Archives of Disease in Childhood, 1988, **63**, 120–126

Original articles

End stage renal failure: 14 years' experience of dialysis and renal transplantation

G OFFNER,* C ASCHENDORFF,* P F HOYER,* H P KROHN,* J H H EHRICH,* R PICHLMAYR,† AND J BRODEHL*

*From the *Department of Paediatric Nephrology and Metabolic Disorders, Children's Hospital, and †Department of Abdominal and Transplant Surgery, Medical School, Hannover*

SUMMARY One hundred and thirteen children (59 boys and 54 girls aged from 2 to 16 years) with end stage renal failure entered the renal dialysis and transplantation programme between 1972 and 1983. They were followed up until December 1985. Ninety eight children were initially treated by haemodialysis in hospital and 15 by renal transplantation. The average wait on dialysis was seven months (range 0·1–43 months). One hundred and six children were given 129 renal transplants, 32 of which were from living related donors.

At the end of 1985 94 of the 113 patients (83%) were alive, 81 (72%) with functioning grafts, 11 (10%) were receiving haemodialysis in hospital, two (1%) were being treated by continuous ambulatory peritoneal dialysis, and three had been lost to follow up. The 14 years actuarial survival was 81%. Four patients receiving dialysis and 12 who had received transplants died, a mortality of 14%. The main complications of treatment were retardation of growth in 49 (43%), hypertension in 75 (66%), and osteopathy in 36 (32%). Retardation of growth could not be reversed by successful renal transplantation. Seventy two patients (88%) assessed their health as good to excellent, and 9 (12%) as poor. Patients with a functioning graft did much better than those receiving dialysis. Treatment of end stage renal failure led to full rehabilitation in most patients, and renal transplantation was more effective than dialysis.

A study by the Arbeitsgemeinschaft fuer Paediatrische Nephrologie showed that in West Germany each year about five children per million develop end stage renal failure.[1] Similar data were collected from the paediatric registry of the European Dialysis and Transplantation Association.[2]

During the past decade dialysis and renal transplantation have both become accepted forms of treatment of end stage renal failure. Long term results have usually been reported separately for paediatric haemodialysis[3] and renal transplantation.[4–7] There have been only a few surveys of the overall outcome of all children treated for end stage renal failure.[8–10] This report describes the 14 years' experience (1972–1985) of a single paediatric centre for dialysis and renal transplantation. The children's hospital of the medical school in Hannover was built in 1972 and soon became a referral centre for patients with end stage renal failure, serving a large area of northern Germany.

Patients and methods

One hundred and thirteen children with end stage renal failure were accepted for treatment during the period 1972 to 1983 and were followed up until the end of 1985. The number of new patients treated annually is shown in table 1. Eighteen children who received transplants had first received dialysis at other centres. Eight other children with end stage renal failure were seen during the period, but not accepted for treatment. In four dialysis was not considered because of the age and size of the infants; this was before the development of techniques for long term peritoneal dialysis. Three children were excluded because of severe mental retardation and one because of severe heart disease. The decisions to exclude these patients were made with the full agreement and informed consent of the parents.

The children were between 2 and 16 years old when they started treatment. The initial treatment

Table 1 *Number of new patients with end stage renal failure treated annually, 1972–83*

Year	*No of patients receiving dialysis*	*No of patients receiving one transplant*	*No of patients receiving two or more transplants*
1972	1	1	0
1973	5	2	0
1974	2	3	1
1975	6	2	0
1976	6	12	0
1977	13	9	3
1978	8	11	2
1979	13	12	1
1980	11	16	1
1981	6	9	5
1982	8	12	4
1983	19	14	0

Table 2 *Age and sex of 113 patients with end stage renal failure*

Age (years)	*No of boys*	*No of girls*
2	2	0
3	1	1
4	0	1
5	1	2
6	3	2
7	4	3
8	8	8
9	3	6
10	6	6
11	5	6
12	4	7
13	7	4
14	4	3
15	7	5
16	1	3

was haemodialysis in hospital (n=98) or renal transplantation (n=15). The youngest child accepted for long term haemodialysis was 2·9 years old and the youngest to have a renal transplant was 2·2 years old. The mean (SD) age at the start of treatment was 10·9 (3·3) years. The sex and age distributions of the 113 children are shown in table 2. The diseases causing the end stage renal failure are summarised in table 3. Ten children (9%) presented with acute renal failure[11] and 103 (91%) with chronic renal failure. In a few children the original diseases were associated with moderate mental retardation, deafness or blindness; these were not considered as contraindications to treatment. The risk of recurrence of the original disease in the transplanted kidney was not a contraindication to transplantation.

