Nutrition and the Pediatric Renal Patient

Cynthia J. Terrill, RD, CSR, CD
Pediatric Renal Dietitian
University Healthcare
Salt Lake City, UT
Email: *Cindy.Terrill@hsc.utah.edu*

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Introduction

Caring for the pediatric or adolescent patient with chronic kidney disease (CKD) presents unique and varied challenges for the entire health care team. Balancing the nutritional requirements of these patients in order to promote appropriate growth and development, along with the need to control the biochemical and metabolic consequences associated with the disease state, can be challenging. The pediatric renal dietitian should work closely with the entire healthcare team in order to achieve nutritional goals for each patient.

Causes of Kidney Failure in Children

Unlike adults with CKD, the primary causes of kidney failure in children are congenital disorders. These include: polycystic kidney disease, renal dysplasia and hypoplasia, obstructive uropathy, reflux nephropathy, congenital nephritic syndrome and cystinosis. Other causes of kidney failure in children include acquired disorders such as glomerulonephritis, interstitial nephritis, hemolytic uremic syndrome, cortical and tubular necrosis, renal arterial or venous thrombosis and vasculitis.

Nutritional Goals

The primary nutritional goals for the pediatric renal patient are to promote optimal nutritional status, growth, and development while controlling the biochemical and metabolic consequences associated with the disease state. Barriers in achieving the nutritional goals in this population include: anorexia and associated poor energy intake, metabolic acidosis and hormonal abnormalities, use of corticosteroids in the treatment of certain kidney disorders and as immunosuppressive therapy, and psychosocial and developmental issues. Cultural influences may also make it difficult to meet nutritional needs due to food preferences and religious beliefs. Additionally, depression, family financial concerns, changes in family structure, increased fatigue, changes in mental status, poor concentration, and forgetfulness can all contribute to poor appetite and intake. Finally, oral aversion and gastroesophageal reflux (GERD), frequently associated with CKD in infancy, may make it difficult to meet nutritional needs by mouth. Each of these areas needs to be addressed by the health care team with the appropriate interventions being implemented (1).

Changes in taste due to renal failure, metabolic abnormalities and dietary restrictions often make it difficult for the child with CKD to meet his or her nutritional needs. It is known that anorexia and associated poor energy intake often seen in children with CKD can negatively impact linear growth and weight gain (2). Correction of metabolic acidosis with base supplements such as sodium bicarbonate or sodium citrate, and dialysis therapy can help to promote increased intake and optimize linear growth and weight gain. Additionally, treatment of anemia associated with CKD using erythropoietin and iron supplementation may promote improved oral intake. Finally, a more liberal diet may encourage the patient to meet nutritional needs. However, it is important to monitor laboratory values closely and adjust the diet as appropriate to maintain optimal biochemical control.

Corticosteroids, such as prednisone are often used to treat certain types of kidney disease including glomerulosclerosis and IgA nephropathy. They are also prescribed as part of the immunosuppressive therapy following renal transplantation. While steroids can be part of effective treatment, they have been negatively associated with linear growth in children. Additionally, high dose steroids can contribute to excessive weight gain due to reported stimulation in appetite (3). It is important to monitor linear growth and weight gain closely in children who are on corticosteroids. Ideally, the lowest possible dose of steroids should be used in order to minimize the impact on growth and potential for weight gain.

Linear growth can be negatively impacted by a poor calcium and phosphorus balance. Close attention to serum calcium, phosphorus and parathyroid hormone (PTH) levels is necessary in order to maximize growth. Dietary phosphorus restriction and use of phosphate binders is essential in controlling serum phosphorus levels. Vitamin D metabolites such as calcitriol and paricalcitol are used to prevent and treat hyperparathyroidism and CKD bone and mineral disorders. Despite adequate nutrient intake and good biochemical control, decreased rate of linear growth is common. While adequate nutrient intake may help to promote linear growth, it will not always achieve catch-up growth (4). If linear growth does not improve after ensuring adequate calorie and protein intake with appropriate treatment of metabolic acidosis and renal osteodystrophy, the use of recombinant growth hormone therapy should be considered. Although pediatric patients with CKD often have normal growth hormone levels in their bodies, growth hormone resistance can be a problem. Giving recombinant growth hormone as a subcutaneous, daily injection can improve linear growth in children with renal failure who still have growth potential or open growth plates (5).

