PAEDIATRIC RENAL NUTRITION TASKFORCE

Enteral tube feeding in children with CKD stages 2-5 and on dialysis

A practical guide

Contents

Foreword

The Pediatric Renal Nutrition Taskforce (PRNT) is an international team of pediatric renal dietitians and pediatric nephrologists who develop clinical practice recommendations (CPRs) for the nutritional management of various aspects of kidney diseases in children.

In 2021, the taskforce published recommendations regarding delivery of a nutritional prescription by enteral tube feeding in children with chronic kidney disease stages 2-5 and on dialysis. The CPR addresses the types of enteral feeding tubes, when they should be used, placement techniques, recommendations and contraindications for their use, and evidence for their effects on growth parameters.

This booklet aims to provide a practical guide on how to implement these recommendations in every day clinical practice and should be read in conjunction with the published paper.*

*Rees L, Shaw V, Qizalbash L et al. Delivery of a nutritional prescription by enteral tube feeding in children with chronic kidney disease stages 2-5 and on dialysis-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce. Pediatr Nephrol. 2021 36(1):187-204. doi: 10.1007/s00467-020-04623-2.
https://www.espn-online.org/nutrition-taskforce/

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Question 3

What investigations may be needed prior to the insertion of a gastrostomy device? What are the possible complications and treatment options?

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Summarising clinical management

Step 1: Assessment for the need for enteral tube feeding

- Enteral tube feeding is necessary when a child is unable to meet their nutritional requirements orally
- Prompt intervention is recommended once a deterioration in weight centile is noted
- Intervention may be appropriate at any age, but is especially important in children <2 years old, where it is likely to reverse poor linear growth

Step 2: Patient characteristics determining which type of feeding device is placed

Short-term feeding?

Nasogastric tube (NGT) is the preferred option

Long-term feeding?

Gastrostomy device (GD) is the preferred option

Step 3: Investigations and precautions pre- and post-gastrostomy device insertion

Investigations pre-GD insertion

- Upper gastrointestinal contrast study (to evaluate the anatomy of the stomach and duodenum, and check for malrotation)
- Esophageal impedance or pH studies may be considered to evaluate gastro-esophageal reflux (GER) - this is especially important if a Nissen fundoplication is considered alongside insertion of a GD

Possible complications and treatment options post-GD insertion

- **GD site infections** – to reduce risk of infection, prophylactic antibiotics may be given perioperatively
- **Peritonitis** - there is increased risk if a peritoneal dialysis catheter is *in situ* – give perioperative broad spectrum antibiotics and an antifungal medication for a minimum of 48 hours. Post-insertion withhold PD for 24 hours if possible, otherwise re-start PD on reduced fill volumes
- **Cross infection of GD and PD catheter sites** - long-term strict attention is required for the care of both exit sites

Step 4: Initiation of enteral tube feeding after gastrostomy device insertion

After discussion with the insertion operator:

- start cautiously with a bolus of water
- progress with the gradual introduction of formula over the next 6 hours
- follow local incremental feeding regimens

Flow chart
(Continued)

Step 5: Delivery of nutritional formula using an enteral feeding tube

- **Supplementary tube feeding** – a proportion of the child's requirements are given via the enteral feeding tube
- **Overnight continuous feeding** – to allow time during the day to promote hunger and an interest in oral feeding
- **Exclusive tube feeding** – all the child's nutritional requirements are given via the enteral feeding tube

The method of feeding (which could include a combination of overnight and daytime feeding), rate and volume should be discussed with the family, taking into consideration the individual child and their home circumstances.

Step 6: Management of vomiting

Conditions that may contribute to vomiting such as GER, acidosis, volume overload or inadequate dialysis must be addressed first.

Continuous infusion feeding may be beneficial. **Note: if continuous feeds are considered via an NGT at home, conduct a local risk assessment. Unsupervised NGT continuous overnight feeding poses a significant risk for aspiration of the formula.**

- If vomiting continues, perform an upper gastrointestinal contrast study (if not already done) and pH studies to exclude malrotation and to define the severity of GER
- Post-pyloric feeding (via a nasojejunal or gastrojejunal tube) or Nissen fundoplication may need to be considered
- Nasojejunal or gastrojejunal feeds need to be delivered by continuous infusion as boluses entering the jejunum are poorly tolerated

Step 7: Transition from tube to oral feeding

Successful transition from enteral feeding to oral diet may not happen until after renal transplantation; however, oral stimulation should be supported at all times.

