MATTHEW'S FRIENDS

The Ketogenic Diet
A Brighter Future for Childhood Epilepsy

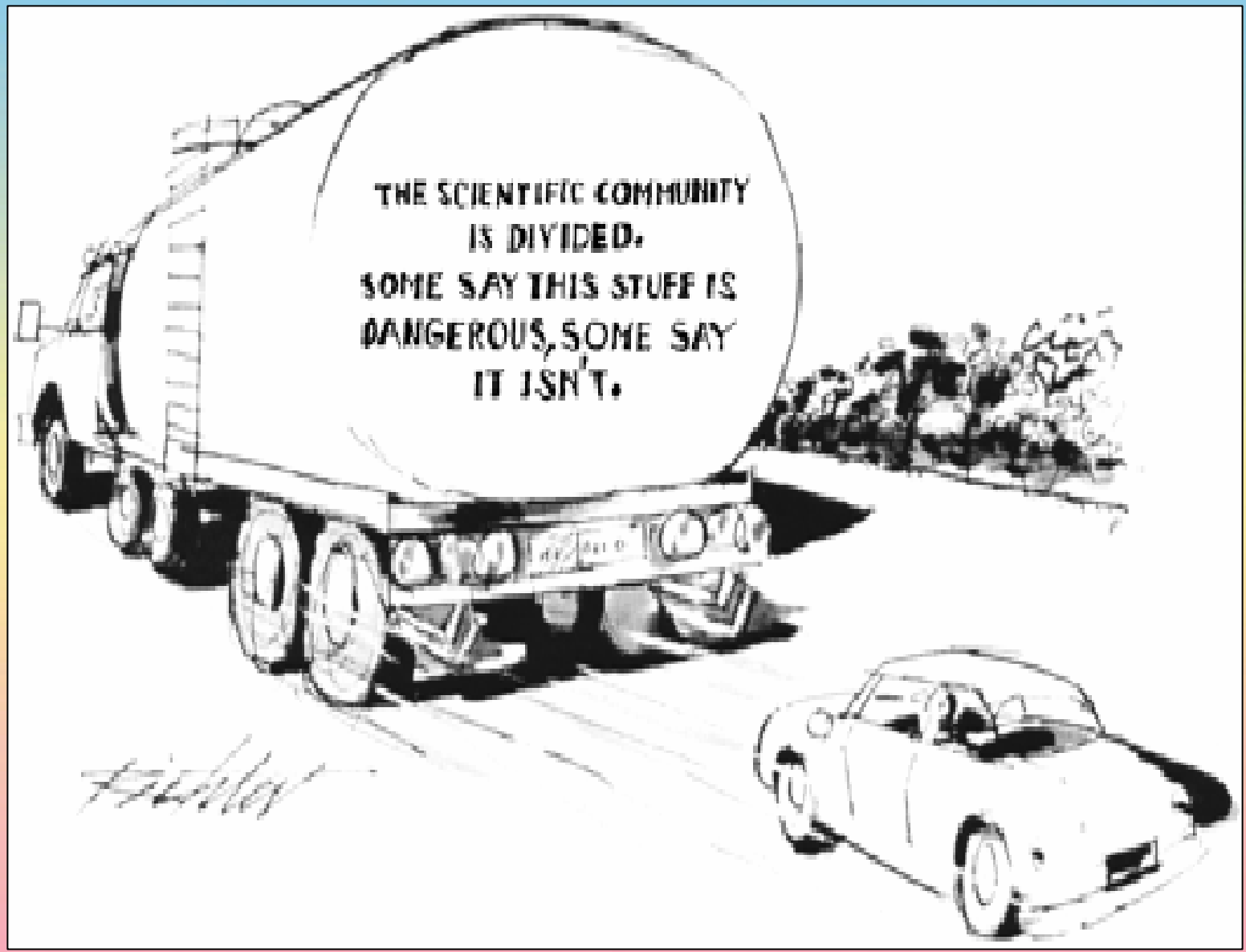
The Ketogenic Diet
An Overview

Ruby Schwartz
Department of Paediatrics
Central Middlesex Hospital
July 2005

What is the ketogenic diet?

A therapeutic diet

High fat, low protein and low carbohydrate diet, with calorie control


THE SCIENTIFIC COMMUNITY
IS DIVIDED.
SOME SAY THIS STUFF IS
DANGEROUS, SOME SAY
IT ISN'T.

