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Five years experience of haemodialysis at the Lagos University Teaching Hospital — November 1981 to November 1986

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Summary

The Dialysis Centre at the Lagos University Teaching Hospital became operational in November 1981 and caters for acute haemodialysis, chronic maintenance haemodialysis and continuous arteriovenous haemofiltration. In the past 5 years, over 600 patients had presented out of whom 245 could be accommodated within the realities of available facilities and patients' financial status. Of the 245 patients, 25 were discharged against medical advice and five were transferred to hospitals abroad but did not survive.

There were 117 patients in end-stage renal failure (ESRF), 75 males, 42 females, ratio M:F 1.8:1, age range 13–69 years, mean 37.5. There were 51 males and 47 females in acute renal failure (ARF), ratio 1.1:1, age range 13–76 years, mean age 32.3 (Table 1).

All patients in ESRF had moderate to severe hypertension (diastolic pressure of ⩾ 120 mmHg or 22.1 kPa) and a creatinine clearance of ⩽ 5 ml/min and about 75% had established cardiac decompensation. Full pertinent investigations were precluded or contra-indicated in most patients in ESRF because of late presentation.

In only 13 patients was renal biopsy performed and the pathohistologies were:end stage renal disease (8), chronic glomerulonephritis (4) and glomerulosclerosis (1).

In ARF the cause of the renal damage was multifactorial in 66.7%, with sepsis being the direct cause of death in 60.0%. The commonest conditions were septicaemia (61.4%), nephrotoxin (17.2%), trauma (31.3%), septic abortion (33.3%) and toxaemia of pregnancy (29.0%) (Table 2).

The dialysis associated complications which were encountered included shunt infection (7%), burst membrane (9%), suspected pyrogen reaction (5.6%) and femoral vein perforation (0.9%).

The survival rate was 66.3% for ARF and 31.6% for ESRF. The mortalities of 68.4% for ESRF and 33.7% for ARF were significantly lower than 100% and 70% respectively before the inception of the centre.

The argument that dialytic therapy is not yet a priority in the third world countries is untenable because many of our patients with severe hypertension presenting in terminal renal failure lie in the age group 20–50 years. This is the age group involved in gainful employment in the community and constituted 79.5% of our patient population. If they do not receive treatment here they will be transferred abroad costing a large amount in foreign exchange.

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Résumé

Le Centre de Dialyse à Hopital D'enseignement de l'universite de Lagos (LUTH) est devenu opérationnel en Novembre 1981, et s'occupe de la nourriture pour l'hémodialyse aiguë, l'hémodialyse chronique d'entretien et l'hémofiltration artère-veineuse continue. Depuis 5 ans, plus de 600 malades eurent présentés, dont 245 auront été acceptés, en vue de la réalité d'equipement disponible et la situation financière de malades. Sur 245 malades, 25 sont renvoyés chez soi contre l'avis médical. Cinq ont été renoyé aux hôpitaux étrangères sans survivants.

Table 1. Number and percentage of acute renal failure (ARF) and end-stage renal failure (ESRF) patients

	Male		Female		
	No.	Percentage	No.	Percentage	Percentage of total
ARF (n = 98)					
Alive	35	35.8	31	31.6	67.4
Dead	16	16.3	16	16.3	32.6
ESRF (n = 117)					
Alive	26	22.2	11	9.4	31.6
Dead	49	41.9	31	26.5	68.4
Patients discharged against medical advice	16*		9*		
Patients transferred to hospitals abroad					
Alive	0		0		
Dead	3*		2*		

*Not included.

Il ya été 117 malades en insuffisance rénale terminales (ESRF), 75 mâles, 42 femelles, à la proportion de M:F 1.8:1. Âgés de 13–69 ans, moyenne 37.5. Il y avaient 51 mâles et 47 femelles avec l'insuffisance rénales aiguë, à la proportion de 1.1:1; âgés de 13–76 ans, moyenne âge 32.3 ans (Table 1).

Tous les malades en insuffisance rénale terminale ESRF eurent l'hypertension artérielle à modérée ou sévère (tension à diastole 150 mmHg ou 22.1 kPa) et le débit de dégagement de créatinine de 5 ml/min et autour de 75% eurent la décompression cardiaque établisée. Tous les examens complémentaires nécessaire étaient exclu ou sont interdit chez beaucoup de malades en ESRF à cause de présentation tardive.

