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The efficacy and adequacy of continuous ambulatory peritoneal dialysis

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SUMMARY

Since it was introduced in 1976, continuous ambulatory peritoneal dialysis (CAPD) has won acceptance in many centres and it is now regarded as an important alternative to haemodialysis. CAPD patients have comparable and, in some circumstances, better survival than those on chronic haemodialysis. It is indicated particularly in patients with diabetes mellitus, cardiovascular instability and at the extremes of life. The success of kidney transplantation is similar in those maintained on CAPD and on haemodialysis. CAPD also achieves satisfactory physical and psychological rehabilitation, and the quality of life, including the level of sexual function, is similar during CAPD and haemodialysis. Women on CAPD menstruate more often than those on haemodialysis. CAPD provides adequate clearance of metabolic wastes, maintains fluid balance and ameliorates neurotoxic cognitive dysfunction. CAPD gives control of hypertension and anaemia which is superior to that on haemodialysis. Neuropathy remains stable but osteitis fibrosa seems to progress. CAPD is the most economical of the various forms of dialysis. We conclude that CAPD is an adequate form of replacement and should be made available in every nephrology centre providing treatment for patients with end-stage renal disease.

INTRODUCTION

Continuous ambulatory peritoneal dialysis (CAPD) was introduced in 1976[1] and soon became one of the most popular modes of home dialysis. There is no single qualitative or quantitative index by which to evaluate the efficacy of CAPD. This paper will present evidence to suggest that CAPD provides adequate dialysis according to the following criteria:

1) It sustains life in patients with end-stage renal disease (ESRD).
2) It maintains patients in a satisfactory condition while awaiting a kidney transplant, and it does not adversely affect the results of transplantation; if the latter fails, CAPD can be recommenced after transplant nephrectomy.
3) It provides a satisfactory quality of life as indicated by adequate rehabilitation and sexual activity.
4) It can sustain children, and facilitate their growth.
5) It can provide adequate biochemical control.
6) It can arrest or even ameliorate uraemic complications.

Furthermore, it is an inexpensive process.

In addition the adequacy of CAPD will be demonstrated by comparing its results with those of the more firmly established dialysis modality — chronic haemodialysis.

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SURVIVAL ON CAPD

In Toronto Western Hospital, survival at the end of 1, 2, 3, 4, 5 years is 90%, 80%, 70%, 65% and 46% respectively (Fig 1). The attrition rate is about 10% per year.

Data concerning the various forms of dialysis used in Canada in 1981-1982[2] shows that the non-diabetic CAPD patients (n = 596), who were, on average, 4 years older than those on haemodialysis, have a 90% and 80% chance of survival at the end of 12 and 24 months respectively. During this same period, the non-diabetics on haemodialysis (n = 1161) had a survival rate of 85% and 75%. At the end of two years, the probability of dropout (failures and deaths together) was 48% on CAPD, and 41% on haemodialysis. Thus by these criteria the two modalities were comparable.

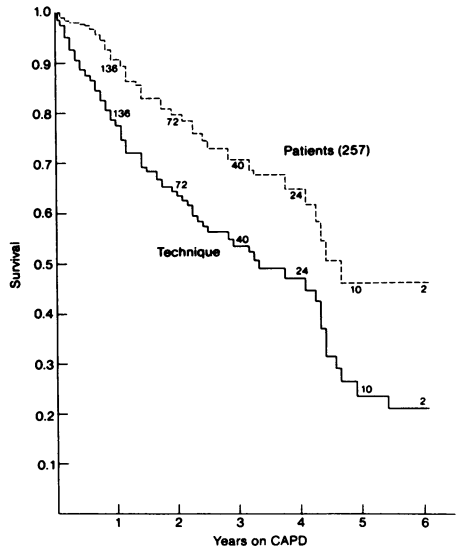

Fig. 1. Cumulative patient and technique survival in 257 CAPD patients at the Toronto Western Hospital.