History

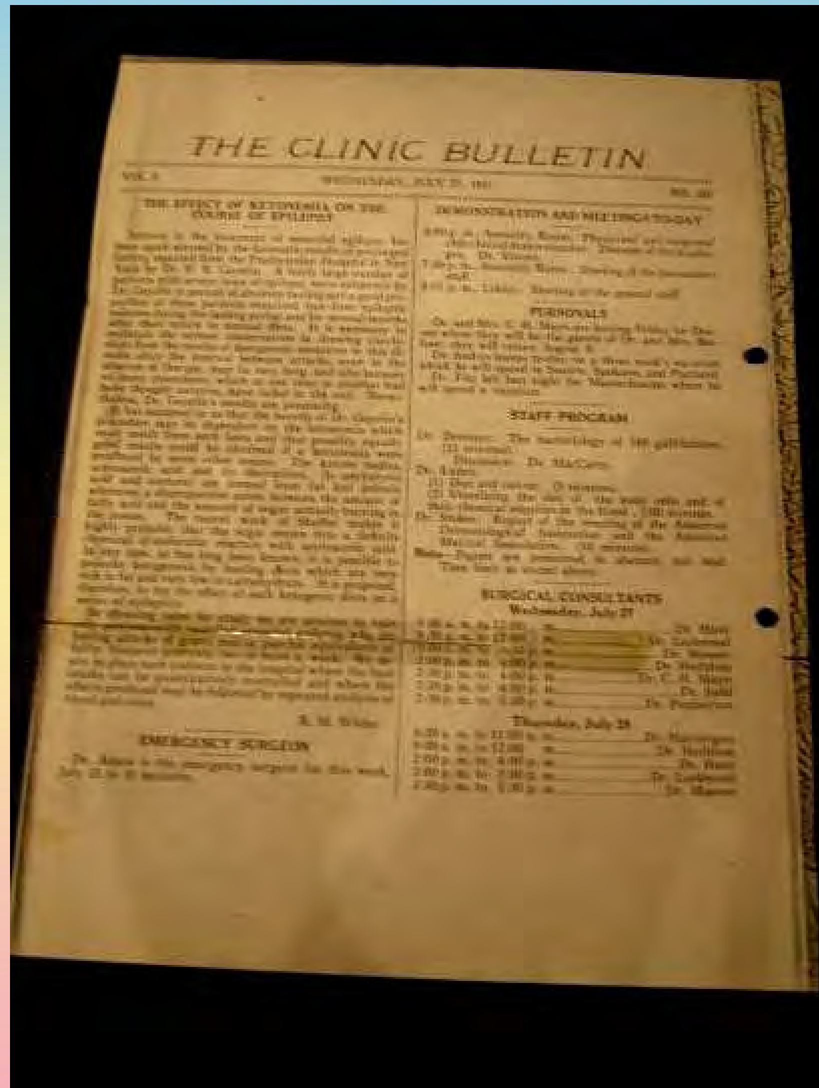
- ? Known since Biblical times

And he said unto them, this kind can come forth by nothing, but by prayer and fasting

St Mark 9:14 - 29

History

- ? Known since Biblical times
- Initiated in the 1920s



THE CLINIC BULLETIN

THE EFFECT OF KETONEMIA ON THE COURSE OF EPILEPSY

DEMONSTRATION AND MEETINGS TODAY

PERSONALS

STAFF PROGRAM

SURGICAL CONSULTANTS

Wednesday, July 27

Thursday, July 28

EMERGENCY SURGEON

History

- ? Known since Biblical times
- Initiated in the 1920s
- 1970s MCT diet introduced

1920s – 1980s

- Advent of new anti epileptic medications
  - Phenytoin 1938
  - Carbamazepine 1972
  - Sodium valproate 1974
  - Clonazepam 1974
  - Clobazam 1979

History

- ? Known since Biblical times
- Initiated in the 1920s
- 1970s MCT diet introduced
- 1990s resurgence of interest

Indications for diet

- Epilepsy
- Metabolic disorders

  e.g.Type-1 glucose transporter(GLUT1) deficiency syndrome
- Other

  e.g. SSPE

Indications in Epilepsy

- Intractable epilepsy uncontrolled by the use of conventional drugs
- Controlled epilepsy but patient suffering side effects of medication
- Parents against drug therapy

Age of Patient

- Majority of patients taking ketogenic diet in UK are between 2 and 12 years
- Diet has been shown to control infantile spasms and to be safe in children 5 months to two years (Kossoff et al., Pediatrics 2002 May;109(5):780-3)
- Adolescents – also tolerate diet (Mady MA et al., Epilepsia. 2003 Jun;44(6):847-51)

Patient selection

- Undertaken by medical staff together with family and dietician
- Depends on diagnosis, seizure type, age and Associated problems

The diet is not suitable for all children

Who treats and who supports?

- Local hospital / regional centre

Depends on knowledge and availability

Pre-diet checks – Clinical

- Has the child got epilepsy?
- Seizure frequency
- Medication taken
- Is there a pre-existing metabolic problem?
- Baseline metabolic studies
- Baseline EEG
- Ultrasound renal tract: is it required?
- Has the child any other problems?

Dietary assessments

- What does the child eat?
- Are there any food fads?
- Are there any allergies?
- Who prepares the food?
- Is the food home cooked or purchased?
- Are packed lunches required?
- Will school or respite prepare the food?

Dietary assessment 2

- Are there any ethnic dietary considerations?
- Are there any financial considerations?
- Does the diet suit the family lifestyle?
- Is any special equipment required?
- Does the family understand the rigidity of the diet?

How is the diet to be given?

- Bottle feed
- Normal food
- Gastrostomy or tube feed

Social Aspects

- Who cares for the child?
- Does the child go to school, nursery or respite care?
- Is the child in residential care?
- Are the parents, carers, teachers and other family members in favour of trying a diet?
- Does the child understand about the diet?

Which diet?

- Classical diet
- MCT diet
- Modified MCT diet
- Polyunsaturated diet

Prescriptions

- Are drugs sugar free
- Have vitamin and mineral supplements been prescribed
- Is monitoring equipment available

When to start?

- Family happy
- Medications changed
- Support in place

When no to start

- Child acutely unwell
- Prior to change of school, move or before holiday
- Over Christmas or when backup not available

Initiation of the Diet

- Home
- Hospital
- Is fasting necessary

Monitoring dietary therapy

- Seizure frequency
- Overall wellbeing
- Psychological educational and developmental effects
- Biochemistry

When should anti-epileptic drugs be reduced?

- Early
- Late
- If drowsiness occurs or child unsteady, consider reducing drugs early.

Duration of diet

- Trial for up to 3 months and discontinue if not producing improvement
- If beneficial, continue for minimum of two years
- Many parents will continue for longer particularly if medication has been reduced or discontinued

Early side effects

- Dehydration (particularly if initial fast)
- Nausea/vomiting, diarrhoea, constipation.
- High triglyceride levels
- Transient high uric acid
- High cholesterol
- Low magnesium
- Low sodium
- Low concentrations of high density lipoproteins
- Metabolic acidosis
- Most are transient

Late side effects

- Loss of bone density
- Renal stones
- Cardiomyopathy
- Secondary low carnitine level
- Iron deficiency anaemia

There have been single case reports of other problems

Does it work?