Le biopsie rénale ont été réalisée chez 13 malades, dont la pathologie histologique étaient: maladie rénale terminale (8), glomérulonéphrite chronique (4) et glomérulosclérose (1).

Dans l'insuffisance rénale aiguë, la cause d'insulte était multifacteur chez 66.7%. La cause directe de morte chez 60.0% étant séptiques. Les conditions les plus communes étaient sépticémies (61.4%), nephrotoxine (17.2%), traumatisme (31.3%), l'avortement séptique (33.3%), et toxémie de grossesse (29.0%) (Table 2). Quinze malades ont présenté en insuffisance rénale aiguë non-oligurique.

Les complications associées de la dialyse ont inclu l'infection de fistule (7%), la rupture de membrane (9%), la réaction pyrogènes suspectée (5.6%) et la perforation de vein fémoral (0.9%).

Le pourcentage de survie fut 66.3% pour l'insuffisance rénale aiguë (ARF) et 31.6% pour l'insuffisance rénale chronique terminale (ESRF). Les mortalités de 68.4% pour ESRF et 33.7% pour ARF furent significativement basse que 100% respectivement avant le commencement du Centre.

L'argument que la dialyse-thérapie n'est pas encore la priorité de pays de tiers monde n'est pas défendable, parce que beaucoup de nos malades avec l'hypertention artérielle sévères presentant à l'insuffisance rénale terminale sont allongés des âges 20–50 ans. Cette tranche d'âges que constituent les mains d'ouvres importants de la communauté ont fait 79.5% de la population de nos malades, et s'ils n'ont pas été soignés ici, ils seront envoyés à l'étrangères coutant la somme colosalle en devises étrangères.

Table 2. Conditions causing acute renal failure

	Surgical (n = 16)				Medical (n = 58)				Obstetric and gynaecological	
	Male	Percentage of group	Female	Percentage of group	Male	Percentage of group	Female	Percentage of group	Female	Percentage of group
Obstruction	3	18.8								
Burns	1	6.2								
Trauma	5	31.3								
Fracture	1	6.2	1	6.2						
Peritonitis	4	25.0								
Septicaemia					18	31.0	8	13.8		
Typhoid fever					8	13.8	2	3.4		
Nephrotoxin					7	12.1	3	5.2	1	3.2
Rapidly progressive acute glomerulo-nephritis					1	1.7	3	5.2		
Hypovolaemia					4	6.9	1	1.7		
Viral hepatitis					1	1.7	1	1.7		
Malignancy			1	6.2			1	1.7		
Septic abortion									10	32.3
Puerperal sepsis									3	9.7
Pre-eclampsia + eclampsia									9	29.0
Carcinoma of cervix and vesicovaginal fistula									5	16.1
Post-partum haemorrhage									3	9.7
Percentage of total (n = 15)		15.2						55.2		29.6

Introduction

Once renal function falls to less than about 2–4% of normal (glomerular filteration rate < 5 ml/min) either acutely or chronically, life cannot usually be sustained for any great length of time without recourse to artificial means.

Haemodialysis is the therapy utilized to ameliorate and/or prevent evolution of uraemic features. Dialysis replaces kidney function in three principal areas: removal of waste metabolites, removal of excess fluid and restoration of acid base and electrolyte balances. It is a blood purification technique where low molecular weight substances are removed by diffusion across a semipermeable membrane while large molecules such as proteins are retained. The electrolyte concentrations in the dialysate fluid are adjusted to maintain normal blood levels of these ions and the volume of body fluid is controlled by ultrafiltration, but control of acid base balance is seldom optimal. Haemodialysis now has an established role in the treatment of renal failure and the technical problems associated with dialysis and difficulty in gaining access to patients' circulation have now been overcome [1,2].

Since the inception of the Dialysis Centre there has been a greater awareness of the dialytic mode of therapy for both acute and chronic renal failure. In this report we highlight our 5 years experience of haemodialysis at the Lagos University Teaching Hospital — November 1981 to November 1986.