The European Dialysis and Transplant Association (EDTA) studied a large number of CAPD patients and compared them with patients on other replacement therapies.[3] They had 3607 patients registered on CAPD by the end of December 1982. Their data showed that the survival of CAPD patients in various age groups is comparable with that on other modalities (Tables Ia and Ib). In all age groups, survival of diabetics on CAPD at one year was consistently better than that of the general diabetic population on renal replacement therapy, although no statistical analysis was provided.

TABLE Ia

One-year survival among non-diabetic patients with end-stage renal disease being treated with kidney replacement therapy in Europe

	Therapy (% of patients alive)			
Age (year)	*Haemodialysis*(1)	*CAPD*	*Cadaveric transplant*	*Any kidney replacement therapy*(2)
15 – 34		97	93	93
35 – 44		96	90	91
45 – 54	90	92	84	90
55 – 64		84	77	85
65		75	77	76

(1) Value extracted from a figure.

(2) Irrespective of any subsequent changes in the mode of treatment.

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TABLE Ib

One-year survival among diabetic patients with end-stage renal disease being treated with kidney replacement therapy in Europe

	Therapy (% of patients alive)			
Any (year)	Haemodialysis[1]	CAPD	Cadaveric transplant	Any kidney replacement therapy[2]
15 – 34		92	72	77
35 – 44		77	77	73
45 – 54	72	80	63	71
55 – 64		71		70
65				58

(1) Number extracted from a figure.
(2) Irrespective of any subsequent changes in the mode of treatment.

Of the factors which influence survival, the most important are age, diabetes, pre-existing cardiovascular disease and depression at the onset of treatment. Survival at four years for patients younger than 40 years, those between 40 and 59, and those older than 60 were 95%, 72% and 40% respectively. This is not surprising because, in general, younger patients are healthier and have fewer cardiovascular and metabolic complications.

Patients with end-stage renal failure due to diabetes are particularly difficult to treat. They have multiple system involvement and significant impairment of visual acuity. Their survival on intermittent peritoneal dialysis is poor.[4] Many diabetics with end-stage renal failure, even those who are blind, are now treated with CAPD.[5] At the Toronto Western Hospital, the overall survival of the insulin-dependent (Type I) diabetics on CAPD is 89%, 65%, 58% and 58% at the end of 1, 2, 3 and 4 years, compared with 92%, 81%, 72% and 66% for non-diabetics.

In a previous study,[6] we demonstrated that patients with pre-existing cardiovascular disease have a lower survival than those who do not have cardiovascular disease at the start of CAPD.

In a selected group of low-risk patients (i.e. those aged between 20 and 60 without co-existing systemic diseases such as diabetes mellitus, vasculitis, scleroderma, amyloidosis and multiple myeloma and without pre-existing cardiovascular complications such as angina pectoris, myocardial infarction and hypertensive cardiomyopathy), we found a 100% survival at the end of 4 years on CAPD (Fig 2).

CAPD AND KIDNEY TRANSPLANTATION

Among CAPD patients awaiting transplantation, the principal risk factors which are related to peritoneal dialysis and may affect the outcome are peritonitis, perforation of peritoneal cavity during the procedure and catheter skin exit infections. Patient and graft survival are comparable in patients who were maintained on haemodialysis or peritoneal dialysis before transplantation.[7] Problems with the catheter and exit-site are uncommon and can be managed

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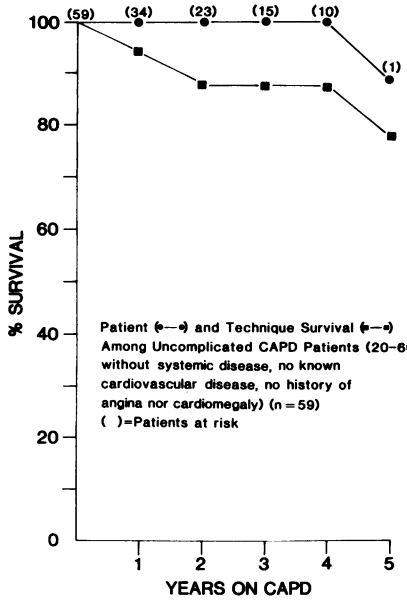

Fig. 2. Survival of low risk patients on CAPD (See text for the definition of 'low-risk')

without complications.[8] If peritonitis develops in the post-operative period, it can be treated easily with antibiotics and early removal of the catheter. Immunosuppressive therapy does not increase the incidence and severity of peritonitis.

