EXPERIENCES IN THE TREATMENT OF RENAL FAILURE BY HAEMODIALYSIS

By Lim Cheng Hong, M.B., B.S., M.R.C.P.E., Lee Guat Siew, M.B., B.S., M.R.C.P., M.R.C.P.E. and Khoo Oon Teik, M.D., M.R.C.P.E., F.R.F.P.S.

(Medical Unit II and Department of Clinical Medicine, General Hospital, Singapore, 3)

INTRODUCTION

Over a half century ago, Abel Rowntree and Turner reported their experiments in extracorporeal dialysis in animals, using colloidin tubes as a dialysing membrane and hirudin as anticoagulant. They were interested in identifying the various constituents of the blood by dialysing them out from the circulating blood of living animals. They coined the term "artificial kidney", and recognised the potential therapeutic usefulness of dialysis in renal failure. Various attempts at construction of an artificial kidney were made through the years, but it was not until 1943 that Kolff in Holland carried out the first treatment of a patient with the artificial kidney he constructed. He used cellophane as dialysing membrane and heparin as anticoagulant. Since then various modifications and types of artificial kidneys have been constructed, and are in use in centres all over the world.

In 1961, we acquired a Kolff Twin Coil artificial kidney and since then we have been treating selected cases of renal failure in our Unit, and cases referred to us from other hospitals in neighbouring countries.

SELECTION OF CASES

It has been the experience of Artificial Kidney Units all over the world that the best results are obtained in the treatment of patients with acute reversible renal lesions. There are of course centres where patients with chronic renal disease are dialysed regularly twice a week indefinitely, and kept alive in this way. This entails tremendous expenditure in terms of cost and staffing, and we are at present not in a position to do this. We have been rather selective in our choice of patients for treatment, but at the same time have not refused dialysis where the diagnosis was in doubt. In that event, some patients with chronic renal disease were also dialysed.

Table I is a summary of all the patients treated in the Unit by haemodialysis. Patients 6, 10, 12, 13 and 15 were referred to us from hospitals in neighbouring countries. Whilst we have certain criteria as indications for haemodialysis, as mentioned above, it will be noticed that a number of patients treated had irreversible renal disease. This was due to the fact that some of these patients had been flown out to us from great distances, and it was felt that they should be given the benefit of at least one haemodialysis. In the other patients, they were given the benefit of the doubt where there was a possibility the patient was having an acute exacerbation of a chronic renal lesion. These patients with chronic renal disease improved with haomodialysis, but were soon back to their old status.

Table II shows the biochemical changes occuring in the patients in 28 haemodialysis. It will be seen that the majority of patients had a 4-5 hour dialysis. The biochemical estimations were done at hourly intervals when the dialysis programme was first started, but fewer estimations were done in the more recent dialyses. The abnormal serum electrolytes and alkali reserve were usually corrected within two hours of dialysis. The bath fluid was changed twice in the course of the dialysis, and this change was facilitated recently by the use of a reservoir 100 litre tank. One unusual feature which we noticed, but were unable to explain, was the bath fluid becoming more alkaline during the process of dialysis.

In the patients with hepato-renal failure, the bath fluid became heavily bile-stained during dialysis, but with little or no appreciable reduction of the serum bilirubin level.

Table III shows the range of blood urea and serum potassium levels before and after dialysis.

Table IV summarises the results of our experiences in 28 haemodialyses performed on 22 patients. We have divided up the patients into various groups on the basis of the aetiology of the renal failure. This would give a better picture of the prognosis in the widely differing types of cases presenting with renal failure.

