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Tips for Aiding Feed Tolerance in Children with Chronic Kidney Disease (CKD)

Managing feeding tolerance for children with CKD and those receiving dialysis can be a challenge for the clinician. Poor appetite, uremia and gastrointestinal (GI) challenges such as reflux, emesis and delayed gastric emptying, can all contribute to why calorie intake can be limited and thus why children with CKD may struggle with weight gain [1, 2]. Addressing these obstacles one at a time will help optimize feeding tolerance for this group of patients.

Poor appetite, intake and uremia: These may be mostly non-modifiable factors and can be due to the decline in kidney function. However, managing biochemical values may potentially aid a reduction in symptoms. Children who are acidotic often experience a poor appetite and poor growth. The KDOQI pediatric nutrition guideline recommend CO_2 levels to remain $\geq$22 mEq/L[1]. North American data indicates that only one third of children with CO_2 levels $\leq$18 are treated with alkali therapy[3]. Using a feed which is low in chloride and potassium, such as Renastart, may help to improve acidosis[3, 5]. **Reducing protein intake** to reduce BUN may be another intervention to reduce uremia[1]. Many children with CKD, and especially those on dialysis, may need tube feeding support[6]. Providing any needed calories and protein via a tube feed and **adjusting the tube feeding timing** to individual tolerance can help to mitigate the effects of a poor oral intake[7, 8].

GI challenges: Children with CKD and on dialysis may lose up to a third of their feeds through emesis[7]. Over 70% have severe gastroesophageal reflux[9]. Delayed gastric emptying is another challenge[8]. **Medication** is certainly an option to treat these conditions[1], however, nutritional intervention can also help. Providing as much breastmilk as possible, if it is available, is an ideal choice[1]. **Breastmilk** is well tolerated, high in whey content, and has a micronutrient profile suited to management of CKD[5]. **Whey proteins** are known to aid with digestion and gastric emptying and so choosing a predominately whey based formula when breastmilk is not available is another option[9]. Using a whey-based renal specific feed, such as Renastart, in conjunction with a standard infant formula or standard paediatric enetral feed, may be an option if hyperkalaemia or hyperphosphatamia are an issue. **Timing of feeding** may be important as well[8]. Although it is ideal to offer daytime bolus feeds to pattern physiologic oral feeding, continuous feeding, especially nocturnal continuous feeding, may help ease volume concerns that trigger GI issues. However, monitoring timing and length of continuous feeding is important. Some children have greater emesis toward the end of overnight continuous feeding because of volume accumulation. Children receiving peritoneal dialysis may have dialysate dwells that, especially toward the end of overnight dialysis passes, may increase volume pressure[5]. **Offering oral intake ad lib,** especially before a tube feed is given, may help a child to self-regulate and learn to gauge volume tolerance independently[7]. Use of a **gastrostomy tube (GT)** is preferred for chronic tube feeding needs (>6 weeks), which is typically expected as CKD progresses[10]. Nasogastric tubes (NG) may irritate the back of the throat and nasal cavity, which can increases emesis and cause oral aversions[11]. Lastly, although using a more concentrated base formula can help reduce volume, which can aid with GI issues, sometimes the **density of the feed** can increase emesis and nausea. So, carefully evaluating the individual child for benefit versus problems with concentrated feeding is important. Individual or combination macronutrient modulars can also help meet increased calorie needs when volume is limited[5].

Volume limitations: Children receiving dialysis may have limited or no urine output, and consequently, **maximizing caloric intake of feeds** is necessary to ensure growth. At the same time, children with CKD, even those on dialysis, may have renal tubular defects which causes problems with concentrating urine[1]. These children have high volume loss and may need supplemental fluid and sodium. For the child who needs volume reduction, increasing the caloric content of the feeds is necessary, either by increasing the base formula density or by **adding macronutrient modulars.** Concentrating base formula density must be done with a careful eye on micronutrient increases, limiting those that can be detrimental in excess for children with CKD, such as potassium or vitamin A[1, 5]. However, there is merit to limiting the number of products necessary for formula mixing, to ease complication for the caregiver and potentially reduce errors[12].

The density of the formula may need to be adjusted based on feeding tolerance, and in some situations, an increase in intensity of dialysis may be necessary to allow for more fluid volume[13]. The child who needs additional fluid may still have difficulty meeting caloric needs with a large volume of formula, as additional formula may cause GI problems.

Thus, some concentration of fortification of feeds may be necessary to meet caloric needs, with **additional free water given to meet fluid needs.** These may be given as flushes after feeding, in between feeds or orally, to satisfy thirst, based on the tolerance and desires of the child. It is important that free water and formula intake be appropriately spaced to prevent unsafe electrolyte declines from a large amount of free water given at one time[1, 5].

Other: Some children may have **unique GI issues** in addition to having CKD. Formula intolerances or cows milk protein allergy may be present in children with CKD in the same percentages that they are present in the general population. In this case, the formula must be chosen based on the GI intolerance to prevent serious issues like allergy related side effects, blood in the stool, extreme diarrhea or vomiting. The formula chosen to aid with the GI concerns can be modified with other formula, medication or modulars to make it more appropriate for renal biochemical issues[5]. In short, whatever the problem a child may be having with feeding tolerance, trialing formula timing and administration alterations may solve the problem, changing the base formula may be the solution, or the use of medications may be enough to resolve these tolerance issues – it just takes the careful eye of a trained clinician and **evaluating the individual child** and their needs or their family's needs to determine the best course[4].

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