Patients in whom renal transplantation fails can be treated again by CAPD. Of 22 such patients who returned to our CAPD programme, survival was 84% at the end of the first year, and 73% at the end of the second year. These figures are slightly lower than those for the general CAPD population, probably because these patients had multiple problems, such as rejection, intensive treatment with cytotoxic drugs and repeated episodes of severe infection. These patients did not have a higher incidence of peritonitis than the general CAPD population.

QUALITY OF LIFE

It is difficult to measure quality of life. Sometimes it can only be inferred from the patient's activity level, employment status, sexual activity and relationship with the other family members.

A review of the level of rehabilitation among the patients in our programme at the end of 1983 (Table II), showed that 38% were working full-time — either in employment or as homemakers with normal activity. The level of the rehabilitation in work scale is low because a large proportion of our patients were over the retirement age; this result is not significantly different from that reported for a large population of ESRD patients on haemodialysis.[9] Fifty-four per cent of our patients claimed that their daily activity was normal. Among the 59 young

TABLE II

Rehabilitation of 86 patients on Toronto Western Hospital CAPD programme on 31 December, 1983

Occupational status		*(%)*	*Daily activity*		*(%)*
Full-time	12	(14)	Normal	54	(63)
Part-time	0		Restricted	26	
Sick leave	6		Requires care	5	
Homemaker (normal activity)	21	(24)	Confined to bed	0	
Homemaker (restricted)	10				
Unemployed	11				
Retired (normal activity)	11	(13)			
Retired (restricted)	14				

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patients without systemic complications (as defined previously), 64% were fully rehabilitated and 85% had normal daily activities.

In a retrospective multicentre survey of the demography, physical activity and employment status of CAPD and haemodialysis patients carried out by questionnaires, Fragola et al[10] found that 68% of the non-diabetic and 48% of the diabetic CAPD patients were capable of greater activities than self-care. Corresponding figures for haemodialysis patients were 59% and 23% respectively. These differences were statistically significant.

Churchill et al tried a new approach in measuring the quality of life in dialysis and transplant patients which they have called the 'time trade-off' technique.[11] The patients were given a hypothetical choice: they could either continue in their present state of health with its physical, emotional and social limitations for a lifetime (t) (determined from actuarial data) or they could choose a shorter time (x) in a state of full health except for the normal ageing process. The value (x/t) is an index of the health state or the perceived quality of life for the individual. They found that the mean values for hospital-based haemodialysis, CAPD and transplantation patients were 0.57, 0.57 and 0.80 respectively.

Sexual function

Sexual dysfunction is common in patients with chronic renal failure and those on dialysis.[12] The patient and the partner are under constant physical and psychological stress. They have to adjust every aspect of daily living to the restraint of dialysis. The patient's illness may force the spouse to change roles in earning income, assuming responsibility for housework and raising of the family. This change produces great stress, and frequently the patient may not be able to accept the new role. In addition to these psychological factors, a concomitant abnormal metabolic and hormonal status may produce a sexual dysfunction. Abnormal sex hormone homeostasis has been implicated in patients with renal failure.[13-15] Sexual dysfunction has been attributed to impaired pituitary function with inadequate levels of FSH and LH, high level of prolactin and low level of zinc.[16, 17] In addition, CAPD patients may find the body image distorted by the presence of the catheter, the empty bag and the dialysis solution in the abdomen, and this may impair libido further. Burton et al[18] showed that substantial numbers of dialysis patients, whether on haemodialysis or CAPD, reported marriage strain, sexual dysfunction, and altered perceptions of sexual identity and attractiveness. However, patients undergoing haemodialysis complained significantly more often about all four kinds of marital-sexual stress than did patients on CAPD.

