Initiation of Diets: Inpatient & Outpatient

Epilepsy & Brain Mapping Program, Huntington Memorial Hospital, Pasadena CA

Danine Mele-Hayes, RD
<table>
<thead>
<tr>
<th>History of KD initiation</th>
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<tbody>
<tr>
<td><strong>Early Initiation</strong></td>
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<tr>
<td>(Wilder 1921)</td>
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<tr>
<td><strong>Fasting Protocol</strong></td>
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<tr>
<td>(Livingston 1954; 1972; Freeman et al 1996)</td>
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<tr>
<td><strong>Gradual Non-fasting Protocol</strong></td>
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<td>(Bergqvist et al 2005)</td>
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Early Fasting Protocol
(Livingston 1954; 1972; Freeman et al 1996).

24-48 hour Fast

Fluid Restriction

1/3 calories First Day

2/3 calories Second Day

4:1 Ratio

Full Calories Three Day
Pre-diet Assessment

- Screen for inborn errors of metabolism
- Screen for diet contraindications
- Keto Blood Work
- Diet History/Diet Analysis
- Reduce carbohydrates from medications and supplements
Non-Fasting Initiation Protocols


**3-5 Day Admission**

- No Fluid Restriction
- Eggnog or Keto Shake
- Goal Ratio and Calories Reached
- Calculated Meals
- Parent Education
Initiation Orders

- Pre-diet labs (If not done prior)
- Vital signs q shift (during waking hours)
- Weight & Height upon admission; daily weights
- Urine ketones and Urine Specific gravity q void
- Accuchecks q 2 hours if infants, after 24 hrs q 4 hrs if no hypoglycemia
- Accuchecks q 4 hours if > 1 years old
- Labs:
  - Day 2: Electrolytes & Fasting Blood Sugar
  - Day 3: Electrolytes, Fasting Blood Sugar, Fasting Lipid Panel, BHB
- Seizure precautions
<table>
<thead>
<tr>
<th>Day 1</th>
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<tbody>
<tr>
<td>• Ketogenic Shake @2.0:1 ratio offered six times per day with goal calories and fluids</td>
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<tr>
<td>Day 2</td>
</tr>
<tr>
<td>• 3 meals &amp; bedtime snack @ 3.0:1 ratio with goal calories and fluids</td>
</tr>
<tr>
<td>Day 3</td>
</tr>
<tr>
<td>• Arbitrary goal ratio is reached. Discharge after lunch if normoglycemia and diet tolerance established and urinary ketones are positive</td>
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</table>
Monitoring KD Initiation

**Goals**

**Urine Ketones:** 80-160 mg/dl

**Blood Ketones:**
- Beta-hydroxybutyrate: 4-10 mmol/L

**Urine Specific Gravity:** 1.010-1.020

**Blood Glucose**
- Accucheks q 2-4 hours: 50-80 mg/dl (non-fasting)

**Acid-base balance**
- Electrolytes: HCO3 ≥18 mEq/L
Treating Diet Intolerance: Nausea and Emesis

- Correct Hypoglycemia
- Correct acidosis
- Correct excessive ketosis
- Give six (6) small feedings
- Separate medication and meal time
Prevention of Dehydration

Adhere to fluid schedule

Maintain Urine Specific Gravity 1.010 -1.020

If dehydration occurs, USG≥1.030
  • Give IV bolus of .9NS if needed
Monitor Blood Ketone Levels

Betahydroxbutyrate (BHB)
- Levels 4-10 mmol/L
- Monitor during initiation and outpatient clinic

Useful in assessing dietary compliance/tolerance for fine tuning the diet
- Diet intolerance, acidosis, dehydration may occur with levels >6 mmol/L.

Treatment for excessive ketosis
- Increase fluids and/or give 15 ml of apple juice. May need to lower ratio.