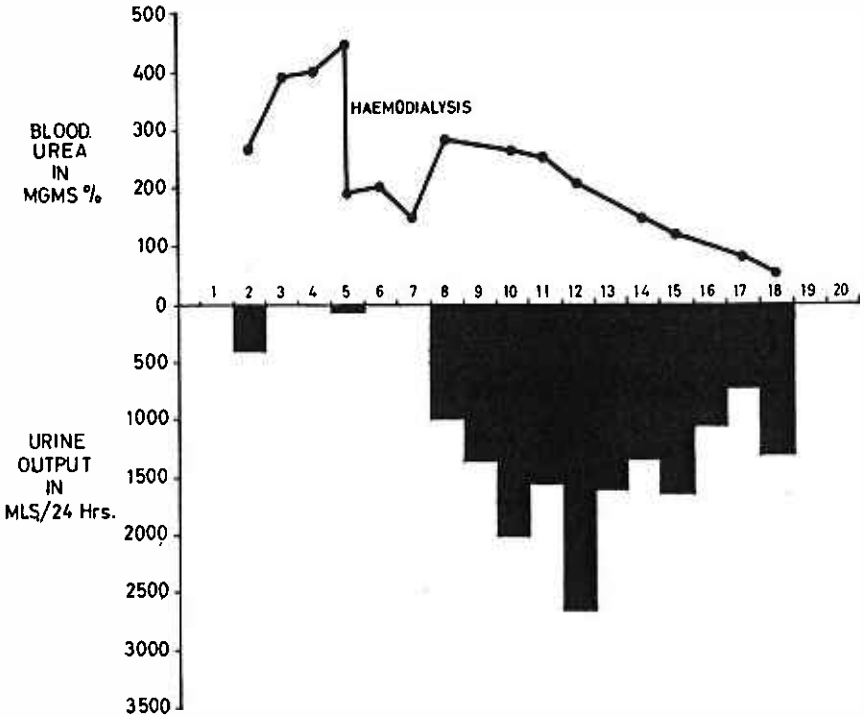
GROUP I: IRREVERSIBLE RENAL DISEASE

In this group, the patients mostly had chronic glomerulonephritis or pyelonephritis. The first

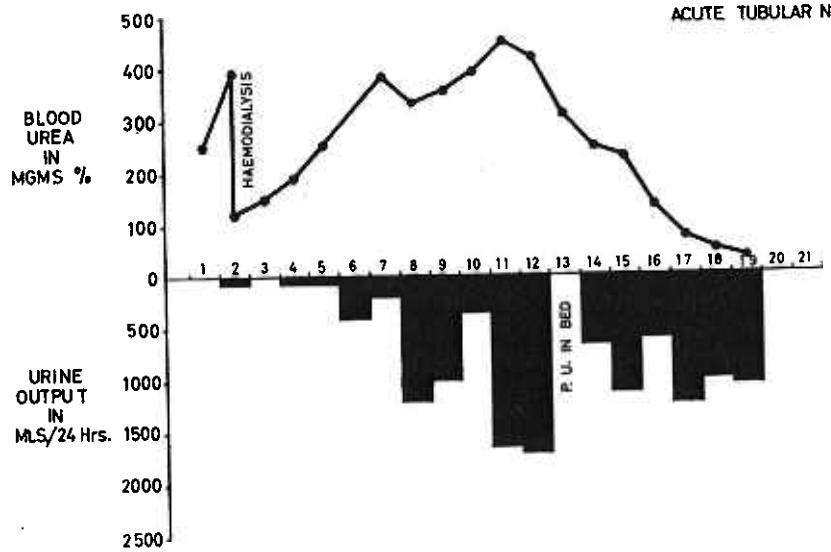
PROGRESS CHARTS

PATIENT No. 2: S.S.C. ♂ 22 yrs.