Resumption of menses

Most women do not menstruate while on maintenance haemodialysis. Galler et al[19] reported that 86% of those on CAPD and only 25% of those on haemodialysis have regular menses. Frequently, amenorrhoeic females on haemodialysis resume menstruation after being started on CAPD. Even though the ovulatory cycle is still rare, resumption of menstruation often has a beneficial psychological effect on women with renal disease.

Pregnancy is still a rare event among women on dialysis and successful pregnancies with a live birth are even more unlikely. Kioko et al[20] described a successful pregnancy in a 26-year-old woman with advanced diabetic nephropathy treated with CAPD. The pregnancy was carried to 34 weeks and an infant

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of 1.7 kg was delivered by Caesarean section. Two other women on CAPD became pregnant,[21, 22] but both ended in spontaneous abortion at 13 and 32 weeks.

CAPD IN CHILDREN WITH ESRD

CAPD has made an important contribution to the treatment of children with ESRD, especially the very small ones.[23]

Baum et al[24] compared two groups of children, one treated by CAPD and the other by haemodialysis. In the children on CAPD, protein and caloric intakes were higher and the growth rate was slightly faster but the difference did not reach statistical significance. CAPD treatment was more cost-effective than haemodialysis. In another report,[25] Balfe reported that children treated by CAPD grew faster than those treated by haemodialysis, although the growth was still not as good as in children with successful renal transplants. It appears that children with end-stage renal failure would have a growth rate which would approach normal, if one controlled hyperparathyroidism and gave optimal nutrition. Kohaut,[26] who described significant catch-up growth in children treated with CAPD, stressed the importance of careful and intensive management of hyperparathyroidism and close attention to nutritional needs; the children in the latter study ingested about 2g of protein/kg of bodyweight. Thus CAPD makes it possible to liberalise the diet and fluid intake in a group of patients who are particularly difficult to manage.

BIOCHEMICAL CONTROL

In most individuals CAPD with eight litres per day (i.e. 4 × 2 litre exchanges) stabilises the biochemical abnormalities (Table III). The following observations about serum potassium and phosphorus may be of particular interest:

Potassium: Each day CAPD removes approximately 25 to 35 mmol of potassium, and some CAPD patients become hypokalaemic despite a liberal potassium intake (60-80 mmol/day). This may be due to increased potassium loss from the gastrointestinal tract,[27] or intracellular accumulation of this ion associated with absorption of glucose from the dialysate or urinary loss, e.g. in a patient receiving large doses of furosemide.

Phosphorus: CAPD alone does not remove enough phosphorus to keep the serum phosphorus at normal levels. Most patients also require a phosphorus-restricted diet and/or a phosphorus binder but in a dose smaller than that required in haemodialysis. Aluminum binders are unpalatable, may aggravate constipation and even precipitate diverticulitis, and may contribute to the development of osteomalacia and dialysis dementia. The risk of these complications can be minimised by using a magnesium-free dialysate in combination with phosphorus binders containing a mixture of magnesium hydroxide and aluminium hydroxide. This mixture. which has a mild laxative effect, binds phosphorus with a lower dose of aluminium hydroxide and is more palatable.

