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End Stage Renal Disease in Children in Bahrain: Etiology and Outcome

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Abstract

Background: End-stage renal disease is an overwhelming illness associated with high morbidity and mortality worldwide. Identifying the risk factors in children and planning preventive strategies is of great significance. The aim of the present study is to assess the etiology and outcome of end stage renal disease in children in Bahrain.

Methods: As a part of the retrospective analysis, all children with end-stage renal disease were below 16 years and were on renal replacement therapies between 2008 and 2018. Data were collected from patients' charts and electronic medical records.

Results: Out of the total 50 children (with end-stage renal disease) who enrolled for the study, the subjects were 37 (74%) and 13 (26%) were boys and girls, respectively. Among the subjects, 19 patients (38%) were diagnosed with congenital anomalies of the kidneys and urinary tract as the main cause of end-stage renal disease. Posterior urethral valve was the main abnormality seen in 12 (24%) patients. Inherited renal diseases were the second leading cause of end-stage renal disease in children 15 (30%) patients. Glomerulopathies accounted for 12% of the total patients, focal segmental glomerulosclerosis was the most common glomerulopathy seen in 5 (10%) patients. 28 patients (56%) received hemodialysis; 18 patients (36%) received peritoneal dialysis. 24 (48%) children had renal transplantation, 4 children (8%) underwent preemptive kidney transplantation, while 3 (6%) children died.

Conclusions: Congenital anomalies of the kidneys and urinary tract is the leading cause of end-stage renal disease in children followed by hereditary diseases. Thus, planning preventive strategies and counseling support for the children and their families are of great significance.

Keywords: Bahrain, chronic kidney disease, kidney transplantation, peritoneal dialysis, renal dialysis, urogenital abnormalities

Introduction

Chronic kidney disease (CKD) is an overwhelming illness in children that further progresses to end stage renal disease (ESRD). It is associated with high morbidity and mortality rate worldwide and its unique complications like impaired linear growth and neurocognitive development is applicable to pediatric population. ESRD significantly affects the

quality of life of children and their families besides imposing a great burden on the national resources due to the high cost of treatment. Early detection and identification of the preventable or reversible causes of the disease is of great importance to prevent progression of CKD in children, predict the prognosis and support the counseling of the children and their families.[1,2,3,4]

The research about CKD in the pediatric population is very less when compared to the extensive research in the adult population. Moreover, there are marked variations in the incidence and prevalence of ESRD in the pediatric population across countries possibly due to racial and ethnic differences.

Since there is no national or regional registry on CKD, the present study aimed to assess the etiology and outcome of ESRD among children in Bahrain. To the best of our knowledge, no study in this regard has been published earlier.

Materials and methods

For the retrospective analysis, the medical records of all children with ESRD undergoing renal replacement therapies (RRT) at Salmaniya Medical Complex, between 2008 and 2018 were reviewed.

The inclusion criteria were glomerular filtration rate (GFR) lesser than 15 mL/min/1.73 m^2 and the age of patients < 16 years. The exclusion criteria consisted of the earlier stages of chronic kidney disease and those patients with GFR more than 15 mL/min/1.73 m^2, not requiring renal replacement therapy.

Salmaniya Medical Complex is the main tertiary care hospital with dialysis facilities for children in Bahrain. Approval of the ethical medical committee of secondary care was obtained.

Data were collected from patients' charts and electronic medical records that included age, gender, primary renal disease, mode of initial renal replacement therapy, clinical outcome including kidney transplantation, patients who survived with a functioning graft or patients with failed renal transplant who were put back on dialysis or patients who succumbed to death.

ESRD was defined according to the CKD classification system as described by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI) as stage 5 based on the GFR being less than 15 mL/min/1.73 m^2.[5] The terminal stage of CKD involves treatment of patients with renal replacement therapy which is necessary to sustain the patient's life. The GFR was estimated by the Schwartz formula or by using diethylene triamine penta acetic acid (DTPA) scan.

***Statistical analysis*:** Data entry was done in Microsoft Excel spread sheet and then transferred to IBM SPSS Statistical Software for Windows, Version 22. Percentages of all categorical variables were calculated. Quantitative data were reported as mean and the qualitative data were presented in percentage.