- If the child develops an interest in taking food by mouth, reduce the nutrition provided by tube feeding in proportion to that provided by oral intake (monitor for adequate weight gain)

Step 1: Assessment for the need for enteral tube feeding

- To improve nutritional status, initiation of enteral tube feeding is recommended in children who are unable to meet their nutritional requirements orally
- Enteral feeding can correct nutritional deficits and support the child to attain and maintain appropriate growth and development
- Prompt intervention is advised once a deterioration in weight centile is seen
- Intervention may be appropriate at any age, but is especially important in children <2 years old, where it is likely to reverse poor linear growth

To determine and assess nutritional requirements refer to:

Shaw V et al (2020). Energy and protein requirements for children with CKD stages 2-5 and on dialysis-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 35(3), 519-531 doi: 10.1007/s00467-019-04426-0

Nelms CL et al (2021). Assessment of nutritional status in children with kidney diseases-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 36(4), 995-10101 doi: 10.1007/s00467-020-04852-5

Step 2: Patient characteristics determining which type of feeding device is placed

Allocate adequate time for counselling with parents/caregivers and, where possible, include the child/young person in the discussion about their feeding device:

- why it is needed and the process of tube feeding
- the different types of tubes and devices available
- the benefits of tube feeding, e.g. reduction in parental anxiety around oral feeding, and use for administration of medications and any additional fluid that might be needed
- possible complications that may arise
- the need for preparing the child for tube/device placement – engage the support of a play therapist, child life specialist or psychologist, where possible

Short term – Nasogastric tube (NGT)

- An NGT is useful for starting enteral feeds in infants and children requiring short-term feeding or until an infant is an acceptable weight for GD placement (this weight will be center specific).
- It is a simple procedure to pass the tube, with no risk of peritonitis.
- Due to the potential of displacement of the internal end of the NGT caregivers must check the position of the NGT before administering any water, formula or medications.

Caution: NGT feeding poses a significant risk for aspiration of the formula if used unsupervised for continuous overnight feeding at home, which can be fatal. Conduct a local risk assessment.

Long term - Gastrostomy device (GD)

- A GD may be inserted percutaneously and endoscopically (PEG), by radiological guidance (RIG) or surgically. All GDs directly enter the stomach through the abdominal wall.
- PEG and RIG are ideal for children who do not have a peritoneal dialysis catheter *in situ*.
- Open surgical or percutaneous laparoscopic assisted gastrostomy (PLAG) are ideal:
  - if the child already has a PD catheter *in situ* or in those having a PD catheter placed simultaneously
  - in those who have had previous abdominal surgery
  - in those with severe kyphoscoliosis, gastric ulcers or varices

Caution: place the GD either prior to or simultaneously with PD catheter insertion. If this is not possible, prescribe perioperative antibiotics and an antifungal medication. Continue treatment for a minimum of 48 hours post-insertion.

Once the enteral tube/device has been placed, educate and train the parent/caregiver (and any others, e.g. grandparents, school staff) on:

- aftercare of the exit site
- administration of formulas, water, medications
- equipment, e.g. syringes, enteral feeding pump
- how to prepare and store formulas/medications
- trouble shooting - tube blockage, testing position of the tube, enteral feed pump alarms
- infection control procedures - hand hygiene, cleaning and disposing of equipment, changing giving sets, hanging times for formulas

Parents/caregivers should be encouraged and supported to maintain their child's oral motor skills whilst avoiding any force feeding. Force feeding can result in vomiting and/or refusal of oral feeds and food, with a consequent detrimental effect on normal feeding behaviour in the long term.

A checklist for preparing a child for discharge from hospital on enteral tube feeding is detailed in Appendix 1.