FLUID INTAKE

One can be more liberal with fluid intake in CAPD than in haemodialysis because ultrafiltration is continuous and thirst is decreased. Large volumes of ultrafiltrate can be removed by the use of hypertonic (4.25% dextrose) exchanges — 600-800 ml/exchange. Recently, however, we have been advising our patients

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TABLE III

The blood biochemical values of patients on four × 2 litre exchanges/day, after one year of CAPD treatment

	Four bag days
	Mean ± std dev.
Blood urea nitrogen (mg%)	54.1 ± 16.6
Creatinine (mg%)	11.5 ± 1.5
Calcium (mg%)	9.3 ± 0.64
Phosphorus (mg%)	4.2 ± 0.75
Uric acid mg%	6.9 ± 1.03
Total protein gm%	6.3 ± 0.93
Albumin gm%	3.2 ± 0.44
Potassium mEq/l	4.0 ± 0.59
Cholesterol mg%	237.2 ± 80.7
Triglycerides mg%	299.3 ± 134.2
Haemoglobin gm%	9.3 ± 1.9
Platelets (x 100/mm^3)	501.3 ± 106.41

against the liberal use of water because frequent hypertonic exchanges lead to increased glucose absorption with all its consequences — lipid abnormalities, obesity and possibly damage to the peritoneum.

CAPD AND URAEMIC COMPLICATIONS

Control of hypertension

Blood pressure is controlled easily in patients on CAPD and usually returns to normal during the first few weeks. We measured blood pressure in 197 patients, before and after CAPD. Before starting CAPD, 77% of the patients had hypertension, defined as a systolic >160 mmHg and/or a diastolic >90 mmHg; all were on antihypertensive medication and only 23% had a normal blood pressure. While on CAPD, 74% of those who initially were hypertensive became normotensive and required no further medication. Another 20% had normal blood pressure on antihypertensive medication, but the dosage was smaller than before. Of the patients who initially were hypertensive, 6% remained hypertensive. Because of the ease with which hypertension is brought under control occasionally we have started CAPD on patients suffering from intractable hypertension, even though their renal failure had not advanced to the point where they required dialysis.

Leenen et al[28] studied with serial M mode echocardiography 17 CAPD patients all of whom had a history of hypertension and had echocardiographic evidence of increased LV (left-ventricular) mass related to both concentric and eccentric hypertrophy. On CAPD the blood pressure returned to normal consistently. In 14 of 17 patients, left-ventricular mass decreased as a result of reduction in both LV wall thickness and LV dimension. Repeat echocardiography showed improvement in three of four patients who initially had impaired LV function. These workers concluded that CAPD improves LV hypertrophy by normalising pressure and volume overload of the left ventricle.

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Control of anaemia

The average haematocrit is 30-35% and the average haemoglobin is about 9-10 g/dl in the CAPD patients. These patients require transfusions and anabolic steroids less frequently than those on haemodialysis.[29] Frequently it has been observed that haemoglobin and haematocrit increase in patients transferred from haemodialysis to CAPD.[30]

In 34 patients on CAPD, DePaepe et al[31] found a significant increase in haemoglobin and haematocrit in the first 6 months of CAPD. The elevated haematocrit represents a combination of true increase in red cell mass and a decrease in plasma volume. The serum PTH and ferritin remained unchanged. Zappacosta also found a significant increase in haematocrit in four of nine CAPD patients,[32] and it appears that those who respond to CAPD are those who have high erythropoietin levels. Three of the four responders had polycystic kidney disease.

As yet we have no explanation for the improvement of erythropoiesis in patients on CAPD. Lamperi et al confirmed the improved erythropoiesis by *in vitro* studies of the colony-formation capacity of the bone marrow cells but found no correlation between the rise in haematocrit levels and the serum erythropoietin levels.[33] They suggested that the improved erythropoiesis results from the removal by CAPD of toxic factor(s), which suppress bone marrow. Hefti et al, who studied red cell survival in 11 CAPD patients, found that the reduction in red cell survival still persisted — the mean 51 Cr red cell half-life was 20 days.[34]

Pericarditis

The incidence of pericarditis in patients with ERSD is reported to be 32%-41%,[35,36] but, with earlier and more effective dialysis, uraemic pericarditis can be prevented. The incidence of uraemic pericarditis among patients on chronic haemodialysis varies from 10% to 18%.[37,38] Pericarditis is an infrequent complication among our CAPD patients. Since the beginning of our programme, we have encountered only 9 episodes of pericarditis among 257 patients. None of these developed tamponade; one developed pericarditis following a reactivation of systemic lupus erythematosus.

