COMPARISON OF PROGRESSION OF RENAL FAILURE IN CHILDREN WITH HYPOPLASTIC-DYSPLASTIC KIDNEYS AND CHRONIC GLOMERULONEPHRITIS

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ABSTRACT

A comparative study was made on two groups of children comprising 20 patients with renal hypoplasia/dysplasia in one group and 12 patients with chronic glomerulonephritis (GN) in the other, presenting with chronic renal failure (CRF) in the Department of Paediatrics, Singapore General Hospital and National University Hospital between 1975 and 1989. The age of onset of CRF, the progression of renal failure and the presence of various clinical complications were analysed and compared.

The mean age of onset of CRF was earlier in patients with renal hypoplasia/dysplasia ($p < 0.001$) but the progression of renal failure in these patients were slower ($p < 0.005$). Hypertension occurred more frequently in the chronic GN group ($p < 0.001$) while urinary tract infection (UTI) occurred more frequently in the renal hypoplasia/dysplasia group ($p<0.004$).

With the early onset of renal failure and slow deterioration of renal function in patients with renal hypoplasia/dysplasia, the provision of good conservative treatment for renal failure is most important in the management of these patients. In the chronic GN patients however, with the rapidity of deterioration of renal function, early preparation for replacement therapy becomes more imminent. However, renal replacement therapy in end-stage renal failure (ESRF) is costly and not readily available, it is more prudent to delay the onset of ESRF by providing effective conservative treatment of renal failure which includes the early recognition and treatment of hypertension in chronic GN and UTI in renal hypoplasia/dysplasia.

Keywords: Chronic renal failure, hypertensions, urinary tract infection.

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INTRODUCTION

The management of children with chronic renal failure among other things, depends on the primary renal disease[1]. The age of onset of renal failure, the progression of renal failure to end stage renal disease and the factors aggravating renal impairment may vary considerably in patients with different underlying renal pathology. The approach and emphasis in the management and counselling of these patients will differ accordingly.

Hypoplastic/dysplastic kidneys and chronic glomerulonephritis (GN) are the two most common causes of renal failure in Singapore children, accounting for 84% of cases[2]. We studied 32 patients diagnosed to have these two diseases in SGH and NUH between 1975 and 1989. The age of onset of renal failure, the progression to end-stage renal failure (ESRF) and the clinical factors aggravating renal impairment were analysed and compared in this retrospective study.

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PATIENTS AND METHODS

Between 1975 and 1989, all children with chronic renal failure (CRF), age of onset before 12 years diagnosed in the Department of Paediatrics, SGH and NUH were studied.

They were followed up regularly and biochemical and renal function tests were done regularly at 3 monthly intervals.

The following data were analysed.

1) Age of onset of CRF
2) Sex
3) Serum creatinine levels at the time of diagnosis and at the last follow-up for estimation of progression of renal failure.
4) Duration of follow-up
5) Duration to ESRF
6) Presence of complications namely hypertension, urinary tract infection (UTI), anaemia and renal tubular acidosis (RTA).

Chronic renal failure was defined as serum creatinine persistently more than 1.5 mg/dl or glomerular filtration rate (GFR) less than 50 ml/min/1.73m^2 while ESRF was reached when serum creatinine was equal to or more than 10mg/dl or GFR less than 8 ml/min/1.73m^2.

Mitch et al and other workers[3,4] had shown that reciprocals of serum creatinine concentration (Cr^{-1}) decline linearly over time and this can give an estimate of the progression of the disease and help to predict when dialysis will become necessary or ESRF is reached.

Thus by determining the reciprocals of serum creatinine at the time of diagnosis (initial Cr^{-1}) and at the last follow-up (final Cr^{-1}), the rates of progression of renal failure in the 2 groups of patients can be calculated from the rate of change of

Serum Cr^{-1} or the slope of regression line in deciliter/milligram - month[3-4]. The following formulae were used:

$$Cr^{-1} = \frac{x - y}{t}$$

where Cr^{-1} = mean rate of change in Cr^{-1} or mean slope of regression line.
x = mean initial Cr^{-1}
y = mean final Cr^{-1}
t = mean time interval from x to y.

The mean time interval (T) to reach ESRF (at the point when serum creatinine = 10 mg/dl or $Cr^{-1} = 0.1$) in each group of patients can thus be estimated by $T = \frac{x - 0.1}{Cr^{-1}}$

Statistical analyses were done using Student t - test and chi-square test.