Step 3: Investigations and precautions pre- and post-gastrostomy device insertion

Investigations

- Upper gastrointestinal contrast study (to evaluate anatomy of the stomach and duodenum, and check for malrotation)
- Esophageal impedance or pH studies may be considered to evaluate GER on an individual basis - this is especially important if a Nissen fundoplication is considered alongside insertion of a GD

Possible complications and treatment options

- **GD site infections** – take a swab to check for microscopy, culture and antibiotic sensitivities, and prescribe oral or topical antibiotics accordingly
- Malnourished children and those on acid-blocking medications (such as histamine H_2 receptor antagonists) are at high risk of fungal infection
- **Peritonitis prevention** – there is increased risk if a peritoneal dialysis catheter is *in situ*
  - give perioperative broad spectrum antibiotics and an antifungal medication for a minimum of 48 hours
  - if possible, withhold peritoneal dialysis for 24 hours or longer after GD placement
  - once PD is started reduce the usual fill volume and slowly build it up over several days, if possible. The nutritional prescription may need to be modified in response to volume overload and abnormal serum electrolytes resulting from reduced dialysis
- **Peritonitis treatment** – peritonitis must be treated promptly; follow local antibiotic policies for the treatment of peritonitis
- **Cross site infections** – pay long-term strict attention to the care of both PD catheter and GD exit sites

Ideally the GD should be inserted prior to the placement of the PD catheter. Place PD catheter and GD exit sites as far away from each other as possible.

Step 4: Initiation of tube feeding after gastrostomy device insertion

There is no evidence for when to start using a GD post-insertion; the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) suggests 4-6 hours post-insertion.

Once the insertion operator has confirmed when the GD can be used, initially start with water. Local practice may vary. The following is a suggested starter feeding regimen for continuous feeding.

- 2 hours post-insertion give a small volume, 30-75 ml, of water or other appropriate clear fluid (depending on the size of the child)
- if this is tolerated, then at 3 hours give 50% of the usual feed volume rate as water

- at 6 hours change to 50% of the usual feed volume rate as formula
- at 7 hours give 100% of the usual feed volume rate as formula
- if this is tolerated, at 8 hours resume the usual feeding regimen

Example:
A 2-year-old child, weight = 10 kg, normally fed 800 ml over 10 hours at 80 ml/hour via pump

Time post-insertion

0-2 hours: nil

2 hours (if deemed safe to do so): 40 ml/hour x 1 hour of water via enteral feeding pump = 40 ml

3 hours: 40 ml/hr x 3 hours of water = 120 ml

6 hours: 40 ml/hr x 1 hour of formula = 40 ml

7 hours: 80 ml/hr x 1 hour of formula = 80 ml

8 hours: 80 ml/hr x 7 hours of formula = 560 ml

Total fluid = 840 ml in 15 hours

Total formula = 680 ml

An alternative starter feeding regimen:

Example:
A 2-year-old child normally fed 800 ml over 20 hours at 40 ml/hour via pump

Time post-insertion

0-4 hours: nil

4 hours (if deemed safe to do so): 40 ml/hour x 4 hours of water via enteral feeding pump = 160 ml

8 hours: 40 ml/hour x 4 hours of formula = 160 ml

12 hours: 80 ml/hour x 4 hours of formula = 480 ml

Total fluid = 800 ml in 16 hours

Total formula = 640 ml

In the case where the child will have a prolonged period of nil via the enteral route, intravenous fluids may be needed, taking into consideration any dialysis. If the child's dialysis is reduced, then the composition of the formula may need to be altered accordingly.

Step 5: Delivery of nutritional formula using an enteral feeding tube

1. Assess oral intake from formulas, oral nutritional supplements and any food and drinks
2. Review growth parameters and plot on centile charts
3. Calculate requirements for energy, protein and fluids
4. Discuss possible ways of delivering the formula with the child, if appropriate, and their parent/caregiver, taking into consideration: fluid restrictions; any gastrointestinal symptoms, e.g. nausea, vomiting, GER; dialysis; timing and types of medications; type of feeding tube; home and school routines

Tube feeding may be exclusive or supplementary to oral feeding.

Supplementary tube feeding

– where a proportion of the child's nutritional requirements are given via enteral feeding.

- **Bolus top up feeds**

May be used in a child who is not managing to take all their feeds orally; the remaining feed can be topped up as a gravity bolus with a syringe.

Bolus feeds can also be delivered using an enteral feeding pump, the rate depending on the child's tolerance.

Example:
A 4-year-old child who requires 2 x 200 ml formula a day to meet their nutritional requirements

The formula may be given via gravity boluses through a syringe or via an enteral feeding pump. Depending on the child's tolerance this could be given over:

- 30 minutes at 400 ml/hour **or**
- 2-4 hours at 100-50 ml/hour

Oral nutritional supplements (where available) can be given in the same way as enteral tube formulas, depending on the child's clinical picture and the formula's composition.

