time when movement or finger extension may be allowed. Amputations are necessary in only 2 per cent. of cases, and, wherever possible, should be designed to suit the work and social status of the patient.

My thanks are due to Mr. Douglas Kidd for the drawings he has made.

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TROPICAL SPRUE AND ITS MODERN TREATMENT*

BY

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Tropical sprue in its typical form is characterized by apyrexial morning diarrhoea with pale, gaseous, bulky, fatty stools, sore tongue, buccal aphthae, intestinal flatulence, megalocytic anaemia, marked wasting, and profound asthenia associated with a low blood pressure. The abdomen is distended, and its thinned parietal wall but scantily covers the coils of gas-distended bowel beneath. Definite skin pigmentation, cramp, tetany, and oedema may be superadded. At times the stools do not conform to the classical type, in other cases intestinal symptoms, characterized by fatty diarrhoea and abnormal carbohydrate fermentation, may occur unaccompanied by anaemia, while occasionally—especially in relapses following respiratory infections—severe megalocytic anaemia may develop in the absence of intestinal features. I have never observed subacute combined degeneration in sprue, though neuritic manifestations are common enough.

The syndrome itself is explicable in terms of a dysfunction of the gastro-intestine, characterized by defective gastric secretion and malabsorption of fat, glucose, calcium—and probably the p.a. factor—in the small bowel. Three cases recently examined within one hour of death by Mackie and the writer failed, as in Thaysen's case (1931), to reveal specific atrophy or inflammatory lesions in the gastro-intestine, and we now regard the intestinal and visceral atrophy, the small heart with its characteristic brown atrophy, and the megaloblastic red marrow as secondary to a gastro-intestinal derangement, the essential cause of which is still under investigation. The absence of a demonstrable parasitic agent such as a virus, bacterium, or fungus, the apyrexial course of the illness, and the essentially non-inflammatory nature of the tissue changes are against an infective origin.

Aetiological Considerations

Sprue generally affects adult Europeans or those of mixed European stock after some years of residence in an endemic area: it may directly follow hill diarrhoea, as emphasized by Rogers (1921), and is not infrequently preceded by a history of dysentery or chronic malaria necessitating prolonged quinine administration. Except in Porto Rico native populations are rarely affected, while damp coastal climates favour its development. Peculiar features are its rarity in Africa and its occasional onset in tropical patients after many years' residence in Europe.

Various theories regarding its causation have been put forward. Ashford (1915) regarded it as a moniliasis of the digestive tract, and later considered the yeast infection to be engrafted on an unbalanced dietary. Elders (1919) regarded it as a primary deficiency disease due to lack of vitamin A and B and amino-acids. Scott (1923) postulated parathyroid deficiency as the aetiological factor. Strauss and Castle (1932) suggested that pernicious anaemia, sprue, tropical macrocytic anaemia, and coeliac disease were conditional deficiencies caused by a lack of a specific reaction between the extrinsic factor taken in the food and the intrinsic factor secreted by the gastric juice; they regarded vitamin B₁₂ as the source of extrinsic factor.

My own view is that sprue arises as a functional breakdown in the gastro-intestine, and that any factor or factors depressing its secretory or absorptive function will predispose. It is known, for example, that certain tropical infections such as malaria and dysentery may depress

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gastric secretion, while residence in a humid climate involves an increased distribution of blood to the skin at the expense of the splanchnic vessels—a state of affairs which, if unduly prolonged, appears likely to depress alimentary function. Again, a diet rich in fat and carbohydrate and poor in first-class protein, which is the main source of extrinsic factor, is the one known to precipitate relapses in sprue, and is probably the most potent single factor in the initiation of the disease in the first instance. From this viewpoint a careful analysis and comparison of the dietaries of Europeans resident in Africa and endemic areas of sprue in India respectively would prove of great interest.

