(Nos. 4, 7, 8) had initial sore tongue. These symptoms had complete relief. One patient (No. 15) had a severe stomatitis, which had resisted many forms of treatment but improved rapidly after the injection. Only one patient (No. 1) developed slight paraesthesiae while under observation, at a time when the blood showed evidence of relapse eight months after the injection. The symptoms disappeared after the second injection and did not return within 49 weeks.

Summary

Fifteen patients with untreated pernicious anaemia were given a single parenteral dose of 1 mg. of vitamin B₁₂ and followed until relapse. The clinical state, blood, and marrow remained normal in one case for as long as 358 days after such a dose, but the earliest relapse occurred in 128 days, excluding one case with hepatic insufficiency where it occurred at 81 days.

The marrow showed minor signs of reversion to megaloblastic haemopoiesis 40–50 days before there was any sign of relapse clinically or in the blood.

No untoward neurological or other clinical symptoms were encountered in any patient with initially uncomplicated pernicious anaemia, but the one patient in the series with subacute combined degeneration had to have intensive treatment resumed at the sixth week because of neurological deterioration.

While of theoretical and practical interest, these findings do not justify, without further trials, the routine treatment of pernicious anaemia by 1 mg. doses of vitamin B₁₂ at long intervals.

We would gratefully acknowledge the assistance given to us by our colleagues in Dundee General Hospitals, in particular Professor Ian G. W. Hill for permission to treat six patients admitted to his wards in Maryfield Hospital. We are indebted to Dr. H. M. Walker, of Glaxo Laboratories Ltd., for the supplies of vitamin B₁₂ used in this study.

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The renaming of Bristol's new health centre after Dr. William Budd will keep alive the memory of a great general practitioner and a pioneer epidemiologist. Budd was one of the first to distinguish between typhoid fever and typhus, and his views on public sanitation, particularly on the importance of a pure water supply, were well ahead of his times. In 1841 Bristol had been declared by a Government commission "the third most unhealthy town in England," surpassed only by Liverpool and Manchester. There was indeed scope in Bristol for Budd's genius. During the 1849 cholera epidemic he recommended rational methods of prevention—the disinfection or destruction of dejecta and fomites, and the provision of pure water. A curious and little-known incident of Budd's later life is recorded in Dr. E. W. Goodall's book, *William Budd* (Arrowsmith, Bristol). Budd was well liked and respected by his colleagues, but once he incurred their severe censure. An article on scarlet fever, somewhat critical of current medical practice and over his own name, appeared in the *Bristol Times and Mirror* the day before it was published in the *British Medical Journal*. A meeting of the Faculty at Bristol, held in Budd's absence, declared this to be "inconsistent with professional propriety."

RENAL CIRCULATION AND CARDIAC OUTPUT IN "LOW-OUTPUT" HEART FAILURE AND IN MYXOEDEMA

BY

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It has been shown in a previous paper (Davies and Kilpatrick, 1951) that the cardiac output, the renal blood flow, and the glomerular filtration rate are reduced in congestive heart failure due to chronic rheumatic heart disease ("low-output" heart failure): the renal blood flow is reduced to a greater extent proportionately than the cardiac output and glomerular filtration rate. Merrill (1946) and Mokotoff, Ross, and Leiter (1948) postulated that retention of salt in low-output heart failure results from a low glomerular filtration rate in association with normal tubular reabsorption, but evidence has been adduced (Davies and Kilpatrick, 1951; Davies, 1951) which suggests that, although low glomerular filtration rate may be a contributory factor in salt retention, increased tubular reabsorption is more important.

The finding by Corcoran and Page (1947) of low renal clearances in two patients suffering from myxoedema suggested the present study, which is a comparison of the renal circulation, the cardiac output, and the ability to excrete salt in patients suffering from rheumatic heart disease and patients suffering from myxoedema. The former required regular administration of mercurial diuretics or severe restriction of salt intake in order to remain free of oedema. In addition, one patient with mitral stenosis and spontaneous myxoedema has been studied.

Normal standards for renal clearances were established in 14 healthy persons, and normal values for cardiac output were obtained from the work of McMichael and Sharpey-Schafer (1944).