- **Overnight continuous feeding**

Giving the formula continuously overnight allows a feeling of hunger to develop in the child during the day and may prompt an interest in oral feeding. It can also reduce the burden of feeding on parents and caregivers when they are struggling to give their child adequate nutrition.

Follow local policy for safe hanging times for formulas given as continuous feeds.

Example:
A 3-year-old child who requires 1000 kcal a day and is managing to take approximately 500 kcal orally

The child has a fluid restriction of 1000 ml. Nursery is attended for 2.5 hours in the morning. 50% of energy requirements could be given overnight, i.e. 500 kcal.

- Give 500 ml of 1 kcal/ml formula overnight, leaving 500 ml fluid during the day for formula/drinks
- A more energy dense formula could be used; however, tolerance may be an issue and this depends on the individual child
- The initial pump rate could deliver the formula over 10-12 hours and then be gradually increased so that the formula is delivered over a shorter period of time

Suggested feeding regimen:

Stage 1: 30 ml/hour x 12 hours = 360 ml

Stage 2: 35 ml/hour x 12 hours = 420 ml

Stage 3: 40 ml/hour x 12 hours = 480 ml

Stage 4: 45 ml/hour x 11 hours = 495 ml

Stage 5: 50 ml/hour x 10 hours = 500 ml

Stage 6: 55 ml/hour x 9 hours = 495 ml

Stage 7: 60 ml/hour x 8 hours = 480 ml

- The time taken to reach each stage depends on the child's tolerance. Issues that may present are: nausea, vomiting, looser stools/diarrhea, abdominal discomfort.
- The number of hours that the child needs to be on the overnight feed depends on the pump rate that they can tolerate and the ideal duration of feeding, taking into account any dialysis and lifestyle factors such as school, afterschool clubs, time of evening meal, bedtime of the child and family members. If there are concerns about tolerance, the pump rate could be increased by as little as 1 ml increments each night.
- If the feed volume needs to be reduced, e.g. due to fluid restriction, the concentration of the formula can be increased gradually to achieve the nutritional prescription in a smaller volume (refer to the Pediatric Renal Nutrition Taskforce practical guide for Energy and protein requirements in children with CKD stages 2-5 and on dialysis).
- If a 1.5 kcal/ml formula is used, the target of 500 kcal is achieved with 500 ÷ 1.5 = 333 ml of formula which can be given over fewer hours overnight, as tolerated, or be given during the evening before the parent's/caregiver's bedtime.

A combination of overnight continuous feeds and daytime boluses can also be used.

Exclusive tube feeding

– where all a child's nutritional requirements are given through a feeding tube. This can be done in a variety of ways:

- gravity bolus feeds via a syringe
- bolus feeds via a feeding pump, as 4-5 feeds during the day given over 30 minutes to a few hours
- an overnight continuous feed with daytime boluses
- continuous feeds, giving the total feed over a maximum of 20 hours, with 4 hours off the pump to allow time for the stomach pH to return to normal

With any feeding regimen monitoring of formula tolerance, growth and biochemistry is essential. Refer to:

Shaw V et al (2020). Energy and protein requirements for children with CKD stages 2-5 and on dialysis-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 35(3), 519-531 doi: 10.1007/s00467-019-04426-0

Nelms CL et al (2021). Assessment of nutritional status in children with kidney diseases-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 36(4), 995-1010 doi 10.1007/s00467-020-04852-5

McAlister L et al (2020). The dietary management of calcium and phosphate in children with CKD stages 2-5 and on dialysis-clinical practice recommendation from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 35(3), 501-518 doi: 10.1007/s00467-019-04370-z

Desloovere A et al (2021). The dietary management of potassium in children with CKD stages 2-5 and on dialysis -clinical practice recommendations from the Pediatric Renal Nutrition Taskforce.
Pediatr Nephrol, 36(6):1331-1346 doi 10.1007/s00467-021-04923-1

Promotion of oral motor skills

Even if all the nutrition is given through an enteral feeding tube or device, parents/caregivers should try to maintain their child's oral motor skills:

- giving positive oral experiences such as gently touching their child's mouth or cheeks, kissing them, giving a pacifier (dummy) or bottle to suck
- encouraging licking or tasting foods with no pressure to chew or swallow them
- letting them mouth toys
- playing with food and sitting up to the table with the family at mealtimes - the social interaction that mealtimes provide promotes a positive association between food and eating
- ongoing oral stimulation is important in tube fed children to help in the transition to normal feeding once they have had a successful transplant

Step 6: Management of vomiting

Vomiting can be an ongoing problem for some infants and children. Persistent vomiting is very stressful for families and has a negative impact on oral feeding. It is important to address correctable medical causes that may contribute to vomiting, e.g. GER (consider alginates, antacids, histamine H_2 receptor antagonists, proton pump inhibitors, prokinetics, anti-emetic medications such as ondansetron), acidosis, volume overload and inadequate dialysis.

