Prophylactic Enteral Nutrition Support in Pediatric Blood & Marrow Transplant

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Learning Objectives
Upon completion of this educational activity, the learner will be able to:
1. Identify common indicators for pediatric transplant and typical admission timeline.
2. Reference pediatric transplant nutrition needs.
3. Identify indications for and barriers to both enteral and parenteral nutrition during transplant admissions.
4. Identify benefits of enteral nutrition during transplant.
5. Follow implementation of nutrition support pathway during transplant.

Disclosure
No commercial disclosures to identify.

Abbreviations
- HSCT = hematopoietic stem cell transplant
- aGvHD = acute graft versus host disease
- EN and PN = enteral and parenteral nutrition
Pediatric Blood & Marrow Transplant Admission Overview

Pediatric Transplant Overview

Types
- Graft type – marrow, peripheral blood stem cell, cord
- Donor type
  - Autologous – from self
  - Allogenic – from donor
    - MUD – matched unrelated
    - MSD – matched sibling
    - HAPLO – half matched HLA donor
- Emerging therapies - CAR-T, gene therapy

Indications
- Hematologic and solid malignancies
  - Leukemias and lymphomas
  - Brain cancers
- Disorders of hematopoiesis (nonmalignant)
  - Diamond Blackfan Anemia
  - Severe Aplastic Anemia
  - Fanconi’s Anemia
- Immune/genetic disorders
  - Sickle Cell disease
  - HLH - hemophagocytic lymphohistiocytosis
  - SCID - severe combined immunodeficiency disorder
  - Wiscott Aldrich

What cell types is the bone marrow responsible for making?
A.) White Blood Cells
B.) Red Blood Cells
C.) Platelets
D.) All of the above

What is the primary role of white blood cells?
DEFENSE!
Transplant Timeline

- **D-10 – D-5**: Common admission
- **D+1**: EN initiation recommendations
- **D+14 – D+21**: Avg engraftment allo
- **D0**: Transplant day
- **D+10 – D+12**: Avg engraftment auto
- **D+30**: Discharge goal, decreased risk of acute complications

Transplant Diet

- Varies amongst institutions
- Names = Neutropenic, “antimicrobial”, “low microbial”, “food safety”

<table>
<thead>
<tr>
<th>Commonalities</th>
<th>Discrepancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow CDC guidelines for safe food cooking and handling</td>
<td>Fresh fruits and vegetables</td>
</tr>
<tr>
<td>No unpasteurized/raw products (juices, milks, honey)</td>
<td>Home prepared meals</td>
</tr>
<tr>
<td>Avoid food sharing</td>
<td>Outside retail foods</td>
</tr>
<tr>
<td>Duration</td>
<td></td>
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</tbody>
</table>

Transplant treatments and common nutrition implications

- **Prep Regimen - chemotherapy**
  - Nausea, vomiting, mucositis, diarrhea, anorexia, dysgeusia, metabolic disturbances
- **Prep Regimen – irradiation “TBI”**
  - Diarrhea, dysgeusia, anorexia
- **Calcineurin inhibitors**
  - Renal electrolyte wasting, nausea, vomiting, decreased gut motility, dysgeusia

Common transplant complications with nutrition implications

- **Infection**
  - Decreased oral intakes, electrolyte abnormalities, GI complications secondary to treatments
- **Acute Graft vs Host – liver, gastrointestinal**
  - Nausea, vomiting, abdominal pain, diarrhea, elevated blood glucose levels secondary to treatment
- **Sinusoidal Obstruction Syndrome (SOS)**
  - Hepatic injury, fluid retention, blood chemistry abnormalities
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Prolonged hospital admission  
Restrictive diet  
Prep regimen with GI toxicities  
Acute complications and their treatments

Malnutrition  
decreased oral intakes, decline in BMI / MUAC z score, weight loss, physical assessment changes

Adverse outcomes:
- Admission duration, engraftment
- Functional status
- Morbidity/mortality

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What percent of pediatric HSCT patients are considered to have suboptimal nutrition prior to transplant?
A.) < 25%  
B.) 25 – 50%  
C.) 50 - 75%  
D.) > 75%

Source: White, M et al 2005

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Estimating Needs

Varies amongst intuitions but generally does include increased calorie and protein needs.