Currently very little data but large numbers of observational studies, some prospective, suggesting positive effect on seizure control particularly in those on multiple anti-epileptic drugs and difficult epilepsy

Does it work?
Johns Hopkins - 1998

Number starting	Seizure control and diet status	3 months	6 months	12 months
150	Seizure free	4 (3%)	5 (3%)	11 (7%)
	> 90%	46 (31%)	43 (29%)	30 (20%)
	50 – 90%	39 (26%)	29 (19%)	34 (23%)
	< 50%	36 (24%)	29 (19%)	8 (5%)
	Continue diet	125 (80%)	106 (71%)	83 (55%)

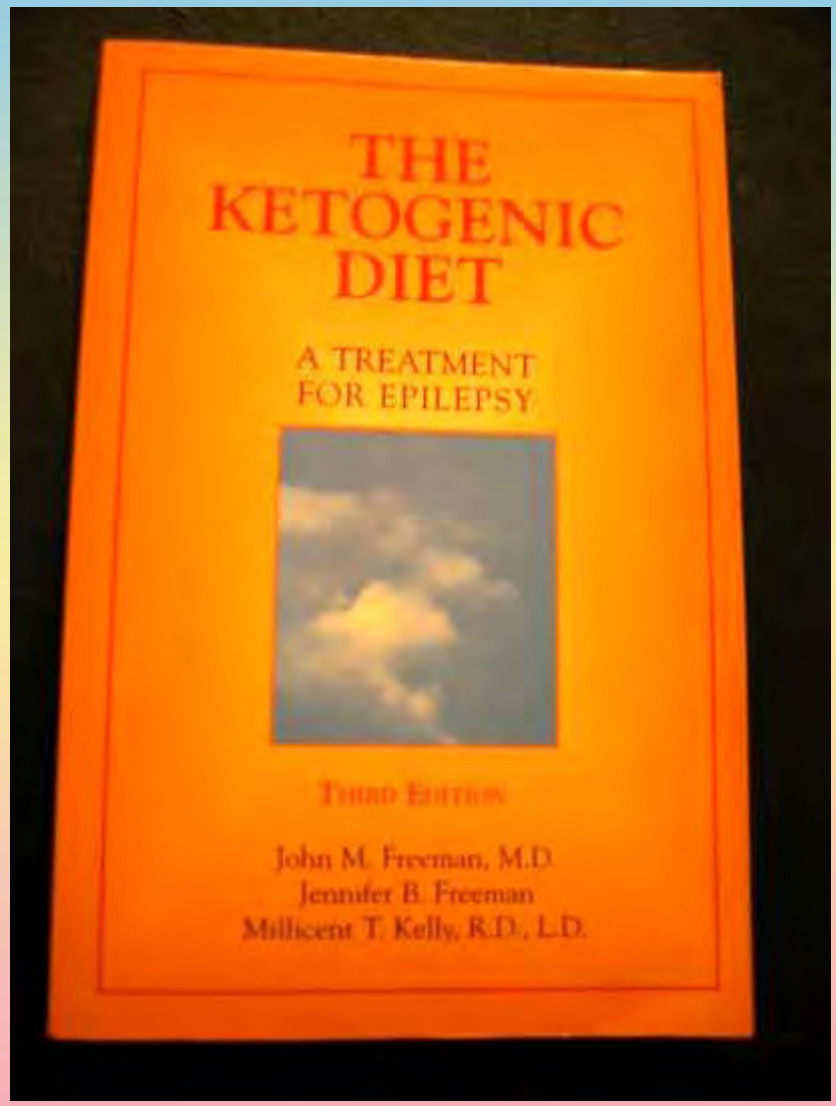
Where can I get my diet?

- All over the world
- 55 academic centres in 34 countries provide the diet, 13 of the 34 countries provided information from two or more centres
- Majority starting 5 to 10 patients annually

(Kossoff 2004)

Timescales

- Diets are difficult to obtain
- Are they the correct treatment?
- Proper assessment prior to starting together with proper calculations and education from skilled dietician are important


THE KETOGENIC DIET
A TREATMENT FOR EPILEPSY
THIRD EDITION
John M. Freeman, M.D.
Jennifer B. Freeman
Millicent T. Kelly, R.D., L.D.

Sources of Information

- Local dietician and medical team
- Internet
- Books
- Ketopag

What’s new in the UK

- Blood ketone testing
- Diet calculation programme
- Matthew’s friends
- Ketopag website

Beware

- Not suitable treatment for all
- Mechanism of action not known
- Each child is an individual and what is right for one may cause harm to others
- It is easy to take a tablet with fixed amount of medication but it is hard to get child to eat same amount each meal

Conclusion

- Ketogenic diets are an effective treatment for children and adolescents with epilepsy
- They are suitable for all ethnic diets and can be used throughout the world
- They are well tolerated
- Multidisciplinary support involving doctors, nurses and dieticians is necessary


MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy

The Ketogenic Diet

Liz Neal

Research Dietitian

Institute of Child Health

- Calculation of classical and MCT diets
- Fine-tuning of the diets
- Vitamin and mineral deficiencies
- UK trial results

Classical Ketogenic Diet

1. Establish energy prescription
2. Establish protein requirements
3. Choose ketogenic ratio - generally 4:1, and use to calculate fat, protein and CHO allowance over the whole day
4. Divide into required number of meals/snacks
5. Work out meal ideas (with parents/carers) and calculate meals
6. Consider necessary supplements and fluid intake

1. Energy prescription

Guidelines:

- UK - 75 kcal/kg for classical diet
- John Hopkins – 75% USA RDA
  75-80 kcal/kg under 1 year, decreasing to 30-40 kcal/kg over 11 years
- Consider current weight and RNI
- Consider activity and seizure levels
- Base on diet history