Laboratory Findings

Laboratory investigations—especially those carried out at the Hospital for Tropical Diseases, London—have revealed a biochemical background to sprue which, though not invariably complete in every patient, is very characteristic of the severer cases, and often affords valuable information in recognizing atypical types. Thus well-established cases generally show an excess of adequately split fat, the total fat constituting 25 to 70 per cent. of the dried faeces, a glucose-tolerance curve with a delayed or low maximal rise rarely exceeding 40 mg. per 100 c.cm., a decreased serum calcium associated with a normal serum phosphorus, a blood cholesterol below 100 mg. per 100 c.cm., and a decreased or absent secretion of HCl as revealed by the fractional test meal curve. Acid secretion follows histamine injection in approximately 70 per cent. of sprue cases, a finding which helps to differentiate it from true Addisonian anaemia. The plasma bilirubin rarely exceeds two van den Bergh units, and not infrequently it is normal.

Following appropriate treatment, as outlined below, the percentage of faecal fat is markedly reduced in quantity, the blood calcium and cholesterol increase, the glucose-tolerance curve returns to normal, and the original curve of acid secretion becomes gradually re-established, though this may take many months or even years to accomplish. Haematological investigation generally reveals a megalocytic anaemia of moderate or severe degree, which in advanced cases may be indistinguishable from Addisonian anaemia; the Price-Jones curves in the two diseases are also similar.

Differential Diagnosis and General Treatment

Other megalocytic anaemias—especially those associated with Addisonian pernicious anaemia, gastro-jejunal fistula, intestinal ulceration with stricture, and tuberculous ulceration with fistulae—may lead to confusion, while diseases giving rise to fatty diarrhoea, such as idiopathic steatorrhoea, abdominal Hodgkin's disease, and tuberculous adenitis of the mesenteric glands with lymphatic obstruction and interstitial pancreatitis, may occasionally need differentiation. In the diagnosis of atypical cases of sprue clinical experience combined with a careful case history, physical examination, and detailed laboratory and x-ray investigation are essential.

The patient with sprue must be put to bed on an appropriate diet for a period of five to eight weeks, and must receive liver extract, per os, in adequate dosage if anaemia be present. Bed rest is essential, as it halves the calorie requirements of the patient and permits alimentary rest, which is of fundamental importance in recovery.

Diarrhoea and Flatulence.—On admission the patient should be given oleum ricini (2 drachms). When the diarrhoea is severe, pulv. bataviae co. (1/2 to 1 drachm t.d.s.) is useful. Several different diets have been advocated empirically, including the fruit diet of van den Bergh, the milk diet of Manson, and the red meat diet of Cantlie. On the basis of the biochemical findings Fairley (1930) successfully employed a series of five graded

high protein, low fat, and low carbohydrate diets, with an energy value varying from 700 to 3,000 calories, and possessing a protein : fat : carbohydrate ratio of 1.0 : 0.3 : 1.3 instead of the usual 1.0 : 1.0 : 4.0. The source of protein was lean red meat, and more recently a defatted high protein milk powder (sprulac) has been introduced by the writer (1932). As the intestinal features subside and the stools become more normal diets of increasing calorie value are gradually substituted, a convalescent high protein diet including fruit and vegetables being generally permitted about the fifth or seventh week.

Anaemia.—Bloomfield and Wyckoff (1927) noted great improvement in a case of sprue given the high liver diet of Minot and Murphy. Ashford (1928) and Fairley (1930) confirmed this result in a larger series of cases, employing liver extract (Lilly No. 343). Almost invariably the anaemia is megalocytic and often hyperchromic in type, and, provided the diarrhoea be controlled by suitable dietary as outlined above, the administration of commercial liver extract in adequate dosage is followed, as in pernicious anaemia, by a maximum reticulocytosis inversely proportional to the red cell count and by rapid blood regeneration. In a severe case I employ liver extract, per os, in a dosage equal to 1½ lb. whole liver for the first month and 1 lb. for the second month, or until such time as the blood has returned to normal. Thereafter a maintenance dose equal to 1/2 lb. whole liver daily may be employed for another month or two, but in the ordinary case a maintenance dose is not necessary over a longer period.

Results of Treatment

The haematological findings on admission and discharge in a recent series of thirty-three cases of sprue treated with high protein (meat), low fat, low carbohydrate diet and liver extract are included in Table I. The haematological findings in another series treated by liver extract, per os, and sprulac are included in Table II.

TABLE I.—Average Haematological Findings in Cases of Sprue Treated with Liver Extract and High Protein (Meat), Low Fat, Low Carbohydrate Diet.

