Current Practice

URINARY TRACT DISEASES

Chronic Renal Failure

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Every year about 7,000 people die in the United Kingdom from chronic renal failure. Many of these are elderly, but an appreciable number—perhaps 3,000—die in the prime of life. Chronic pyelonephritis is the commonest lesion found in the old and in the young patients, but glomerulonephritis is commoner among adolescents and young adults, accounting for about two-thirds of the deaths in them. Polycystic disease of the kidneys, accelerated hypertension, calculous disease, analgesic nephropathy, diabetes, amyloidosis, and gout all occur in diminishing order of frequency.

Once serious impairment of renal function has developed, the clinical picture is determined more by the renal failure than by the underlying disease and the patients all have similar problems. The clinical presentation therefore is remarkably constant and most patients appear with anorexia, fatigue, dyspnoea, oedema, or severe hypertension. Some patients may have an unfavourable response to an incidental illness that brings the renal failure to light, while others develop renal failure during treatment of a progressive renal disease.

Consequences of Chronic Renal Failure

Normal renal function serves to control the body’s content of fluid, electrolytes, and hydrogen ion and to excrete certain non-volatile metabolites. Both facets may determine the consequences of renal failure and patients may suffer as much from water and electrolyte imbalance as from nitrogen retention. As a result there are many possible consequences of renal failure, the commonest of which are shown in the Table.

<table>
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<th>Commonest Consequences of Renal Failure</th>
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<td>General</td>
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Diagnosis

History and Examination

A careful history may give valuable clues to the nature and duration of the renal disease. Thus knowledge of the earlier presence or absence of proteinuria, haematuria, hypertension, or urinary infection will all be useful. Disturbance of micturition or a family history of renal failure may lead to the diagnosis of bladder neck obstruction or polycystic kidneys. The time of onset of nocturia or polyuria may also give a clue to the duration of the renal failure.

Examination is usually directed towards detecting the complications of renal failure but occasionally signs of diagnostic value are found.

Investigation

This may be considered under the following headings:

Assessment of Renal Function.—The blood urea level is the index most commonly used but, as shown in the Figure, is varied substantially by the diet and gives much less information than the creatinine clearance.

![Blood urea level vs. creatinine clearance](image)


As renal function declines it becomes increasingly important to measure the ability to excrete urea, sodium, and potassium as this will dictate much of the dietary management.

Pathological diagnosis.—This may be surprisingly difficult to achieve, as the end results of several pathological processes may be similar. Furthermore, any renal lesion may become infected and even at necropsy it is sometimes impossible to decide whether the primary disease was pyelonephritis or glomerulonephritis.

The essential step is to determine whether or not there is any urinary tract obstruction, as this must always be relieved. Using large doses of contrast media and renal tomography the radiologist is now able to investigate virtually every patient with chronic renal failure whatever the blood urea level. The presence of obstruction can always be shown, and the retrograde pyelogram has now been relegated to the role of defining more precisely its level and nature. If the kidneys are small and scarred investigation need probably proceed no further; biopsy of small scarred kidneys is difficult and dangerous and seldom produces material of diagnostic value. However, if the kidneys are of normal size there is a case for carrying out a needle biopsy provided that this is done in a specialist unit.

Detection of Urinary Infection.—This should include the microscopic examination of a fresh urine sample and a quantitative bacterial culture.

Detection of the Complications of Renal Failure

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**Treatment**

There are really two aspects to this problem; the first is to treat the underlying renal disease and the second is to make the best possible use of the residual renal function.

**Treatment of the Renal Disease**

**Obstruction.**—This may be at any level and its relief is usually a surgical problem. Assessment of the likely degree of recovery is difficult but it is always worth relieving obstruction when it is found. At worst it should be possible to prevent further deterioration.

**Infection.**—Urinary infection may occur in any patient with renal disease, particularly if there is any abnormality of drainage of the urinary tract. Apart from antibiotics, treatment may well require surgical procedures designed to lower the residual urine volume. Follow-up is essential.

**Hypertension.**—Renal damage produced as a result of arteriolar necrosis is usually irreversible. Nevertheless, occasional patients show slight functional recovery if the blood pressure is well controlled for several weeks. Prevention of such damage is vital and is one of the main reasons for the long term follow-up of patients with chronic renal disease. The development of hypertension should be recognized early and effective treatment started forthwith. The therapeutic importance of salt restriction cannot be overemphasized.

**Glomerulonephritis.**—Once this has progressed to a stage of chronic renal failure treatment of the underlying renal disease is generally unsuccessful. Corticosteroids may be dangerous because of the ease with which they produce severe hypertension and because their action on protein carabolism produces a rise in blood urea level. Other immunosuppressive agents are also likely to be ineffective.