The nutritional prescription should be monitored and altered as necessary. Some strategies that may help:

- giving small frequent bolus feeds
- increasing the energy density of the formula to allow a reduction in the volume of the formula
- continuous infusion feeding may be beneficial – if so, consider changing from an NGT to a GD
- post-pyloric feeding - nasojejunal/gastrojejunostomy

If feeding is by continuous infusion -
reduce the rate of delivery and give the feed over a longer period of time

↓

If the enteral feed is being given via an NGT change to a GD –
an NGT may stent open the gastroesophageal junction
thus increasing any tendency to vomit

↓

If growth is negatively affected –
exclude malrotation (upper gastrointestinal contrast studies);
gastroesophageal reflux (pH studies)

↓

Placement of gastrojejunostomy or Nissen fundoplication may be needed –
any post-pyloric feeding needs to be delivered by continuous infusion as boluses entering the jejunum are poorly tolerated

Step 7: Transition from tube to oral feeding

- Successful transition from enteral feeding to oral diet may not happen until after renal transplantation
- If the child develops an interest in taking food by mouth reduce the nutrition provided by tube feeding in proportion to oral intake, provided adequate growth is maintained
- The feed volume can be reduced initially by 25% to promote an appetite for food
- Moving from continuous to bolus feeds provides a more normal eating pattern
- Set a daily the target for eating, with bolus supplements of the nutritional deficit given via the tube after meals where intake is below target
- The plan for transition from enteral to oral feeding should be individualised according to the child's feeding skills and behaviors

Assessment of intake should take into consideration appropriate weight and height gain. Some continued tube feeding in the post-transplant period may provide the opportunity to achieve some catch-up growth. Conversely, children who are tube fed post-transplant have been found to be overweight or obese, associated with steroid medication.

Example:
A 5-year-old child post-transplant whose pre-transplant feeding regimen was 800 ml at 50ml/hour over 16 hours

- The feeding regimen could be changed initially to a combination of overnight feeding and daytime boluses
- If the child starts to eat during the day reduce the amount of formula given overnight or stop the daytime bolus feeds, depending on food intake

As the child eats more, and if the rate of growth is acceptable, the amount of feed given overnight can be further reduced and eventually stopped. The enteral feeding tube may be used to achieve the necessary increased fluid intake post-transplant:

- if the child is unable to achieve their fluid target orally dilute the formula, e.g. ¾ volume as formula, ¼ volume as water
- if unable to drink enough fluid, water can be given as flushes through the tube
- if oral fluid intake is not adequate, water can be given overnight as a continuous infusion

Appendix 1: Checklist for discharging a child with an enteral feeding tube

This is a suggested checklist. Follow local policies and practices for discharging a child home with an enteral feeding tube

Training	Date	Signature
Risk assessment for nasogastric feeding at home (if applicable)		
Checking the position of the tube (if applicable)		
Care of exit site (if applicable)		
Cleaning of syringes		
Formula preparation		
Formula storage		
Formula decanting		
Flushing technique		
Feeding technique: Bolus Feeding pump		

Medications	Date	Signature
Preparing and measuring		
Storage		
Administration		
Trouble shooting		
What to do if tube is dislodged or falls out		
Feed pump alarms		
Unblocking tubes		

Equipment and documentation to be supplied for discharge	Date	Signature
Spare replacement tube (if applicable)		
7-10 days supply of formula (if applicable)		
7-10 days supply of giving sets (if applicable)		
pH indicator sticks		
7-10 days supply of formula containers/reservoirs		
7-10 days supply of syringes - including those for medications 1ml 3ml 5ml 10ml 20ml 60ml		
Arrangement of ongoing provision of formula and feed equipment		
Medications		
Feeding plan		
Type and size of enteral feeding tube		
Contact made with community nursing team		
Contact numbers: Dietitian Community nurse Feed delivery company		

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