(Average stay in hospital = 42.5 days)

Time of Observation	R.B.C.s. per c.mm.	Haemoglobin per cent.	Colour Index	Average Diameter of R.B.C.s. (microns)
Admission ...	2,860,000	57	1.0	8.1
Discharge...	4,520,000	77	0.85	7.8
Improvement ...	1,660,000	20	0.15	0.3

The total cases numbered thirty-three: the reticulocytic response was investigated in nineteen, the maximum figure averaging 17.1 per cent.

TABLE II.—Average Haematological Findings in Cases of Sprue Treated with Liver Extract and Sprulac

(Average stay in hospital = 43 days.)

Time of Observation	R.B.C.s. per c.mm.	Haemoglobin per cent.	Colour Index	Average Diameter of R.B.C.s. (microns)
Admission ...	2,589,000	57.0	1.12	8.0
Discharge...	4,324,000	76.5	0.88	7.7
Improvement ...	1,735,000	19.5	0.24	0.3

The total cases numbered ten.

It will be seen that the results obtained in these two series were very similar, and from both a clinical and a haematological viewpoint it appears immaterial whether meat or milk protein be utilized provided liver extract in adequate amount is administered.

One of the unexpected features of sprue is the satisfactory haematological response to the oral administration of

liver extract, and only rarely, in my experience, has it been necessary to resort to parenteral injections. Occasionally, however, intractable cases are encountered, and here absorption is either defective or a dosage of liver extract greatly in excess of the normal is required to initiate an effective marrow response. The chart of Case I illustrates this feature. The patient, a woman aged 60, had contracted sprue in Shillong in 1924, and had never satisfactorily responded to liver therapy per os. Extralin in full dosage was given for a fortnight without benefit. Following a series of intramuscular injections of campolon (6 c.cm.) there was a remarkably rapid blood regeneration, a reticulocytosis of 35 per cent. being noted on the seventh

1 drachm) may be given thrice daily after meals with benefit when acid secretion has been found defective. Blood transfusion should be employed only as an emergency measure to tide a gravely anaemic patient over the few days which liver extract takes to exert its action on the megaloblastic marrow. Marmite is only occasionally effective, and, in my experience, neither it nor ventriculin is as satisfactory as liver extract in sprue.

Provided the patient is on a diet low in fat the complication of tetany only calls for the administration of calcium lactate (40 grains) thrice daily; the hypocalcaemia rapidly decreases under this regime, and the blood calcium is restored to 9-10 mg. per 100 c.cm. within three weeks.

Chronic sprue showing lack of blood regeneration with extralin per os and rapid haematological response with intramuscular injections of campolon.

day and an increase of 3,400,000 corpuscles occurring in twenty-four days. Complete recovery ensued. In my experience parenteral injections of liver extract in the ordinary dosage advocated have proved disappointing in sprue, and for this reason I always inject excessively large doses parenterally or administer, in addition, liver extract per os.

As blood regeneration proceeds the rate of red cell production generally exceeds the percentage increase of haemoglobin, so that by the time normal counts are reached the colour index approximates to 0.9. There is a simultaneous decrease in the average diameter of the corpuscles, anisocytosis gradually disappears, and the Price-Jones curve, which generally shows a well-defined displacement to the right and broadening of the base at first, returns to its normal position and symmetry. Sometimes a lag in the production of haemoglobin occurs, the cells appear hypochromic, and the colour index approaches 0.7; in these circumstances iron in full dosage is indicated (ferri et ammon. cit. 30 grains t.d.s., p.c.). This is not often necessary, and, when it is, intercurrent disease or some complication such as intestinal ulceration should be suspected. Acid. hydrochlor. dil. (B.P.) (1/2 to

After-care

Once recovered, the sprue case should continue with a well-balanced diet, adequate in protein and vitamins, avoiding fat and carbohydrate excess, rich spiced foods, and condiments. Aperients should be taken with caution, and worry, chill, and respiratory infections avoided so far as possible. Though it is impossible to say definitely that a given case of sprue will never relapse, patients under 55 years of age may be permitted to return to the Tropics, provided there have been no alimentary symptoms and the blood picture has been normal for six months following cessation of treatment, and provided they are otherwise healthy.

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