Sixty five children were already being seen in a paediatric clinic before they developed end stage renal failure; 26 of these were being seen in this centre, and they had a mean creatinine clearance of 26·4 ml/minute/1·73 m^2 body surface. Forty eight children entered our treatment programme after developing end stage renal failure, and 18 had already received dialysis in other units. When the creatinine clearance in children weighing more than 20 kg approached 10 ml/minute/1·73 m^2, a vascular access route was created. At the same time tissue typing was performed and three units of packed red cells were transfused. When the creatinine clearance fell to 5 ml/minute/1·73 m^2 the children were entered in the Eurotransplant Registry. If the parent donated the kidney no arteriovenous fistula was created.

DIALYSIS

The vascular access used for haemodialysis was a subcutaneous Cimino fistula at the forearm in 51 (52%) children. Young children weighing less than 20 kg and children with acute renal failure, who made up 46 (47%) children, received a standard Quinton Scribner Silastic arteriovenous shunt in the leg. One child had a Shaldon catheter inserted through the femoral vein for a week while waiting for a kidney from his mother.

Table 3 *Diseases leading to end stage renal failure in 113 children*

Disease	*No of patients (%)*
Congenital or familial:	
Hypoplasia or dysplasia	18 (16)
Cystinosis	16 (14)
Nephronophthisis	15 (13)
Obstructive uropathy	10 (9)
Familial nephritis	7 (6)
Oxalosis	3 (3)
Infantile cystic kidneys	2 (2)
Acquired	
Proliferative glomerulonephritis	14 (12)
Focal glomerulosclerosis	8 (7)
Haemolytic uraemic syndrome	7 (6)
Undifferentiated glomerulonephritis	3 (3)
Reflux nephropathy	3 (3)
Other renal diseases	7 (6)

Haemodialysis was performed in the hospital except in one case. It was carried out two or three times a week and lasted between three and six hours. The mean (SD) duration of dialysis was 14·5 (3·2) hours a week. Appropriately sized dialysis plates made by Gambro (Mini Minor, Minor, and Lundia) and hollow fibres made by Asahi (AM 06, and 09), were used for the first treatment. Special paediatric systems were used for small children to

keep the extracorporeal volume below 10% of the blood volume. For later haemodialysis, machines were used that had dialysate containing acetate: the National Kidney Centre (Fairholme Gardens, London, UK), the HD 103 (Braun, Melsungen, West Germany), and the AK10 (Gambro, Lund, Sweden). The flow rate of the dialysate was standardised at 500 ml/minute or 600 ml/minute depending on which machine was used. The water was obtained from a central deionisor. The final concentration of calcium was 2 mmol/l and of sodium 140 mmol/l. The dose of heparin given was 100 U/kg body weight; 1000 U were given initially as a bolus, and the rest as a continuous infusion. Glucose (10 g/dl) was given to minimise dysequilibrium.

Continuous ambulatory peritoneal dialysis was introduced here in 1984. A Tenckhoff double cuffed peritoneal catheter was inserted surgically. Commercial dialysis solutions in 0·5–2·0 litre bags (Fresenius, Homburg, West Germany) were exchanged four times a day. The volume used was 40 ml/kg body weight for each exchange.[12]

Each patient's biochemical and haemotological state was monitored by measuring concentrations of sodium, potassium, urea, creatinine, and haemoglobin in the blood, the packed cell volume, the white blood count, and the platelet count, each once a week. Phosphate and calcium concentrations, and alkaline phosphatase activity were measured once a month, and an *x* ray picture of the wrist was taken once a year. All patients were given phosphate binders (aluminium hydroxide, calcium carbonate) and vitamin D. Packed red cells were transfused when the haemoglobin concentration fell below 50 g/l. A relatively normal diet was encouraged, though water and potassium were restricted.

