Analysis of pathogeny and clinical manifestation in children with end-stage renal disease in China

Running title: Children with end-stage renal disease

Xiaohui Li[1], Yajun Wang[1], Yan Li[2*]

[1]Department of Pediatrics, The First Affiliated Hospital of Harbin medical University, Harbin, China
[2]Department of Radiology, Shandong Tumor Hospital, Jinan, China
E-mail: liyan3899@126.com

Abstract: Objective: End-stage renal disease (ESRD) is the complete or almost complete failure of the kidneys to work. This kind of kidney failure is permanent and cannot be fixed. Most cases of ESRD are caused by diabetes or high blood pressure. Now the most effective methods of ESRD treatment are hemodialysis (HD) or kidney transplantation. In China, the pediatric patients with ESRD were increased in decades. Thus, it's important to study the pathogeny and clinical manifestation of children with ESRD. Our study will contribute to the better knowledge and clinical treatment to children with ESRD. **Methods:** We examined the etiology and clinical manifestation of pediatric patients with ESRD before treatment in the First Affiliated Hospital of Harbin medical University from 2009.7 to 2013.6. A total of 126 pediatric patients were included, with the average age of 9.16±2.32 years old. **Results:** We demonstrated the clinical manifestation of children with ESRD as well as followed-up results of patients treating with HD or kidney transplantation. The results showed that 59.52% of total patients have hypertension, 91.27% anemia and 80.16% cardiovascular disease. These clinical manifestation are highly correlated with ESRD in children, and would aggravate the risk of death in these children. **Conclusion:** Our study found several complications, such as hypertension and anemia, were highly correlated with ESRD in China; which could contribute to a better knowledge of pediatric ESRD in China, thus serving for ESRD treatment in future.
[Xiaohui Li, Yajun Wang, Yan Li. **Analysis of pathogeny and clinical manifestation in children with end-stage renal disease in China.** *Life Sci J* 2014; 11(10):740-743]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 120

Key words: End-stage renal disease; pathogeny; clinical manifestation; hemodialysis; kidney transplantation

1. Introduction

End-stage renal disease (ESRD) is a chronic and permanent renal disease caused by a variety of kidney diseases, such as chronic renal failure (CRF). ESRD could impair kidney functions and bring mental pressure to patients, especially to children. This kind of kidney failure is permanent and cannot be fixed. Most cases of ESRD are caused by diabetes or high blood pressure. Now the most effective methods of ESRD treatment are hemodialysis (HD) and kidney transplantation. In China, the pediatric patients with ESRD are increased in decades [1]. Thus, it's of importance to better understand the pathogeny and clinical status of children with ESRD before diagnosis. In this study, we analyzed the pathogeny and clinical features of children with ESRD who receive HD treatment in our hospital. We demonstrated the clinical manifestation of children with ESRD as well as followed-up results of patients treating with HD or kidney transplantation. We showed that 59.52% of total patients have hypertension, 91.27% anemia and 80.16% cardiovascular disease. These complications were highly correlated with ESRD in children, and aggravate the risk of death in these children. Our study will contribute to a better knowledge of pediatric ESRD in China, thus serving for ESRD treatment in future.

2. Materials and methods

2.1 General information

The medical records of 126 cases of patients with ESRD from the First Affiliated Hospital of Harbin Medical University were voluntarily participated in the study, from July 2009 to June 2013, including 66 males and 60 females. The age of patients was between 2.0~14.5 years old, and the average was 9.16±2.32 years. The study was approved by the ethics and investigation committee and carried out according to the guidelines of NIH.

2.2 Observed indexes

We collected clinical data of children with ESRD before treatment and made comparisons, including the proportion of complicated hypertension, the hemoglobin (Hb) contents, parathyroid hormone (PTH) contents and the proportion of enlargement of atrioventricular in echocardiographic, as well blood indexes, such as serum contents of potassium, calcium, phosphorus, alkaline phosphatase, urea nitrogen and creatinine. In addition, renal biopsy was also performed.

2.3 Clinical treatment and follow-up visiting

All the 126 patients underwent HD treatment. Another dialysis treatment for more than one month was performed in 98 cases, for 2~3 times a week and 3~4 hours each time. According to the efficiency of HD, the patients received further kidney transplantation or other treatments. After treatment, 105 patients were followed-up by telephone visiting until December 2012.

2.4 Statistical methodology

All statistical analysis was performed by SPSS software (SPSS 16.0, Chicago, IL). Quantitative data were showed in $\bar{x}\pm s$ using t-tests for comparisons. The value 0.05 was assumed as the level of significance for the statistic tests carried out.

