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Original Research Article

Growth and nutritional status in children with chronic kidney disease on maintenance dialysis in Poland

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ABSTRACT

Purpose: Despite vast availability of modern methods of treatment of chronic kidney disease and its complications, the short stature still is a major point of concern in adolescents with chronic kidney disease. The aim of the study was to assess changes in growth and nutritional status of Polish children on renal replacement therapy in the decade, 2004–2013.

Material and methods: The study was designed as a cross-sectional analysis of anthropometric values and selected indices of growth status amongst children receiving dialysis in Poland between the years 2004 and 2013. Data were acquired during two different multicentre studies on hypertension in dialyzed children in Poland. Basic anthropometric parameters (body weight, body height/length, body mass index – BMI), dialysis adequacy and duration of RRT were assessed.

Results: The study showed that anthropometric parameters of children undergoing renal replacement therapy had not significantly changed in the last 10 years of observation. Children on RRT were still of short stature despite availability of modern methods of hormonal therapy and nutrition. Median of height *z*-score was −2.10 in 2004 and −2.19 in 2013. Expected clinical improvement in these measures was not proven.

Conclusions: The cause of chronic kidney disease, method of dialysis, time on dialysis or dialysis adequacy did not influence the anthropometric parameters significantly in dialyzed children in Poland.

1. Introduction

The prevalence of the renal replacement therapy (RRT) in children across the world was assessed as 9 per million of the age-related population. In Europe the incidence of CKD stages 4–5 was around 11–12 per million of age-related population [1].

Although the management of patients with ESRD is getting more and more modern and efficient, children from this group still have 30 times higher mortality rate than healthy peers [2,3]. Usually they die due to cardiovascular complications. The malnutrition inflammation atherosclerosis (MIA) syndrome widely described in adult population could have significance in children population too [4]. Still one of the primary concerns in patients on maintenance

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dialysis is the malnutrition and growth failure which as a common complication is one of predictive factors of mortality [5]. It has been assessed that the more profound the height deficit, the higher the mortality with 14% increase for every decrease in height SDS [6,7]. Despite the vast availability of modern methods of treatment (i.e. specially designed feeding formulas, recombinant growth hormone therapy), the short stature still is a major point of concern in adolescents with CKD, with incidence in 30–60% of patients [8,9]. Besides, it is proven that higher mortality individuals with growth failure present lower self-esteem and difficulties in adaptation which reflects lower quality of life [10]. In the last decade the progress in dialysis efficacy was maintained. The availability of different RRT methods enabled the individually tailored dialysis protocols, both, in peritoneal dialysis (PD) and hemodialysis (HD). However, the delivered dialysis dose remained a point of concern. The optimal dialysis dose for maintaining growth is still uncertain. Though it is still unclear if inadequate dialysis should have been listed as a factor of malnutrition or short stature.

In the present study we assessed changes in growth and nutritional status of Polish children on dialysis with special regard to dialysis adequacy in the decade, 2004–2013.

2. Material and methods

2.1. Study design

The study was designed as a cross-sectional analysis of anthropometric values and selected indices of growth status amongst children receiving dialysis in Poland between the years 2004 and 2013. In 2004, data from 11 out of 13 pediatric dialysis centers were evaluated, whereas in 2013, 10 out of 12 centers responded for the invitation. The data were collected as clinical questionnaires filled out for every individual patient by the treating physician. Data were acquired during two different multicentre studies on hypertension in dialyzed children in Poland (2004–2013) [11].

Basic anthropometric parameters were assessed – body weight (kg), body height/length (cm), and body mass index – BMI. Acquired data were compared to normative values of Polish population and standard deviation score (SDS, *z*-score) was calculated [12]. Normal values most frequently are considered to be within range of ±2.0 SD from mean value for age and gender. Consequently, the cut-off values for short stature, underweight and low BMI were set below −2.0 SD. Additionally, the dialysis adequacy (KT/V, urea removal rate – URR) was analyzed. Dialysis was assessed adequate for KT/V 1.2 for HD and 2.0 for PD children [13]. Clinical questionnaires comprised the medical history of the patient with special regard to the diagnosis of CKD (clinical entity, rate of progression) and the treatment. Exclusion criteria comprised of genetic abnormalities that could influence analysis results (e.g. meningocele).

