Nutritional Management of the Pre- and Post-Kidney Transplant Pediatric Patient

Pirayeh Pedarsani, MS, RD
September 13, 2019

Disclosures and Objectives

- Disclosures - none to report
- Objectives:
  - To understand the goals of nutrition management and nutritional needs for the pre- and post- kidney transplant pediatric patient
  - To understand role of the pediatric RD as part of the transplant team
  - To identify the criteria used for selection of a potential kidney transplant pediatric recipient
  - To gain understanding of short and long term complications and therapy for post-kidney transplant pediatric recipients
Pre-Transplant (Recipient)

• Goals/Focus of nutrition management:
  • Prevention and treatment of malnutrition
  • Help minimize post-transplant morbidity due to poor nutritional status and/or non-compliance

Role of the Pediatric RD

• Assessment of nutritional status
• Assessment of dietary & medication compliance
• Identification of those candidates in need of more intensive nutritional support and monitoring
• Education on pre- and post-transplant dietary guidelines
Pre-Transplant Clinic Procedure (Pediatric Recipient)

- All pediatric renal patients screened by RD the week of clinic for full pre-transplant assessment (patients <15 years old seen by peds RD, teens > 15 years old seen by adult RD)
- Nutrition screening is documented in the EMR (we use EPIC)
- A separate nutrition assessment is also completed and documented in EPIC

Pre-Transplant Clinic Procedure (Pediatric Recipient)
### Pre-Transplant Clinic Procedure (Pediatric Recipient)

**Progress Note - CCST**

**Medical Nutrition Therapy**

**Initial Evaluation - Pediatric Kidney Transplant Clinic**

**Anthropometrics:**

- **Height:**
  - Most Readings from Last 3 Encounters: 07/03/19
  - 6’ 1” (1.85 m) (95%, Z = -1.33)**
  - *Growth percentiles are based on CDC (Girls, 2-20 Years) data.

- **Weight:**
  - 5’ 10” (1.78 m) (95%, Z = -2.01)**
  - *Growth percentiles are based on CDC (Girls, 2-20 Years) data.

<table>
<thead>
<tr>
<th>Conditions Affecting Food Intake</th>
<th>Yes/No/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food allergies</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Changes in taste</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Get full easily</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Difficulty swallowing</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Difficulty chewing</strong></td>
<td>Yes, depending on the food</td>
</tr>
<tr>
<td><strong>Nausea/Vomiting</strong></td>
<td>Nausea in am until clears throat</td>
</tr>
</tbody>
</table>

**Pre-Transplant Clinic Procedure (Pediatric Recipient)**

**Knowledge of current diet:**

- Good:
  - Compliance to current diet: Good.
  - Motivation to initiate improvements: Good.
  - Knowledgeable about diet and medications.

- Needs improvement on food choices for variety.

**Intervention:**

1. Planned education on: selecting a high calorie diet including Organ supplement 2 cartons per day; 2. Reviewed possible future restrictions in diet based on kidney function and lab results.

**Anticipated Compliance:**

- Good.

**Patient:**

- A good candidate for kidney transplant from a nutritional perspective.

**Ketten:**

- Piyeah Pedersen, M.D., MD, MD
- 434-314-3701
- On an outside line: 434-314-3701

**Diagnosis:**

- Kidney transplant referral for CHF stage IV in the form of congestive hypertensive versus perivascular AH.

- Patient has a past medical history of Chirnical anemia (07/2018), failure to thrive (07/2018), and pulmonary edema (07/2018). Hyperkalemia results (all as of 11/2018). Sarcopenia contracture progression with removal of G tube on 11/2018, also was born at 54 weeks GA.

- Labs reviewed: no N/A, most states last creatinine was 5.0
- Medications reviewed: no natriuretic, furosemide, furosemide, etc.
- Herbal supplements: no

**Estimated Needs based on CIB using actual weight:**

| 24 g protein (1 g protein) |
|--------------------------|----------------|
| Total time spent: 60 minutes (30 minutes face-to-face) |

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Pre-transplant (Pediatric Recipient)

- Nutrition Assessment for Pediatric Patients Includes:
  - Height, Weight, BMI with %iles and Z-scores from the EMR
  - Growth Chart
  - Diet (24-hour recall)
  - Identification of changes in appetite, GI symptoms (nausea, vomiting, diarrhea, constipation)
  - Level of physical activity
  - Medical history
  - Labs
  - Medication, Vitamins & Minerals/Supplements
  - Physical assessment (fat stores, muscle tone or weakness, any signs of muscle depletion and wasting)
  - Evaluation of patient’s/caregiver’s compliance and readiness for change