3. Results

3.1 Pathogeny

In the total 126 cases, the onset time was distinguished from 3 days to 8 years, and the average time before ESRD diagnosed was 25.52 ± 6.09 months. In 18 cases (14.29%), the etiology was unclear, because the patients were diagnosed as ESRD at the first examination. In other 108 cases, the etiology of 50 patients (39.68%) with ESRD was derived from congenital kidney diseases, such as congenital renal dysplasia and renal cystic diseases; 56 cases (44.44%) were caused by acquired renal diseases; one case (0.79%) was induced by Goodpasture syndrome and another one (0.79%) by chronic tubulointerstitial nephritis (Table 1).

Table 1: The etiology distribution of 126 children with ESRD

Etiology	Cases (n)	Percentage (%)
Unclear	18	14.29
Congenital	50	39.68
Acquired	56	44.44
Chronic glomerulonephritis	28	22.22
Nephritic syndrome	19	15.08
IgAN	3	2.38
Hemolytic uremic syndrome	2	1.59
Systemic lupus erythematosus	2	1.59
Anaphylactoid purpura nephritis	1	0.79
Rapidly progressive glomerulonephritis	1	0.79
Goodpasture syndrome	1	0.79
Chronic tubulointerstitial nephritis	1	0.79

3.2 Clinical manifestation

All the 126 patients with ESRD had similar clinical manifestations, such as anemia, hypodynamia, anorexia, nausea, dizziness headache, convulsion and developmental retardation. There were 115 patients (91.27%) that had different degrees of anemia, and 16 patients (12.70%) with mild anemia, 62 patients (49.21%) with moderate anemia and 37 patients (29.37%) with severe anemia. 75 patients (59.52%) suffered from high blood pressure with the systolic blood pressure of 146 ± 24 mmHg and diastolic blood pressure of 99 ± 14 mmHg. The details are shown in Table 2.

Table 2. Statistical analysis of clinical manifestations in 126 children

Items	Cases (n)	Percentage (%)
Anemia	115	91.27
Hypodynamia	109	86.51
Anorexia and nausea	87	69.05
Edema	86	68.25
Dizziness headache	54	42.86
Convulsion	28	22.22
Developmental retardation	49	38.89
Hypertension	75	59.52

3.3 Laboratory examinations

To further investigate the ESRD characterizations in these pediatric patients, we examined the serum contents in the total 126 ESRD patients. We found that the serum Hb content of the ESRD patients was 34~126 g/L (reference range: 65.82 ± 23.25 g/L) and serum potassium was 2.75~8.63 mmol/L (4.26 ± 0.96 mmol/L). Of note, serum potassium of 25 patients was less than 3.5 mmol/L, while other 21 patients more than 5.5 mmol/L and rest 80 patients in normal range. The concentration of serum creatinine was 200~2360 μmol/L (1125.96 ± 321.74 μmol/L), urea nitrogen 10~108 mmol/L (45.93 ± 13.05 mmol/L), blood calcium 0.82~2.57 mmol/L (1.66 ± 0.35 mmol/L), serum phosphorus 1.0~5.5 mmol/L (2.55 ± 0.93 mmol/L) and alkaline phosphatase 36~886 IU/L (246.48 ± 189.92 IU/L). We also noted that hypocalcemia (<2.1 mmol/L) appeared in 82 cases (65.08%) and hyperphosphatemia in 94 cases (74.6%). Moreover, 52 cases of total were applied to PTH examination, with the result of 32.5~2500 pg/ml (852.06 ± 428.89 pg/ml). It's also noted that there was 38 cases with PTH concentration more than 300 pg/ml. The echocardiographic examination showed the heart of 25 cases were normal, 32 cases with mild enlargement of atrioventricular, 33 cases with moderate enlargement of atrioventricular and 36 cases with severe enlargement of atrioventricular.

3.4 HD treatment and follow-up results

All the 126 patients underwent HD treatment. Another dialysis treatment for more than one month was performed in 98 cases, for 2~3 times a week and 3~4 hours each time. After treatment, 105 patients were followed-up by telephone visitings. We found that 31 patients (29.52%) died, 5 (4.76%) stopped further treatment, 42 (40.00%) underwent maintenance HD treatment for 26.32 ± 24.19 months in average and 27 (25.71%) performed kidney transplantation, in which 25 patients lived healthy and 2 died.