Nutritional Assessment of the Pediatric Renal Patient

The nutritional assessment of the pediatric renal patient is best performed by an experienced pediatric renal dietitian. Interval measurements of growth and nutrition parameters should be obtained on a regular basis and assessed for trends (6). Necessary measurements include height or length (in children less than 2 years of age or for those who are unable to stand without assistance), weight, and head circumference (in children less than 3 years of age). Weight for length and Body Mass Index should be evaluated and plotted on the appropriate growth chart for age. Infants and small children require more frequent assessment to monitor adequacy of intake, tolerance to feedings and growth. The World Health Organization (WHO) Growth Standards should be used as the reference for children from birth to 2 years of age. After age two, it is appropriate to change to the Centers for Disease Control and Prevention (CDC) reference curves (7).

Length measurements should be done on a measuring board by two people in order to get an accurate measurement. One person holds the crown of the head against the headboard while the other person moves the footboard up to the heels of the infant's feet as legs are straightened. When obtaining height measurements, the child should remove his or her shoes and stand on the floor, looking straight ahead. It is preferable that length and height measurements be obtained by the same well-trained person at each assessment. Both length and height measurements should be recorded to the nearest 0.1 cm.

To obtain an accurate weight, an infant should be undressed completely and the weight obtained on an infant scale. Older children may be weighed in light clothing without footwear in a standing position. Weight should be recorded to the nearest 0.1 kg. It is important to consider the fluid status of the patient when evaluating for weight gain. Fluid weight gain may be misinterpreted as actual weight gain and an increase in measured lean body weight. Pediatric dialysis patients should be weighed both before and after a dialysis treatment. Blood pressure measurements, heart rate and clinical appearance may be helpful in assessing whether a patient is at his or her "dry weight" following a dialysis treatment. High blood pressure, which resolves following fluid removal with dialysis, can indicate excess fluid weight. Similarly, low serum sodium and albumin levels may be markers of overhydration. Rapid, unexpected weight gain, in the absence of significantly increased nutrient intake, must be evaluated very carefully when assessing dry weight.

The maximum head circumference should be measured in children up to age 36 months and recorded to the nearest 0.1 cm. Findings should be plotted on the 2007 WHO Growth Standards head circumference-for-age curves (6). Head circumference measurements help in assessing the adequacy of nutrient intake and typically reflect brain growth and development. A sudden acceleration in head growth may signal a change in medical condition such as hydrocephalus. Conversely, a decline in rate of head growth can indicate chronic malnutrition.

In addition to accurate anthropometric measurements, laboratory data is essential in assessing the patient's nutritional status and needs. Albumin is a measure of visceral protein stores and plays an important role in the general evaluation of patients with CKD (6). There are a number of reasons for decreased albumin levels including: inadequate calorie and protein intake, urinary protein losses, nephrotic syndrome, recent surgery, liver disease, peritonitis, volume overload, and other inflammatory processes. Patients on peritoneal dialysis will experience increased protein loss in their dialysate solution, which may lead to hypoalbuminemia (3). These patients require an even higher protein intake than patients on hemodialysis. Measurement of blood urea nitrogen (BUN) can be helpful in assessing the protein intake of the pediatric renal patient. A low BUN in relation to serum creatinine frequently reflects poor protein intake while an excessively high BUN may suggest dehydration, excess protein intake or catabolism. Other laboratory data that needs to be evaluated includes: serum sodium, potassium, calcium, phosphorus, intact or bio-intact PTH, hemoglobin, iron studies (iron, % saturation, ferritin), and CO_2 levels. These labs can help to identify patients who are not adequately meeting nutritional needs and also help to assess and monitor for development of anemia or bone and mineral disorders. There is limited data on the use of protein catabolic rate (PCR) in helping to assess dietary protein intake in the pediatric population. However, regularly obtaining PCR in adolescent patients on hemodialysis has been correlated with prediction of weight loss or gain. Dietary modifications must be made frequently, based on laboratory values. Assessing dietary intake with food records can assist with this task. It is particularly important to individualize the diet plan for the pediatric patient. **Dietary restrictions should only be initiated when indicated necessary by laboratory values, medical condition and medical therapy.** Modifications in calories, protein, sodium, potassium, phosphorus, and fluid intake may be necessary depending on the patient's medical condition and therapy, dialysis modality, medications, blood pressure, fluid balance and urine output, laboratory values, nutritional status, growth, weight gain, and age.