Subjects and methods

Patients

CRF. There were 117 patients aged 13–69 years (mean 37.5) with a male:female ratio of 1.8:1. Patients usually presented at the terminal stage of chronic renal failure. Clinical features included sallow complexion, anuria, oliguria, disturbed sensorium, cardiomegaly, pallor, periorbital and/or peripheral pitting oedema and high systemic blood pressure. Seventy-five per cent of the patients showed clinical evidence of cardiomegaly, confirmed by chest X-ray and electrocardiography.

ARF. There were 98 patients comprising 57 medical, 12 surgical and 29 obstetric and gynaecological cases. Eighty-three were oligurical and 15 were non-oliguric (daily urine volume ≤ 400 mls, and > 400 mls, respectively).

Five of the 10 medical patients whose acute renal failure (ARF) was due to nephrotoxin belonged to a religious organization and the nephrotoxin was apparently a greenish blue solution termed 'Holy Water'. The nephrotoxin was unidentified in the five patients who had intravascular haemolysis as exhibited by pallor, mild jaundice and haemoglobinuria. Four of the medical patients had rapidly progressive glomerulonephritis as confirmed on histopathology of the necropsy material.

Of the 12 surgical patients, five were victims of armed robbery and sustained multiple gun shot wounds and fractures complicated by sepsis. Peritonitis due to perforation of the intestine was present in three and hypovolaemia due to haemorrhage occurred in all five patients.

Ten of the 29 obstetric and gynaecological patients had septic abortion, one of whom had hypovolaemia due to severe haemorrhage and another had intravascular haemolysis from ingestion of unidentified nephrotoxin. There were seven patients with post-partum eclampsia, one of whom also had puerperal sepsis.

Fourteen medical and one surgical patient were non-oliguric. All the 12 surgical and about half the total number of medical and obstetric patients were severely ill on referral.

Methods

Using the Sequential Multiple Analyser SMA 12/60 (Technicon, Basingstoke, U.K.), the pre- and post-dialysis electrolytes, urea and creatinine were estimated monthly in chronic renal failure (CRF) patients and at each dialysis session in ARF patients. The haemogram was estimated by the Coulter Counter (R) model (Coultronics, France). Chest X-ray, electrocardiogram and skeletal survey were done when indicated in the CRF patients. Peripheral blood film examination, blood cultures, cultures of mid-stream or catheter specimen or urine and wound swab, X-rays and Widal tests were performed where applicable. Creatinine clearance was peformed in all patient with CRF before institution of dialysis and in ARF patients during the recovery stage, usually 6 weeks post-admission. Renal biopsies were

performed in 13 patients with CRF, and in 2 other patients with intravenous pyelography.

Operational

Our policy was to dialyse early to ameliorate existing uraemic features and prevent evolution of others. Our decision to dialyse depended more on the clinical state of the patient and less on biochemical data, which were not readily available in all patients before dialysis was commenced. However, our guidelines for dialysis were: blood urea ≥ 33.3 mmol/l (200 mg/dl) or 8.3 mmol (50 mg) rise per day; creatinine ≥ 442.0 μmol/l (5.0 mg/dl) or 176.8 μmol (2 mg/dl) rise per day; potassium of ≥ 7 mmol/l (mEq/l); and bicarbonate of ≤ 10 mmol/l (mEq/l). In CRF patients, a creatinine clearance of ≤ 5 ml/min indicated end stage renal failure and the need for supportive therapy or transplantation.

Our criteria for patients' selection for chronic maintenance dialysis included exclusion of the very young, very old, patients with multisystemic disorders and those with carcinomatosis. We dialysed all patients with ARF except with advanced carcinomatosis with no hope of any form of anticancer regime.

Initially we catered for both haemodialysis (HD) and intermittent peritoneal dialysis (IPD) but in the last 4 years we concentrated on haemodialysis.

The dialysis machines used were Extracorporeal DM201 positive pressure batch tank system (Philadelphia, U.S.A.) utilizing coil dialysers and the relatively new Gambro AK-10 (Gambro Ltd, Lund, Sweden). The artificial dialysers were Gambro hollow fibres and parallel plates.

The access routes for maintenance HD were Quinton Scribner shunts using silastic teflon cannulae and arteriovenous fistulae. The shunts were used on a temporary basis usually for 4–6 weeks before the fistulae matured for usage. For acute HD, access routes were shunts or vein–vein femoral cannulation, the latter being performed at each dialysis session.

