ORIGINAL RESEARCH

The Effect of Intradialytic Intralipid Therapy in Pediatric Hemodialysis Patients

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Objective: Growth of children on maintenance hemodialysis is poor. Oral nutritional supplements are the preferred way to augment nutrition; however, many children have difficulties adhering to prescribed oral supplements. In our unit, we have been utilizing intralipid (IL) therapy as nutritional supplement during hemodialysis sessions. The aim of this study was to assess the safety, efficacy, and benefits of intradialytic IL therapy.

Design: A retrospective chart review.

Subjects: Fifteen pediatric hemodialysis patients receiving intradialytic IL therapy for at least 3 months from July 2011 through July 2014.

Main Outcome Measure: For each patient, anthropometric measurements and laboratory nutritional parameters were compared prior to and at the end of IL therapy. Anthropometric measurements evaluated were dry weight, height, body mass index (BMI), and BMI corrected for height age. Laboratory nutritional parameters evaluated were albumin, normalized protein catabolic rate, predialysis blood urea nitrogen, transferrin, cholesterol, and triglyceride levels. Adverse events during therapy were also noted.

Results: Significant improvement was noted in albumin levels, predialysis blood urea nitrogen, and normalized protein catabolic rate during therapy ($P = .02$; $P = .03$; $P = .03$, respectively). Six patients (37.5%) improved their weight standard deviation score, and eight patients (50%) improved their BMI standard deviation score though not statistically significant ($P = .59$; $P = .9$, respectively). No significant side effects were noted.

Conclusions: Administration of IL alone during hemodialysis is well tolerated with beneficial effects on nutritional parameters. The provision of IL alone is relatively cheap and does not require additional resources. In conjunction with other measures of nutritional support, it can help improve nutritional status of pediatric hemodialysis patients.

Introduction

GROWTH OF CHILDREN during maintenance hemodialysis has been reported to be uniformly poor. According to the 2011 NAPRTCS report, children initiating hemodialysis are on average -0.91 ± 0.04 standard deviations (SDs) below normal in weight and -1.4 ± 0.04 SDs below normal in height.[1] While continuing hemodialysis, there is a progressive decline in weight and height standard deviation score (SDS) especially in children who are 6 years and older.[1] The term protein-energy wasting (PEW) is used to describe the loss of protein mass and energy stores that occur in many patients with chronic kidney disease and end-stage renal disease.[2] The etiology of PEW in dialysis patients is diverse and includes inadequate dietary intake, chronic inflammation, nutrient loss into dialysate, and altered responses to anabolic hormones.[2] PEW has significant ramifications in pediatric hemodialysis patients; anthropometric measurements and biochemical indicators of PEW such as body mass index (BMI) and serum albumin levels have consistently predicted morbidity and mortality in epidemiological studies of both adults and children.[3-7]

The KDOQI 2008 guidelines state that the enteral route is preferred for supplemental nutritional support in children on dialysis who fail to achieve expected rates of weight gain.[8] When energy requirements cannot be met with oral supplementation, tube feeding should be considered.[8] Though oral supplements are the preferred method to augment nutrition, many children find it difficult to adhere to the prescribed oral supplements. Placement of a feeding tube or a G-tube is an invasive procedure that many patients are reluctant to accept. This is especially true in older children and adolescents in whom social awareness and body image plays an important role. Noncompliance with feeding regimens may also hinder the effectivity of tube feeding.

Intradialytic parenteral nutrition (IDPN) had been proposed in previous studies as a way to augment nutrition in malnourished hemodialysis patients.[9,10] Most studies have

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utilized typical IDPN prescriptions containing amino acids, dextrose, and fat. Provision of IDPN requires substantial resources not available in many pediatric hemodialysis units. In our unit, we have been utilizing intralipid (IL) therapy as nutritional supplement during hemodialysis sessions in children who have not improved on enteral supplements alone. The aim of this study was to assess the tolerance, safety efficacy, and benefits of intradialytic IL therapy.