RENAL TRANSPLANTATION

Human leucocyte antigen (HLA) matching and cytotoxic cross matching were carried out for all patients.[13] Since 1976 all children have received at least three transfusions of packed red cells before transplantations. A negative cross match and ABO compatibility were the only criteria for the first transplantation. Most kidneys were transplanted retroperitoneally into the iliac fossa.[14] Bilateral nephrectomy before transplantation was usually performed only if the kidneys were infected, but four children developed severe hypertension after transplantation and also required nephrectomy. Implantation of the ureters into an ileal loop was necessary in three children with obstructive disease. The immunosuppressive treatment comprised azathioprine and prednisolone until 1982 (99 transplantations). Since then, cyclosporin A together with low doses of prednisolone have been used as previously described (30 transplantations).[15] Children stayed in hospital for six weeks after an uncomplicated renal transplant.

Rejection episodes, diagnosed by a rise in serum creatinine concentration, fever, hypertension, a decrease in urine output, and renal scintigraphy, were treated with intravenous prednisolone 30 mg/kg for three to six days until 1979, and since then with 10 mg/kg. Additionally local radiation of the graft was performed between 1972 and 1979. Antilymphocyte globulin (15 mg/kg) was given between 1977 and 1979 for the first two weeks after transplantation, but this did not reduce the number of episodes of rejection.[16] More recently antithymocyte globulin (5 mg/kg) has been given for five days if vascular rejection was diagnosed.

Results

In December 1985, 94 of the 113 children (83%) with end stage renal failure who entered the treatment programme were alive, 81 (72%) with a functioning graft, 11 (10%) receiving haemodialysis, and two (1%) having continuous ambulatory peritoneal dialysis (fig 1). Three patients on haemodialysis were lost to follow up. The actuarial patient survival, therefore, was 81% after 14 years (fig 2).

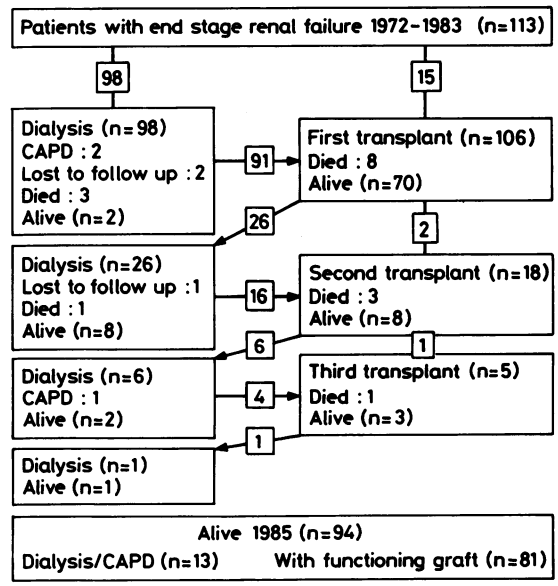

Fig 1 *Clinical course and outcome of the 113 children; each rectangle gives actual No of patients with corresponding treatment in 1985. CAPD=continuous ambulatory peritoneal dialysis.*

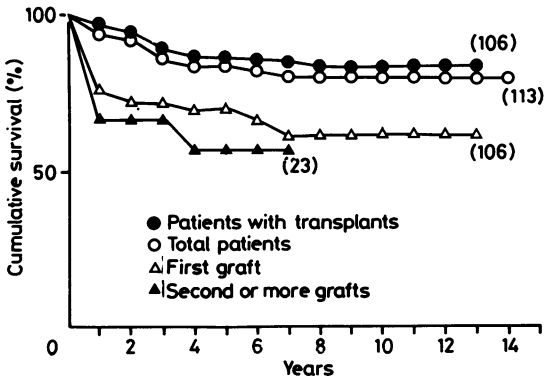

Fig 2 *Acturial survival rates of the 113 children.*

Of the 98 patients who entered the programme already receiving haemodialysis the median time spent before they received a transplant was 0·64 years (range 1 day–3·8 years). At the end of 1985 two children had not had transplants but were waiting for suitable donors. One of them started treatment in an adult dialysis unit in 1968 when she was 8 years old, and has been receiving haemodialysis at home for 16·5 years. She has had osteomyelitis and endocarditis and developed 100% cytotoxic antibodies. Three other children were treated with continuous ambulatory peritoneal dialysis after developing cytotoxic antibodies due to multiple blood transfusions while they were receiving haemodialysis. One subsequently received a renal transplant and in one, two transplants were rejected.