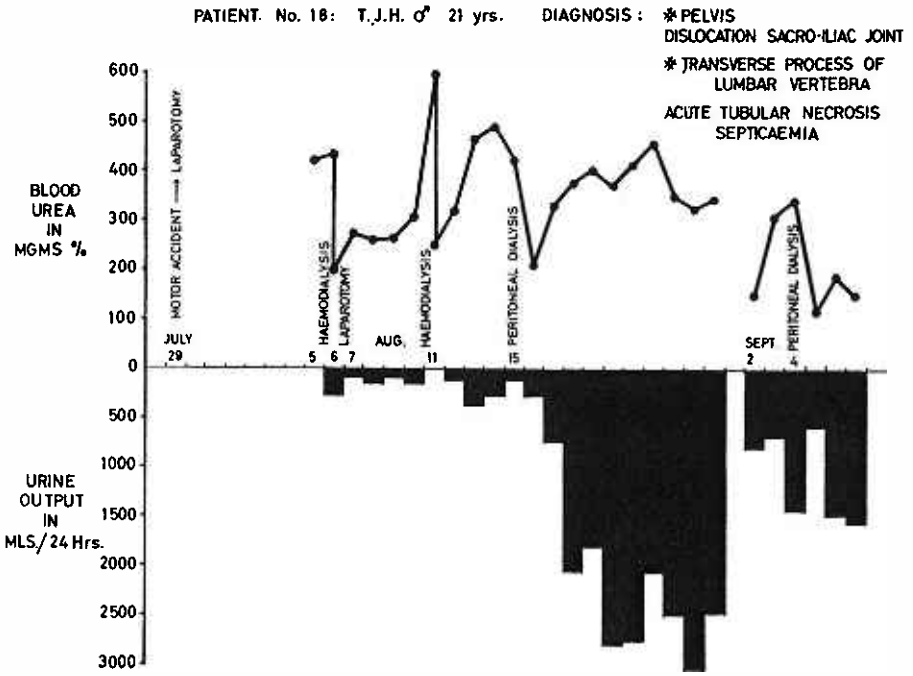
DIAGNOSIS: SULPHONAMIDE ANURIA



PATIENT No. 12: R. bte M. ♀ 22 yrs. DIAGNOSIS: TRANSFUSION HAEMOLYSIS
Rh INCOMPATIBILITY
ACUTE TUBULAR NECROSIS



PROGRESS CHARTS



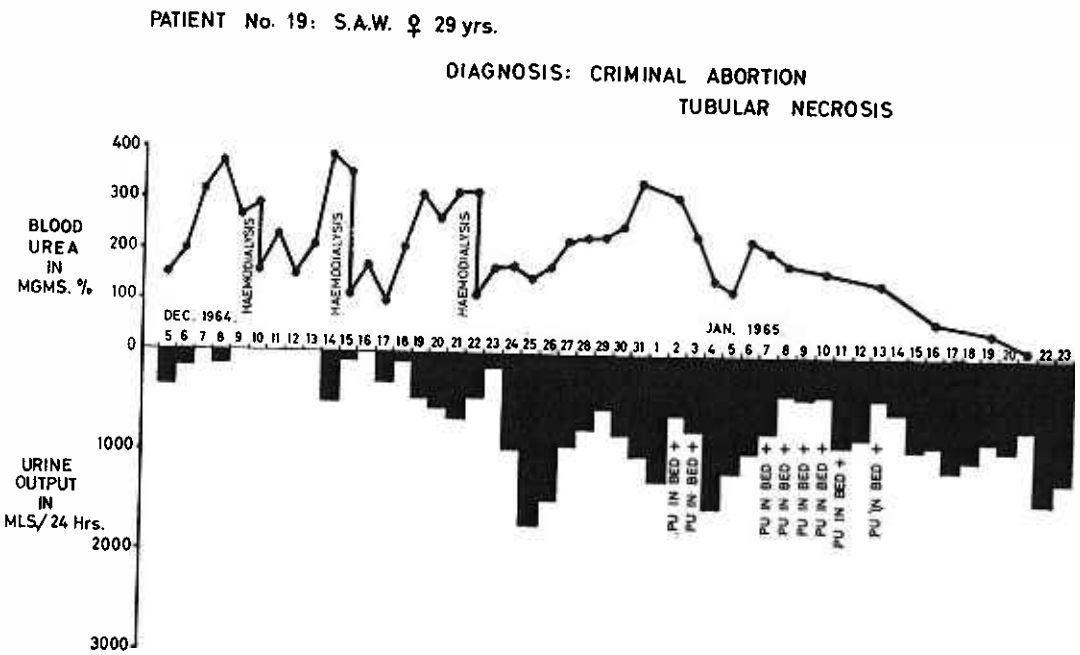


TABLE I

SUMMARY OF PATIENTS TREATED BY HAEMODIALYSIS

Case No.	Name	Age	Sex	Race	Diagnosis	No. of Dialysis	Result
1.	N.C.T.	27	F	Ch.	Chronic Nephritis	1	Died
2.	S.S.C.	22	M	Ch.	Sulphonamide Anuria	1	Survived
3.	C.W.B.	27	M	Br.	Burns: Acute Tubular Necrosis	3	Died
4.	O.	12	F	Indon.	Sulphonamide Anuria	1	Survived
5.	T.Y.S.	16	M	Ch.	Beri-Beri Acute Renal Failure	1	Died
6.	G.P.T.	22	M	Ch.	Chronic Nephritis	1	Died
7.	M.	41	M	Ind.	Chr. Duodenal Ulcer: Pyloric Stenosis	1	Died
8.	T.M.T.	12	F	Ch.	Acute Nephritis	1	Died
9.	K.H.C.	69	M	Ch.	Chronic Pyelonephritis Bilateral Ureteric Calculi Left Hydronephrosis	1	Died
10.	T.A.	33	F	Ch.	Accidental Haemorrhage Transfusion Haemolysis	1	Survived
11.	L.T.	41	M	Ch	Chronic Cholecystitis Acute Haemorrhagic Pancreatitis Hepato-renal Failure	1	Died
12.	R.M.	20	F	Ind.	Post Partum Haemorrhage Transfusion Haemolysis	1	Survived
13.	S.Z.	28	F	Mal.	Abortion. Ruptured Uterus Chronic Pyelonephritis	1	Died
14.	H.P.K.	20	M	Ch.	Hepato-renal Failure	1	Died
15.	M.M.	32	M	Mal.	Acute Renal Failure. Septicaemia	1	Died
16.	A.J.	24	F	Mal.	Leptospirosis. Hepato-renal Failure	1	Died
17.	S.Y.T.	63	M	Ch.	Chronic Nephritis	1	Died
18.	T.J.H.	21	M	N.Z.	Fracture of Pelvis. Acute Tubular Necrosis Perinephric Abscess	2	Died
19.	S.A.W.	29	F	Ch.	Criminal Abortion Acute Tubular Necrosis	3	Survived
20.	L.E.C.	23	M	Ch.	Leptospirosis. G-6 P.D. Deficiency Acute Haemolysis Acute Tubular Necrosis	2	Survived