Neuropathy

Neuropathy was identified as a complication of advanced renal failure in 1961,[39] but its cause remains an enigma. Frequently it has been attributed to an accumulation of uraemic toxins of middle molecular size.[40] Initially we hoped that CAPD patients might have a lower incidence and slower progression of uraemic neuropathy than those on haemodialysis or intermittent PD because it achieves a better clearance of middle molecules.

We have studied the electrophysiological parameters in 23 non-diabetics and 6 diabetics who have been on CAPD for three years or more. Figs 3a and 3b show the sequential motor and sensory conduction velocities in these patients. Linear regression analysis of nerve conduction velocity as a function of time showed no significant change following dialysis. Motor nerve conduction velocities in diabetic patients also remained unchanged. These data suggest that peripheral neuropathy does not progress in patients on CAPD for prolonged periods. Contrary to our findings, Lindholm et al[41] showed that peripheral neuropathy may worsen during CAPD. However, the presence in their study of a marked predominance of males may have influenced their results, because men are more prone to uraemic neuropathy than women.[42]

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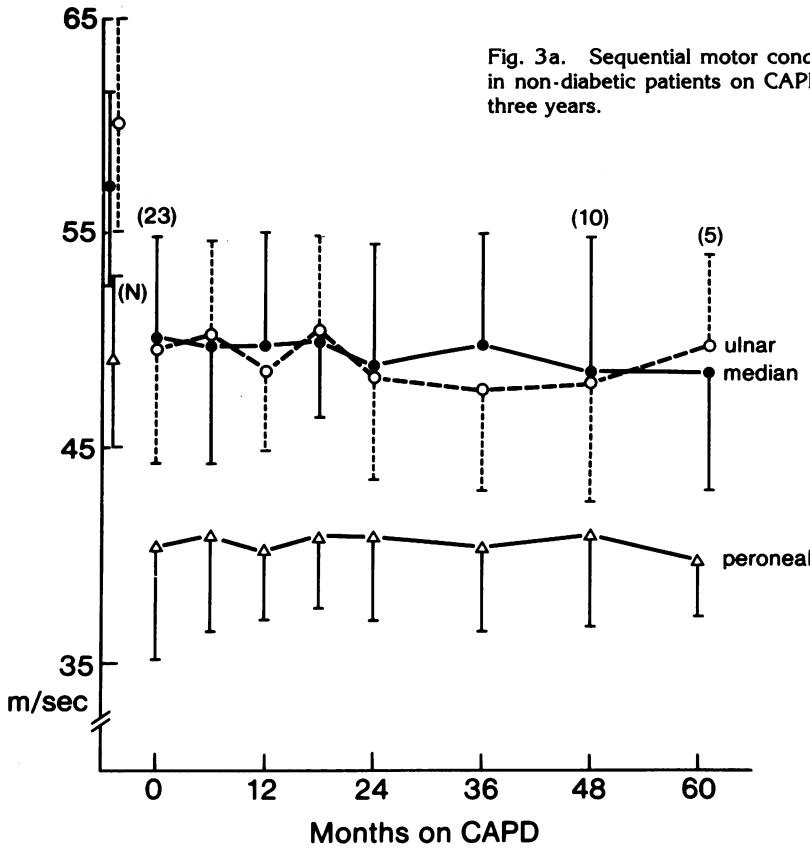

Fig. 3a. Sequential motor conduction velocities in non-diabetic patients on CAPD for more than three years.