**Metabolic Factors.**—The reversal of chronic hypercalcaemia may be followed by slow improvement in renal function, and it is important not to miss this rare diagnosis. Allopurinol has been used to treat patients with chronic uric acid nephropathy but does not improve renal function, though it may prevent further deterioration. Cessation of analgesic intake usually stops progression of renal failure in patients suffering from analgesic nephropathy.

**Making the Best of Residual Renal Function**

Like any other failing organ the diseased kidney becomes unable to vary its function in response to varying demands. Hence treatment is designed to encourage the patient to take an appropriate amount of fluid and electrolytes and adjust his diet so that accumulation in the circulation of toxic metabolites is kept to a reasonable level.

**Water Balance**

Loss of the ability to concentrate the urine is one of the earliest signs of renal functional impairment; urine volume generally rises to accommodate even a normal solute load, and the patient should be encouraged to maintain a high fluid intake. This must be increased further during an incidental illness, when the solute output may be expected to rise. Unfortunately the illness frequently prevents this because of anorexia or vomiting; the intake may actually fall and the patient becomes dehydrated with a rising blood urea. This situation should not be allowed to occur, but once established it requires fluid replacement, usually by the intravenous route, with either glucose or saline, depending upon the state of sodium balance (v. infra).

As the renal disease moves into a terminal phase the ability to excrete water diminishes so that it is no longer possible for the patient to maintain a high urinary output. Oedema and dilutional hypotraumatia develop and it becomes necessary to restrict the fluid intake.

**Sodium Balance**

Maintenance of correct sodium balance is one of the most important aspects of the management of chronic renal failure. Either excess or deficiency is dangerous and must be recognized early. Regular weighing allows this recognition as major changes can be due only to an alteration of hydration.

**Depletion.**—The ability of the body to conserve sodium is impaired most in those patients whose renal disease is associated with primary damage to the renal tubule. Thus patients with pyelonephritis and obstructive ureopathy are at the greatest risk. Provided that intake is normal this deficit is only rarely important, but if the intake is diminished by inappropriate dietary management, or by incidental illness, severe sodium depletion may occur. This produces contraction of the blood volume, with a fall in renal blood flow and further deterioration in renal function. Commonly this is associated with water depletion and there may be a surprisingly small fall in the serum sodium concentration. Replacement should be via an intravenous route using normal or hypertonic saline according to whether the serum sodium concentration is normal or low. Often relatively large volumes of fluid need to be given rapidly and it is easy to overshoot unless a careful watch is kept on the patient’s neck veins and lung fields.

Lesser degrees of sodium depletion may still be important but relative hard to detect. Frequently the diagnosis can be made only by the therapeutic trial of a sodium supplement in a patient who does not already show signs of sodium overload. During the trial he should be examined repeatedly for the appearance of these signs, and when they do appear the urinary sodium excretion should be measured and the intake reduced to a value just below this. When a patient known to have renal impairment undergoes an elective surgical procedure, it is essential to keep an account of sodium losses from the body and to replace them completely with an additional allowance for unmeasurable losses due to sequestration of fluid within the operative field and intestinal lumen.

**Overloading.**—This leads to expansion of the extracellular fluid volume and produces oedema, hypertension, and heart failure. Though there are other causes for these signs, their appearance suggests the need for sodium restriction.

**Potassium Balance**

Hyperkalaemia is the usual problem in patients with renal failure and is due as much to displacement of intracellular potassium as to overloading of the body as a whole. Its principal danger arises from its effects, combined with those of hypocalcaemia and hypermagnesaemia, on the myocardium. As the plasma level rises from 6 to 9 mEq/l there is a steady increase in the incidence of E.C.G. changes and fatal cardiac arrhythmias. Treatment of minor degrees of intoxication may consist of lowering the potassium intake and administering a cation exchange resin in the sodium or calcium phase. The former is more effective but may be contraindicated by the presence of signs of sodium overload. If the electrocardiogram shows definite abnormalities treatment should be more aggressive and include the intravenous administration of glucose, insulin, and sodium bicarbonate—all of which return potassium to the cells—and calcium gluconate, which protects the myocardium. The effect is usually temporary and preparations should be made for dialysis.