2. Protein Requirements

References

- Energy and Protein Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. WHO Technical Report no. 724. Geneva 1985

- Dewey KG et al. Protein Requirements of Infants and Children. *Eur J Clin Nutr*, 1996 50 (supp 1) 119-50

3. Ketogenic Ratio and calculation of Daily Allowances

Example using 4:1 ratio: 1 dietary unit = 36 kcals from fat (4 X 9), and 4 kcals from protein and CHO (1 X 4), = total 40kcal per dietary unit

- Divide total kcals allowed by number of kcals per dietary unit (eg. if allowed 1500 kcals/day, divide 1500 by 40 = 37.5 dietary units daily)

- Amount of fat daily = number of dietary units multiplied by amount of fat in ketogenic ratio, eg. 37.5 X 4 = 150g
- Amount of protein and CHO daily = number of dietary units multiplied by amount of protein and fat in ketogenic ratio, eg. 37.5 X 1 = 37.5g
- Amount carbohydrate = 37.5 – determined protein requirements

4. Number of meals and snacks

- Base on individual child
- NB. Avoid long gaps overnight

5. Meal Ideas and Calculation

- Discuss with parents and carers
- Fat sources - cream, butter, oil, mayonnaise, calogen/solagen
- Protein sources - avoid added CHO
- CHO sources - mainly fruit and vegetables (can use exchange list)
- Emergency milkshake recipe
- Include ‘treats’

MCT Ketogenic Diet

1. Establish energy prescription
2. Choose starting level of MCT in diet (30% / 60%)
3. Calculate daily amounts of MCT(liquigen) , other fat, protein and CHO
4. Work out meal ideas (with parents/carers) and calculate exchanges /? Divide into required number of meals/snacks / ? Calculate meals
5. Consider necessary supplements and fluid intake

1. Energy Prescription

- UK recommendations = RNI
- ? Same principles as classical diet
- Consider current weight
- Consider activity and seizure levels
- Base on diet history

2. Choose MCT level

- Original MCT diet= 60% energy MCT, 10% protein, 19% CHO, 11% fat in foods OR 60% energy MCT and 40% as 100kcal exchanges
- Modified MCT diet = as above, but 30% energy MCT and 30% LCT
- Balance need for good ketosis with need for tolerance - ? 40-50% MCT good starting point

3. Daily Prescription

1. Liquigen –30- 60% energy

   NB. ? Energy content of MCT fat
2. Protein – 10% energy, increase if low energy requirements to ensure meeting protein requirements
3. Carbohydrate – 15 –19 % energy
4. Remaining is LCT

4. Dietary prescription

- Either use exchanges (flexible or structured over day) or calculate actual meals)
- Work out a milk allowance
- ? Vegetable allowance / ? free vegetables
- Exchanges – carbohydrate, protein and fat
- If using structured exchanges/actual meals – base on current daily pattern
- Practical ways to incorporate liquigen – eg. Milk drinks, sugar free jelly, cake recipe
- Emergency milkshake recipe

Dietary fine tuning

- Energy prescription – increase / decrease calories, 100 – 150kcal increments
- Ketosis - increase or decrease – ratio or MCT levels adjusted
- Meal / snack distribution
- Additional CHO sources – eg. medications
- ? Fluid intake

Vitamin / mineral deficiencies – literature evidence

- Hoyt et al, 1979 – thiamine deficiency – optic neuropathy (2 children)
- Hahn et al, 1979 – vitamin D deficient osteomalacia (5 children) – decreased serum vit D, calcium and bone mass. ?Influence of medication.
- Both studies - Reversed by supplementation
- ? No supplementation with ketogenic diets

Supplementation

- Forceval Junior – 1-2 capsules daily
- Calcium
- ? Magnesium
- Must be carbohydrate free

The UK ketogenic diet trial– background

- Many studies have reported effective use of diet
- Lefevre & Aronson, 2000 – Systematic review - sufficient evidence of efficacy but lack of controlled studies
- Cochrane review – no randomised controlled trials

Is classical diet more efficacious than MCT diet? – no literature evidence or randomised trials?

Schwartz et al, 1989

- Clinical and metabolic effects of the 3 types of diet (55 children and 4 adults)
- Classical diet induced significantly greater ketosis, but equal effectiveness of all 3 diets in seizure control
- Non-randomised study

Current UK practice

McGrath et al, 2000 –

- 22 centres using ketogenic diet
- 13 using classical diet (59%), and 9 using MCT diet (41%)

The UK ketogenic diet trial

Aims –

1. To compare efficacy of classical and MCT ketogenic diets in controlling seizures

2. To compare efficacy of both diets with group acting as their own controls

Inclusion criteria

Age 2-16

- Any seizure type/syndrome
- Failure of at least two anticonvulsant drugs
- At least 1 seizure/day or 7 seizures/week
- No previous ketogenic diet
- No organic acid deficiency syndromes, history of hyperlipidaemia or renal stones

Drop out rate

- No. commencing diet (at Dec 2004) = 76
- Stopped before 3 months = 18 (24%)