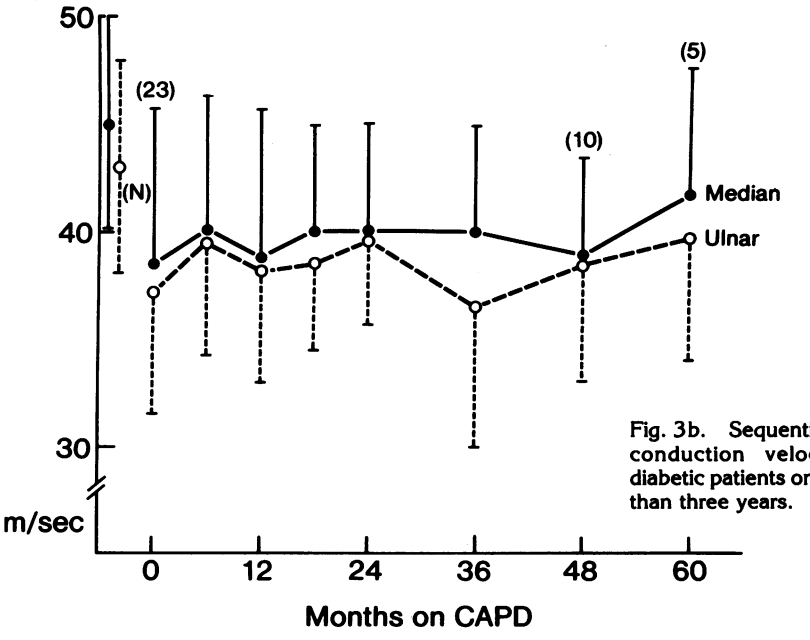

Fig. 3b. Sequential sensory nerve conduction velocities in non-diabetic patients on CAPD for more than three years.

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Cognitive function

A large proportion of patients with advanced renal failure have a significant degree of cognitive dysfunction which is attributed to neurotoxicity before treatment. Kenny[43] developed an 'impairment index' to assess cognitive dysfunction in individual CAPD patients. This index, which ranges from 0.0 (no impairment) to 1.0 (severe impairment), is calculated on the basis of eight psychometric tests. He studied 46 patients over 12 months of CAPD treatment. In the beginning, only 37% of them had normal cognitive function (score 0.0 – 0.2), whereas 22.7% had markedly impaired function (score > 5.0). At the end of one year, 59% had normal cognitive function and the proportion of those with markedly impaired scores dropped to 13%. The population of non-impaired patients increases up to 70% after treatment for two years or more.

Renal osteodystrophy

Renal osteodystrophy is a major complication of long-term dialysis. With the better control of serum phosphorus, one would expect improvement in the course of renal osteodystrophy in CAPD patients. So far the results have been conflicting. Tielemans et al[44] found that osteitis fibrosa progressed in 15 patients who were on CAPD for 7 to 28 months. Teitelbaum et al[45] studied six CAPD patients by repeated bone biopsies and found that osteomalacia improved whereas the osteitis fibrosa worsened. Gokal et al[46] studied 40 CAPD patients dialysed with a dialysate calcium of 7 mg/dl and found improvement of both osteomalacia and osteitis fibrosa during the first year. The parathyroid hormone level declined in three-quarters of the patients. Digenis et al[47] reviewed the radiological evidence of renal osteodystrophy in 27 patients who had been on CAPD for three years or more. According to the radiological findings at the beginning of the treatment, they divided these 27 patients (10 males and 17 females) into two groups: Group A (10 patients) included those who had no subperiosteal resorption, and group B (17 patients) those with increased subperiosteal resorption. In group A, the radiological findings remained normal in 8 and progressed in 2. In group B, subperiosteal resorption remained unchanged or progressed in 14, while it improved in the other 3. Plasma PTH levels paralleled the radiological changes. Of the 27, 7 developed spontaneous fractures which, however, healed with callus formation. Thus secondary hyperparathyroidism persists in patients on long-term CAPD in our experience; this may be due to a low dialysate calcium and low oral calcium intake.

Abnormalities in lipid metabolism

Almost one-half of those on CAPD develop hypertriglyceridaemia, which has been attributed to the large load of glucose (150-200 g) absorbed daily from the dialysate.