During dialysis the vital signs were recorded hourly and the clotting time estimated hourly by the Haemochron Model 400 (Blood coagulation timing system; International Technidyne Corp., New Jersey, U.S.A.). To prevent blood clotting in the machine, heparin was given at an average dose of 6000 units for 6 hours dialysis. On days between dialysis, shunts were kept patent and functional by intravenous or direct injection, into shunts of 5000 units of heparin once or twice daily. Protamine was occasionally used at a dose of 25–50 mg after dialysis when bleeding from the access site was difficult to control after applying adequate pressure. Patients with shunts were placed routinely on 3–6 mg warfarin daily.

Saline (0.9%) was used for priming and was administered during dialysis to counteract any hypotensive episodes, especially in septicaemic patients (average volume 500–1000 ml). A number of patients required blood transfusions which were usually given as packed cells, either during dialysis or in between dialysis sessions. Effort was made to keep the haematocrit level at ≥ 25% at which level the patients apparently responded better to therapy. Antibiotics were administered judiciously when required and there was no incidence of any toxic effect.

Over the past 5 years, due to financial constraint we made some modifications to the dialysate volume and access route cannulae. Using the DM201, we tried a 100 l and a 50 l volume (instead of the usual 200 l) by recycling the dialysate. We produced some dialysate concentrate locally, but since we still depend on importation of the raw materials it would take some time for the Drug Manufacturing Unit of the Hospital Pharmacy Department to meet all our requirements. Cannulae shortage was sometimes solved by using Medicut cannulae (1.7 mm OD, 45 mm length; Medical Industries, Sherwood, Eire) with amputated infusion sets attached for effective length. Another modality of treatment was continuous arteriovenous haemofiltration. This involved removal of excess fluid by ultrafiltration using a disposable haemofilter (Gambro fibre-haemofilter, FH101) or a dialysing machine in which the Ultrafiltration component was incorporated. We are still in the early stage of this modality of treatment and our experience will be reported fully in another study.

Results

Chronic renal failure

The histopathological reports on the 13 renal biopsies were necrosis and hyalinization of the

renal parenchyma and vessels (8), chronic glomerulonephritis (4) and focal glomerulosclerosis (1). The two intravenous pyelograms showed no excretion.

The mean pre- and post-dialysis blood urea concentrations were 41.6 mmol/l (250 mg/dl) and 8.3 mmol/l (50 mg/dl) respectively. The mean pre- and post-dialysis serum creatinine concentrations were 2121.4 μmol/l (24 mg/dl) and 707 μmol/l (8 mg/dl) respectively.

The mean haematocrits pre- and post-dialysis were 18% and 21% respectively. Ten CRF patients were initially dialysed peritoneally; six were discharged against medical advice and four died. The overall mortality in CRF was 68.4%.

Acute renal failure

The blood cultures were negative in 50% of cases, and the organisms isolated in the positive cultures were *Salmonella typhi*, coagulase-positive *Staphylococcus* and atypical *Coliforms*. Organisms isolated from urine cultures were *Escherichia coli* and *Streptococcus faecalis*. Blood films showed leucocytosis of 11.0–35.0 × 10^9/l with 80–90% neurophils and toxic granulation in all cases of septicaemia. Widal tests were positive in seven of the eight patients with suspected typhoid septicaemia.

Death usually occurred during the first week and by the 6th week patients were either discharged or dead. The survival rate was 66.3% and the creatinine clearance varied from 39.3 to 72.2 ml/min at 6 weeks post-admission.

The group mortality in ARF was 12.3% medical, 66.6% surgical and 37.9% obstetric gynaecological with an overall mortality of 33.7% (Table 3). Five ARF patients who were initially treated by peritoneal dialysis, were subsequently dialysed and they all survived.

Discussion

Chronic renal failure

In this study we observed an ethnic bias with the majority of the patients being Igbos or Yoruba; only three Hausa males and one Hausa female were included in the study. The four Hausa patients did poorly on dialysis and were among those with very high blood pressure (over 150 mmHg or 22.1 kPa diastolic pressure).