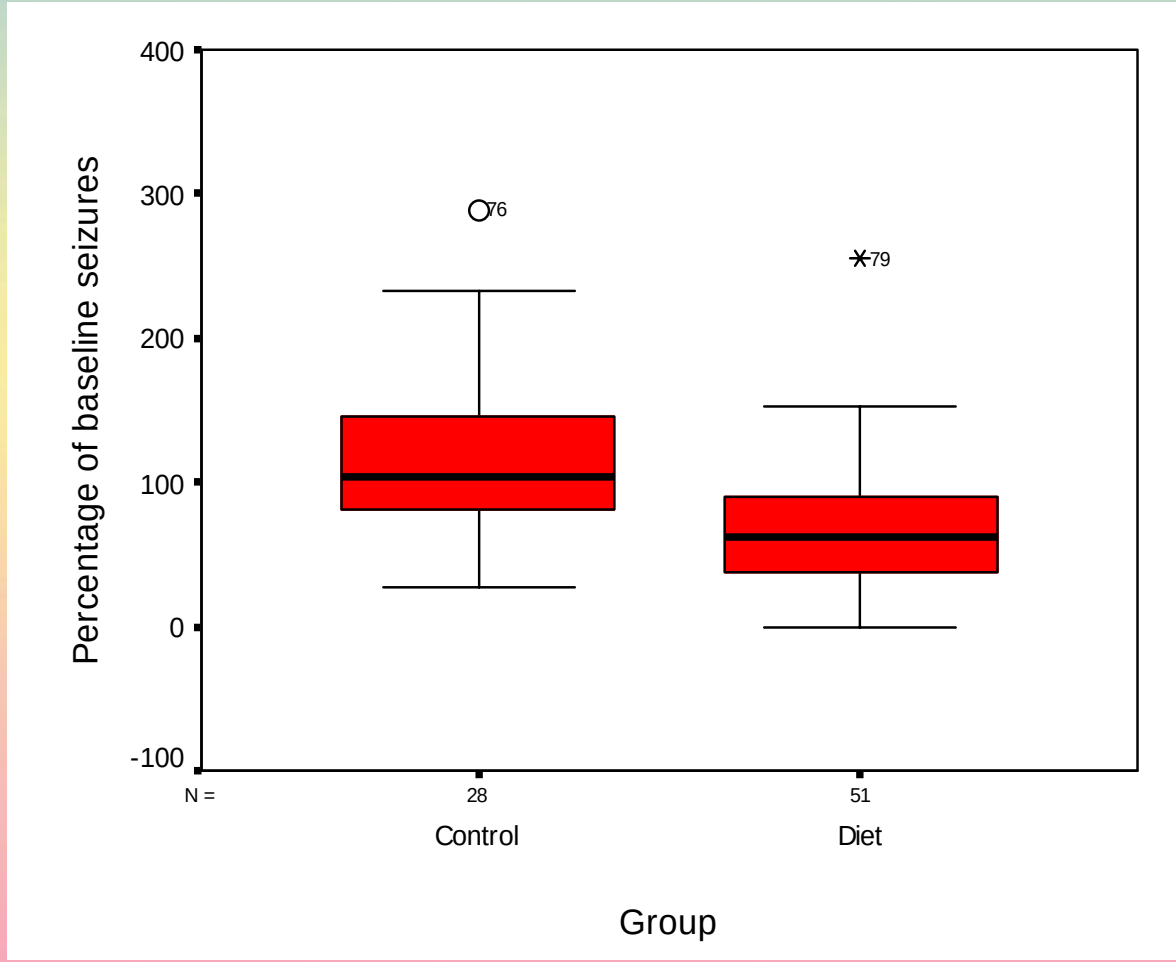
  (5 reported gastrointestinal side effects, 6 increased seizure frequency, 7 unable to cope with restrictions)
- Stopped at 3 months = 11 (14%)

  (limited efficacy)

Results – numbers at Dec 2004

- Seizure data available for 51 children after 3 mo on diet, and 28 controls
- Questionnaire data available for 53 children after 3 mo on diet

Seizure frequency at 3 months



- Diet group (n=51)
  – 69 % of baseline
- Control group (n=28)
  – 119 % of baseline
  (P<0.0001)

Seizure control

- > 50% reduction in seizures at 3 mo:
  - 21/51 diet group (41%)
  - 3/28 control group (10%)

  P=0.004
- Reduction in anti-epileptic medication dosage at 3 mo: 26/51 diet group = 51%

Parental questionnaire data at 3 mo (n=53) – compliance and ease of use

- 35 found diet easier than expected (66%)
- 3 found it harder than expected (6%)
- 37 improved child quality of life (70%)
- 32 improved family quality of life (50%)
- 46 orally fed children – 36 had no problems with taste of food (78%)

Conclusions to date

- The diet does work!
- Seizure reduction in approx half of those tried; many other benefits reported
- Parents and other carers must be motivated
- Needs good medical/dietetic/?nursing support
- Must be well monitored


MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy

Questions – with answers?

J Helen Cross

Institute of Child Health & Great Ormond Street Hospital for Children NHS Trust, London

Why questions
– can they be answered?

- Make no pretence diet is easy to administer
- Medical literature/experience – it works!
- Frustration for many
  - Lack of understanding how it works
  - Limitations

Use of medicines

Safe use of medicines

- Low in carbohydrate content
- What is classed as a ‘sugar’ – sugar free does not always mean carbohydrate free
- Practicality – as low in CHO as possible
- Common concerns
  - Pain relief
  - Constipation
  - Fever

Fever/pain relief

- **Use sugar free ibuprofen or paracetamol**
- **Medinol – sugar free paracetamol suspension**

Constipation

- Why are they constipated?
- Longstanding or acute?
- Quality of stool
  - Stool softener?
  - Bowel stimulent?
  - Both?

Constipation

- Dietary manipulation where possible
- Lactulose limited absorption – vary in absorption/CHO content between preparations
- Fybogel useful
  - Other brands of ispaghula husk may contain aspartame
- Senna in conjunction with stool softener
  - Three generic brands do not contain significant absorbable CHO

Use of diet in school

Ability to succeed at school

- Communication
- In able children – recognise need to avoid other foods
- Use of the school nurse

What tests and how often?

