The widespread osteosclerosis, which is greatly against a diagnosis of primary hyperparathyroidism, is of interest. Burnett *et al.* (1949) noted periosteal new bone formation in one of their cases and demonstrated dense cortical bone in another by bone biopsy. Reifstein (1958), in a general discussion on bone metabolism, states that increased matrix calcification does not occur. Unfortunately, we did not measure the proportion of mineral phase of the bone in our patient. The radiological findings coupled with those of the bone biopsy indicate that increased trabeculation and new bone formation had occurred, and it is reasonable to link this up in some way with the gross increase in calcium intake. Another explanation is that the osteosclerosis may be secondary to the renal failure (Crawford *et al.*, 1954).

All but one of the cases of the chronic milk-alkali syndrome so far reported have occurred in the U.S.A., this perhaps being related to the generous milk-drinking habits and pronounced self-medication in that country. We believe the present case to be the first to have been described in Britain and to be the second time that this syndrome has occurred in a woman.

The exact aetiology of these cases is obscure. Becker *et al.* (1952) noted at necropsy on 99 patients, each with a chronic duodenal ulcer, the presence of renal parenchymal calcification in 36% of them, compared with an incidence of 13% in a non-ulcer control group. In 68% of these cases with renal calcification there was a history of a high intake of alkali, well above the rate in the ulcer cases without such changes. They postulated the occurrence of transient, asymptomatic, hypercalcaemic incidents in these patients taking a high calcium diet. Burnett *et al.* suggest that there is an interference with the renal handling of calcium in such cases, and Kyle offers the following sequence of events: an initial alkalosis causing renal impairment, with a resulting decrease in the renal excretion of calcium, and this, in conjunction with the increased intake, producing the hypercalcaemia. In some of the reported cases the presence of antecedent renal damage has been noted. Carpenter and Pautler (1954) suggest that the chronic milk-alkali syndrome is probably primary hyperparathyroidism with atypical changes due to excess alkali therapy, but, as Kyle points out, it is doubtful if their own case conformed to the syndrome, as no history of excess milk and alkali intake was present.

The prognosis is variable and probably depends in general on the degree of renal damage present by the time the condition is first recognized. Improvement has varied greatly in the reported cases and its extent seemed unpredictable. In some, disappearance of calcinosis was dramatic, particularly from subcutaneous deposits and in those in the region of joints, while in others little change was evident.

Summary

A case of the chronic milk-alkali syndrome following prolonged excess intake of alkali but not of milk is described. A favourable response was obtained after withdrawal of alkalis and the prescription of a low calcium, high fluid intake. An interesting feature was the generalized osteosclerosis.

We are grateful to Dr. J. McIntosh for permission to publish this case. We are indebted to Dr. B. E. C. Nordin, who often advised us on the management and carried out some of the special investigations. We thank Dr. J. W.

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LATE RESULTS AND PROTEIN STUDIES AFTER PARTIAL GASTRECTOMY

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In a recent investigation into the incidence of coronary ischaemia after partial gastrectomy (Walker *et al.*, 1958), a study was made of 40 male gastrectomy patients in whom a Polya type of operation had been performed approximately 10 years before. This provided the opportunity for a simultaneous study of the long-term incidence of post-gastrectomy symptoms, and as each patient had previously been interviewed by one of us in 1952-3 (Anderson *et al.*, 1955) it was possible to make an assessment of their clinical progress.

The incidence of nausea, bilious vomiting, and dumping is initially high after operation (Muir, 1949), but in most cases improvement is rapid and symptoms lessen or disappear in the first few months. Clinical experience suggests that there is a tendency towards improvement after the first post-operative year, but information about the late results is scanty.

Loss of weight is a common sequel of the operation (Anderson *et al.*, 1955), and the labelled-fat studies of Everson (1954) suggest that fat absorption may be impaired in some cases. Evidence of increased nitrogen

loss in the faeces (Wollaeger *et al.*, 1946) suggests that protein absorption may also be impaired, and we undertook estimations of plasma protein levels in these 40 patients to determine whether any alterations had occurred.

Methods

Forty men over 45 years of age were interviewed, each having undergone a Polya type of partial gastrectomy for duodenal ulcer about 10 years previously (mean 9 years 10 months; range 7 to 13 years). The mean age at operation was 44 years. The incidence of post-gastrectomy symptoms and loss of work for any reason was ascertained, loss of weight was estimated, and haemoglobin was measured by the Eel colorimeter. This information was also available from the 1952 survey (Anderson *et al.*, 1955), and the findings were compared.

Total plasma protein was estimated by the Biuret method. Albumin/globulin fractionation was performed with sodium sulphate, and the absolute values given in this paper are obtained from this chemical separation. Electrophoretic separation of the protein fractions was carried out on each specimen using the standard Eel method, and the strips were stained with azocarmine B before planimetry.