RESULTS

A total of 32 children with CRF were studied. They were divided into 2 groups for the purpose of this study. Group A comprised 20 patients with hypoplastic/dysplastic kidneys and Group B comprised 12 patients with chronic GN. Their ages ranged from 0.1 to 12 years. The mean duration of follow-up was 6.2 ± 4.7 years in Group A and 3.2 ± 2.9 years in Group B.

The clinical characteristics of patients were compared (Table I). The mean age of onset of chronic renal failure was early in Group A at 1.4 years compared with Group B at 6.4 years ($p < 0.001$). When analysing the sex ratio of the 2 groups, it was found that there was a significant male predominance in Group A ($p < 0.04$) while in Group B there was no significant difference in gender.

Table I
Chronic Renal Failure in renal hypoplasia/dysplasia and chronic glomerulonephritis: Comparison of Clinical Characteristics

	Group A Hypoplastic/dysplastic Kidneys (n = 20)	Group B Chronic GN (n = 12)	p Value
Mean age of onset (years)*	1.4 ±2.4	6.4 ±4.6	< 0.001
Sex (Male : Female)	9 : 1	1 : 1	< 0.04
Hypertension	10%	92%	< 0.001
UTI	70%	25%	< 0.04
Anaemia	45%	67%	ns
RTA	30%	58%	ns
Mean duration of follow-up (years) *	6.2 ±4.7	3.2 ±2.9	

* Mean ± S.D.

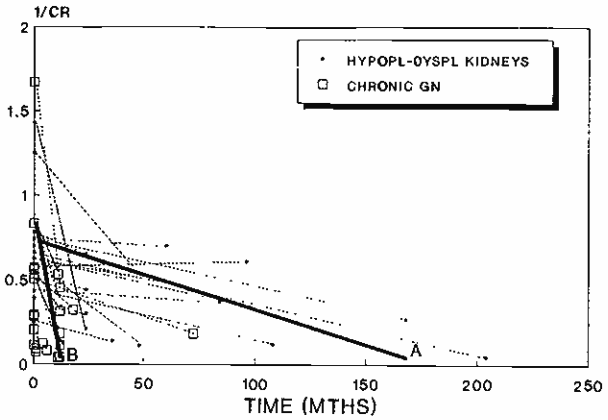
When comparing the incidence of hypertension and UTI in the 2 groups, hypertension was found in significantly higher number of patients in Group B ($p < 0.001$) while UTI was present in greater number in Group A patients ($p < 0.04$).

Although anemia and RTA were present in more than half of all patients in Group B (67% and 58% respectively) compared with a lower incidence in Group A (45% and 30% respectively), these differences were not significant statistically.

The rate of progression of CRF were compared in the two groups of patients using reciprocals of creatinine value against time (Fig 1). The mean rate of progression of CRF or rate of change of Cr^{-1} in both groups of patients were estimated and extrapolated to calculate the mean time interval to reach ESRF (ie when serum creatinine = 10mg/dl or $Cr^{-1} = 0.1$)

The mean rate of progression of CRF was much slower in group A compared with group B and the mean time interval to reach ESRF in group A was much longer compared with group B ($p < 0.0005$) (Table II)

Fig 1: Progression of chronic renal failure to ESRF



Slope A (in bold line) represents the mean rate of change of Cr^{-1}/mean rate of deterioration of renal function to ESRF in group A (Hypopl-dyspl kidneys).

Slope B (in bold line) represents the mean rate of change of Cr^{-1}/mean the rate of deterioration of renal function in Group B. (Chronic GN).

Table II
Chronic Renal Failure in renal hypoplasia/dysplasia and chronic glomerulonephritis: Progression of Renal Failure

	Group A (n = 20)	Group B (n = 12)	P Value
Mean value of initial Cr^{-1} (x)	0.662 dl/mg	0.572 dl/mg	-
Mean value of final Cr^{-1} (y)	0.357 dl/mg	0.207 dl/mg	-
Mean time interval from x to y (t)	73.2 months	14.4 months	-
Mean rate of deterioration/ slope of regression line (ΔCr^{-1})	-0.00417 dl/mg-month	-0.0253 dl/mg-month	$p < 0.0005$
Mean time interval (T) to reach ESRF when $Cr^{-1} = 0.1$	134.9 months	18.6 months	$p < 0.0005$

DISCUSSION

Studies[3,4,6] had shown that CRF characteristically progresses inexorably towards ESRF. The rate of progression of renal failure, once established remains remarkably constant with little deviation from a straight line until ESRF occurs. This observation allowed us to study and compare the rate of progression of CRF in children with hypoplastic/dysplastic kidneys and chronic GN.