The comparatively higher mortality in the female patients cannot be explained readily. The tendency of female hypertensives, in contrast to their male counterparts, of having very high blood pressure without apparent symptoms might cause, in an insidious manner, more extensive damage to target organs like the kidneys.

In terms of morbidity, the response to dialytic therapy varied from patient to patient and also from time to time. When instituted on dialysis, diet and fluid were still restricted to

Table 3. Survival and mortality in acute renal failure patients

	Male	Percentage of group	Female	Percentage of group	Total (n = 98)	Percentage of total
Surgical (n = 12)						
Alive	3	25.0	—	—	3	3.1
Dead	8	66.6	1	8.4	9	9.2
Medical (n = 57)						
Alive	33	57.9	11	19.3	43	44.8
Dead	7	12.3	6	10.5	13	13.3
Obstetric and gynaecological (n = 29)						
Alive	NA		18	62.1	18	18.4
Dead	NA		11	37.9	11	11.2

NA = not applicable.

some extent. An average oliguric patient (urine volume < 400 ml per day) on 4-hourly sessions three times a week was allowed 60–70 g protein diet daily, 100 ml of fluid (during the wet season) and 1500 ml of fluid (during the hot season). Most patients failed to comply and drank more fluid, especially during the hot season. They were frequently fluid overloaded between dialysis sessions, and therefore required more dialysis sessions and/or sometimes hospitalization (when in severe pulmonary oedema). In those who were able to comply, the morbidity was low but unfortunately this was not constant in any patient or groups of patients so actual figures cannot be given.

However, within 3 weeks of being established on dialysis, all patients were discharged to report for treatment as out-patients. Most of the patients still have to continue on antihypertensive drugs but these were omitted on dialysis days to prevent hypotensive episodes on dialysis.

The dialysis-associated problems we encountered were: burst dialyser membrane (9%, due to high venous pressure from poorly functioning shunts), shunt infections (7%), pyrogen reaction (5.6%, exhibited by fever and shivering on dialysis without any focus of infection), and perforated femoral vein (0.9%, resulting in death in one patient).

Problems with vascular access are probably the most common complication of extracorporeal haemodialysis if one sets aside the expected abnormalities of sodium, volume overload, hypertension hyperkalaemia, hypocalcaemia and the many metabolic derangements that are present even in well dialysed patients. Twenty of the patients had to have refashioning or recreation of their shunts due to poor or non-functioning. One patient (female aged 38 years) had four shunts, four fistulae, two bovine grafts and subclavian vein cannulation due to atheromatous and narrowed blood vessels, and after 2 years of dialysis, she died of cerebrovascular accident. There was no fistula infection but false aneurysm occurred at the site of repeated puncture in six patients, though none of these resulted in hyperkinetic heart failure. Increase in cardiac output is a well documented concomitant of fistula creation [3] and serious cardiac complications have been reported [4].

The incidence of muscle cramp was surprisingly low in our patient population (only five patients) considering the climatic conditions and the amount of fluid lost (average of 3 kg per session). The cause of muscle cramp at the cellular level is unclear [5] but the association with ultrafiltrative removal of excess total body water during dialysis is recognized. Treatment therefore included infusion of physiological saline, lowering of ultrafiltration pressure and blood flow.

Viral hepatitis occurred in five patients and apart from the mild to moderate jaundice and hepatomegaly they were apparently well and the liver function tests (LFTs) returned to normal with 2–3 weeks, and during the course of the illness, these patients were isolated. Viral hepatitis is a well known hazard in any dialysis Unit [6]. Two patients developed resistant ascites (with persistently normal LFTs) which defied dialysis and paracentesis abdominis. One lost her ascites following a liver-donor transplant which unfortunately was rejected later. The ascites, however, never recurred when she was re-instituted on dialysis. The other patient retained her ascites until she died at home apparently from pulmonary oedema. The cause of this type of ascites is yet to be explained.

It would have been of interest to document fully the renal histopathologies and perform other pertinent investigations in all the patients but these were precluded by the late presentation, severity of the disease, high urea level, high arterial pressure and the limited facilities at our disposal.

Chronic glomerulonephritis and accelerated hypertension are the two commonest causes of CRF in our community [7,8]. An autopsy study performed at the University Teaching Hospital, Ibadan showed that renal disease was the fourth most common cause of death in middle-aged Nigerians [9]. In this work consent for necropsy study was denied in all cases.