Methods

The methods employed for the measurement of glomerular filtration rate (inulin clearance), renal plasma flow (*para*-aminohippuric-acid clearance), and renal blood flow ($\frac{\text{Renal plasma flow} \times 100}{100 - \text{Haematocrit}}$) have been described previously (Dick and Davies, 1949; Davies and Kilpatrick, 1951). The validity of *para*-aminohippuric-acid clearance as a measure of renal plasma flow in patients suffering from myxoedema has not been established by determination of the concentration of *para*-aminohippuric-acid in renal venous blood. Cardiac output was measured by the methods of McMichael and Sharpey-Schafer (1944). The ability to excrete salt was measured by observing the effect of a diet containing 10 g. of salt and 1,500 ml. of fluid daily on the patients' weight.

Results

The findings in normal subjects, in patients with rheumatic heart disease, in patients with myxoedema, and in the single patient with both diseases are recorded in Tables I, II, and III.

TABLE I.—Renal Clearances in 14 Normal Subjects

	Range	Average
Glomerular filtration rate (ml. per minute)	119–174	145
Renal plasma flow (ml. per minute)	540–817	645
Renal blood flow (ml. per minute)	981–1,483	1,177

TABLE II.—Renal Circulation and Cardiac Output

Case No.	Sex	Age	G.F.R. (ml./min.)	R.B.F. (ml./min.)	O ₂ Consumption	B.M.R.	A–V O ₂ Diff. Vols. %	C.O. litres/min.
<i>Patients with Low-output Heart Failure</i>								
1	M	42	51	323	275		9.5	2.8
2	F	44	53	510	270		9.7	2.8
3	F	48	60	330	280		7.7	3.6
4	F	47	77	367	—		—	—
5	F	67	52	520	—		—	—
6	M	41	62	450	—		—	—
7	F	38	94	483	275		7.3	3.8
8	F	15	56	487	200		8.1	2.4
9	F	38	80	490	255		8.2	3.0
10	M	27	78	429	250		6.05	4.1
<i>Patients with Myxoedema</i>								
11	F	56	72	435	140	–35%	4.75	3.0
12	F	60	55	560	150	–22%	4.5	3.3
13	F	67	81	633	135	–20%	5.0	2.7
14	F	47	62	354	101	–44%	4.3	2.7
15	F	46	48	467	—	–35%	—	—
16	F	41	90	520	—	–36%	—	—
<i>Patient with Rheumatic Heart Disease and Myxoedema</i>								
17	F	43	56	320	134	–31%	—	—

G.F.R.—Glomerular filtration rate. R.B.F.—Renal blood flow. C.O.—Cardiac output.

TABLE III.—Effect of a Diet Containing 10 g. of Salt Daily on Body Weight

Case No.	G.F.R. (ml./min.)	R.B.F. (ml./min.)	No. of Days on Diet	Initial Weight (kg.)	Final Weight (kg.)
<i>Patients with Chronic "Low-output" Heart Failure</i>					
1	51	323	5	57.0	60.8
4	77	367	6	50.0	54.3
5	52	520	6	60.4	65.0
6	62	450	6	48.6	51.8
<i>Patients with Myxoedema</i>					
11	72	435	12	77.0	77.1
12	55	560	12	54.7	55.1
14	62	365	9	48.8	49.7
<i>Patient with Mitral Stenosis and Spontaneous Myxoedema</i>					
17	56	320	16	61.5	61.6

G.F.R.—Glomerular filtration rate. R.B.F.—Renal blood flow.

