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Original Article

End-stage Renal Disease in Children on Maintenance Dialysis in Benghazi, Libya

Ekram A. Barakat Ben Sauod[1], Ahmed Awad Aklifa[2,3]

[1]Departments of Family and Community Medicine and [3]Pediatrics, Faculty of Medicine, University of Benghazi, [2]Department of Pediatric Nephrology, Benghazi Pediatric Hospital, Benghazi, Libya

Abstract

Background: End-stage renal disease (ESRD) is a major cause of morbidity and mortality worldwide. Understanding the risk factors of ESRD can help identify preventive strategies and is critical for planning interventions to minimize the disease morbidity and mortality. **Objectives:** The aim is to identify the demographic and clinical characteristics and risk factors that contribute to ESRD 2005–2016. **Settings:** The dialysis unit of Benghazi Pediatric Hospital, Benghazi, Libya. **Patients and Methods:** This is a descriptive case series of all children with ESRD on maintenance dialysis (hemodialysis or peritoneal dialysis) between January 2006 and June 2016. Data were collected from patients' charts and the statistics department of the hospital. Demographic information, the age of onset, duration, and type of dialysis, likely etiology (if documented), complications and comorbidities were all documented and outcome including the cause of death. **Results:** The mean age of onset of ESRD was 8.5 years; nearly 41% of patients started dialysis at 6–10 years. The majority of patients (72%) resided locally. Male to female ratio was 1.5:1. Consanguinity of parents and family history of renal disease were reported by 12% and 16% of patients, respectively. More than half of patients (51.3%) had had no complications from dialysis. The most common known cause of ESRD was glomerulopathy (18.4%); including glomerulonephritis and nephrotic syndrome. Congenital and hereditary disorders involved 17.1% of cases. These were obstructive uropathy in 9.2% of the patients. The cause was not known in a large proportion (52.6%). Nearly 80% of the patients were alive during the study. Encephlophay (10.5%) and sepsis (6.5%) are the most common causes of death. **Conclusions:** The clinical profiles, causes, and outcome of ESRD in a specialized center in Benghazi were documented. The study is limited by the high proportion of unknown etiology. Full documentation of underlying etiology is a good clinical practice that should produce better epidemiological studies.

Keywords: End-stage renal disease, hemodialysis dialysis, peritoneal dialysis, risk factors

Introduction

Chronic kidney disease (CKD) has become a significant public health concern worldwide, as it is associated with substantial morbidity.[1] Dialysis or transplantation is the only definitive choice if life is to be sustained in patients with end-stage renal disease (ESRD). The treatment of CKD and ESRD imposes substantial societal costs. Expenditure is highest for renal replacement therapy (RRT), especially in-hospital hemodialysis.[1-3] For successful renal replacement, comprehensive programs are required. These involve medical, nursing, and technical skills, facilities and continued financial and organizational support from society, government, and profession.[4] Epidemiological studies of the adult population in several countries report CKD prevalence of 9%–11%. In Libya, data on the prevalence of CKD is lacking. However, the reported incidence of ESRD is 80–100 per million per year, and there are approximately 2100 patients currently on dialysis in Libya.[1,3] In concert with the worldwide pandemic, ESRD in Libya has also increased exponentially in recent decades.

A systematic review identified all relevant papers published in English from 2003 to 2012 found in three databases.[5] The total number of dialysis centers was 40 with 61 nephrologists. Nephrologist/internist to patient ratio was 1:40, and nurse to patient ratio was 1:3.7. Only 135 living-related kidney transplants had been performed between 2004 and 2007. There were no published data on most macroeconomic and

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Address for correspondence: Dr. Ekram A. Barakat Ben Sauod, Department of Family and Community Medicine, Faculty of Medicine, University of Benghazi, Benghazi, Libya.
E-mail: ibarakatb@yahoo.co.uk

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renal service factors. They concluded that ESRD is a major public health problem in Libya with diabetic kidney disease and chronic glomerulonephritis being the leading causes. The most frequent comorbidities were hypertension, obesity, and the metabolic syndrome. In addition to provision of RRT, preventive strategies are also urgently needed for a holistic integrated renal care system. CKD is a public health issue with significant humanitarian and economic implications.[4,5]

Principles and practice of ESRD management are well documented in authoritative texts and clinical practice guidelines. However, the extent to which outcomes of clinical practice in the real world achieve, these targets and key performance indicators need to be monitored regularly.[4,5] Hence, this study of the characteristics and outcomes of a cohort of ESRD in children on maintenance dialysis in Benghazi, Libya.