One hundred and six patients received 129 renal transplants of which 32 were from living related donors. Eighteen patients received a second graft, and five a third graft. The actuarial survival of all transplanted patients was 83% after 13 years (fig 2). The survival rate of the first graft was 61% after 13 years, and of the second and third graft 57% after seven years. The grafts from living related donors had a 10% better survival rate after five years.[17] The mean observation time of patients with functioning grafts was 4·5 years (range 0·2–12·9).

MORTALITY

Sixteen children (14%) died during the observation period. Nine of the deaths occurred between 1972 and 1976. Four patients died while receiving haemodialysis, a total of one death in 380 patient months. Three of them died after 4, 6, and 23 months, because of gastrointestinal bleeding, hyperkalaemia, and pulmonary oedema, respectively. One child with oxalosis died from cardiac failure two years after the failure of his first transplant. Twelve patients died after transplantation, eight after the first graft, three after the second, and one after the third, respectively, a total of one death in 424 patient months. Five children died of septicaemia, and three of uraemia after the first graft had failed and further dialysis was refused by the parents. Two children died from intestinal bleeding, one from a perforation by a central venous line during operation, and one of cardiac failure, though the graft was functioning.

MORBIDITY

The morbidity was analysed by adding the number of days spent in hospital during long term dialysis and the number of days spent in hospital after successful transplantation. During the period of dialysis the children were admitted for a mean of 32·3 days a year (range 1–165). The major complications were thrombosis and infection of the arteriovenous fistula (38%). Others were septicaemia (14%), malignant hypertension (6%), and fluid overload (4%). After successful transplantation children were admitted to hospital for an average of 16·9 days (range 0–170) during the first year, which then decreased subsequently to a mean of 3·9 days (range 0·26) after four years. The usual reason for admission was an increased serum creatinine concentration (46%). Other causes were infections (24%), malignant hypertension (11%), osteochondritis dissecans (6%), and surgical complications of the operation (1%).

The mean (SD) haemoglobin and blood urea concentrations and creatinine clearance in patients with chronic renal failure, end stage renal failure, and those who received haemodialysis and successful renal transplantation are shown in table 4. The best rehabilitation was achieved after successful transplantation. During dialysis the average rate of blood transfusion was one unit of packed red cells a month for each patient.

The growth rates expressed as standard deviation scores of height for chronological age as described by Tanner[18] were consistently low even after successful transplantation (fig 3). The mean scores include those of the 16 children with infantile cystinosis who had an extremely poor mean standard deviation scores of −5·3 (1·6). Their mean growth after successful renal transplantation, however, was no less than that of the rest of the patients. On the contrary, standard deviation scores of body weight correlated with actual height increased consistently (fig 3). Hypertension is a major complication of end stage renal failure, and in this retrospective study patients were considered hypertensive only if they were being treated with anti-

Table 4 *Mean (SD) concentrations of haemoglobin and blood urea, and creatinine clearance at different stages of treatment for renal failure during the 14 year period*

Stage of treatment	*No of patients*	*Haemoglobin (g/l)*	*Blood urea (mmol/l)*	*Creatinine clearance (ml/minute/1·73 m²)*
Chronic renal failure (not receiving dialysis)	65	103 (17)	16·8 (10·3)	26·4 (5·4)
End stage renal failure (not receiving dialysis)	98	66 (11)	46·1 (12·8)	4·7 (1·1)
End stage renal failure (receiving dialysis)	85	66 (8)	28·6 (5·7)	—
Six weeks after transplant	80	103 (16)	9·0 (6·0)	72·6 (32·5)
One year after transplant	73	128 (15)	8·8 (5·2)	64·6 (27·4)
Two years after transplant	59	133 (17)	7·7 (4·2)	64·5 (24·2)
Three years after transplant	47	134 (17)	7·7 (5·1)	64·4 (24·2)
Four years after transplant	41	133 (22)	7·9 (6·5)	63·9 (21·5)
Total No with functioning grafts in 1985	81	122 (26)	11·5 (8·0)	48·4 (22·5)