Treatment of Acidosis

Give 100% Maintenance Fluids plus up to 20% more
Treatment of Acidosis

Give 100% Maintenance Fluids plus up to 20% more

**Bicarbonate:**
- 0.5-2.0 mEq/kg

**Phosphorous:**
- About 50% DRI
- Dosage based on age

**Potassium:**
- ≤ 30% DRI

**Baking Soda**
- (54.7 mEq Bicarbonate/tsp)
- Mix with at least 120 ml of water (NOT FORMULA) give 2-3 times per day.

**Dosage based on age**

**Morton’s lite Salt**
- May be sprinkled on food or mixed with formula.

**Give 3-4 times per day.** (longer acting buffer)
Outpatient Initiation Protocol

Duration 3-4 weeks

Start at 0.5:1 or 1.0:1 Ratio

Advance ratio every week

Start with Goal Calories

No Fluid Restriction

Labs obtained after one week of 2:1 Ratio

Ratio not advance if seizure control is achieved.
Outpatient KD Training

Food Preparation (Weighing techniques)

Ketodietcalculator™

Monitoring Ketones/hypoglycemia

Vitamins/Minerals

Sick days

Fluids
## Outpatient Initiation: (Low and Slow method)

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
</tr>
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<tbody>
<tr>
<td>1.0:1 Ratio</td>
<td>2.0:1 Ratio</td>
<td>3.0:1 Ratio</td>
<td>Ratio advanced based on seizure control and diet tolerance</td>
</tr>
<tr>
<td>Calculated meal plans at goal calories and fluids</td>
<td>Blood Work at the end of week 2</td>
<td>Additional Supplements as needed</td>
<td></td>
</tr>
<tr>
<td>Start Vitamins/Minerals</td>
<td></td>
<td></td>
<td>Children &gt;2 years old</td>
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</table>
### Initiation Diet: Infant/ Toddlers & Enteral Fed Patients

<table>
<thead>
<tr>
<th>Week</th>
<th>Ratio</th>
<th>Goal Calories &amp; Fluids</th>
<th>Keto Formula &amp; Baby/Enteral Formula</th>
<th>Start Vitamins/Minerals</th>
<th>Goal Calories/Fluids</th>
<th>Keto Formula &amp; CHO/Protein Source</th>
<th>Blood Work at the end of this week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>0.5:1 Ratio</td>
<td>Goal Calories &amp; Fluids</td>
<td>Keto Formula &amp; Baby/Enteral Formula</td>
<td>Start Vitamins/Minerals</td>
<td>Goal Calories/Fluids</td>
<td>Keto Formula &amp; CHO/Protein Source</td>
<td>Blood Work at the end of this week</td>
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<tr>
<td>Week 2</td>
<td>1.0:1 Ratio</td>
<td>Goal Calories &amp; Fluids</td>
<td>Keto Formula &amp; Baby/Enteral Formula</td>
<td>Start Vitamins/Minerals</td>
<td>Goal Calories/Fluids</td>
<td>Keto Formula &amp; CHO/Protein Source</td>
<td>Blood Work at the end of this week</td>
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<tr>
<td>Week 3</td>
<td>1.5:1 Ratio</td>
<td>Goal Calories &amp; Fluids</td>
<td>Keto Formula &amp; Baby/Enteral Formula</td>
<td>Start Vitamins/Minerals</td>
<td>Goal Calories/Fluids</td>
<td>Keto Formula &amp; CHO/Protein Source</td>
<td>Blood Work at the end of this week</td>
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<tr>
<td>Week 4</td>
<td>2.0:1 Ratio</td>
<td>Goal Calories &amp; Fluids</td>
<td>Keto Formula &amp; Baby/Enteral Formula</td>
<td>Start Vitamins/Minerals</td>
<td>Goal Calories/Fluids</td>
<td>Keto Formula &amp; CHO/Protein Source</td>
<td>Blood Work at the end of this week</td>
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Outpatient Monitoring

**Daily**
- Urine Ketones 1-2 times per day for one month
- Bowel Movement
- Seizure Log

**Week**
- Blood Work after one week of 2:1 Ratio
- Phone or Office Visit RD and/or Nurse
- Weekly weight

**Month**
- Office follow up in one-month then every 3 mths
- Blood Work after first month & every 3 mths thereafter for first year
## Advantages for Dietitian and Patient

<table>
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<tr>
<th>Dietitian</th>
<th>Patient/Family</th>
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<tr>
<td>More than one initiation per month</td>
<td>Longer diet adjustment</td>
</tr>
<tr>
<td>Better time management</td>
<td>More variety of food options</td>
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<tr>
<td>Develop more palatable meals</td>
<td>Home environment</td>
</tr>
<tr>
<td>KD education prior to initiation</td>
<td>Parents work schedule not altered</td>
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</tbody>
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Case Study

10 year old female with medical history of Epilepsy ( >20 seizure per day), Cerebral Palsy, Gastrostomy Tube
Baseline Weight and Height