Gastrointestinal (GI) disturbances such as nausea, vomiting, diarrhea, constipation, delayed gastric emptying, and early satiety are frequently seen in children with CKD. Each should be considered when evaluating the pediatric renal patient's nutritional status and dietary needs. These can all negatively impact the patient's ability to meet nutritional needs and may necessitate medical nutrition therapy modifications and adjustments in medications. The renal dietitian can be particularly helpful in alerting the rest of the medical team of these conditions to be addressed and treated appropriately. Proton-pump inhibitors, H-2 antagonists, motility agents, anti-diarrheal agents, antimicrobial agents and probiotic therapy may be useful in treating these problems, although dosages need to be adjusted for renal failure (8).

Nutritional Recommendations for Children with CKD

Calorie and protein needs for children are based on age, gender, medical condition, treatment modality, nutritional status, and response to therapy. Specific nutritional recommendations for children with CKD can be found in Table 1 (3). The 2008 KDOQI Clinical Practice Guideline for Nutrition in Children with CKD is also an excellent reference. Calorie needs are initially based on the estimated energy requirements (EER) for chronological age, but may be adjusted depending on nutritional status, growth, medical complications, inter-current illnesses, activity level, and other factors that could impact calorie needs. As previously stated, dietary restrictions are only initiated when indicated necessary by laboratory values, progression of renal insufficiency, or presence of hypertension or edema. Protein intake changes depending on the stage of CKD and treatment modality. Patients on dialysis should be encouraged to choose high quality protein foods such as beef, chicken, fish, pork, and eggs on a daily basis. Protein powders and liquids may also be necessary to help meet protein needs. Powerpacking, using calorically dense foods such as simple carbohydrates and fats/oils, may help to increase calorie intake and meet nutritional needs while staying within dietary limitations.

Additional Nutritional Recommendations for Children on Dialysis

For children on hemodialysis, interdialytic weight gain should be between 3% -5% of body weight. Fluid restriction is based on achieving this goal. Generally, patients on peritoneal dialysis will have a more liberal fluid allowance than those on hemodialysis. Total fluid intake allowed considers insensible losses, urine output, ultrafiltration capacity, and other losses. Insensible losses will vary depending on the size of the child. They will also increase with fever, phototherapy, open warmers, or tachypnea and decrease in patients who are ventilated with humidified air. Therefore, total fluid intake allowed may change depending on the medical condition of the child.

Dietary restriction of sodium, potassium, and phosphorus for children on dialysis is only implemented when warranted, based on laboratory values. Sodium restriction is necessary for patients who are oliguric or anuric, edematous, or hypertensive. Potassium restriction is needed for patients with hyperkalemia. Phosphorus restriction is recommended with the presence of hyperphosphatemia and/or hyperparathyroidism. Phosphate binders, either calcium or non-calcium based, and vitamin D metabolites are used to prevent and treat hyperparathyroidism and renal osteodystrophy. Vitamin intake may be supplemented to meet 100% of the Dietary Reference Intakes (DRI). Typically a water soluble, renal multivitamin is used. Iron supplementation, frequently necessary for those patients on erythropoietin therapy, is usually given intravenously for patients on hemodialysis and orally for patients on peritoneal dialysis (3). The age, size, stage of development, and preference of the child and parent will determine which type of preparation is used.