Results

A total of 50 children with ESRD were enrolled in the study over a ten-year period. Male predominance was noted 37 boys (74%) while the girls were 13 (26 %). The age of the patients ranged from 0.3 to 16 years with a mean of 5.9 years.

CAKUT was the main cause of ESRD seen in 19 (38%) patients. Among those abnormalities, obstructive uropathy, PUV was the main problem seen in 12 (24%) patients. Inherited renal diseases were the second leading cause of ESRD in children 15 (30%) patients.

Glomerulopathies accounted for 12% of the total patients with ESRD, where FSGS was the most common glomerulopathy seen in 5 (10%) patients. Unknown causes accounted for 8% of the cohort (4) children. Table.1 summarizes the causes of CKD in children included in the study.

Most children i.e., 29 (58%) patients were less than five years at the time of presentation with ESRD. Table 2 presents the age distribution of children at their presentation.

Table 1: Causes of chronic renal failure in children in our study patients (n=50). The table caption to be placed on top

Diagnosis	Number of patients	%
Urinary system anomalies	**19**	**38%**
Posterior urethral valve	12	24
Aplastic/hypoplastic/ dysplastic kidney	6	12
Reflux nephropathy	1	2
Hereditary conditions	**15**	**30%**
Congenital nephrotics	10	20
Cystinosis	3	6
Polycystic kidney disease (ARPKD)	2	4
Glomerulopathies	**6**	**12%**
Focal segmental glomerulosclerosis	5	
Rapidly progressive glomerulonephritis	1	
Unknown cause	**4**	**8%**
Multisystemic diseases	**3**	**6%**
Systemic lupus erythematosus	2	
Behcet disease	1	
Miscellaneous (Ischemic/ vascular)	**2**	**4%**
Ischemic renal failure post cardiac surgery	1	
Trauma to renal artery post exchange	1	

Table 2: Age distribution of ESRD* children at their first presentation

Age (years)	Number of patients	%
< 5	29	58
5-9	13	26
10-16	8	16

*ESRD: end stage renal disease

Associated problems encountered in the cohort included the following:

Three children had various syndromes (Down syndrome, Joubert, Behcet disease). Two patients had multiple congenital anomalies and global developmental delay.

Regarding the initial dialysis modality 28 (56%) children were put on hemodialysis as initial RRT while 18 (36%) patients received peritoneal dialysis.

Twenty-four children had renal transplantation (48%), 4 children (8%) underwent PKT. The most common type of donor–recipient relationship in the study is parent-to-child kidney transplant found in 21 cases, one case of sibling transplant and two cases of living non-related donors from commercial renal transplantation.

Three children (6%) died suddenly at home. Figure.1 represents the clinical outcome of the children with ESRD.

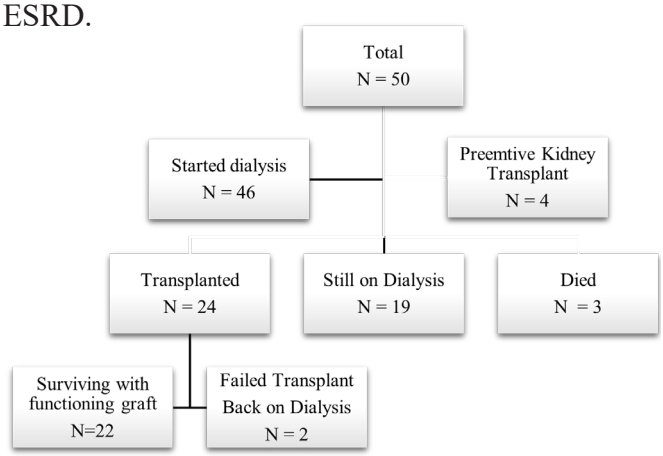

Figure 1: The clinical outcome of the children with ESRD

Discussion

The present study demonstrated that CAKUT is the leading cause of ESRD in children in Bahrain followed by hereditary diseases. Male predominance was also recognized. These results are similar to the findings reported by other studies in the region. CAKUT is the leading cause of CKD found in 50% of the Saudi children [6] and 33% of the Iranian children.[7] Moreover, several studies worldwide demonstrated the same findings.[8,9,10,11]

Consanguinity was noted in 40% of the patients. This possibly explains the high incidence of inherited renal diseases in the cohort. Interestingly, most of the patients were started put on hemodialysis as initial RRT (56%), followed by peritoneal dialysis (36%).