Note on Malnutrition in Pediatric Candidates

- Potential pediatric renal transplant recipients with a weight for length (< 2 years) or BMI for age (>= 2 years) and Z-score of < 2 SD need diet intervention prior to transplant
- Options:
  - If receiving formula, increase concentration with powder or additives, such as protein powder, oil, or glucose polymers
  - Add fat to foods (i.e. oil, butter, and/or avocado if not hyperkalemic)
  - Appetite stimulant (in consultation with physician)
  - Consider G-tube placement if unable to meet estimated needs orally
Note on Obese Pediatric Candidates

• Obese pediatric renal transplant recipients (BMI for age ≥ 95th %ile and/or Z score > 2 SD) are associated with:
  • Higher rates of delayed graft function
  • Higher rates of surgical complications including wound infections
  • Prolonged post-transplant hospital stay
  • Higher incidences of post-transplant diabetes mellitus
  • Increased immunological graft losses and decreased graft survival associated with higher mortality rates

• At CSMC, the pediatric surgeon will assess abdominal fat distribution to determine candidacy

Post-transplant Recovery Phase

• Goals for Nutrition Management:
  • To provide adequate nutrients to meet each patient’s individual needs
  • To promote normal growth and weight gain
  • To promote wound healing
  • To prevent infection
  • To minimize side effects of medications

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### Post-transplant Recovery Phase - Nutrient Needs

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calories</strong></td>
<td><strong>Equations to Estimate Energy Requirements for Children at Healthy Weights</strong></td>
</tr>
<tr>
<td></td>
<td>Age Estimated Energy Requirement (EER) (kcal/d) × 1.2 - 1.5 = Total Energy Expenditure + Energy Deposition</td>
</tr>
<tr>
<td></td>
<td>13-35 mo EER = [89 x weight (kg) - 100] + 20</td>
</tr>
<tr>
<td>3-8 y</td>
<td>Boys: EER = 88.5 - 61.9 x age (y) + Activity factor x [26.7 + weight (kg) + 903 x height (m)] + 20</td>
</tr>
<tr>
<td></td>
<td>Girls: EER = 135.3 - 30.8 x age (y) + Activity factor x [10 x weight (kg) + 934 x height (m)] + 20</td>
</tr>
<tr>
<td>9-18 y</td>
<td>Boys: EER = 88.5 - 61.9 x age (y) + Activity factor x [26.7 + weight (kg) + 903 x height (m)] + 25</td>
</tr>
<tr>
<td></td>
<td>Girls: EER = 135.3 - 30.8 x age (y) + Activity factor x [10 x weight (kg) + 934 x height (m)] + 25</td>
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Food and Nutrition Board: Dietary reference intakes for energy. Washington, DC, National Academies, 2002
Post-transplant Recovery Phase - Nutrient Needs

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<thead>
<tr>
<th>Nutrient</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>DRI (Daily Recommended Intake) x 1.2</td>
</tr>
<tr>
<td></td>
<td>DRI</td>
</tr>
<tr>
<td></td>
<td>1-3 y 1.05</td>
</tr>
<tr>
<td></td>
<td>4-13 y 0.95</td>
</tr>
<tr>
<td></td>
<td>14-18 y 0.85</td>
</tr>
</tbody>
</table>


• Increase intake of phosphorus
  • Blood phosphorus levels may fall too low after kidney transplant
  • Consuming high-phosphorus foods such as milk, yogurt, cheese will help to maintain normal blood phosphorus levels
  • May also need to give a phosphate supplement (PhosNaK) acutely until level normalizes
### Medications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Possible Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tacrolimus</td>
<td>Hyperglycemia, hyperkalemia, HTN; hypomagnesemia</td>
</tr>
<tr>
<td>Sirolimus</td>
<td>Hyperlipidemia; hypokalemia</td>
</tr>
<tr>
<td>Cyclosporine</td>
<td>Hyperglycemia, hyperkalemia, HTN, hyperlipidemia; hypomagnesemia</td>
</tr>
<tr>
<td>Mycophenolate mofetil</td>
<td>Diarrhea, nausea/vomiting, bloating, abdominal cramping</td>
</tr>
<tr>
<td>Corticosteroids (prednisolone, solumedrol)</td>
<td>Hyperglycemia, hyperlipidemia, Na retention, increased appetite and weight; decreased Ca absorption</td>
</tr>
<tr>
<td>Valgancyclovir</td>
<td>Hyperglycemia, increased appetite; hyper/hypokalemia, hypomagnesemia/Ca/Phos</td>
</tr>
</tbody>
</table>