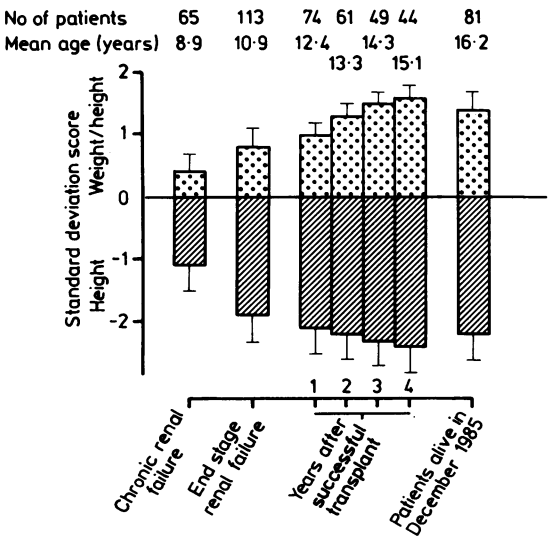

Fig 3 *Development of height and weight during the different stages of renal failure expressed as mean (SEM) standard deviation scores.*

hypertensive drugs. The incidence of hypertension was highest (77% of patients) four years after transplantation, and lowest (65%) during chronic renal failure.

The overall rate of complications could be assessed in 89 of 94 living patients in 1985 (table 5); 81 had functioning grafts and eight were receiving dialysis. Forty nine patients were receiving conventional immunosuppression with azathioprine and prednisolone, 29 were receiving cyclosporin A, and prednisolone, and three were receiving azathioprine, cyclosporin A and prednisolone. The main complication was hypertension (66%), followed by growth retardation (48%), and Cushingoid appearance (45%). Pubertal development was retarded in 19 of the 61 children (31%) who had entered the pubertal age range. Renal osteopathy was present in 24%, osteochondritis dissecans being the most frequent complication in patients who had had transplants. Cataracts were present in four of 81 patients who had had transplants. Three patients developed liver disease due to azathioprine toxicity in one and haemosiderosis in two. Two required steroid replacement because of adrenal suppression. Of the 30 children treated with cyclosporin A, seven had hypertrichosis and two gingival hyperplasia.

REHABILITATION

Rehabilitation was assessed by the patient's own estimation of state of health, school performance, and occupational performance. In a personal interview 70 of 74 patients (95%) who had had transplants judged their state of health to be good to excellent, but only two of seven patients on dialysis (29%) felt as well as that. Fifty of 52 children of school age who had had transplants were attending school regularly, and two were being taught at

Table 5 *Complications in 89 patients being treated for end stage renal failure in December 1985*

Complication	*No with functioning graft (%) (n=81)*	*No receiving dialysis (%) (n=8)*
Hypertension	57 (64)	2 (2)
Cushingoid appearance	39 (44)	1 (1)
Retardation of growth	38 (43)	5 (6)
Retardation of puberty	15/16 (25)	4/61 (7)
Osteochondritis dissecans	12 (14)	0
Osteodystrophy	1 (1)	8 (9)
Hypertrichosis	7 (8)	0
Cataract	4 (5)	1 (1)
Azathioprine toxicity	1 (1)	0
Haemosiderosis	0	2 (2)
Adrenal insufficiency	1 (1)	1 (1)
Gingival hyperplasia	2 (2)	0

home. Of five school children receiving dialysis, four attended school part time and one was taught at home. The mean delay in school education was one year (range −3 to +1) compared with the appropriate grade for age of the healthy child population. Twenty one of 25 adult patients who had had transplants (84%) had full time jobs, but only two of five patients receiving dialysis did so. Six patients were unemployed but able to work (four with functioning grafts and two receiving dialysis).

Discussion

The outlook for children with end stage renal failure has improved remarkably in the last 20 years,[8] and regular dialysis and renal transplantation are now both acceptable methods of treatment.[4 5] In 14 years at our centre we have treated 113 children with end stage renal failure. The mean time receiving dialysis while waiting for a transplant was 0·6 years, which is shorter than waiting times reported from other centres.[9 10] For this reason only four patients received dialysis at home solely because of the long waiting time.

Anaemia was a serious problem during dialysis with a transfusion rate of 1·0 units of packed red cells each month; this is similar to the 1·2 units a month reported by Trachtman *et al.*[9] Multiple blood transfusions occasionally caused iron overload and the development of cytotoxic antibodies with the consequent delay in renal transplantation. Fortunately hepatitis B infection did not occur. Uraemia was well controlled during dialysis, as shown by the results of laboratory tests (table 4).