This was also reflected in the U.S. Renal Data System (USRDS) Annual Data Report of 2018 as hemodialysis (HD) being the most common initial RRT modality in children (51.2%), followed by

peritoneal dialysis (PD) (25.7%) and (20.0%) with transplant.[12]

The 2011 annual report of the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS) registry, compared the clinical parameters and patient survival in the first 10 years of the registry (1992–2001) with the last decade of the registry (2002–2011) and showed a significant increase in hemodialysis as the initiating dialysis modality in the most recent cohort (42% vs. 36%).[13] On the contrary in Japan, the majority of their patients had peritoneal dialysis as initial RRT (61.7%), while 22.3% and 16% accounted for hemodialysis pre-emptive transplantation (Tx), respectively.[11] Whereas in Europe recent published data from the ESPN/ERA-EDTA Registry regarding RRT in 22 European countries from 2007–2016 showed stable distribution with 80% of patients commencing RRT on dialysis (HD and PD both 40%), while 20% received a pre-emptive kidney transplant.[14] The higher number of patients on hemodialysis in the cohort is due to multiple factors including social reasons, family preferences in addition to some medical contraindications to PD. Favel *et al*[15] evaluated the multifactorial aspects influencing the decision-making process regarding the choice of modality and time of initiation of RRTin children with ESRD. Emphasis on better understanding of this complex decision-making process is given in order to achieve a positive impact on the patients and their families. [15]

Kidney transplantation is the best modality of treatment for children with ESRD, preferably PKT defined as a transplant serving as the initial RRT modality. PKT prevents the dialysis complications and improves the long-term outcome of the patient and the graft.[16] In spite of the well-known benefits of PKT, it remains the least frequently utilized initial RRT modality in children with ESRD. The present study showed that twenty-four (48%) children had renal transplantation and only four (8%) children had PKT. To fully embrace preemptive transplantation in our community, education and increased awareness is required.

Three children died suddenly at home. It is assumed that sudden cardiac death could be due to hyperkalemia or other causes. Cardiovascular disease is a well-known leading cause of mortality in children with ESRD and sudden cardiac death has been reported extensively by various registries as well as single and multicenter studies.[13,17,18]

A recent report by the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS) summarizing data on > 6000 children on dialysis has compared clinical parameters and patient survival in the first 10 years of the registry (1992–2001) with the last decade (2002–2011). Statistics showed that cardiopulmonary complications are the leading specified cause of death (21%) in both cohorts.[13] Similarly, in Europe data from population-based registry from 6473 pediatric patients undergoing chronic RRT in 36 European countries in the years 2000–2013 highlighted that cardiovascular disease is the main contributor to death in European children with end-stage renal disease on dialysis (18.2%), with cardiac arrest/sudden death (54.4%).[18]

CKD is a silent disease associated with significant morbidity and mortality, CAKUT is the leading cause in children, therefore early detection and intervention is mandatory to halt the progression of the disease. Implementing primary preventive measures mainly involves addressing structural abnormalities of the kidney and urinary tract and exposure to environmental risk factors and nephrotoxins.[19] Raising awareness about CKD screening, planning preventive strategies and counseling support for children and their families are of great significance.

Furthermore, greater emphasis on kidney transplant education in the community is necessary to improve the outcome of children with kidney disease.

This study has several limitations due to its retrospective nature, difficulty in gathering data and some missing data. Despite its limitation, this study represents the first effort that shed light on the etiology of end stage renal disease in children in Bahrain. A future prospective study is required.

Conclusions

CAKUT is the leading cause of ESRD in children followed by hereditary diseases. Planning preventive strategies and counseling support for the children and their families are of great significance.

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Conflict of interest

No conflict of interest.

Informed consent: Consent was not required from the patients. However, this study was ethically approved by the secondary care ethical committee at the Ministry of Health, Bahrain.

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