For patients on peritoneal dialysis, it is necessary to include calories absorbed from the dialysate solution in the total nutrient intake. Protein needs are increased above the DRI for chronological age due to increased protein losses associated with the peritoneal dialysis process. Sodium restriction is usually not necessary unless the patient is edematous or hypertensive. Infants on peritoneal dialysis may actually require sodium supplementation as they are predisposed to substantial sodium losses, even when anuric. Additionally, infants with renal dysplasia can have increased urinary sodium losses. High ultrafiltration requirements per kilogram body weight can further contribute to sodium loss. Potassium restriction is usually not necessary if dialysis is adequate, although this also depends on transporter type used when on peritoneal dialysis.

Nutritional Recommendations for Children with a Renal Transplant

The nutritional goals following a successful renal transplant are to promote wound healing and anabolism, prevent infection, obtain optimal growth, minimize medication side effects, maintain electrolytes and minerals within normal limits, and stabalize blood pressure within normal limits. It is important to continue

Table 1
Daily Nutrient Recommendations for Children with Chronic Kidney Disease

Note: Restrictions should be implemented only where warranted and kept as liberal as possible to optimize energy intake and prevent malnutrition.

Pediatric dietary restrictions usually take the form of a "low-nutrient X diet" with education about avoiding or limiting foods high in that nutrient. Depending on the response in the parameter relevant to that nutrient (eg, blood pressure; biochemical value) the restriction can be liberalized or tightened.

Prescriptions for specific amounts of a nutrient (eg, 3 mEq nutrient X/kg) are rarely used in pediatrics. Amounts provided in the table can be used as references for assessment of daily intake obtained from food records.

Nutrient	Infant, birth to 1 y	Toddler, 1-2 y	Child, 3-8 y	Adolescent	
Energy (kcal/kg/d)* Boys Girls	 Birth to 6 mo: 95 7-12 mo: 82 Birth to 6 mo: 87 7-12 mo: 75	 87 82	 87 82	 63 60	 52 44
Protein (g/kg/d)	Birth to 6 mo: 1.52† 7-12 mo: 1.1-1.5‡	0.88-1.10‡	0.76-0.95‡	0.76-0.95‡	Boys: 0.73-0.85‡ Girls: 0.71-0.85‡
Sodium (Recommendations for patients with edema or hypertension)	• No salt shaker and avoid salty foods (≥ 200 mg sodium/serving). • Infants and toddlers: restrict to 1-3 mEq/kg/d.§ • Children and adolescents: restrict to 87-174 mEq/d§ (2-4 g/d).				
Potassium (Recommendations for patients with hyperkalemia)	• Avoid foods with high potassium levels, such as bananas, chocolate, and orange juice. • Infants and toddlers: restrict to 1-3 mEq/kg/d.§ • Children and adolescents: restrict to 51-103 mEq/d§ (2-4 g/d).				
Calcium	• 100% of the DRI. • Monitor total calcium load, including calcium from phosphate binders.				
Phosphorus (mg/d) (Recommendations for patients with hyperphosphatemia)	Restrict to low-phosphorus formula and foods.	≤ 400-600		≤600-800	
Vitamins	• If needed, supplement to 100% of the DRI. • Supplement with vitamin D metabolite to prevent hyperparathyroidism and renal osteodystrophy.				
Trace Minerals	• If needed, supplement to 100% of the DRI. • Iron supplementation is usually needed with erythropoietin therapy.				
Fluids	• Unrestricted unless warranted for fluid management (indications would be decreased urine output, edema, or hypertension). • If restriction is needed: Total Fluid Intake (TFI) = Insensible losses + Urine output + Other losses.				