21.	A.R.	50	M	Ind.	Diabetes Mellitus. ? K-W Kidney Deep Vein Thrombosis Left Leg. Enlarged Prostate	1	Survived
22.	I.O.	46	M	Mal.	Leptospirosis. Hepato-renal Failure	1	Survived

TABLE II

BIOCHEMICAL RESULTS IN 28 HAEMODIALYSIS

	Duration of Dialysis in hours	Blood Urea in mgm.%		Serum Na in mEq/litre		Serum Cl. in mEq/litre		Alk. Reserve Vol.% CO_2		Serum K in mEq/litre	
		Init.	End	Init.	End	Init.	End	Init.	End	Init.	End
Case 1	4	216	143	104	122	61	88	64	56	4·3	2·6
Case 2	4	440	198	122	133	71	91	36	43	5·2	3·6
Case 3	4	200	45	122	135	90	96	48	53	7·7	5·3
	4½	361	220	141	137	103	97	54	-	8·4	6·7
	5	444	290	143	146	103	-	40	-	8·4	6·6
Case 4	4	200	80	150	141	78	103	66	54	3·9	4·2
Case 5	4½	252	140	127	127	76	94	67	52	3·6	4·1
Case 6	3	436	334	141	135	83	93	36	43	6·9	4·1
Case 7	6	341	124	102	127	44	86	93	63	4·5	3·1
Case 8	4½	252	117	122	135	76	94	53	-	7·8	3·9
Case 9	4	324	202	125	131	86	94	41	53	8·2	3·9
Case 10	5	228	113	96	127	73	93	56	-	6·1	3·9
Case 11	4	464	192	158	143	106	-	48	44	4·3	3·9
Case 12	6	393	124	133	133	87	101	31	54	8·2	4·2
Case 13	4	252	44	139	-	105	-	64	49	4·7	-
Case 14	5½	346	173	127	135	89	-	-	-	6·8	4·7
Case 15	4	444	218	137	-	90	-	-	-	3·0	2·5
Case 16	4	201	58	122	125	96	109	-	-	2·9	2·9
Case 17	4	312	200	141	122	95	-	-	-	4·4	3·9
Case 18	5	426	200	129	-	96	-	-	-	6·4	4·4
	4	592	252	129	148	89	100	-	-	7·2	4·9
Case 19	5	292	160	122	-	84	-	-	-	4·8	3·9
	5	354	110	127	133	83	95	-	-	6·3	4·0
	4	318	118	129	127	85	90	-	-	4·0	3·9
Case 20	4½	185	85	131	134	90	94	36	48	5·4	5·0
	5	315	130	127	136	70	85	-	-	5·5	4·1
Case 21	4	340	145	124	127	77	91	34	48	2·9	3·7
Case 22	5	465	205	138	136	85	96	54	66	5·3	4·8