In a prospective study of the effect of three to six months on CAPD[48] on serum lipids, we found that patients with high triglycerides before starting CAPD continued to have high levels, which, in some, rose even further. The VLDL cholesterol also increased whereas HDL cholesterol did not change. Serum triglyceride and cholesterol levels remained normal in those who had normal lipid profiles at the start of CAPD. After three to six months of CAPD, the HDL cholesterol increased significantly in this group. Lindholm et al[49] also found that the serum lipids remained normal in a large proportion of their CAPD patients.

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Hypotension and peripheral vascular disease

CAPD controls blood pressure so effectively that occasionally these patients develop orthostatic hypotension. Brown et al[50] reported that a drop in the systemic blood pressure and in the already impaired perfusion of the ischemic limbs could exacerbate symptoms of peripheral vascular disease. It may be necessary to remove patients from CAPD and allow their blood pressure to increase so as to alleviate the symptoms of peripheral vascular disease. Leenen et al[51] studied 5 symptomatic, hypotensive patients before and after oral salt loading, during which they did not allow a concomitant increase of body weight. The patients received between 85 and 170 mmol of sodium per day in addition to the original daily intake. Salt-loading lasted two to three weeks. Supine blood pressure increased markedly after salt loading, from 94/67 mmHg to 121/78 mmHg, and the symptoms of orthostatic hypotension disappeared. Salt-loading appears to confer its benefits by increasing extracellular fluid volume and sympathetic tone, as assessed by plasma norepinephrine levels and the pressor responsiveness to norepinephrine.

Causes of death

Of 257 patients on our CAPD programme, 42 had died. Sixteen died of cardiovascular causes and 10 died suddenly. We believe that most of the latter died of cardiac causes, because most of them had evidence of cardiac abnormalities on routine tests before death and none had electrolyte disturbances. Thus cardiovascular deaths accounted for more than one-half of the deaths on CAPD. Seven patients died of peritonitis. They either had a *Staphylococcus aureus* infection or faecal peritonitis due to perforation of viscus. The remaining 9 deaths were due to causes such as pancreatitis, withdrawal from dialysis and malignancies.

COMPARISON OF THE COSTS OF THE VARIOUS MODES OF DIALYSIS

The most expensive part of any dialysis therapy is the services of medical personnel and the provision of equipment. CAPD achieves the most effective reduction in labour costs because the patient carries out the entire procedure. This mode requires only minimal equipment. The Toronto ESRD Task Force has calculated that (per patient year) CAPD costs much less than centre peritoneal dialysis and haemodialysis.[52] It is also cheaper than home dialysis.[52, 53] In Toronto (1983) CAPD costs Can $15,000 per patient year compared with Can $27,000 for centre haemodialysis and Can $18,000 for home haemodialysis.

Most centres refer patients of advanced age and those with cardiovascular diseases to the CAPD programme because it achieves a stable haemodynamic and biochemical condition. These patients tend to have multiple medical problems and hence to require frequent admissions which invariably add to the total cost of CAPD.

Even though CAPD is less expensive than hospital or facility based haemodialysis, it still remains relatively expensive and we should continue our efforts to lower the cost of dialysis solutions — the main expense. We can reduce the cost of CAPD by decreasing the frequency of exchanges from four to three per day, using either 2 or 3 litre bags. This modification would lower the total cost of dialysis solution but also would reduce the cost of peritonitis treatment, because the frequency of

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peritonitis is much lower in those using three exchanges per day.[54] At a time when economic resources are limited, reducing the cost of renal replacement therapy to a minimum will enable physicians to treat more patients with end-stage renal failure.

CONCLUSION

As this paper explains, CAPD provides adequate removal of metabolic wastes, ameliorates some of the common long-term complications and restores disturbed physiology towards normal in end-stage renal failure. Thus CAPD is an important treatment for patients with end-stage renal disease. While it is the treatment of choice for some patients it may not be tolerated by others who then will be maintained by haemodialysis. Centres which cannot provide both haemodialysis and CAPD with equally high standards function under a considerable handicap.

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