<table>
<thead>
<tr>
<th>Energy</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 mnths</td>
<td>WHO x 1.6-1.8</td>
</tr>
<tr>
<td>1-6 yrs</td>
<td>WHO x 1.4-1.6</td>
</tr>
<tr>
<td>7-10 yrs</td>
<td>WHO x 1.5-1.6</td>
</tr>
<tr>
<td>11-14 yrs</td>
<td>WHO x 1.3-1.5 or 25-30 kcal/kg</td>
</tr>
<tr>
<td>15-18 yrs</td>
<td>BMR x 1.5-1.6</td>
</tr>
<tr>
<td>Adults</td>
<td>BMR x 1.3-1.5 or 25-30 kcal/kg</td>
</tr>
</tbody>
</table>

Sources:
1. Oncology Nutrition for Clinical Practice 2nd Edition 2021

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Nutrition Support During Transplant
Enteral nutrition indications

- First line of nutrition support in transplant patients when oral is not tolerated – ASPEN, ESPN, EBMT
  - Oral intakes < 60-70% of estimated energy needs for > 3 days
- CONTRAINDICATIONS: unsafe placement (ex. "neutropenic", active/open sores)
  - Guidelines vary by institution for nasogastric, nasointestinal, and gastrostomy tube placement
  - Gastrostomy tube placement limited opportunity related to healing time required

Enteral nutrition risks vs benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased risk infection</td>
<td>Can exacerbate nausea/vomiting, diarrhea</td>
</tr>
<tr>
<td>Gastric/intestinal motility</td>
<td>Degree of absorption unknown (nausea/vomiting, diarrhea)</td>
</tr>
<tr>
<td>Maintenance of mucosal gut integrity and barrier</td>
<td>Loss of tube</td>
</tr>
<tr>
<td>Stimulus of mucosal repair</td>
<td>Epistaxis in thrombocytopenia</td>
</tr>
<tr>
<td>Decreased risk of hyperglycemia</td>
<td>Parent/family/patient concern</td>
</tr>
<tr>
<td>Gut microbiome and graft vs host disease</td>
<td>Discomfort</td>
</tr>
<tr>
<td>Decreased cost compared to PN</td>
<td>Source: varied, see reference slide</td>
</tr>
</tbody>
</table>

Parenteral nutrition indications

- Intractable vomiting
- High volume lose stool output > 1 liter per day (or body weight based)
- Ileus
- Malabsorption
- Symptomatic acute gastrointestinal graft verses host disease
- Mucositis > grade 3
- Inability to safely place NGT/NIT

Parenteral nutrition risks vs benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal rest, unlikely to exacerbate nausea/vomiting</td>
<td>Central blood stream infection in an immunocompromised population</td>
</tr>
<tr>
<td>Electrolyte provision, modification</td>
<td>Hyperglycaemia</td>
</tr>
<tr>
<td>Malabsorption not related</td>
<td>Volume overload</td>
</tr>
<tr>
<td>Hepatic dysfunction</td>
<td>Hepatic dysfunction</td>
</tr>
<tr>
<td>Gut mucosal atrophy without trophic feeds</td>
<td>Gut mucosal atrophy without trophic feeds</td>
</tr>
<tr>
<td>Delayed platelet engraftment</td>
<td>Source: varied, see reference slide</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
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Research

