

Options for non-surgical candidates: Ketogenic Diet

Dr Krisnachai Chomtho MD DCH MRCPCH
Lecturer in pediatric neurology
King Chulalongkorn Memorial Hospital

Ketogenic diet (KD)

- High fat
- Adequate protein
- Low carbohydrate
- Calorie control

- Therapeutic diet for epilepsy
- As effective as an AED or VNS

Optimal use of KD

- International Ketogenic Diet Study Group
- 26 ped epileptologists & dietitian (9 countries)
- Consensus statement (2008)
- More standardized protocol

Practical approach

- Case selection
- Pre-KD evaluation
- Ketosis induction
- Effectiveness evaluation
- Maintenance & F/U
- KD discontinuation

Particular benefit in

- GLUT-1 deficiency
- Pyruvate dehydrogenase deficiency (PDHD)
- Myoclonic-astatic epilepsy
- Tuberous sclerosis complex
- Rett syndrome
- Dravet syndrome
- Infantile spasms
- infants or enterally fed patients

Suggestion of benefit in

- Selected mitochondrial disorders (complex I)
- Glycogenosis type V
- Landau-Kleffner syndrome
- Lafora body disease
- SSPE

Absolute Contraindication

- Carnitine deficiency (primary)
- Carnitine palmitoyltransferase (CPT) I or II deficiency
- Carnitine translocase deficiency
- β -oxidation defects
- MCAD/ LCAD/ SCAD

Absolute Contraindication

- Long-chain 3-hydroxyacyl-CoA deficiency
- Medium-chain 3-hydroxyacyl-CoA deficiency.
- Pyruvate carboxylase deficiency
- Porphyria

Relative Contraindication

- Inability to maintain adequate nutrition
- Surgical focus
- Caregiver noncompliance

Committee conclusions

KD should be strongly considered in

- A child after failed 2/3 AEDs
- regardless of age / gender
- symptomatic generalized epilepsies
- sooner in GLUT1, PDHD and Dravet, infantile spasms, Doose, TSC
- Probably, but limited benefit in surgical case

Pre-KD evaluation

- Counseling
- Nutritional evaluation
- Lab evaluation
- Optional tests

Counseling

- Seizure reduction, medication
- Cognitive expectations
- Psychosocial barriers to KD
- Review drugs for CHO content
- Parent-oriented KD information

Nutritional evaluation

- Baseline Wt, Ht, and BMI
- Nutrition intake history
- Establish diet formulation/ route
- Formula selection
(LCT/ MCT/ mod Atkins/ low GI)
- Calculation of calories, fluid, and KD ratio
- Nutritional supplements
(Ca, MTV, trace element)

Available formulas

- Classical formula (LCT)
 - MCT formula
 - Modified Atkins
 - Low glycemic index (LGI)
- Diet route
- Bottle feed / normal food / tube feed

Classical KD

- Widely used
- 4: 1 ratio of fat: protein - carbohydrate
- Main fat source = LCT
- Adequate protein > 1 g/kg
- Low carb - just to prevent hypoglycemia
- Calorie control = 75 - 100% requirement
- Fluid restriction - not necessary

MCT KD

- Increasingly used
 - Better ketosis from MCT
 - 30% (modified MCT) fat: total energy to 60% (classical MCT)
 - More carbohydrate allowance
 - Less restrictive, bigger meal
 - Similar efficacy
- MCT can't be cooked → not palatable

Modified Atkins

- Similar composition to classical KD
 - 1: 1 ketogenic ratio
 - Restrict carbohydrate
 - No limit on protein, fluids, and calories
 - Easier meal planning
- Preliminary effective

Low GI

- Less fat than KD
 - More carbohydrate 40–60 g/day
 - CHO type → low glycemic index <50
 - e.g.lentils, grapefruit, whole grain bread
- Less ketone level than KD
- Still preliminary effective

Lab evaluation

- CBC
- Electrolytes, Ca, PO₄, Mg, Zn, (Se)
- LFT, BUN, Cr
- Fasting lipid profile
- Urinalysis
- Urine calcium / creatinine

Additional recommendation

- AED levels
- Serum acylcarnitine profile
- Urine organic acids
- Serum amino acids

Optional tests

- EEG
- MRI
- Renal ultrasound (if HX of kidney stones)
- CSF (if unclear etiology)
- EKG (& echo) if Hx of heart disease

Committee conclusions

- Several prerequisites for safety & success
- Comparable efficacy of MCT & LCT
- Chosen on dietary needs and habits
- Preliminary evidence for mod Atkins , LGIT
- No negative effect with AED, VNS

Ketosis induction

- Rapid induction
 - fasting (12 h - whenever ketosis)
 - admission required
 - risk of dehydration, glucose, acidosis
- diet titrating up to the target ratio
- caregiver training during admission

Ketosis induction

- Gradual initiation
 - without fasting
 - admission = optional
 - slower but comparable Sz control at 3 m
 - lower initial side effect

Maintenance phase

- 1st month visit, then 3 monthly
- tolerance, palatability, bowel habits
- height, weight, head circumference
- seizure control
- urinary ketone
- Blood tests
- Adverse effects

- Efficacy evaluation after 3 month

Early side effects

- Dehydration (if initially fast)
- GI symptoms: N/V, diarrhea
- Hyperlipidaemia
- Hyperuricaemia
- HypoCa, HypoMg
- Metabolic acidosis

* Most are transient

Late side effects

- Osteopenia
- Renal stones
- Low carnitine
- Fe deficiency anaemia
- Cardiomyopathy (rare)

* Lipoid pneumonia, hepatitis, pancreatitis were reported

Committee conclusions

- MTV, mineral supplements recommended
- Citrate - prevents kidney stones
- 3 monthly Visits with ready access
- Rare serious effects, mostly no need to discontinued KD

Discontinuation

- Sudden diet cessation → aggravate Sz
- Sudden glucose intake → aggravate Sz
- Diet maintenance - 2 years if effective
- Slow weaning over 2-3 months

- overall recurrence risk - 20%
- Higher in TSC, abnormal EEG, MRI,

Committee conclusions

- discontinue the KD after
- 3 months if unsuccessful
- 2 years if completely successful
- longer as necessary for GLUT-1, PDHD

- Prior EEG, clinical review recommended

CU experience

- LCT KD & (modified) MCT KD
- CU protocol & KD booklet
- Ped neuro & ped nutrition
- Admit for rapid induction 7 d
- Direct access for dietary/ neurology advice
- Retrospective LCT study
- Ongoing prospective controlled MCT trial

CU LCT KD

- 14 cases
- age 6m-12 y, all intractable on 3-4 AEDs
- Mean Sz frequency 0.5 - 40 /d
- < 50% Sz reduction = 30% - stop KD
- >50% Sz reduction = 70%
- Sz free = 20%
- 6/11 (54%) drop-out (diet difficulty)
- 3/6 cases switched to MCT& continued so far

CU MCT KD

- 13 cases
- age 6m-16 y, all intractable on 3-4 AEDs
- Mean Sz frequency 0.64 - 49.14 /d
- Statistically Sz reduction in all
- >50% Sz reduction = 61.5%
- 38.5% Sz free
- 1 (7.6%) drop-out (diarrhea at 2 wk)
- 23% continued > 2 years so far

Thank you for
your attention