* Energy recommendations are the estimated energy requirements (EERs). They are based on physical activity levels (PAL) as the level recommended to maintain health and decrease risk of chronic disease and disability. EERs are presented in kcal/kg as determined by dividing the active PAL EER (total kcal/day) by the reference weight for each respective age.
†Protein recommendations are the adequate intake (AI) for ages birth to 6 months.
‡Protein recommendations are the range of estimated average requirement (EAR) to recommended dietary allowance (RDA) for ages 7 months to 18 years.
§For sodium and potassium, mEq = mmol.
Source: Data are from selected *Dietary Reference Intakes* publications (38-42).

to monitor nutritional status and growth closely. Acceleration in rate of linear growth may occur, particularly in younger children. The use of recombinant growth hormone following transplant is controversial due to the potential for deterioration in renal function. Excess weight gain may occur due to increased appetite and intake, a more liberal diet, immunosuppressive medications, and decreased physical activity. Calorie needs are based on EERs for age. They also take into consideration physical activity levels and the level recommended to maintain health and decrease risk of chronic disease and disability. A low saturated fat diet may be necessary for patients with hyperlipidemia. Hyperlipidemia in transplant patients is generally related to immunosuppressant medications. A limited calorie diet may be ordered to combat excessive weight gain following transplantion. Protein needs are initially increased after transplant (1.2-1.5 g/kg/protein x DRI) and return to the DRI for age after three months. Moderate sodium intake is recommended for patients with edema or hypertension. Hyperkalemia may occur in the immediate post-transplant period, often as a result of immunosuppressive drug toxicity, the use of ACE inhibitors, or impaired renal function in the allograft kidney. If hyperkalemia is present, it is usually necessary to temporarily limit intake of high potassium foods until potassium decreases to within normal range. Calcium intake should meet 100% of the DRI for age as these patients are at an increased risk of decreased bone mineral density. If the patient is unable to meet calcium needs with diet alone, a calcium supplement can be provided to ensure adequate calcium intake. Phosphorus supplementation may be necessary initially due to previous hyperparathyroidism and resultant hypophosphatemia associated with immunosuppressant therapy. Magnesium supplementation may also be indicated if hypomagnesemia occurs due to immunosuppressive medications. Vitamin supplementation is generally not necessary, except for the possible exception of vitamin D, unless the child has a poor diet or poor oral intake. If the diet is inadequate, vitamins and trace minerals are supplemented up to 100% of the DRI for age. With stable renal function, high fluid intake should be encouraged to avoid dehydration and volume depletion. Herbals and botanicals are currently contraindicated as they may interact with immunosuppressive medications and potentially contribute to renal dysfunction (3).

Nutritional Support for the Pediatric Renal Patient

If oral intake is inadequate to achieve and maintain optimal nutritional status, enteral nutrition may be necessary to avoid malnutrition. Nasogastric or nasojejunal enteral feedings can be used temporarily. If enteral feedings will be needed long-term, gastrostomy tubes may be placed either surgically or non-surgically. Because the placement of a gastrostomy tube in a patient on peritoneal dialysis has been associated with an increased risk of infectious complications, it may be prudent to place a gastrostomy tube before dialysis is initiated. It is important to consider the risks and benefits of placing a feeding tube on an individual basis. Enteral feedings can be given as either a bolus feeding or as a continuous feeding using a feeding pump depending on feeding tolerance and oral intake. Bolus feedings can supplement oral intake during the day with continuous feedings given overnight to meet goal formula volumes. Continuous enteral feedings may also be given overnight to encourage oral intake during the day. They are usually started at 1 to 3 mL/kg/day and increased as tolerated. Feeding schedules may need to be adjusted for patients on dialysis. The choice of formula is based on age, nutritional requirements, fluid requirements, laboratory values, and concurrent medical problems.