Materials and Methods

This is a retrospective chart review of all pediatric hemodialysis patients receiving intradialytic IL therapy for at least 3 months from July 2011 through July 2014. Patients were started on IL therapy according to the discretion of the attending physician, when no improvement in nutritional status was noted on oral supplements alone. To encourage enteral intake, all our patients and their parents have monthly regular meetings with a renal dietitian and attending physician to inform them of their nutritional status and encourage increased oral intake. Commercially available oral liquid supplements and protein bars, designed specifically for dialysis patients, are prescribed to increase caloric intake. When no improvement or deterioration in nutritional status was noted despite prescribed oral supplements, IL therapy was added. IL was administered during the dialysis session.

Data collected included baseline renal disease, age and date of starting dialysis, weight, height, and BMI [BMI = wt(kg)/ht^2(m)] of patients at the start of dialysis. Data regarding height, dry weight, BMI, postdialysis blood pressure, and antihypertensive medications were obtained from monthly dialysis clinic visits prior to starting IL therapy until the end of therapy. To allow comparison between children of different ages, weight, height, and BMI SDS were calculated according to the CDC growth charts.[11] Since height is stunted in many pediatric dialysis patients, BMI SDS corrected for height age was calculated according to the KDOQI guidelines.[8] Dose of IL therapy, duration of treatment, and reason for discontinuation were recorded. Midweek monthly nutritional laboratory assessment included serum albumin, predialysis blood urea nitrogen (predialysis BUN), creatinine, hemoglobin, transferrin, and parathyroid hormone. Single-pool KT/V, urea reduction rate, and normalized protein catabolic rate (nPCR) were calculated by the Daugirdas natural log model and estimated urea generation rate.[12] Since predialysis BUN and nPCR are elevated in patients with severe inflammation due to muscle catabolism and are therefore not reflective of nutritional status, patients with active glomerulonephritis with predialysis BUN $>$ 100 and nPCR $>$ 1.8 despite adequate dialysis were excluded from analysis of these two parameters. Serum triglyceride, total cholesterol, high density lipoprotein (HDL) cholesterol, and low density lipoprotein (LDL) cholesterol levels were checked prior to starting IL therapy. Thereafter, serum triglyceride levels were monitored monthly and cholesterol levels every 6 months. Prescribed oral nutritional supplements were recorded from the medical charts. The study was approved by the Stanford Institutional Review Board.

Descriptive statistics are presented as percentages. Parametric and nonparametric data are presented as mean (SD) and median (interquartile range), respectively. Paired *t* tests and Wilcoxon sign-rank test were used to compare parametric and nonparametric data, respectively, prior to and at the end of IL therapy. *P* values less than .05 were considered statistically significant. All statistical analysis was performed using JMP Pro 10.0.0 (SAS Institute Inc).

Results

Fifteen patients received IL therapy during the study period. One patient received IL therapy at two different time periods that were analyzed separately. All patients received IL therapy three times a week during each hemodialysis session. Baseline patients' characteristics, IL dose, and duration are presented in Table 1. All patients were prescribed commercially available renal appropriate oral nutritional supplements and/or protein bars for a median time of 4.3 months before initiating IL therapy (Table 1). Six patients were prescribed one daily can of liquid renal supplement, three patients were prescribed two cans a day, and five patients were prescribed one to two protein bars a day. Two

Table 1. Baseline Characteristics of Patients Receiving IL Therapy

Baseline Characteristics	
Age (Median, Range)	12.5 y (1-20 y)
Male gender (%)	50
Primary renal disorder (%)	
Systemic vasculitis	8 (50)
Primary glomerulonephritis	1 (6)
Focal segmental glomerulosclerosis	3 (19)
Obstructive uropathy	1 (6)
Other	3 (19)
No. of patients with feeding tube (%)	3 (19)
No. of patients on growth hormone treatment (%)	6 (37.5)
No. of patients with residual renal function (%)	3 (18.8)
Time on dialysis before starting IL therapy (median, IQR)	4.3 mo (3.4-23.6 mo)
Dose of IL (gr/kg) (median, range)	0.5gr/kg (0.23-1gr/kg)
Length of IL therapy (median, IQR)	6 mo (4.75-7.25 mo)
Reason for discontinuing IL (%)	
Transplant	5 (31)
Improved nutrition	3 (19)
Continue therapy	6 (38)
Change in dialysis modality	2 (13)

IL, intralipid; IQR, interquartile range.