- Two pediatric HSCT studies comparing EN to PN -
  - Lower incidence of grade III-IV aGvHD
  - Faster platelet engraftment
  - Lower mortality rate and non-relapse mortality rate (one study)
- One ped and adult HSCT meta-analysis – lower incidence rate of aGvHD, grade III-IV aGvHD, intestinal aGvHD
- Pediatric oncology study & adult HSCT study - EN acts with a trophic effect of mucosa, maintaining gut barrier function and reducing bacterial translocation
- Pediatric HSCT study – statistically significant lower rates of sinusoidal obstruction syndrome
- Adult HSCT study - EN lower rate of ICU transfers, pediatric ICU study – improved survival
- Adult HSCT study – EN associated with more rapid neutrophil engraftment
- Multiple pediatric HSCT studies – EN associated with shorter hospital duration in comparison to requirement of parenteral nutrition
- One pediatric HSCT study – PEG placement beneficial association with transplant related mortality, 5yr overall survival
- Gut microbiome diversity faster return to pre-transplant baseline for EN over PN populations

Research cont.

- A 2019 American Society for Transplantation and Cellular Therapy systematic review comparing EN & PN in pediatric HSCT studies found no statistically significant difference in …
  - Weight change >10%
  - BMI z score
  - MUAC z score
  - Hypoalbuminemia
  - Hypophosphatemia
  - Septicemia, viremia, positive blood cultures, mucositis
  - Time to neutrophil engraftment
  - Day 100 overall survival
  - Day 100 non-relapse mortality

Steps towards policy change

- RD staffing for appropriate medical nutrition therapy provision
  - Inpatient vs outpatient coverage
  - Full time vs part time coverage
- Journal club article discussion
- Interdisciplinary team meeting – team members: division chief, physicians, advanced practice providers, nurse clinical coordinator and/or manager, dietitian
  - Review of current literature
  - Team vote
  - Policy development
  - Task force to monitor
Policy Development

Considerations:

- Duration
  - Tube placement day
  - Enteral nutrition start day
  - End day
- Type tube
- Type of formula
- Initiation and advancement of enteral nutrition
- How/when to include with parenteral nutrition when needed into policy
- Enteral nutrition weaning off versus to a home feed plan
- Education - how/when to address with patients/families
- Dietitian outpatient follow up/monitoring abilities

Enteral Nutrition Decision Tree: Part 1

- Pre-transplant RD initial Assessment
  - Autologous
    - Nourished = oral diet
    - Malnourished = NIT placement
  - Allogeneic
    - Nourished or malnourished = NIT Placement

Enteral Nutrition Decision Tree: Part 2

- NIT placed – during sedated procedure on first day of admission with central line placement
  - Admit through D-1
    - If PO intakes <75% of estimated needs and/or GI symptoms reported
    - Initiate trickle feeds @10-20ml/hr (weight dependent)
  - D 0 = nutrition rest day (no advancement or starting)
  - D+1 initiates trickle feeds @10-20ml/hr (weight dependent)
  - Advance as tolerated based on intakes documentation and reported symptoms

Formula choice = Semi-elemental
Nutrition Monitoring

1. Full initial assessment – assess degree of malnutrition
   • Automatic consults?
   • Within specific duration of admit, ex. 24-48 hours?
   • Include protocol guidelines in initial assessment documentation
2. Monitoring per hospital clinical nutrition team protocol
3. Discharge Education – include documentation
   • Handoff as appropriate

Assessing policy implementation

Recommend a before and after study of implementation of protocol comparing:

- Malnutrition diagnosis at time of admission and discharge
- Hospital admit duration in days
- Duration of days using both enteral and parenteral nutrition
- Rates of blood stream infections
- Rates of acute graft verses host disease

Microbiome – independent study

“Food” for thought - post transplant admission

- Post transplant admission, patient population remains highly susceptible to various complications including infection and chronic GvHD.
- Long term post transplant complications may be associated with weight loss and malnutrition.
- Parenteral nutrition is not a preferred home nutrition plan related to infection risk.
- Possibility for continued restricted diet pending institutional practices.
- Enteral tube placement during transplant admission and discharge with a home EN plan has the possibility of preventing chronic malnutrition in outpatient setting.

“Nutrition is an important part of the transplant process!”

Thank you!
References


References Cont.


Icons

To change the color, double-click on an icon and choose a new color from the ASPEN palette on the previous slide.

Icons Lists

1. Numbered text. Current references to support your overall presentation