Renal Circulation

(a) Glomerular Filtration Rate

Normal subjects	..	119–174 ml./min.; Average, 145 ml./min.
Rheumatic heart disease	..	51–94 " " 66 "
Myxoedema	..	48–90 " " 68 "
Rheumatic heart disease and myxoedema	..	56 " "

(b) Renal Blood Flow

Normal subjects	..	981–1,483 ml./min.; Average, 1,177 ml./min.
Rheumatic heart disease	..	323–520 " " 439 "
Myxoedema	..	354–633 " " 495 "
Rheumatic heart disease and myxoedema	..	320 " "

Cardiac Output

(a) Oxygen Consumption

Normal subjects*	..	Average normal adult, 240 ml./min.
Rheumatic heart disease	..	200–280 ml./min.; Average 258 ml./min.
Myxoedema	..	101–150 " " 131 "
Rheumatic heart disease and myxoedema	..	134 " "

(b) Arteriovenous Oxygen Difference

Normal subjects*	..	3.0–5.2 vols.%; Average 4.0 vols. %
Rheumatic heart disease	..	6.05–9.7 " " 8.0 "
Myxoedema	..	4.3–5.0 " " 4.6 "

(c) Cardiac Output

Normal subjects*	..	4–8 l./min.; Average 5.3 l./min.
Rheumatic heart disease	..	2.4–4.1 " " 3.2 "
Myxoedema	..	2.7–3.3 " " 2.9 "

(d) Cardiac Output per 100 ml. of Oxygen Consumed

Normal subjects*	..	Average 2.2 l./min.
Rheumatic heart disease	..	" 1.2 "
Myxoedema	..	" 2.2 "

Salt Excretion

All the patients with rheumatic heart disease required severe restriction of salt intake or mercurial diuretics at varying intervals in order to remain free of oedema, whereas none of the patients with myxoedema showed pitting oedema while on an ordinary diet. The administration of a diet containing 10 g. of salt and 1,500 ml. of fluid daily caused a rapid increase of weight and a rise of venous pressure in the patients with rheumatic heart disease, but these changes did not occur in the patients suffering from myxoedema or in the single patient suffering from both diseases (Table III).

Discussion

These observations show that in two small groups of patients suffering from low-output heart failure or myxoedema the glomerular filtration rate, renal blood flow, and cardiac output were low, and that the values obtained in the two conditions were of the same order. There were, however, important differences. In the patients with myxoedema the capacity to excrete ingested salt and water was normal, whereas it was severely impaired in the patients with low-output heart failure. Moreover, the low cardiac output of myxoedema was associated with a normal arteriovenous oxygen difference, and the cardiac output per unit of oxygen consumed was within normal limits, which suggests that the circulation was fulfilling the tissue requirements for oxygen in a normal manner. However, a normal arterio-mixed-venous oxygen difference does not necessarily mean that the arteriovenous oxygen difference of individual organs is also normal.

The difference in capacity to excrete salt suggests several possible explanations. In low-output heart failure retention of salt may be due to a diminished glomerular filtration rate in association with normal tubular reabsorption, or to increased tubular reabsorption alone, or to a combination of these two factors. If a glomerular filtration rate of the order found in these two groups of patients causes salt retention in the presence of normal tubular reabsorption, it follows that tubular reabsorption is below normal in myxoedema. If, on the other hand, salt retention in low-output heart failure is wholly or partly due to increased tubular reabsorption, then in myxoedema tubular reabsorption may be normal or below normal. That some aspects of tubular function are depressed in myxoedema is shown by the presence of a low maximum tubular excretory capacity (Corcoran and Page, 1947). Depression of tubular reabsorption of salt may be due either to local changes in the cell or possibly to diminished hormonal stimuli, since Zarrow and Money (1949) have shown that experimental hypothyroidism causes atrophy of the adrenal cortex.

The findings reported here may explain to some extent the old-established clinical observation that induced myxoedema prevents or diminishes oedema in chronic heart failure. It was assumed (Blumgart *et al.*, 1933) that clinical improvement resulted from diminished cardiac work, but

*After McMichael and Sharpey-Schafer (1944).

Sharpey-Schafer (1946) found that myxoedema artificially induced by thiouracil in patients with chronic heart failure did not lead to a change in the work of the heart (cardiac output $\times$ mean blood pressure).

It seems possible, therefore, that the beneficial effect of induced hypothyroidism is, in part, the result of changes in the tubular reabsorption of salt and water. It is of interest, in this respect, that the patient who suffered from both mitral stenosis and spontaneous myxoedema was able to excrete salt and water normally although her renal clearances were at the same level as those of patients with low-output heart failure.