Patients and Methods

Objectives

The aims were (1) to estimate the magnitude of ESRD among children attending the Pediatric Hospital, Benghazi City (the second largest city of Libya) and (2) to ascertain demographic characteristics, and risk factors that contribute to the ESRD and outcome.

Settings

This is a descriptive case series of all children with ESRD on maintenance dialysis (both hemodialysis and peritoneal dialysis). Data were collected retrospectively between January 1, 2006 and June 30, 2016. Patients charts kept at the nephrology and dialysis units and data held by the hospital's statistics department were used.

Data analysis

Variables included personal history (age, gender, and residence), the age of patients, age at start of dialysis, type of dialysis (hemodialysis vs. peritoneal dialysis), family history of renal disease, consanguinity of the parents, and associated comorbidity. Descriptive statistics were used.

Results

Demographic and clinical characteristics

The mean age at the onset of ESRD was 8.5 (3.8) years. Nearly 41% of patients started dialysis at the ages between 6 and 10 years [Table 1]. The majority of patients (72%) resided locally within the city of Benghazi. The male to female ratio was 1.5:1. Consanguinity of parents and family history of renal disease were reported by 12% and 16% of patients, respectively.

Etiology of end-stage renal disease

Causes of ESRD included glomerular disease (clinical glomerulonephritis and nephrotic syndrome), chronic pyelonephritis, or congenital, and hereditary disorders (obstructive uropathy, polycystic kidney disease, renal agenesis, and hypoplastic kidney), but in an unusually high proportion (52.6%) causes were undetermined.

Table 1: Summary of the demographic and clinical characteristics, details of dialysis, complications, and outcomes of 76 children on maintenance dialysis for end-stage renal disease seen in Benghazi Pediatric Hospital between 2006 and 2016

Characteristics/ parameters	Details	*n* (%)
Age at the start of dialysis (years)	≤5	18 (23.6)
	6-10	31 (40.7)
	≥11	27 (35.5)
Past and family history	Parental consanguinity	9 (11.8)
	Family history of renal disease	12 (15.7)
	Co-morbidity*	4 (5.2)
Etiology of CKD	Glormerulonephritis	5 (6.5)
	Nephrotic syndrome	9 (11.8)
	Pyelonephritis	9 (11.8)
	Obstructive uropathy	7 (9.2)
	Polycystic kidney renal aplasia	4 (5.2)
	Renal agenesis or hypoplasia	2 (2.6)
	Unknown	40 (52.6)
Type of dialysis	Peritoneal dialysis	25 (32.9)
	Hemodialysis	51 (67.1)
Dialysis-related complications	Complication present	37 (48.6)
	No complications	39 (51.3)
Nature of complications	Hepatitis B or C	7/37 (9.2)
	Arteriovenous fistula	18/37 (23.6)
	Peritonitis	12/37 (15.7)
Mortality	Alive	61 (80)
	Dead	15 (19.7)
Cause of death	Sepsis	5 (6.5)
	Hypertensive encephalopathy	8 (10.5)
	AVF complications	1 (1.3)
	Subarachnoid or intracranial hemorrhage	1 (1.3)

*Comorbidity, three sickle cell anemia, two cases epilepsy, one case hypothrodism, one bronchial asthma and ambigious genitilia and bladder extrophy one case. AVF: Arterio-venous fistula complications (thrombosis, aneurysm), CKD: Chronic kidney disease

Outcome

Complications such as hepatitis B or C, arteriovenous fistula complications or peritonitis and associated comorbidity and death rates were examined. More than half of patients 51.3% in this cohort had no complications of dialysis. Eighty percentage were alive at the time of the study. Deaths were mostly related to sepsis and hypertensive encephalopathy [Table 1].