The same estimations were carried out in two other groups of similar age—namely, a group of 40 male patients suffering from chronic duodenal ulcer, and a group without digestive symptoms who were admitted to hospital for routine surgical operations.

Results

Post-gastrectomy symptoms have been classified as follows: (1) Nil (a feeling of fullness after meals was disregarded); (2) mild symptoms of bilious vomiting and/or dumping; (3) severe symptoms of bilious vomiting and/or dumping; and (4) hypoglycaemia. Twenty-seven patients were symptom-free at both interviews (1952 and 1957); seven showed no alteration in symptoms; five stated their symptoms had disappeared during the five-year period; and one developed mild bilious vomiting in his seventh post-operative year. The details are recorded in Table I.

TABLE I.—Alteration in Symptoms

Change in Symptoms	No. of Patients	Symptoms	
		1952	1957
No change (34)	27	Nil	Nil
	3	B.V. and D.	B.V. and D.
	1	B.V.	B.V.
	1	B.V. and D. ++	B.V. and D. ++
	1	B.V. ++	B.V. ++
Improved (5)	1	D. ++	D. ++
	3	B.V.	Nil
	1	D.	"
Worse	1	Hypoglycaemia	"
	1	Nil	B.V.

B.V.=Bilious vomiting. D.=Dumping. ++=Severe symptoms.

Of eight patients who suffered from mild bilious vomiting or dumping in 1952 (Table I), four experienced relief of symptoms by 1957, and in one of these relief of dumping was achieved by converting his Polya gastrectomy to a Billroth I type in 1956. The other four showed no change. One patient who suffered from hypoglycaemia ultimately became free of symptoms. Three patients whose symptoms were severe did not improve at all (Table I).

Comparison of the recorded weights showed that the group mean was 131 lb. (59.4 kg.) in 1952 and 132 lb.

(59.9 kg.) in 1957, there being only nine patients in whom a weight difference of more than 4 lb. (1.8 kg.) was found. One who developed pulmonary tuberculosis lost 16 lb. (7.3 kg.), and the patient who had a Billroth conversion gained 11 lb. (5 kg.). Those in whom post-gastrectomy symptoms disappeared did not gain weight.

The mean haemoglobin levels were 84.8% in 1952 and 88.2% in 1957, but there was a wide range of individual differences, as 19 patients varied by 10% or more. Five patients who were anaemic (70% or less) in 1952 had responded to treatment with oral iron, but a sixth had relapsed. Two others developed an iron-deficiency anaemia (75→63% and 85→59%). The patients with symptomatic improvement showed no material improvement in haemoglobin.

Comparison of work records showed that these 40 men lost a total of 297 weeks in 1952 and 234 weeks in 1957, the principal cause of the difference being the improved employment record of three men. The high average loss per man is due to the poor record of a few, as 60% lost no work in either period. There was a close correlation between work lost and the severity of post-gastrectomy symptoms.

In Table II the mean values for total protein, albumin, and globulin obtained by the Biuret method are recorded for the three groups of patients. The mean

TABLE II.—Mean Values of Plasma Proteins (g./100 ml.) (Biuret Method)

Group	No. of Patients	Total Protein	Albumin	Globulin
Gastrectomy	40	7.00	4.87	2.13
Ulcer	40	7.21	4.97	2.24
Control	40	7.37	5.06	2.30

values of total protein show significant differences ($F=4.2$; $P<0.05$): the difference between the gastrectomy control groups is highly significant ($t=2.9$; $P<0.01$). Albumin mean values are not significantly different ($F=1.6$), but a real difference may possibly exist between the gastrectomy and control groups ($t=1.76$; $0.05<P<0.1$). Globulin mean values suggest significant differences between the groups ($F=2.6$; $0.05<P<0.1$) and a t-test shows that a significant difference exists between the gastrectomy and control groups ($t=2.26$; $P<0.05$).

The expected weight of each gastrectomy patient was calculated from height and age tables (Levine, 1923), and grouped according to the difference between this and actual weight. The majority were below expected weight, but no correlation between the difference (expected weight minus actual weight) and plasma protein levels was found (Table III). There was also no correlation between protein levels and actual weight.

When the globulin fraction had been analysed by planimetry the results were expressed as a fraction of total globulin, as assayed by the Biuret method (Table

TABLE III.—Relation of Protein to Weight in 40 Gastrectomy Patients

Amount Below Expected Weight		No. of Cases	Mean Plasma Proteins (g./100 ml.)		
lb.	kg.		Total	Albumin	Globulin
<7	<3.2	5	7.05	4.82	2.23
<21	<9.5	11	7.13	4.92	2.21
<35	<15.9	17	6.93	4.94	1.99
<36	<16.3	7	6.90	4.64	2.26

IV). The differences were found to be slight, but the following were statistically significant: α_2 -globulin in the gastrectomy group is lower than in the other groups ($P<0.01$), and α_2 -globulin is lower in both gastrectomy and ulcer groups than in the control group ($P<0.01$).