### Long Term Management

- **Goals:**
  - Achieve or maintain desirable weight
  - Maintain acceptable blood glucose levels
  - Maintain cholesterol levels ≤ 200mg/dl
  - Maintain normal blood pressure
  - Maintain optimal bone density
  - Minimize side effects of medications
  - Maintain healthy lifestyle
Long Term Management - Nutrient Needs

- Check 25 hydroxyvitamin D levels every 6 months

KDOQI Nutrition in Children with CKD: 2008 Update (Guideline 7)

Long-term Complications and Therapy

- Obesity/Weight gain
- Medical Nutrition Therapy: Healthy eating choices
- Recommendations:
  1. Mindful eating (hunger cues, slowed eating, portion control, avoiding sweets and sugar-sweetened beverages)
  2. Exercise regimen of appropriate frequency, duration, and variety
  3. Maintenance of normal BMI %ile for age and Z-score
  4. Educate on side effects of medications (prednisolone)
  5. Encourage family members to avoid purchasing processed foods, soda and other sugar-sweetened beverages
  6. Limit screen time
Long-term Complications and Therapy

- **Hypertension**
  - **Medical Nutrition Therapy:** Sodium-restricted diet
  - **Recommendations:**
    1. Reduce dietary sodium to < 1500 mg/day  
       (< 2300 mg/day **)
    2. DASH*** diet (less red meat/sodium/sugars, more whole grains/fruit/veggies)
    3. Appropriate weight
    4. Adequate exercise
    5. Behavior modifications

*American Heart Association 2012  
**Dietary Guidelines 2015-2020  
*** Dietary Approaches to Stop Hypertension

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Long-term complications and therapy

- **Hyperglycemia (elevated HgbA1C)**
  - **Recommendations:**
    1. Diet education (avoiding concentrated sweets and sugar-sweetened beverages)
    2. Appropriate weight
    3. Appropriate hypoglycemic medications
    4. Adequate exercise
    5. Monitor glucose levels
    6. Reduce corticosteroid doses as able (at Cedars we do a steroid avoidance protocol in patients that have low immunologic risk for rejection)
Long-term complications and therapy

- **Hyperlipidemia**
- **Recommendations:**
  1. Heart healthy diet: whole grains, variety of fruits & vegetables, healthy fat from fish & plant sources
  2. Limit sugar, saturated fat & trans fats; <10% of calories as saturated fat
  3. Achieve & maintain a healthy body weight
  4. Adequate physical activity
  5. Monitor lipid levels
  6. Lipid-lowering drugs as needed
  7. Adjust immunosuppression drugs if able
  8. Recommend increased intake of omega 3 rich fish (or quality controlled fish oil supplements – UPS Verified Mark)

Possible Long-term Complications and Therapy

- **Hyperkalemia**
- Some patients develop elevated levels of serum potassium as a side effect from taking tacrolimus or cyclosporine
- It is important to correct this imbalance in order to avoid heart irregularities
- Potassium is found primarily in milk, dairy products, nuts, beans, fruits, and vegetables, and also meats (list of low, medium, and high K foods/beverages can be given)
Additional Dietary Guidelines

- **Increase intake of fish which contain large amounts of Omega-3 fatty acids**  - May help reduce the toxic effects of Prograf and cyclosporine on the kidney and may help improve blood viscosity?
  - Supplementation provides slight improvement in HDL chol & diastolic BP; too modest to recommend routine use but no harmful effects (Cochrane Database Review 2016)
  - Supplementation showed no benefit on graft survival or reduction in early or late acute rejections (Tufts-NEMC Evidence-based Practice Center 2005)
  - One controlled trial: supplementation favorably influenced renal function in recovery phase after a rejection episode (Tufts-NEMC Evidence-based Practice Center 2005)

Additional Dietary Guidelines

- **Food Safety**
  - Patients on immunosuppressive medications are at higher risk of infections related to foods which are improperly prepared or stored
  - Advised to always wash your hands before eating or preparing food
  - Advised to make sure meat, poultry, fish and eggs are well cooked before eating
  - Advised to thoroughly clean all fruits and vegetables with a scrub brush even when the outer covering will not be used
  - Based on an FDA warning, it is advised that people with transplants avoid eating commercially grown raw sprouts, which are particularly susceptible to carrying harmful bacteria
Additional Dietary Guidelines