- Weight 46 lbs (20.865 kg)
- Percentile: 10-50% Weight for Age
  ▫ Based on CP Group 5 for girls 2-20 years old
- Height 114.3 cm (45 in)
- Percentile: 10-50% Height for Age
  ▫ Based on CP Group for girls 2-20 years old
Diet History

- Formula: Boost Kids Essential 1.5
- Regimen: Continues feeding full strength at 60 ml per hour for 15.5 hours per day
- Total Calories: 950 kcals per day
- Total fluids per day: 1008 ml of free water
- Supplements:
  - 50 mg Vitamin B6 per day
  - D-Vi-Sol 1 ml per day
Estimated Nutritional Needs

- 1080 calories per day (50 kcals/kg BW)
- 21-25 grams Protein per day (1.0-1.2 g Pro/kg BW)
- Recommended fluids: 1500 plus 20 (wt-20) mL/day = 1518 mL : Source; Holiday-Segar Method
Initiation of KD (STEP 1)

- 240 ml of Boost Kids Essentials
- 474 ml of KetoCal Liquid 4:1 Ratio
- 240 ml of water
- Run at 60 ml per hour for 18 hours
- Flush 120 ml (4 oz) of water after formula finishes
- 20-30 ml of water for medication
- Continue for 1 week if tolerated

Provide 1052 kcals, 1400 ml Fluids, 1:1 Ratio 81.98 g FAT, 29.74 g Pro, 48.67 CHO
Initiation of KD (STEP 2)

- 160 ml of Boost Essential for Kids 1.5
- 570 ml of KetoCal 4:1 Ratio LQ
- 360 ml of Water
- Run pump at 60 ml for 18 hours
- Flush 120 ml of water after formula finishes
- 20-30 ml of water for medication
- Continue for 1 week if tolerated

1080 kcals, 1400 ml fluids 1.5:1 Ratio, 92.37 g FAT, 27.8 gPro, 34.37 g CHO
Supplements started on (STEP 2)

• 1/2 tablet of Centrum Multivitamin per day.
• 1 tablet of Nature Made 600mg Calcium and 400 IU Vitamin D
• 50 mg Vitamin B6 1 tablet per day
• 2 ml of Levocarnitine three times per day.
• 1/4 teaspoon of Morton's Lite Salt per day (mix into the formula)
Initiation of KD (STEP3)

- 100ml of Boost Essential for Kids 1.5
- 630 ml of KetoCal 4:1 Ratio LQ
- 360 ml of Water
- Run pump at 60 ml for 18 hours
- Flush 120 ml of water after formula finishes
- 20-30 ml of water for medication
- Continue for 1 week if tolerated

1078 kcals, 1400 ml fluids 2.0:1 Ratio, 98.12 g FAT, 25.8 g Pro, 23.14 g CHO
Assessment & Labs one week after 2:1 Ratio

- KD follow up labs unremarkable
- BHB 3.08 mmol/L
- 50% improvement in seizures less than 10 years per day
- Lipid Panel WNL
- Liver Function WNL
Fine-tuning KD (STEP 4)

• 76 ml Prune Juice Sunsweet Light
• 707 ml KetoCal 4:1 LQ
• 300 ml Water
• Run pump at 60 ml for 18 hours
• Flush 120 ml of water after formula finishes
• 20-30 ml of water for medication
• Continue for 1 week if tolerated

1078 kcals, 1400 ml fluids 3.0:1 Ratio, 104.71 g FAT, 22.16 g Pro, 12.52 g CHO
## Conclusion

<table>
<thead>
<tr>
<th>Inpatient Initiation</th>
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<tr>
<td>Most Common Method</td>
<td>Evolving New Method</td>
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<tr>
<td>3-5 days admission</td>
<td>3-4 weeks initiation</td>
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<tr>
<td>Rapid transition to ketosis</td>
<td>Slower transition to ketosis</td>
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<tr>
<td>Use an arbitrary goal ratio which may be too high</td>
<td>Seizure control can be achieved with lowest ratio</td>
</tr>
<tr>
<td>Diet adjustments every 18-24 hours</td>
<td>Diet adjustments 7-14 days</td>
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<tr>
<td>Limited food available in the hospital</td>
<td>Variety of foods available at home</td>
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<tr>
<td>Acute metabolic fluctuations may occur</td>
<td>Less occurrence and severity of metabolic fluctuations</td>
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