4. Discussion

ESRD is one of the significant life-threatening diseases to the children. However, there are few clinical manifestation and pathogeny analysis of children with ESRD in China. The main etiology of ESRD was acquired renal diseases, in which the chronic glomerulonephritis occupied the first place. According to Poland's reports [2], about 48% ESRD was caused by acquired glomerular diseases and 30% by congenital urinary tract anomalies. In present study, we demonstrate that the average age of children with ESRD was 9.16 ± 2.32 years, which was earlier than 12.1 years in the United States [3].

Children with ESRD were lack of specific clinical manifestations, it is often involved the blood system and digestive system. A significant feature between children and adults with ESRD is growth retardation. Moreover, children with ESRD often suffer from hypertension as we described. The reason of hypertension in ESRD patients is complicated, mainly due to sodium and water imbalance. Hypertension is the risk factor of occurrence of cardiovascular complications in ESRD patients [4, 5]. We find that the rate of hypertension is 59.52% in our study, consistent with previous results. We note that the etiology of ESRD was still unknown in 18 cases, in which the urine routine and renal function were not monitored. Therefore, children should have routinely urine test and blood biochemical test for the early diagnosis of ESRD. Of note, we also found that the children with ESRD in our study often have anemia. As erythropoietin (EPO) synthesis deficiency, erythrocyte lifetime shorten, bone marrow suppression and lack of nutritional factors (especially iron), anemia is often observed in ESRD children. Our data confirms that 91.27% ESRD children have anemia, suggesting that the anemia is highly correlated with ESRD and need to be considered during clinical treatment. We also find that ESRD children often have calcium and phosphorus metabolic disorders and secondary hyperparathyroidism, consistent with Rahman's report [6], suggesting that calcium and phosphorus metabolic disorders should be paid high attention in ESRD children. Similarly, cardiovascular disease, the second death factor in ESRD patients [7, 8], is easily happened in our ESRD children, of which 80.16% patients have enlargement of left atrioventricular.

Now, the best treatment for children with ESRD is renal replacement therapy, especially kidney transplantation, and the survival rate could be improved significantly compared to dialysis [9]. In our study, 27 patients performed kidney transplantation, and the survival rate was 92.59%. This supports the notion that kidney transplantation is an efficient method for ESRD treatment and should be extended in China, with the improvement of surgical techniques.

In conclusion, we present the clinical manifestation and pathogeny analysis in 126 cases of ESRD children in China. For there are few clinical reports and analysis about ESRD in China, our work could contribute to a better knowledge of pediatric ESRD in China, thus serving for ESRD treatment in future.

Corresponding author:
Yan Li
Department of Radiology, Shandong Tumor Hospital, Jinan, China
E-mail: liyan3899@126.com

There is no conflict of interest.

References:

1. Liu L, Zhang H, Fu Q, et al. Current status of pediatric kidney transplantation in China: data analysis of Chinese Scientific Registry of Kidney Transplantation. Chin Med J (Engl). 2014; 127(3):506-10.
2. Ziółkowska H, Adamczuk D, Leszczyńska B, et al. Glomerulopathies as causes of end-stage renal disease in children. Pol Merkur Lekarski. 2009 Apr; 26(154):301-5. Polish.
3. Seikaly MG, Ho PL, Emmett L, et al. Chronic renal insufficiency in children: the 2001 Annual Report of the NAPRTCS. Pediatr Nephrol. 2003, 18(8):140.
4. Mitsnefes M, Stablein D. Hypertension in pediatric patients on long-term dialysis: a report of the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS). Am J Kidney Dis. 2005; 45: 309-15.
5. Parekh RS, Carroll CE, Wolfe RA, Port FK. Cardiovascular mortality in children and young adults with end-stage kidney disease. J Pediatr. 2002; 141: 191-7.
6. Rahman MH, Hossain MM, Sultana S, et al. Correlation of serum parathormone level with biochemical parameters in chronic renal failure. Indian Pediatr. 2005; 42(3):250-4.
7. Mitsnefes MM. Cardiovascular disease in children with chronia kidney disease. Adv Chronic Kidney Dis. 2005; 12: 397-405.
8. Mitsnefes MM, Barletta GM, Dresner IG, et al. Severe cardiac hypertrophy and long-term dialysis: the Midwest Pediatric Nephrology Consortium study. Pediatr Nephrol. 2006 Aug; 21(8):1167-70.
9. McDonald SP, Craig JC. Long-term survival of children with End-Stage Renal Disease. N Engl J Med. 2004, 350: 2654-62.

4/7/2014