- Avoid Grapefruit, Pomelo, Pomegranate, Seville Oranges, Starfruit, and their juices while taking cyclosporine, sirolimus, tacrolimus or certain statins & antihypertensive medications (Tangelos = tangerine + grapefruit are allowed)
- Avoid Herbal teas including peppermint, dandelion, camomile, green, ginger, and turmeric teas due to interactions with tacrolimus (black and white tea are allowed)
- Avoid Herbal supplements including Vitamin C, St. John’s Wort, Echinacea, Ginseng, and Feverfew due to interactions with transplant medications


Case Study 1

- 17 yo male with CKD 3 in transplanted kidney
- Past Medical History: ex-32 weeker, acute renal insufficiency secondary to in-utero ACEi exposure, ESRD s/p DDRT kidney transplant in 2005, on chronic immunosuppression, chronic lung disease, asthma, developmental delay NOS, hearing loss, short stature, OSA, eczema, osteopenia, HTN, optic nerve hypoplasia, eustachian tube dysfunction, G-tube dependence
- Social History: mom didn’t know she was pregnant and was on anti-hypertensive medications
- Height- 134.7 cm (4’5”) < 1st %ile, Z score = -4.95
- Current Weight- 32.4 kg (71.5 lb) < 1st %ile, Z score = -5.59
- BMI 17- 8th %ile for age, Z score = -1.43 SD
Case Study 1

- **Labs include:** Glu 96, Na 141, BUN 29, Cr 2.0, K 3.6, Phos 5.6 H, Mg 2.2, 25 OH Vit D 58.2, HgbA1C 6.1 H

- **Medications include:** mycophenolate, prednisolone, tacrolimus, growth hormone

- **Supplements include:** Renal supplement 3 cans per day, liquid MVI, and cholecalciferol 400 IU per day
Case Study 1

- Has been re-evaluated for another kidney transplant and is listed as inactive (too well currently)

- The patient demonstrates good understanding and compliance of a renal diet per diet recall. He and mom report he's taking his renal supplements 3 times daily orally, eats a regular diet, but mom admits that > 50% of intake is with liquified foods via G-tube 5-6 times per day

- From a nutritional perspective, the patient is an acceptable candidate for kidney transplant but would benefit from increased PO intake and weight gain to increase BMI for age Z-score to within -1 to +1 SD

Case Study 1

**Interventions:**

- Consider decreasing renal low protein formula to 2 cans/day and liquified foods via G-tube

- Encourage increased oral intake of low Phos foods (Goal is to increase PO intake and decrease the use of the Mickey button until next May when he graduates from high school and then remove it)

- Continue cholecalciferol @ 400 IU/day and dc MVI

- Continue encouraging solids before offering purees via Mickey button, adding oil, butter, avocado (no issues with serum K levels)

- Consider starting a Phosphate binder with meals/formula supplement since restricting diet too much is not desired
Case Study 2

- 3 year old male s/p LRKT from mom on 1/15/19
- Past Medical History: PUV, CRF, recurrent UTIs, short stature, ESRD received kidney transplant pre-emptively
- Height
  - On 2/11/19: 92.3 cm (3’) 1st %ile, Z score = -2.21
  - On 7/08/19: 97 cm (3’2”) 5th %ile, Z score = -1.67
- Weight
  - On 2/11/19: 14.3 kg (31.5 lb) 16th %ile, Z score = -1.00
  - On 7/08/19: 15.2 kg (33.5 lb) 19th %ile, Z score = -0.87
- BMI
  - On 2/11/19: 16.8 81st %ile, Z score = 0.89
  - On 7/08/19: 16.2 70th %ile, Z score = -1.43
# Case Study 2

- **Diet and nutrition support order:**
  - Prior to transplant in 2018, was on 20 oz/day of renal powder formula + low K, low Phos solids
  - On 2/11/19: NAS, high phos, protein for healing + 500 mL Pediatric Formula 1.2 via G-tube nocturnally
  - On 7/08/19: NAS, DRI for protein, age-appropriate diet (G-tube feeds discontinued in March, but still uses G-tube to meet 50% of fluid requirements and for medications)