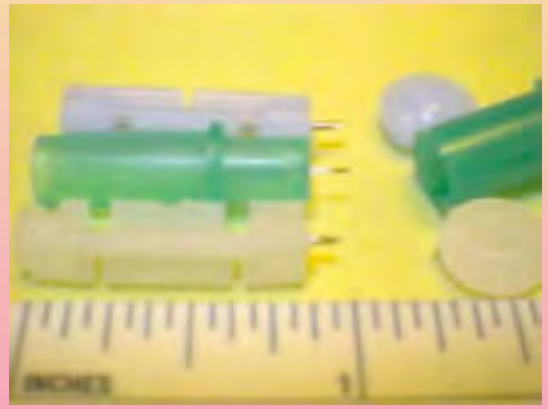
What are the risks –

what are we testing for?

Ketones

Urine

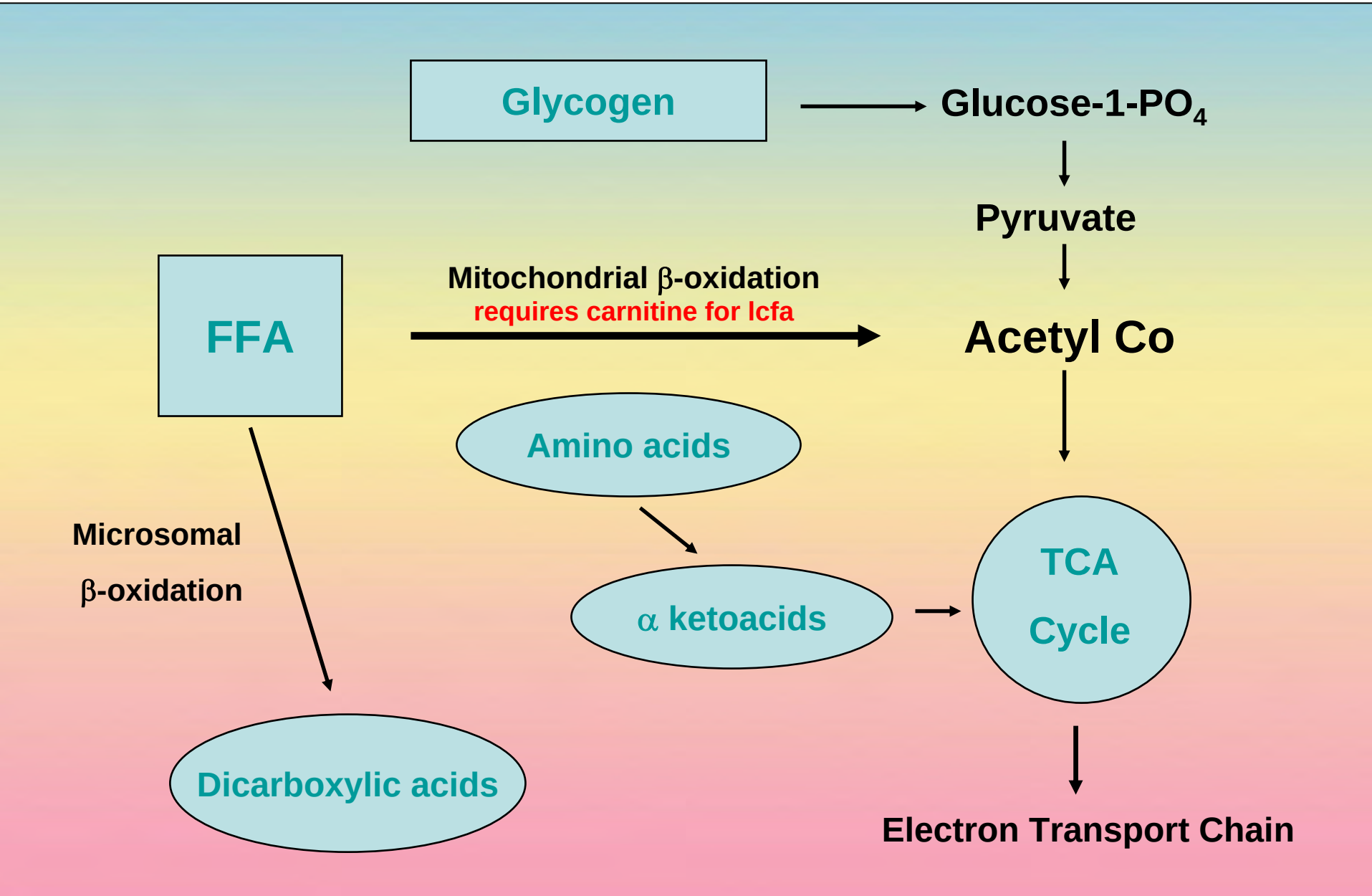
dip twice daily until established



Or blood?

Carnitine supplementation?

Energy Metabolism



Carnitine Supplementation

Is it necessary?

- **One report re concern about carnitine deficiency with no measure of such – complications not clearly related**
- **Two studies – documented carnitine over time with no documented deficiency**
- **Most units do not routinely supplement - ?role in lowering blood fat**

Access to the diet

UK ketogenic diet practice

McGrath et al, 2000

- **Postal survey of 250 BDA Paediatric group members**
- **127 replied**
- **22 centres using ketogenic diet**
- **13 using classical diet (59%), and 9 using MCT diet (41%)**

UK ketogenic diet practice
Coombes et al 2004

- **Postal survey 432;195 replied**
- **22% using the diet; 56% dieticians have used or are using the diet**

	Classical	John Radcliffe	MCT	GOSH	Other
Total	51	34	12	7	6
%	46	31	11	6	7

Access to the diet in the UK

- Most paediatric neurology centres recognise the need to offer this treatment
- Barrier is dietetic time with expertise
- Maybe personal preference as to which diet
- Route to referral
  - Ask about possibility
  - Requires a decision about whether appropriate way forward
  - Referral to centre able to do this
  - Study open for at least a further 6m

Are there alternatives?