TABLE IV.—*Electrophoresis of Plasma Proteins—Mean Values (g./100 ml.)*

Group	Globulins			
	α_1	α_2	β	γ
Gastrectomy ..	0.23	0.39	0.56	0.96
Ulcer ..	0.25	0.50	0.60	0.90
Control ..	0.29	0.54	0.63	0.84

Discussion

Improvement in post-gastrectomy symptoms is common in the early months (Muir, 1949), and these results show that late improvement is also possible in mild cases, though less likely when symptoms are severe. Late deterioration as described by Wells and MacPhee (1954) was found in one patient.

The majority, however, show little change over the five-year period, and the weight of each patient has been remarkably stable, though weight normally tends to increase with advancing years. Johnston *et al.* (1958) showed that gastrectomy patients gained weight with intensive dietary supervision, but the increase was small and not necessarily maintained when the diet returned to normal. In our patients whose symptoms improved there was no corresponding rise in weight.

While none of our cases showed levels comparable with the low serum albumin described by Forshaw (1958), the significant difference between the total protein and globulin mean values of the three groups is interesting. This may indicate a poorer absorption of protein or merely reflect a lower intake by gastrectomy patients; the intermediate position of the ulcer cases may bear a relation to altered diet. The significant, or probably significant, difference in the group comparison tends to confirm the view. An attempt to relate this to weight was unsuccessful. The significance of the alteration in α_2 -globulin fraction is not apparent.

In another investigation (Walker *et al.*, 1958) it was found that the serum lipoproteins of gastrectomy patients did not differ to any significant extent from those of ulcer and other patients.

Summary

Studies of 40 patients 10 years after Polya gastrectomy showed relatively little change in post-gastrectomy symptoms, weight, or work records between 1952 and 1957, though late symptomatic improvement occurred in four cases and late deterioration occurred in one. Improvement in symptoms was not associated with a gain in weight or haemoglobin.

Measurements of total plasma protein, albumin, and globulin, and electrophoresis of plasma proteins indicate that total protein and α_2 -globulin may be lower after Polya gastrectomy, but no gross deviations from normal were found.

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NON-ADDISONIAN MEGALOBlastic ANAEMIA, COMPLICATED BY SUBACUTE COMBINED DEGENERATION OF THE CORD

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Subacute combined degeneration of the cord (S.C.D.) is classically associated with Addisonian pernicious anaemia and is attributed to malabsorption of vitamin B₁₂, due to lack of intrinsic factor consequent on gastric atrophy. S.C.D. may, however, occur in any type of non-Addisonian megaloblastic anaemia due to vitamin-B₁₂ deficiency. One such type is associated with structural intestinal changes such as fistulae or anastomoses, with diversion of vitamin B₁₂ by bacteria in stagnant areas of bowel, and another with malabsorption of vitamin B₁₂ due to short-circuit operations or small-bowel infiltration by tuberculosis or tumour. Richmond and Davidson (1958) found only five cases of each type in the literature, and described one further case of each type of their own.

The case presented here had certain features common to both types, since there was a megaloblastic anaemia, normal gastric acidity, S.C.D., operative and radiological evidence of intestinal anastomosis and fistula formation, biochemical evidence of a malabsorption syndrome with steatorrhoea, and impaired absorption of ⁵⁴Co-labelled vitamin B₁₂.

Of additional interest was the time relationship of the neurological signs to isoniazid therapy.

Case Report

In 1940 the patient had a gastro-jejunostomy performed at the Glasgow Royal Infirmary for a chronic duodenal ulcer. He was readmitted in 1943 with symptoms due to chronic indurated prepyloric and stomal ulcers. At operation the site of the gastro-jejunal anastomosis was firmly adherent to the transverse colon. The previous anastomosis was left untouched and a new gastro-jejunostomy was performed. Three years later he was again admitted because of further ulcer symptoms, and vagotomy was done, with considerable relief of symptoms.

In 1950 he was first admitted to Stobhill General Hospital with a six-months history of diarrhoea, and a barium-meal examination showed a gastro-colic fistula. Ileo-sigmoidostomy was performed and the patient discharged to out-patient supervision.

He remained well until 1951, when he was readmitted to Stobhill Hospital with a recurrence of diarrhoea. Haemoglobin was 14 g./100 ml., and a blood film normal.