A fully integrated service of dialysis and transplantation permitted the optimal treatment at any time. In such a system, particularly when living related donors were available, renal transplantation without prior dialysis was possible in 15 children. The high proportion of living related donors (25%) reflects our conviction that renal transplantation is the most effective treatment and should be offered early to children with end stage renal failure; this is confirmed by Fine[19] and Chantler.[10] The main advantage of using living related donors is the short period of end stage renal failure.

The overall survival rate of the children was 81% after 14 years, which is comparable with other large series.[10] The mortality of 14% included cases from the early learning period when the dialysis unit was being built up, and after transplantation when too much immunosuppressive treatment led to lethal septic complications. During the last 10 years only seven patients died, comparing favourably with the mortality of 9% reported by Trachtmann.[9]

The morbidity was considerable in both patients who received dialysis and patients who had transplants. Hospital admissions lasted for an average of 32·2 days a year during dialysis, and for 16·9 days during the first year after transplantation. Later on the average stay decreased to 3·9 days after four years.

Growth is nearly always impaired in children with chronic renal failure.[20 21] The short stature is already obvious by the time renal function is reduced to 25%, and becomes even more so after successful renal transplantation. The retardation of growth observed in our series may be worse than in other series because ours included a high percentage of patients with cystinosis (10%). Their development after transplant, however, was not different from the group as a whole. None of our patients was malnourished as shown by standard deviation scores of weight correlated to actual height. Other factors, therefore, such as renal osteodystrophy, and steroid dosage seem to be responsible for retardation of growth. More normal growth after renal transplantation was recently reported, however, when treatment with cyclosporin A had been given, which permitted lower doses of steroids to be used.[22 23] Sexual development was unfortunately not adequately documented in our cases, and so only the pubertal stages during the clinical evaluation in 1985 were investigated. At that time 19 of 61 patients of pubertal age showed pubertal retardation, which is consistent with other reports.[10 24]

Hypertension is another common complication of end stage renal failure that threatens long term prognosis. In our review the incidence of hypertension varied from 65% in chronic renal failure to 77% four years after renal transplantation. One patient with a functioning graft died from hypertensive cardiac failure. The underlying disease and

fluid overload are common causes of hypertension during dialysis.[25] After renal transplantation, steroids dosage and renal artery stenosis are major causes.[26]

Rehabilitation as measured by school attendance and full time employment was excellent after successful transplantation. Most patients judged their own state of health to be good or excellent. We hope that steroid induced complications will become less common in the future as the use of cyclosporin A increases, allowing a major reduction in the use of steroids. Nevertheless, new problems such as nephrotoxicity from cyclosporin A have yet to be solved.[27]

The management of children with end stage renal failure and their families comprises a complex regimen of dialysis, hospital admission, medication, nutrition, and operations. It requires a sympathetic staff of paediatric nephrologists, nurses, dietitians, teachers, social workers, and psychologists. Their strenuous efforts will be rewarded by the high rate of full rehabilitation of children who otherwise would not survive.

References

1 Pistor K, Olbing H, Schaerer K, Arbeitsgemeinschaft fuer paediatrische Nephrologie. Children with chronic renal failure in the Federal Republic of Germany: I epidemiology, modes of treatment, survival. *Clin Nephrol* 1985;**23**:272–7.

2 Broyer M, Donckerwolcke RA, Brunner FP. Combined report on regular dialysis and transplantation of children in Europe, 1980. *Proceedings of the European Dialysis and Transplant Association* 1981;**18**:59.

3 Kjellstrand CM. Hemodialysis for children. In: Friedmann EA, ed. *Strategy in renal failure.* New York: John Wiley and Sons, 1978:149–74.

4 Potter D, Feduska N, Melzer J, *et al.* Twenty years of renal transplantation in children. *Pediatrics* 1986;**77**:465–70.

5 Broyer M. Kidney transplantation in children: results of 383 grafts performed at Enfants Malades Hospital from 1973 to 1984. *Adv Nephrol* 1987;**16**:307–34.

6 Arbus GS, Geary DF, McLorie GA, *et al.* Pediatric renal transplants: a Canadian perspective. *Kidney Int* 1986;**30**:31–4.