Atkins diet

- **High fat low carbohydrate diet**
  - **20g CHO/day**
- **No amount restriction – aim to eat to satiety**
- **No protein restriction – free foods are high protein foods**
- **Comparison of products reveals Lo-Carb to be relatively high in protein**

Could it work?

Kossoff et al 2003

- **Six patients 7-52 years drug resistant epilepsy**
- **Atkins diet**
- **5 achieved ketosis**
- **3 seizure reduction with reduction AEDs**
- ***?alternative for adults***


MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy

EKM

Ketogenic Calculator
An Introduction

MATTHEWS FRIENDS CONFERENCE 2005

Presented by Bruce Carroll – 15th July 2005

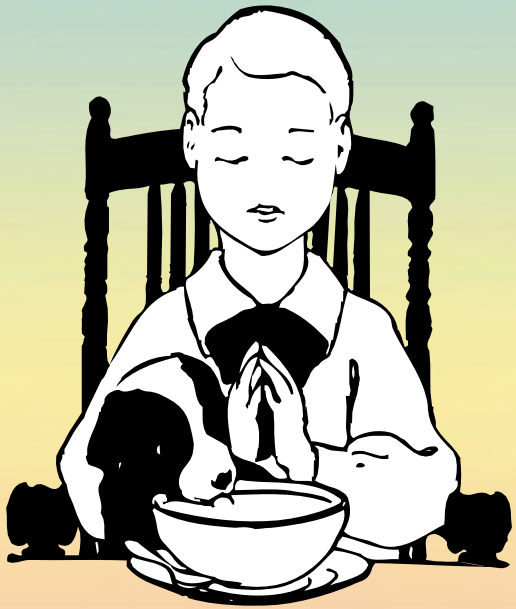
Design Principals

1. Keep it simple
2. Stable (nothing to do with horses)
3. Effective

Data Overview

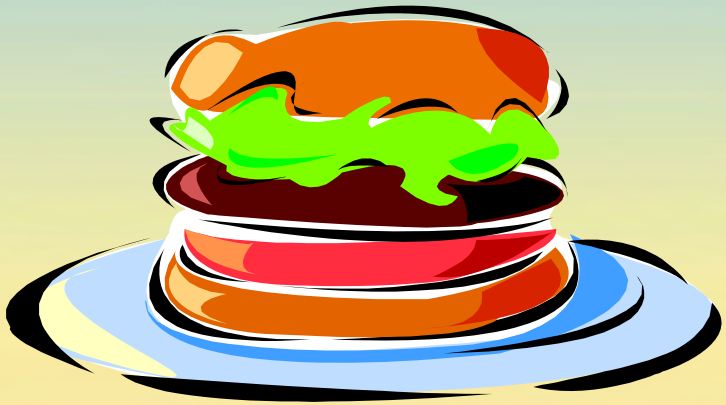
1. Patient + meal
2. Products in meal

Patient & Meal



In EKM the details of the patient and meal are stored together. This is to keep the design as simple as possible.

Products



- Products are anything you add to make a meal
- The details of the products are stored in a Products database file
- The accuracy of the meal is dependant on the accuracy of the products data!

Steps to add a meal

- Add patient and meal details – Save!
- Add Products – auto saves each line!
- Make and eat! (or should I say: Ready, Steady, Cook!)

Detail on adding products

- You can select a product and enter the amount required.
- You can also add the level of Fat, Protein or Carbohydrate for that product directly and EKM will calculate the amount required.
- To fine tune the amount the + or – keys can be pressed to increase or decrease the selected amount by 1g.
- Press [or] to adjust by + or – 0.1g.

Future plans for EKM

- Email option to send and receive meal plans
- Event diary to document all events and provide detailed print out.
- Possibly a ‘Pro’ version with more nutrients.

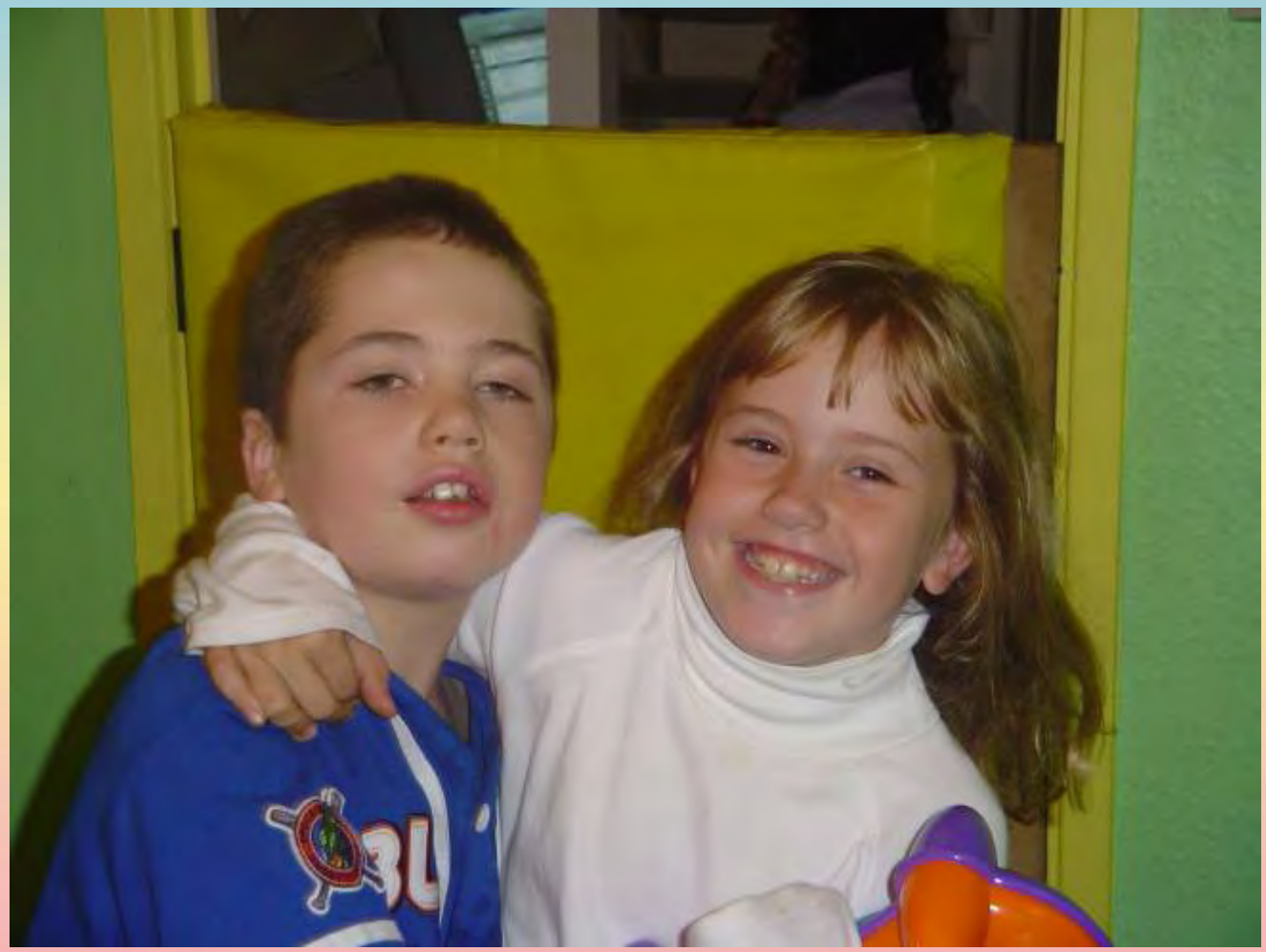
- What are your needs or suggestions?