Summary

The renal circulation and the capacity to excrete salt have been studied in small groups of patients suffering from myxoedema or chronic rheumatic heart disease, and in one patient suffering from both conditions. In some patients from each of the two groups the cardiac output has been measured.

The glomerular filtration rate and renal blood flow were reduced to approximately the same extent.

In spite of the similar renal circulatory changes the patients with myxoedema were able to excrete salt and water, whereas that function was seriously impaired in the patients with rheumatic heart disease.

One patient with mitral stenosis and spontaneous myxoedema had renal clearances of the same order as the other patients studied, but was able to excrete salt and water.

The cardiac output was low in both groups, but, whereas the arteriovenous oxygen difference and the cardiac output per unit of oxygen consumed were abnormal in the patients with rheumatic heart disease, these values were normal in the patients with myxoedema.

The significance of these findings is discussed.

We are indebted to Professor C. H. Stuart-Harris for his help and for the opportunity of studying patients under his care, and to Dr. M. W. A. Gatman for many biochemical estimations.

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An important service rendered by Post Office wireless stations on the coasts of Britain is the transmitting of medical advice to ships at sea. In the absence of a ship surgeon, illnesses among the ship's company are generally dealt with by the captain, so far as he is able, with the aid of the ship's medical chest. In serious cases where the captain feels that a doctor's opinion is desirable he may forward particulars to a coast station by radio. If suitable equipment is installed in the ship it is possible for the captain and the doctor to speak directly to each other by a combination of the radio link and the normal telephone system. These messages are sent either in plain language or in a special code devised to overcome language difficulty when dealing with foreign ships. During 1951, 469 medical messages were handled by Post Office coast stations.

THE TREATMENT OF LUMBAR INTERVERTEBRAL DISK PROTRUSION

AN ASSESSMENT OF CONSERVATIVE MEASURES

BY

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So common has become the diagnosis of intervertebral disk protrusion as a cause of backache and sciatica that it is important to emphasize the small part that operation plays in the treatment of this disorder. O'Connell (1951), in a review of 500 cases treated by operation, made it clear that most of his patients were referred to him only because long periods of conservative treatment from general practitioners, physicians, neurologists, or orthopaedic surgeons had failed. Of all patients seen in his clinic, he considered that less than 20% needed operation.

In a disorder with a tendency to natural cure a patient may receive many different lines of treatment while the natural history of the condition unfolds. The success or failure of such treatment is too often judged on a basis of trial and error. The purpose of this review is to assess, so far as is possible, the results of the various forms of conservative treatment carried out in the orthopaedic department of St. Bartholomew's Hospital over five years.

Material and Results

In all, 500 unselected patients have been observed for a period of not less than 18 months from their initial treatment. They attended the orthopaedic department between 1946 and 1951 with symptoms and signs giving rise to the diagnosis of lumbar disk protrusion. This number is only a very small fraction of all the patients with lumbar and sciatic pain who attended the hospital in that time. Those with backache but without evidence of lumbar root involvement or neurological disturbance have been excluded from this series. Of the total number, 314 were men and 186 women. Two patients have died since discharge from hospital—apparently from causes unconnected with their spinal condition; five recovered spontaneously while awaiting treatment.

The upset caused by disk protrusion is essentially subjective and the results of conservative treatment are therefore difficult to assess. In the accompanying Table the term "relieved" implies complete loss of pain and disability without recurrence during the period of review; "improved" indicates that the patient has been able to resume work or normal life. The number of patients completely relieved by treatment is very small when compared with O'Connell's (1951) figures for those treated by operation. But, as he himself said, patients requiring operation have suffered severe or prolonged disability and mild post-operative symptoms are unlikely to give cause for complaint. Conservative treatment, on the other hand, is given for all degrees of severity and rarely produces such dramatic changes as operation. Recurrence, moreover, is to be expected unless advice on such matters as the lifting of heavy weights without bending the spine and the avoidance of stooping is followed carefully.

Of the 500 patients, 406 were initially improved or relieved, and only 58 were considered eventually to require operation. Sixteen were not improved, but were deemed unsuitable for operation because of associated functional