Parenteral nutrition may be necessary if the GI tract is non-functioning or non-accessible, or if enteral feedings are insufficient to meet nutritional needs. Fluid limitations, dialysis modality and route of infusion, either peripheral or central, may impair the ability to fully meet nutritional needs using parenteral nutrition. The most concentrated forms of dextrose, amino acid, and lipid solutions available should be utilized to limit fluid intake in dialysis patients if parenteral nutrition is necessary. There is no scientific evidence to support the use of essential amino acid solutions in the renal patient. Electrolytes should be individualized to meet the patient needs. Standard dosages of multivitamins for parenteral nutrition, as established by the American Medical Association Nutrition Advisory Committee are recommended. Monitoring for potential vitamin A toxicity in patients on long-term parenteral nutrition is necessary (6). Interdialytic parenteral nutrition (IDPN), the provision of macronutrients through the venous drip chamber of the hemodialysis machine may be used in pediatric hemodialysis patients to help meet nutritional needs. Although it will not fully meet nutritional requirements, it may be used in supplementing enteral intake. Strict criteria must be met in order to justify use of IDPN. Intraperitoneal parenteral nutrition (IPN), which substitutes an amino acid solution for one or two glucose exchanges per day when on peritoneal dialysis, may be utilized for pediatric peritoneal dialysis patients who are not able to fully meet their protein requirements. IPN may be indicated in patients with malnutrition who have inadequate calorie and protein intake and are unable to tolerate oral or enteral supplementation. KDOQI guidelines for use should be followed (6).

Infant Nutrition in Pediatric Renal Disease

Meeting the nutritional needs of infants with CKD can be especially challenging since inadequate nutrient intake is common in this population. Decreased appetite, GERD and oral aversion are frequently observed with the infant refusing most or all oral liquids and solids. Texture aversions are also very common. Enteral feedings may be necessary to meet 100% of nutritional needs (9).

Since breast milk has a very low renal solute load in comparison to infant formulas, it is the ideal choice for feeding infants with CKD. However, because it is difficult to assess adequacy of intake in a breast-fed infant, it may be necessary for the mother to pump her breast milk and give in a bottle or as enteral feedings. Using expressed breast milk facilitates accurate assessment of intake and also allows for addition of modular components as necessary to increase caloric density. Specialized infant formulas designed for children with CKD are lower in sodium, potassium, and phosphorus and have a lower renal solute load than standard infant formulas. It may be necessary to use these formulas to meet nutritional needs and maintain optimal biochemical control. Modular components of protein, carbohydrate, and fat can be added to increase the caloric density and protein content of the formula when necessary without increasing mineral and electrolyte content. Formulas should not typically be concentrated due to increased electrolyte and mineral content. Cost, shelf stability and availability should be considered when choosing formulas and modular components. Table 2 outlines several different formulas and modular components used for children with CKD.

Adult renal formulas, which are calorically dense, high or low in protein, low in electrolytes and phosphorus, and designed for adults with CKD are not usually recommended for children less than 2 years of age due to increased osmolality and inappropriate vitamin and mineral content. With use, it may be necessary to dilute these formulas to ¼ or ½ strength to achieve tolerance. Serum magnesium levels should be monitored closely as magnesium content is significantly higher in adult renal formulas in comparison with infant formulas and may contribute to hypermagnesemia (3). Sodium polysterene sulfonate (Kayexalate) can be effectively used to precipitate potassium from infant formula prior to feeding when hyperkalemia occurs despite use of a low potassium formula (12). However, pretreatment of formula

Table 2
Common Formulas and Modular Components Used for Children with CKD (10,11)