7 Samuel KS, Mauer SM, Nevins TE, *et al.* Current results in pediatric renal transplantation at the University of Minnesota. *Kidney Int* 1986;**30**:25–30.

8 Potter D, Holliday M, Piel CF, *et al.* Treatment of end stage renal disease in children: a 15 year experience. *Kidney Int* 1980;**18**:103–9.

9 Trachtman H, Hackney P, Tejani A. Pediatric hemodialysis: a decade's (1974–1984) perspective. *Kidney Int* 1986;**30**:15–22.

10 Chantler C, Carter JE, Bewick M, *et al.* Ten years' experience with regular haemodialysis and renal transplantation. *Arch Dis Child* 1980;**55**:435–45.

11 Offner G, Brodehl J, Galaske GR, Rutt T. Acute renal failure in children: prognostic features after treatment with acute dialysis. *Eur J Pediatr* 1986;**144**:482–6.

12 Fine RN, Salusky IB. CAPD/CCPD in children: four years experience. *Kidney Int* 1986;**30**:7–10.

13 Albert E. Histokompatilitaetstestung und ihre klinische Relevanz. In: Pichlmayr R, ed. *Transplantationschirurgie.* Berlin: Springer Verlag, 1981:171–203.

14 Pichlmayr R, Tidow G. Operationsmethoden und Operationstechnik—Standardverfahren. In: Pichlmayr R, ed. *Transplantationschirurgie.* Berlin: Springer Verlag, 1981:529–68.

15 Hoyer PF, Offner G, Wonigeit K, Brodehl J, Pichlmayr R. Dosage of cyclosporin A in children with renal transplants. *Clin Nephrol* 1984;**22**:68–72.

16 Hoyer PF, Offner G, Brodehl J. Acute rejection episodes after renal transplantation in children. *Clin Nephrol* 1983;**19**:61–6.

17 Offner G, Brodehl J, Krohn HP, Vossmann J. Verwandtentransplantation unter Berueecksichtigung der Risiken fuer den Spender. In: Mildenberger H, Holschneider AH, eds. *Kongressberichte 1984 Kinderchirurgie.* Stuttgart: Hippokrates, 1985:221–4.

18 Tanner JM, Whitehouse RH. Clinical longitudinal standards of height, weight, height velocity, weight velocity and stages of puberty. *Arch Dis Child* 1976;**51**:170–9.

19 Fine RN. For children renal transplantation is the only realistic choice. *Kidney Int* 1985;**28**(suppl):15–17.

20 Jones RWA, Rigden SP, Barratt TM, Chantler C. The effect of chronic renal failure in infancy on growth, nutritional status and body composition. *Pediatr Res* 1982;**16**:784–90.

21 Kleinknecht C, Broyer M, Gagnadoux MF, *et al.* Growth in children treated with long-term dialysis. A study of 76 patients. *Adv Nephrol* 1980;**9**:133–63.

22 Offner G, Hoyer PF, Jueppner H, Krohn HP, Brodehl J. Somatic growth after kidney transplantation: beneficial effect of cyclosporin A in comparison with conventional treatment. *Amer J Dis Child* 1987;**141**:541–6.

23 Conley SB, Flechner SM, Gilbert R, Van Buren CT, Brewer E, Kahan BD. Use of cyclosporine in pediatric renal transplant recipients. *J Pediatr* 1985;**16**:45–9.

24 Boineau FG, Lewy JE. Sexual maturation in children with renal insufficiency: response to dialysis and transplantation. In: Fine RN, Gruskin AB, eds. *Endstage renal disease in children.* London: WB Saunders, 1984;291–5.

25 Ingelfinger JR. Hypertension in children with ESRD. In: Fine RN, Gruskin AB, eds. *Endstage renal disease in children.* London: WB Saunders, 1984;340–58.

26 Broyer M, Guest G, Gagnadoux MF, Beurton D. Hypertension following renal transplantation in children. *Pediatr Nephrol* 1987;**1**:16–21.

27 Hoyer PF, Krohn HP, Offner G, *et al.* Renal function after kidney transplantation in children: a comparison of conventional immunosuppression with cyclosporin A. *Transplantation* 1987;**43**:489–93.

Correspondence to Dr Gisela Offner, Kinderklinik der Med Hochschule Hannover, Konstanty Gutschow Str. 8, D–3000 Hannover, West Germany.

Received 1 September 1987