Chronic renal failure is fortunately uncommon in childhood, and the number of patients reaching ESRF is even smaller[5]. However, the morbidity and mortality are considerable in ESRF and the cost of renal replacement therapy is tremendous[2]. It is therefore prudent to place greater emphasis on the provision of optimal conservative management of children with CRF to delay as far as possible the onset of ESRF.

We have found in this study that the age of onset of CRF was very early in patients with dysplastic/hypoplastic kidneys with a mean age of 1.4 years. This has an important implication because CRF occurred at a time when growth acceleration is maximal[7]. Growth in these patients would consequently be affected[8-10]. Furthermore, the slower progression of CRF over years before ESRF ensues exposes these patients to greater risk of growth retardation and bone disease [11,12]. It is therefore

imperative in the management of these patients to aim at optimizing growth and treatment of renal osteodystrophy.

In patients with chronic GN, growth retardation may be less severe because of later onset of CRF. However, with the rapidity in deterioration of renal function to ESRF, preparation for replacement therapy becomes more imminent and assumes greater importance[13] and the necessary psychosocial support, education, establishment of vascular access to prepare patient and parents for ESRF should all be established as soon as possible.

The higher incidence of UTI in patients with renal dysplasia/hypoplasia could be explained by a higher incidence of associated obstructive uropathy found in these patients[14] which predisposes them to UTI. While in chronic glomerulonephritis, the associated renal parenchymal disease accounts for a higher incidence of hypertension[15] in this group of patients.

The onset and progression of disease may differ in renal dysplasia/hypoplasia and chronic GN and entail differing approach in the management of the patients, but the primary objective in the treatment of both groups of patients remains the same, aiming at prevention or retardation of further deterioration in renal function. Aggravating factors like hypertension that is prevalent in chronic GN and UTI in those with renal hypoplasia - dysplasia should be recognised early and effective treatment given promptly.

References

1. Fine RN. Growth in children with renal insufficiency. In: Nisseuson A, Fine RN, Gentile D. eds. Clinical Dialysis. New York, Appleton - Century Crofts, 1984; 661.
2. Saw AH, Yap HK, Murugasu B et al. Chronic renal failure in children in Singapore, Abstract. 22nd Singapore-Malaysia Congress of Medicine 1988.
3. Oksa H, Pasternack A, Luomala M, Sirvio M. Progression chronic renal failure. Nephron 1983; 35: 31 - 4.
4. Mitch WE, Walser M, Buffington GA, Lemann Jr J. A simp method of estimating progression of chronic renal failure. Lan 1976; ii: 1326 - 8.
5. Helin I, Winberg J. Chronic renal failure in Swedish childr Acta Pediatr Scand 1980; 69: 607 - 11.
6. Nahas AM El, Masters-Thomas A, Brady SA, Farrington Wilkinson V. Selective effect of low protein diets in chronic re failure. Br Med J 1984; 289: 1337 - 41.
7. Tanner JM, Whitehouse RH: Clinical longitudinal standards . height, weight, height velocity, weight velocity and stages of p berty. Arch Dis Child 1976; 51: 170.
8. Bett PR, Magrath G. Growth pattern and dietary intake of cl dren with chronic renal insufficiency. Br Med J 1974; 1: 189 - 9
9. Shärer K: Growth in children with chronic renal failure. Kidr Int 1978; 13 (Suppl 8): 68.
10. Broyer M: Growth in children with renal insufficiency. Paed Clin North Am 1982; 29: 991.
11. Mehls O, Ritz E, Gilli G et al. Effect of vitamin D on growth experimental uraemia. Am J Clin Nutr 1978; 31: 1927.
12. Chan JCM, Kodroff MB, Landwehr DM. Effect of 1, 2 dihydroxyvitamin - D3 on renal function, mineral balance growth in children with severe chronic renal failure. Paediatr 19 68: 559 - 71.
13. Donckerwolcke RA, Chantler C, Broyer M et al. Combined re on regular dialysis and transplantation of children in Europe 19 Proceedings of EDTA, Vol. 17 Tunbridge Wells, Pitman Medi 1980; 87 - 115.
14. Bernstein J. Renal hypoplasia and dysplasia. In: Edelmann. Paediatric Kidney Disease, Vol. 2. Boston Little, Brown, 19 541 - 57.
15. Dillon MJ. Hypertension. In: Postlethwaite RJ. ed. Clinical Pa atric Nephrology. Wright, 1986; 5 - 6.