Product	Description	Calories	Protein (g)	Comments
Human Breast Milk	Low renal solute load	20 kcal/mL	1.1 g/100 mL	Low renal solute load and low mineral content
Similac PM 60/40	Low renal solute load	20 kcal/30 mL	1.6 g/100 mL	Minerals comparable to human milk. Not generally available off the shelf
Suplena CHO Steady	Calorically dense, lower protein	1.8 kcal/mL	4.5 g/100 mL	Adult renal formula; may need to dilute
Renalcal	Calorically dense, low protein	2.0 kcal/mL	3.4 g/100 mL	Adult renal formula; may need to dilute
Nepro CHO Steady	Calorically dense, high protein	1.8 kcal/mL	8.1 g/100 mL	Adult renal formula; may need to dilute
Novasource Renal	Calorically dense, high protein	2.0 kcal/mL	7.3 g/100 mL	Adult renal formula; may need to dilute
ProMod	Protein liquid modular	3.3 kcal/mL	3 g/TBSP	Used to increase protein in formula
Resource Beneprotein	Protein modular	3.6 kcal/g	4 g/TBSP	Used to increase protein in formula
Polycose powder	Glucose polymer	3.8 kcal/g	2 g/tsp (8 kcal/tsp)	Used to increase calories with low osmolality, low minerals and electrolytes
Microlipid	50% fat emulsion	7.5 kcal/g	0g	Mixes easily, used to increase calories without minerals or electrolytes
Vegetable oil	Safflower or canola oil	8.4 kcal/g	0g	Non-emulsified; does not stay mixed. Used to increase calories without minerals or electrolytes

can result in an increase in sodium content while decreasing formula levels of calcium and magnesium. Close attention to possible complications from these minerals is necessary.

Fluid needs in infants with non-oliguric CKD, usually due to congenital renal dysplasia, may be significantly increased due to the infants inability to concentrate urine. There also may be increased urinary sodium losses, necessitating sodium supplementation to achieve optimal growth and weight gain (13). Calorie and protein dense formulas, using modular components, are frequently necessary to meet calorie and protein needs without compromising biochemical control. However, these formulas may exacerbate GI disturbances such as vomiting and diarrhea. Frequent adjustments in the formula, feeding modality, and nutritional plan by the pediatric renal dietitian, in conjunction with the pediatric renal team, is often necessary to achieve optimal nutrient intake and promote appropriate growth and weight gain. Introduction of solids should be done on a normal schedule when the patient is developmentally appropriate. The infant may benefit from occupational and speech therapy involvement to promote oral intake and avoid or limit oral aversion.

Nutritional Concerns for School-Aged Children and Adolescents with CKD

Children and adolescents with CKD who are short in stature, may experience increased social difficulties as they grow older. It is important for caregivers and medical staff to treat the child in an age-appropriate manner and not view them as younger than their chronological age based on height. Children who are short may also have increased problems with peers as they grow older, resulting in behavioral changes such as anger or withdrawal. The medical team needs to provide emotional support to the child when such difficulties occur and consider changes in, or additions to, the medical and dietary management of the patient in order to optimize growth potential. As previously discussed, optimal biochemical control and nutrient intake is essential in maximizing growth in children with CKD.

As the child becomes older, dietary and medication adherence may be adversely impacted due to an increased need to assert independence. Additionally, food choices at school may not be ideal for children with CKD. There may be more irregular eating patterns with skipped meals and increased peer pressure to eat foods that are typically limited in the diet. Parents are frequently reluctant to allow their child more independence in making appropriate food choices and taking medications as scheduled. Conversely, some parents may allow their child more independence in these areas than they are emotionally and intellectually ready to handle, which can adversely impact their nutritional status, growth, and medical condition. The renal dietitian and other health care professionals can work closely with parents and patients in achieving the appropriate balance of autonomy and independence related to medical and dietary therapy. Nutritional counseling should be individualized based on the nutritional assessment and plan of care. The child with CKD should be included in discussions related to diet, nutrition, growth, laboratory data, and medications between medical staff and parents/caregivers (when developmentally appropriate). It also may be helpful for health care professionals to contact the child's school and provide education to peers, teachers, school nurses, and school food service workers regarding the child's medical condition and dietary and health needs. School breakfast and lunch programs may need to be modified to accommodate the diet limitations of the child.

Conclusion

Providing care to the pediatric patient with CKD is complicated and requires the cooperation and coordination of the entire health care team, including nurses, social workers, dietitians, physicians, technicians, child life specialists, and the patient and family. Optimizing nutritional status and growth, and maintaining good biochemical control is essential in achieving a good outcome medically, physically, and emotionally for these patients. Nutritional status and needs should be assessed frequently and dietary modifications made as needed to meet these goals.

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