Acute renal failure

Acute renal failure is one of the most dramatic, therapeutically demanding, yet gratifying clinical conditions with which the physician has to deal. Its importance lies in the potential for restoration of renal function in patients, who except for correct diagnosis, careful and skilled management would otherwise die.

Reviews of ARF have shown an almost equal sex distribution and our review supports this with a male to female ratio of 1.1:1.0. In the child bearing age group (21–40) the male to female ratio was 0.6:1.0, similar to the ratios of 0.65:1.0 and 0.54:1.0 found in the age group 20–29 and 30–39 respectively by Eliahou *et al.* [10]. This finding stems primarily from the underlying conditions that are specific to women, such as pregnancy and post-partum complications.

Almost all studies in ARF recognized that it is often caused by multiple factors [10–14] and our study supports this. In 66.7% the renal insult was multiple with sepsis being the commonest causative, contributory or superimposed factor in the three aetiological groups.

Many deaths in ARF are usually not due to uraemia *per se* but to the underlying disease, the precipitating or contributory factors [10–12, 16–17]. The inclusion of deaths from underlying disease in the evaluation of outcome and therapy in ARF is probably the reason for the discrepancies between the data of those who found that early dialysis decreased mortality and morbidity [11,18–20] and those who doubted its usefulness [11,13]. However, in our series despite the inclusion of deaths from basic disease, precipitating or contributory factors, the overall mortality was still reduced — though we recorded a high mortality in the surgical and post-traumatic patients, an experience shared by other authors [11–4,18–20].

Sepsis remains the most frequent cause of death in ARF [10–12,15–17,20–22]. Stott *et al.* [22] and Kennedy *et al.* [12] emphasized that the persisting role of sepsis might be explained in part by the higher proportion of severely ill patients now referred to the renal unit. In our series, all the 12 surgical patients and almost 50% of the medical and obstetric patients were severely ill on referral and sepsis accounted for more than half of the deaths.

The most common type of ARF is oliguric failure but the awareness of non-oliguric failure is increasing. Although any condition may cause non-oliguric renal failure, it has been reported with particular frequency for nephrotoxins, burns and surgery [13,18,23,24]. Estimates of the relative frequency of oliguric and non-oliguric ARF vary; Teschan *et al.* [14] reported that eight out of 51 patients with acute tubular necrosis following military trauma were non-oliguric; Vertel and Knochel [24] reported that 11 out of 25 patients with acute tubular necrosis caused by heat stroke had normal urinary output; and in our series 15 of 98 patients (15.3%) were non-oliguric and the commonest cause of non-oliguric renal failure was nephrotoxin. The better prognosis (mortality rate 13.3%; 2 out of 15 patients) and relatively milder course of non-oliguric renal failure were comparable to the findings of other authors [13,18,22,23].

The extensive use of haemodialysis during the last three decades has in general improved the prognosis in ARF, though a high mortality rate is still observed in patients with ARF of surgical or post-traumatic origin.

In our series, early and adequate haemodialysis drastically reduced the mortality in ARF. The commonest cause of non-oliguric renal failure was nephrotoxin and in the patients with non-oliguric renal failure a significantly lower mortality rate was recorded. The high mortality rate in the surgical and post-traumatic patients was primarily due to the precipitating factors and septicaemia, and not to uraemia *per se*.

It seems proper to quote Swann and Merrill's [23] statement of 1953 which still holds true that 'perhaps in few other diseases does therapy directly influence the clinical course and outcome as it does in acute renal failure'.

Conclusion

The argument that dialysis is not yet a priority in the third world countries in untenable as far as Nigeria is concerned because many of our patients presenting in terminal renal failure lie in the age group 20–50 years, the age group involved in gainful employment in the community and constituting 79.5% of our patient population. Moreover, if this modality of treatment is not available, a huge amount in foreign exchange will be expended in sending patients abroad for treatment. At present patients are sent abroad for possible renal transplantation, not because we lack surgical expertise but because of lack of appropriate facilities for pre-transplant screening and the harvesting of kidneys. A national health insurance scheme and national participation in international dialysis and transplantation associations will be cost saving and beneficial.

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