- **Labs include:**
  - Pre-transplant - (7/19/18) Na 139, K 4.8, BUN 75 H, Ca 10.8, Phos 5.1 (nl range for age 4.5-6.5 for 1-5 yo), Mag 3.1 H
  - Post-transplant - (7/2/19) Na 139, K 4.6, BUN 17, Cr 0.45, Ca 9.6 (4/15/19) Phos 4.3, Mag 1.9, Vitamin D 25OH 50.6, HgbA1c 5.0

- **Medications include:**
  - Pre-transplant - FeSO4, gummy MVI, oxybutynin, sodium citrate, growth hormone, salt solution
  - Post-transplant - mycophenolate, oxybutynin, prednisolone, sulfamethoxazole, tacrolimus, valganciclovir

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# Case Study 2

- Was evaluated for kidney transplant in September 2017 and then received a planned LRKT in January 2019

- In the transplant evaluation assessment by the RD, “the patient is a good candidate for kidney transplant from a nutritional perspective”

- **Interventions:**
  - Continue NAS age-appropriate diet, working on taking all fluids and medications orally with a goal of removing the G-tube
Case Study 3

- 17 yo male s/p DDRT 12/28/2013
- Past Medical History: ESRD of unknown etiology with abnormal glomerular and tubular basement membranes on biopsy, maintained on PD for 2 years, chronic active antibody mediated rejection, arterial nephrosclerosis, Obesity and HTN dx’d 7/2014
- Type 2 DM dx’d 11/2018
- Social History: Dad states he's diabetic and there's a strong family history on both sides of diabetes

Case Study 3

- Height
  - On 12/28/13: 147 cm (58”) 52nd %ile, Z score = 0.05
  - On 07/01/19: 178 cm (70”) 64th %ile, Z score = 0.37
- Weight
  - On 12/28/13: 39.1 kg (86.2 lb) 53rd %ile, Z score = 0.08
  - On 07/01/19: 117.1 kg (258.2 lb) 19th %ile, Z score = 2.71
- BMI
  - On 12/28/13: 18.6 66th %ile, Z score = 0.42
  - On 07/01/19: 36.9 99th %ile, Z score = 2.54
Case Study 3

- **Diet order:**
  - Pre-transplant – DRI for protein x 1.3 (on PD), low sodium, low phosphorus
  - Post-transplant (currently) - NAS, No concentrated sweets

- **Labs include:**
  - Pre-transplant - (12/28/13) Na 142, K 3.7, BUN 47 H, Cr 8.8 H, Ca 9.7, Phos 7.9 H
  - Post-transplant – (10/9/14) HgbA1C 5.1 (11/26/18) HgbA1C 6.5 (04/01/19) HgbA1C 6.3 (07/01/19) Na 139, K 3.9, BUN 13, Cr 1.0, Ca 9.5, Phos 3.9, Vitamin D 25OH 25.2 L

- **Medications include:**
  - Pre-transplant - docusate, sodium bicarb, epoetin monthly, amlodipine, calcitriol, sevelamer 3 with meals, renal MVI, vitamin D 5000 units/week
  - Post-transplant – amlodipine, mycophenolate, prednisone, tacrolimus, vitamin D 2,000 units/day, metformin XR 500 mg 4 tabs per day
Case Study 3

- Was evaluated for kidney transplant at CSMC in February 2013 and then received a planned DDKT in December 2013
- In the transplant evaluation assessment by the RD, “the patient is a good candidate for kidney transplant from a nutritional perspective”
- **Interventions/Recommendations to patient at the most recent visit (7/01/19):**
  - Avoid pepperoni. Continue healthy fats as a snack such as unsalted roasted peanuts/pumpkin seeds
  - Decrease pizza to 1-2 slices at a time and eat less frequently
  - Limit sweets to a small serving no more than once per week
  - Eat more vegetables (carrots and cucumber). Have a fruit after dinner instead of cereal or skip snack at night
  - Walk around campus while in summer school during the break

Summary

- The pediatric RD is an important part of the transplant team for the nutritional management of the pre- and post- kidney transplant pediatric patient
- It’s important to understand the short and long term complications for post-kidney transplant pediatric recipients in order to provide optimal nutrition intervention and guidance
References

- CSMC Comprehensive Transplant Center- Policies & Procedures Manual

References

- [www.kidney.org](http://www.kidney.org) (The National Kidney Foundation/KDOQI guidelines)
- [www.TransplantLiving.org](http://www.TransplantLiving.org)