Discussion

In this series, 51 patients were on hemodialysis and 25 patients on peritoneal dialysis. There were slightly more males (59.2%), and 40.8% were females. The vast majority of patients lived locally in Benghazi. Ages of patients range from 2 to 22 years. Most of them started dialysis at 6–10 years age (41%). However, it is known locally that female patients prefer to continue at the pediatric services even after they turn 18 years old (which is the

formal age of transfer patients to adult care). This is consistent with the findings reported by Zaied *et al*. from another hospital in Benghazi where 56% out of 136 patients were males. This could be due to the higher occurrence of obstructive uropathy among men caused by the presence of congenital posterior urethral valve.[6] In our study, there were 49,458 admissions to the pediatric hospital from January 2006–June 2016. Only 76 cases were diagnosed to have ESRD. This represented about 0.14% of the total number of admissions. We observed a gradual increase in new cases from seven cases in 2006 to 24 cases in 2015. In another study of adults in Libya, the prevalence of ESRD was estimated at 34.7% patients per 100.000 populations.[7] Furthermore, a study at El-Minia, in the neighboring Egypt, revealed an annual increase of new ESRD patients. Interestingly, the relatively high prevalence of ESRD reported in England and France despite the low incidence of the glomerular disease might be attributed to better care facilities in West European countries.[8]

The literature originating from India and Pakistan revealed that the real size of the problem of ESRD is not known. Facilities for the provision of renal transplant therapy are grossly inadequate and not accessible to a large part of the population. RRT is expensive; transplantation remains the best option among different RRT modalities. Finally, increased awareness of the renal disease among the population is needed, as are strategies to facilitate early detection and prevention to delay the onset of ESRD.[2]

This study should increase awareness about the renal disease among the patients and physicians of the relevant risk factors. The most frequent causes of ESRD were glomerulopathy and nephrotic syndrome. Congenital and hereditary disorders followed this. In particular, an obstructive posterior urethral valve caused by a congenital membrane–like structure was the most common cause of bladder outlet obstruction in male newborns and infant.[9] Chronic pyelonephritis was the third frequent cause of ESRD in our study. However, in a substantial number of patients (40), no cause was recorded.

These results are similar to the data reported by Wood *et al*. in the North American Pediatric Renal Transplant Cooperative Study.[10] The study was designed to assess risk factors in patients aged younger than 6 years at initiation of dialysis therapy. Reportedly, 42% had renal aplasia, hypoplasia or obstructive uropathy.[10] In a study done in Tripoli, Libya in 2004, Fituri *et al*., revealed that the posterior urethral valves (PUV) was a complex disorder and lead to ESRD and it was the most common cause of severe obstructive uropathy in infants and children. Furthermore, the cause of ESRD in 25% of Libyan children was hereditary nephropathies. Glormulopathies (4%) and reflux bladder outlet obstruction (53%) accounted for the remaining cases in Tripoli children hospital.[11] In a study of adults, Zaied *et al*. in two major hospitals showed that the most cases are caused by hypertension, followed by obstructive uropathy, glormerulonephritis in decreasing frequencies.[6] A similar study done in Misurta, Libya demonstrated that the most common causes of ESRD were found to be were diabetes and hypertension affecting young-age population followed in order by undetermined causes, glomerulonephritis in chronic pyelonephritis due to drug nephrotoxicity. Other less common causes such as obstructive uropathy, polycystic kidney disease, gout, and IgA nephropathy also was reported in Misurta study.[7] While in Banaga *et al*. indicated that the hypertension is a leading cause of ESRD in Sudan followed by chronic glomerulonephritis among adult patients.[12] A study in Cairo reported that the principal causes of ESRD are interstitial nephritis often attributed to environmental pollution and inadvertent use of medications; glomerulonephritis. Mesangioproliferative and focal segmental sclerosis; diabetes, and nephrosclerosis. Obstructive reflux nephropathy, attributed to urinary schistosomiasis which is common in Egypt, Libya, and southern Algeria and urolithiasis is a frequent cause of obstructive nephropathy in the western regions of Africa.[13]