2.2. Statistical methods

Normality of distribution of variables was assessed using a Shapiro–Wilk test. The median and 25–75 interquartile ranges defined the qualitative variables. Non-parametric tests, Mann–Whitney test, Yates-corrected chi-squared test and Fisher's exact test, evaluated differences between groups. Multivariable models were used to evaluate the impact of potential determinants adjusted for confounding factors (age, gender, CKD background, dialysis method and duration, dialysis adequacy, hemoglobin and total protein concentration, epoetin treatment, blood pressure SDS) on height and weight SDS.

Significance was assumed for $p < 0.05$. Statistica 10 PL package was used for the analysis.

3. Results

3.1. Characteristics of the study groups

Total number of patients analyzed in the study was 193 (M: 129; F: 64). In 2004, the group consisted of 134 children, whereas in 2013, 59 children were included. Median of children age in 2004 was 142 months, in 2013, it was 128 months and the difference was not significant. All children were on chronic dialysis (both HD and PD) for at least 3 months. In 2004, 57 children (43%), and in 2013, 29% were on RRT for longer than 2 years. Detailed characteristics of both groups are presented in Table 1.

3.2. Anthropometric parameters

In both time-points of analysis, in 2004 and 2013, children on RRT were shorter than healthy peers by *z*-score analysis (−2.10 and −2.19, respectively). In 2004, 51% children were of short stature (their median *z*-score of height −3.47), and in 2013, 56% (their median *z*-score of height −3.35). Neither in 2004 nor in 2013 median value of body weight did meet the assessed underweight criteria (*z*-score < −2.0 SDS). In 2004, 31% children were underweight whereas in 2013, it was 20%. BMI of children in each year was considered normal – only 2% of children each year had BMI *z*-score below −2.0 SDS. Only 1.5% of children in 2004 were obese (BMI *z*-score over 2.0 SDS), and none in 2013. There was no significant change in anthropometric parameters between two time-points of observation (Table 1 and Fig. 1).

Table 1
Characteristics of children on RRT in 2004 and 2013.

	2004 $n=134$	2013 $n=59$	p
Age (months)	142 (76.5–175.5)	128 (62.5–171.5)	0.154
Age at the dialysis	110 (50–157)	117 (41–160.25)	0.299
M:F ratio	89:45 66%:34%	40:19 68%:32%	0.786
Height			
cm	135 (107.2–149.7)	125 (102–149)	0.101
z-Score	−2.10 (−3.47 to −1.31)	−2.19 (−3.42 to −1.01)	0.142
Weight			
kg	29.2 (18–39.2)	24.5 (14.6–39.7)	0.218
z-Score	−1.47 (−2.15 to −0.81)	−1.34 (−1.92 to −0.75)	0.497
BMI			
kg/m^2	16.4 (15.1–18.0)	16.4 (14.7–18.6)	0.405
z-Score	−0.51 (−1.07 to −0.11)	−0.48 (−1.06 to −0.03)	0.360
PD:HD ratio	90:44 67%:33%	37:22 63%:37%	0.589
Length of RRT (months)	19 (8–39.75)	16 (6.5–27)	**0.023**
Age of CKD diagnosis (years)	1 (0.2–6)	0 (0 –5.5)	0.125
Hemoglobin (g/dl)	11 (10.125–11.7)	10.6 (9.75–11.65)	0.064
Epoetin dose (kg/week)	92.27 (54.17–171.42)	121.21 (70.71–160)	0.114
KT/V			
HD	1.4 (1.115–1.8)	1.4 (1.04–1.6)	0.241
PD	2.40 (2.0–2.9)	2.45 (2.095–2.955)	0.370