Hypoalcaemia occurs less frequently, usually when renal function is improving rapidly, as after relief of an obstruction or after severe acidosis responding to treatment. Its occurrence can be predicted and replacement therapy started before dangerously low plasma levels have developed.
Nutrition

The principles of the dietary management of renal failure depend on the fact that the metabolites that accumulate in the blood derive almost entirely from protein catabolism. The aim therefore is to give sufficient fat and carbohydrate for all normal metabolic purposes and to restrict the protein intake by a degree which is determined by the severity of the renal functional impairment. The effect of this on the blood urea at any level of renal function is shown in the Figure, and it can be seen that a creatinine clearance level of 10 ml./min. a change in the protein intake from a high to a very low level may change the blood urea from more than 200 mg./100 ml. to 100 mg./100 ml. This change might be associated with loss of the gastrointestinal symptoms of uremia, improvement in general well-being, and a small rise in haemoglobin concentration. There is no evidence that lowering the blood urea in this way to less than 100 mg./100 ml. will improve symptoms further, and it is not worth restricting protein intake to a level below that which achieves this effect.

As renal function declines protein intake must be restricted with increasing severity until the least possible intake compatible with 7 to nitrogen balance is reached. The modified Giovanni diet, which is in general use, restricts protein intake of less than 20 g. daily and it is essential that this is given as protein with the highest possible biological value. Egg and milk provide such proteins but meat and fish are of rather lower quality. Proteins of vegetable origin have a low biological value and should, ideally, be removed entirely from the diet. This raises considerable practical problems because wheat flour contains a large amount of second-class protein and must be replaced by artificial protein-free foods. Several of these are now available on prescription in Britain.

When calculating the amount of dietary protein that can be allowed it is helpful to know the daily urea excretion. This is derived from roughly three times its weight of protein and, provided conditions are fairly stable, it may be assumed that if this quantity of protein is given then the blood urea level will remain constant. If there is heavy proteinuria it is important that the amount of this is added in to the diet.

Acidosis

The urine is the only available route for the excretion of non-volatile acid from the body, and as renal failure develops the patient goes into positive acid balance. In the short term, minor degrees of acidosis seem to be of no importance. In the long term, however, they may well play a major part in causing the osteomalacic component of renal osteodystrophy, and it is logical to treat the patient with sodium bicarbonate.

Severe acidosis produces symptoms and appears to predispose the patient to cardiac arrhythmias, particularly during surgical procedures. This risk also exists immediately following correction of such an acidosis with parenteral bicarbonate. Rapid correction may also lead to tetany and fits due to increase in the protein-bound fraction of the plasma calcium at the expense of the ionized fraction. Thus correction of a severe acidosis should be carried out cautiously with the aim of producing a plasma bicarbonate concentration of about 15 mEq/litre.

Anaemia

A normochromic normocytic anaemia is invariably found in patients with severe renal failure. Its origin is multifactorial, due both to decreased red cell production and to increased red cell destruction. The haemolytic element is partly related to the blood urea level and improves when this is lowered by dietary means.

Treatment other than blood transfusion is generally ineffective and as the rate of red cell destruction is high this produces only a transitory benefit and is best avoided except in special circumstances. There is a risk of precipitating cardiac failure and the blood should be given as packed cells, one unit at a time. Generally speaking, patients tolerate severe chronic anaemia surprisingly well and it is better to accept defeat and leave this complication of chronic renal failure alone.

Increased Susceptibility to Infection

Patients with renal failure are both more susceptible and more vulnerable to infection than normal. The scarred urinary tract readily becomes infected and provides a route for the development of sepsicaemia. Defences against this may be weakened by impairment of polymorph function and of antibody production and the increased protein catabolism produces a rapid rise in blood urea.

The associated illness may prevent the patient eating and drinking and he becomes dehydrated. It is essential that infection is diagnosed and treated early, and preference should be given for the use of bacteriical rather than of bacteostatic drugs. However, the effect of renal failure on the pharmacology of these drugs should not be forgotten.

Renal Osteodystrophy

Symptomatic bone disease is rare and develops only when severe renal failure has been present for many years. Treatment is difficult and includes the cautious administration to selected patients of very large doses of Vitamin D. The main hazard is of hypercalcaemia, which may produce metastatic calcification and further deterioration in renal function. Occasional patients with severe secondary hyperparathyroidism require parathyroidectomy.

Pericarditis

The development of this complication of renal failure heralds the end of the illness. In itself it usually matters little, though it may be painful. Very rarely it is complicated by pericardial tamponade which requires drainage.

Acute on Chronic Renal Failure

Self-evidently the patient with chronic renal failure may lead a rather precarious existence, with periods of fair health punctuated by severe illnesses precipitated by relatively minor incidents. If, however, his renal disease is not progressive he may survive in this state for several years provided that he can be tided over the various crises. Simple correction of salt and water balance and control of infection may be sufficient but from time to time he may require temporary dialysis. Even though it may not be possible to offer him maintenance dialysis, short-term support should always be considered.