The etiology of ESRD was unknown in 52.6% in our study and was 27% in El-Minia study[8] in contrast to contrast to the very low unknown etiology of ESRD in the United States (3.7%). This limitation of the current study and that of Traina *et al*.[7] caused by the incomplete documentation of medical information in patients' charts is inexcusable and calls for better more meticulous attention and keeping of patients' charts. However, these could be caused by lack or inconsistent supply of diagnostic facilities. The unknown cause category might be due to environmental factors or mistakes in diagnosis, but these remain speculative.[7] Moreover, preventive strategies to integrate the healthy lifestyle into the community approach to primary prevention should start early to change bad habits to good behavior.[14] Comparing to Iran the most common cause of ESRD among HD patients was hypertension, in the United States was due to hypertension was the most common cause of ESRD. In the present study which may mirror high prevalence of bacterial, viral, and parasitic infection in Benghazi approximately (6.5%) were post-streptococcal glomerulonephritis similar to El-Minia study.[8] Diabetic nephropathy as a cause of ESRD in El-Minia is increasing as it constituted 5% causes of ESRD. Furthermore, schistosomiasis was common. These patterns are different from the US data.[8] For the UK, there is an increase in the rate of "etiology uncertain" from 6% at 12–15 years to 21% by 18–21 years. This figure of 21% remains constant for the older patients in their third and fourth decades.[15]

In addition, a study of risk factors of ESRD in adult patients in Saudi Arabia reported that the two major factors that influence the CKD status are the very high rate of diabetic nephropathy and shift in age demographics.[16] Comparison between our study and the previous studies shows the difference between causes of ESRD in different ages. Congenital diseases were common in children and rare in adults. This may be caused by their death before reaching adulthood. Family history is considered another risk factor for developing ESRD, in our study, consanguinity of parents was present in 12% of patients and family history of renal disease was reported positive in 16% of patients. This is in line with the results of McClellan, *et al*. who showed that the first- or second-degree family members of patients with ESRD have two to three times as likely to have incident ESRD.[17]

This study showed that around 20% of cases of ESRD died, the cause of death reported as hypertensive encephalopathy was responsible for 10.5%. A similar study demonstrated that seizures occurring as a complication of ESRD, represent part of the generalized encephalopathy which occurs in about 15% of children with prolonged renal dysfunction. The hypertensive encephalopathy results when autoregulation of cerebral blood flow fails and blood flow to the brain increases. The symptoms and signs include a severe headache, irritability, dizziness, altered mental capacity, seizures, and coma.[18] Infections caused one-fourth of deaths of studied cases of ESRD similar to those found by Wood *et al*. Infection accounted for 6 out of 15 deaths. The remaining deaths were caused by intracranial hemorrhage. Wood *et al*.[11] found that non-renal disease caused nearly two-third deaths included central nervous system, cardiovascular, liver disease, gastrointestinal, and pulmonary disease.

Many studies have shown poor outcomes in younger patients versus older patients. Mortality rates were higher in children aged <2 years than in older children.[10] ESRD is one of the serious consequences of chronic renal disease Identification of risk factors for ESRD supports intervention policies to minimize morbidity and mortality. In addition, this study might increase awareness about the renal disease among the clients with the identified risk factors to decrease morbidity and mortality from this disease.[13]

Conclusions

More of ESRD patients on dialysis were males, the leading causes of ESRD in Benghazi City were glomerulopathic including glomerulonephritis and nephrotic syndrome followed by congenital and hereditary disorders. The etiology of the majority of ESRD cases was not known, and finally, hypertensive encephalopathy and sepsis were the main causes of death. Further actions are needed. Early detection by measures to improve early nephrology referral of renal patients and adequate treatment of cases of glomerulonephritis, pyelonephritis, and nephrotic syndrome and antenatal screening for renal anomalies (PUV) may decrease the prevalence of ESRD and give a chance for an early surgical intervention of obstructive uropathy. Also screening programs of people at high risk of renal disease. Furthermore, proper follow-up and conservative management of cases of CKD to prevent early progression to ESRD.

Authors' contribution

Both authors contributed to the work substantially and they have drafted, revised and approved the final version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

The study was conducted as a quality assurance exercise with no experimental work involved. No formal IRB approval was required.

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