TABLE III

	Blood Urea in mg.%	Serum Potassium in mEq/Litre
Before Dialysis	592 - 185	8·2 - 2·9
Mean	(338)	(5·8)
After Dialysis	334 - 44	6·7 - 2·5
Mean	(160)	(4·1)

Table III: shows the range of blood urea and serum potassium values before and after dialysis.

TABLE IV

RESULTS OF HAEMODIALYSIS IN VARIOUS AETIOLOGIC GROUPS

Aetiology	No. of Cases	No. Lived	No. Died	Mortality %
Irreversible Renal Disease	6	-	6	100 %
Trauma	2	-	2	100 %
Transfusion Haemolysis	2	2	-	Nil
Obstetrical Complication	1	1	-	Nil
Nephrotoxin	2	2	-	Nil
Hepato-renal Failure	5	2	3	60 %
Miscellanous	4	1	3	75 %
Total	22	8	14	63·3 %

patient we dialysed was a chronic nephritic who was already in the terminal stages of uraemia. She improved after dialysis, but deteriorated again, and died eighteen days later. This pattern was repeated in all the other five patients in this group. We now try to restrict haemodialysis to patients with acute reversible renal failure, but whenever there was a possibility of an acute exacerbation of a chronic renal lesion precipitating failure, dialysis was not withheld.

GROUP II: TRAUMA

There were two patients in this group. One of them (Case 3) had extensive third degree burns involving about 50% of body surface area. He had 3 haemodialysis but died. He had what Silva et al termed "hypercatabolic" acute renal failure as his blood urea and serum potassium rose very quickly after each dialysis.

The other patient (Case 18) developed acute renal failure following a motor accident. He had two haemodialysis and two peritoneal dialysis, and was oliguric for twenty-one days. Unfortunately, he developed a perinephric abscess and septicaemia during the late diuretic phase and died.

GROUP III: TRANSFUSION HAEMOLYSIS

In this group were two patients who presented with jaundice, oliguria, haemoglobinuria and uraemia following blood transfusion. Case 10 had an accidental haemorrhage at 38 weeks gestation. She was given a pint of Group "O" Emergency blood, her own blood group being "B". The following day she developed jaundice, oliguria and haemoglobinuria. Her blood urea began to rise, and she was sent to us for dialysis, with good results. The other patient (Case 12) had a still-born foetus, thought to be Hydrop Foetatis. She had a retained placenta which was manually removed. PPH followed and she was given 2 pints of matched Group "B" blood. She developed jaundice, haemoglobinuria and oliguria the following day. Subsequently she was found to be Rh negative, and the haemolysis due to Rh incompatibility.

GROUP IV: OBSTETRICAL COMPLICATIONS

This patient (Case 19) had a criminal abortion, and was hospitalised with fever, rigors and bleeding per vagina. She went into renal failure, and was dialysed 3 times. After a stormy course, she made a complete recovery.

GROUP V: NEPHROTOXINS

Two patients developed renal failure following a history of ingestion of sulphonamides. Both made good recoveries following dialysis.