Thank you

And enjoy your lunch!

Presented by Bruce Carroll – 15th July 2005


MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy




MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy

Matthews Friends conference

Russ Hill Hotel
15 July 2005

Patricia Wallis
Manager Nutritional Services
SHS International Ltd

Proposed contents of presentation

- Introduction to SHS International Ltd.
- Products for the ketogenic diet
  - LCT based
  - MCT based
  - Complete feeds
  - Vitamin & Mineral mixes
- Questions & Answers

Liverpool- 2008 City of Culture


Scientific Hospital
Supplies


SHS
SHS

Business definition

SHS is in the business of researching, developing, manufacturing and marketing of branded *specialised clinical nutrition* for the dietary management of various disorders.

SHS International Ltd

Renowned for being

a forward thinking organisation within the medical nutrition field.

SHS International Ltd

Providing specialist products where nutrition is crucial

Metabolic Disorders, Gastroenterology and Food Allergy, Neurology, Special Energy Requirements and Coeliac Disease

Products available for :

Metabolic Disease e.g.
PKU
Galactosaemia
Fatty acid oxide.disorder

Gastroenterology and Allergy
Cow Milk Allergy
Multiple Food Protein Intolerance
Crohn’s disease
Short Bowel Syndrome
Chylothorax

Disease Specific Supplements
Disease specific energy supps (elderly,oncology,CF)
Cystic Fibrosis
Paediatric Liver disease
Paediatric Renal disease

Neurology
Epilepsy
Movement Disorders

SHS International Ltd

Committed to continuing innovation, working with key opinion leaders and patient groups.

Focus on providing creative solutions by responding quickly and effectively to the ever changing needs within clinical nutrition.

SHS: represented world wide

- Argentina
- Australia
- Austria
- Bahrain
- Belgium
- Brazil
- Bulgaria
- Canada
- China
- Croatia
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hong Kong
- Hungary
- Ireland
- Israel
- Italy
- Korea
- Latvia
- Lebanon
- Lithuania
- Malta
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Russia
- Slovak Republic
- Spain
- Sweden
- Switzerland
- Taiwan
- Turkey
- UK
- USA

The ketogenic diet

Up to 25% of children with epilepsy do not respond to anti-epileptic/anticonvulsant medication. The ketogenic diet may provide a solution for these children. The ketogenic diet is designed to induce and maintain ketosis, which has been shown to result in a reduction of seizures. This is achieved by manipulating the ratio of fat to carbohydrate and protein.

SHS and Ketogenic diet

- LCT products
- MCT products
- Complete feeds
- vitamin & mineral mixes

SHS: LCT Products

Calogen: LCT emulsion

Unflavoured

Strawberry

Butterscotch

Banana

Solagen: LCT emulsion

SHS: MCT Products

Liquigen: MCT emulsion

MCT Oil


SHS
MCT OIL
MCT Oil is a mixture of triglycerides
containing mainly caprylic and capric acids.
ONLY TO BE USED
UNDER MEDICAL SUPERVISION
NOT FOR PARENTERAL USE
500 ml

SHS: Complete Feeds

Ketocal

Unflavoured

Ketocal

Vanilla

SHS: Vitamin and Mineral Mixes

Phlexy-Vits


SHS
PHLEXY-VITS®
A concentrated, powdered vitamin, mineral and trace element preparation.
A food for special medical purposes.
For the dietary management of phenylketoguria and similar amino acid disorders in children and adults.
Part of the PHLEXY-10 system
IMPORTANT NOTICE:
Use under medical supervision.
Suitable for children and adults.
Not suitable as a sole source of nutrition.
Only intended for use by patients with phenylketonuria and similar amino acid disorders.
Not for parenteral use.
Best before end:
Batch No.
30 x 7g
PHLEXY-VITS®
SHS

Future

- Infant formulation
- flexible components
- specific vitamin & mineral mixes
- ??????

Thank you

Any Questions ?


MATTHEWS FRIENDS
The Ketogenic Diet
A Brighter Future for Childhood Epilepsy