GROUP VI: HEPATO-RENAL FAILURE

There were five patients in this group, presenting with features of liver and renal failure *viz.* marked jaundice and a high blood urea. Three of these patients were thought to have leptospirosis with a positive S.E.L. test. In dialysing these patients, the bath fluid was usually heavily bile-stained, but there was no appreciable reduction of the serum bilirubin levels.

GROUP VII: MISCELLANEOUS

In this group are patients with widely differing causes for their renal failure, and who could not be placed in any of the other preceding groups. Only one of these four patients survived (Case 21). He was a diabetic who developed deep vein thrombosis in the left leg, and subsequently went into renal failure. He had a haemodialysis and later on a peritoneal dialysis, and made a good recovery.

COMMENTS

This is a report of the experience in the treatment of renal failure by haemodialysis in Medical Unit II, using the Kolff Twin-Coil Artificial Kidney. Twenty-two patients had a total of twenty-eight dialyses. Most of these patients had one dialysis, whilst two had two dialyses and two had up to three dialyses during the course of their illness.

As shown in Table IV, there was an overall mortality of 63·6%. About a quarter of the patients had irreversible renal disease, but no attempt was made to put them on a programme of chronic dialysis. It was felt that we did not have the resources to embark on such a venture. Excluding these cases of chronic renal disease, there is still an appreciable mortality in patients with acute renal failure, even with treatment with the artificial kidney. L. B. Bluemle and others in an analysis of 100 cases of acute tubular necrosis treated with and without haemodialysis found that surgical complications carried a mortality of 22%, trauma 83%, transfusion haemolysis 29%, obstetrical complications 25%, nephrotoxins 55% and a miscellanous group where the responsible factors could not be determined, 55%. These figures were in accord with other

published reports. In our series, we have also found that the patients developing acute renal failure as a result of obstetrical complications and transfusion haemolysis had a better prognosis. Both our traumatic cases succumbed to renal failure and septicaemia, after having gone into diuresis. There is no doubt that getting the patient over the oliguric phase and into the diuretic phase is not the end of the treatment, and indeed, many patients would require further dialysis in the early diuretic phase. We have on occasions put these patients on peritoneal dialysis (Cases 15, 18, 20 and 21) and have found this a useful adjunct to haemodialysis in the management of acute renal failure.

During the latter part of our programme, we obtained arterio-venous shunts designed by Nayman for use in acute renal failure. It proved to be very useful and enabled us to dialyse patients more than once without the necessity of a fresh cannulation each time. The most number of dialysis a patient had was 3. We have tended to keep the time of dialysis on the short side as we find our patients very tired and worn out after 4-5 hours of dialysis time. This excludes the time taken for bath changes, which took us about half an hour each time. We have since cut this down to less than ten minutes by the use of a 100 litre reservoir tank.

On the whole, although our results are not spectacular, we feel that the Artificial Kidney is an invaluable means of treating cases of renal failure. However, the conservative management of acute renal failure with protein restriction and careful balancing of fluids and electrolytes is still important, and would suffice for a large number of cases of renal shut-down. More important perhaps is the recognition of the circumstances in which such a complication might arise and prophylaxis against it.

SUMMARY

An account of the experiences in the treatment of renal failure by haemodialysis in Medical Unit II, General Hospital, Singapore is presented. Twenty-two patients had a total of twenty-eight haemodialysis. The various types of cases of renal failure encountered are described. The results show that patients with acute renal failure because of transfusion haemolysis and obstetrical complications do very well with haemodialysis, whilst those with irreversible renal disease did not benefit for long from such treatment.

ACKNOWLEDGEMENT

Our thanks are due to the following:

1. Professor E. S. Monteiro for his advice and encouragement.
2. All the doctors who have taken part in the dialyses, particularly Dr. Gwee Ah Leng, Dr. Charles Toh Chai Soon and Dr. Beatrice Chen.
3. Sister M. H. Ling and her team of nurses.
4. Dr. Lee Kum Tatt and his laboratory staff responsible for the biochemical estimations.
5. Last but not least, Dr. Kwa Soon Bee and the Blood Transfusion Unit without whose ready co-operation this work would not have been possible.

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