

# Dietary Management of Paediatric Food Allergy

Janice M. Joneja, Ph.D., RD 2005

# Most Common Allergens Relative to Peak Age of Food Sensitivity

[Hannuksela, 1983]

## Years

## Foods

0-2	Milk, Soy, Egg, Fish, Pea, Banana,
2-7	Egg, Fish, Nuts, Apple, Pear, Plum, Carrot, Celery, Tomato, Spices
Over 7	Fish, Nuts, Apple, Pear, Plum, Carrot, Celery, Tomato, Spices

# Development of Tolerance

[Sampson et al, 1989]

## To Specific Foods :

- After 1 year:
  - 26% decrease in allergy to:
    - Milk
    - Soy
    - Peanut
    - Egg
    - Wheat
  - 2% decrease in allergy to other foods
- Allergy to some foods more often than others persists into adulthood:
  - Peanut
  - Shellfish
  - Soy
  - Tree nuts
  - Fish

# Development of Tolerance

Incidence:

After 1 year:

– 25% of infants lost all food allergy symptoms

- After 2 years

– 9% more infants lost food allergies

# Prognosis

- Most infants will outgrow milk allergy by 3 years of age, but may become intolerant to other foods
- About 25% will develop respiratory allergies

[Study: Bishop et al 1990]

- Age at which milk was tolerated by milk-allergic children:
  - 28% by 2 years of age
  - 56% by 4 years of age
  - 78% by 6 years of age
- Additional observations of children studied:
  - 50% were also allergic to egg and soy
  - 30% to peanut

# Cow's Milk Allergy (CMA) as a model for food allergy in children

- Associated with a variety of different medical conditions
- Mechanisms responsible are not all understood
- Include IgE-mediated and non-IgE mediated reactions
- Known collectively as CMA

# Symptoms and Mechanisms Responsible for CMA

IgE-mediated reactions include classical allergy symptoms:

- Urticaria (hives)
- Wheezing
- Exacerbation of eczema
- Cough

Non-IgE-mediated reactions include:

- Colic
  - Nausea
  - Diarrhea
  - Abdominal pain
  - Vomiting
- Children with IgE-mediated allergy with eczema may experience only gastrointestinal symptoms on challenge

# Suggested Classification Scheme for CMA

[Hill et al, 1986]

## Group 1: Immediate Reactors

- Reaction within 45 minutes after milk ingestion
- Symptoms include urticaria, angioedema, exacerbation of eczema, cough, wheeze, vomiting
- Skin test positive (STP) to CMA
- Elevated IgE to CMA by RAST or ELISA



# IgE-mediated Reaction

Typical scenario of first reaction to cow's milk or other food allergen:

- Infant refuses to take more after first taste
- Cries as if in pain
- Swelling of lips, tongue, and mucous membranes of throat in 1-2 minutes
- May be followed by laryngeal edema (throat constriction)

# IgE-mediated Reaction continued

- May be accompanied by wheezing
- Occasionally urticaria spreads over entire body
- In severe cases shock may occur
- Usually spontaneous recovery in 15-60 minutes
- Infant appears exhausted after reaction



# Suggested Classification Scheme for CMA

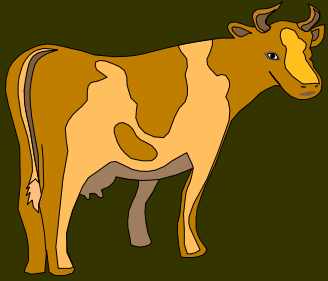
## Group 2: Intermediate Reactors

- Reaction 45 minutes to 20 hours after milk ingestion
- Symptoms include vomiting, diarrhea
- Skin test negative to cow's milk allergens
- Insignificant elevation of IgE to cow's milk in RAST or ELISA

# Suggested Classification Scheme for CMA

## Group 3: Late Reactors

- Reaction more than 20 hours after milk ingestion
- Symptoms include diarrhea, colic, with or without wheezing, with or without exacerbation of eczema
- Those with eczema skin test positive to cow's milk allergens
- Insignificant elevation of IgE to cow's milk in RAST or ELISA



## Cow's Milk Antigens

- More than 25 proteins in cow's milk can induce antibody production in humans
- $\beta$ -lactoglobulin (in whey), casein, and bovine serum albumin are the most important antigens
- Clinical reactions have occurred to all the major cow's milk antigens
- Some are heat-stable: allergic persons cannot tolerate boiled milk
- Some are heat-labile: allergic people can tolerate boiled milk

# Milk Antigens from Other Species

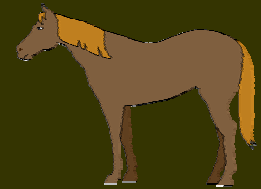
## Goat Milk

- Many goat's milk proteins cross-react with cow's milk proteins
- The majority of children allergic to cow's milk are or will become allergic to goat's milk
- Goat's milk is deficient in folate



## Mare's Milk

- Fewer proteins are similar to cow's milk proteins
- In research studies, most milk allergic children tolerated mare's milk (25 children +CMA; 1 + Mare milk)



# Lactose Intolerance

- Caused by a deficiency in the enzyme (lactase) that digests milk sugar (lactose)
- Is not the same as milk allergy
- Milk proteins can be tolerated
- Foods and beverages free from lactose need not be avoided

# Symptoms of Lactose Intolerance

- Watery loose stool
- Abdominal distention
- Cramping pain in abdomen
- Flatulence
- Vomiting
- Poor weight gain





# Lactose Intolerance

## 1. **Congenital alactasia:** *evident from birth*

- Rare inherited condition

## 2. **Idiopathic lactase deficiency:** *natural attrition*

- 80% of the world's adult population have some degree of lactose intolerance, which usually appears in adolescence
- There is normal lactase production in childhood

## 3. **Secondary lactase deficiency:** *temporary condition*

- Common in early childhood often as a result of digestive tract infection
- Lactase returns to normal levels after cell injury resolves

# Management of Lactose Intolerance

- Only the milk sugar, lactose, needs to be avoided
- Milk proteins are tolerated
- Lactose occurs in the whey (liquid) fraction of milk
- Milk products free from lactose and free from whey are safe
- These foods include:
  - Milk treated with lactase (Lactaid®; Lacteeze®)
  - Hard cheeses (whey is removed; casein remains and is fermented to form cheese)
  - Many people tolerate yogurt, where lactose is broken down by bacterial enzymes

# Tests for Food Allergies

- There is no single laboratory test that will diagnose food allergy
- All tests must be confirmed by elimination and challenge
- Tests in common use include:
  - Skin prick
  - Patch tests
  - Blood tests for elevated food-specific IgE (RAST; ELISA)
- In research studies
  - Elevated serum cationic protein
  - Basophil histamine release

# Recent Research Studies on Diagnosis of Food Allergy in Infants

(Saarinen et al 2001)

- 6209 unselected infants followed from birth for development of cow's milk allergy: 118 positive by challenge (1.9%) at 6.9 months
- Four tests used:
  - Skin test
  - Patch test
  - Elevated IgE to cow's milk proteins (RAST)
  - Elevated eosinophil serum cationic protein
- Conclusions:
  - No single test or combination of all four tests could predict the challenge outcome acceptably
  - A negative response to all four tests does not rule out the possibility of cow's milk allergy

# Diagnosis of Food Allergy in the Infant: Elimination and Challenge

- Reliable diagnosis is based on elimination and challenge:
  - All sources of suspect foods are eliminated from the infant's diet, and from the mother's diet if the child is breast-fed
  - Symptoms of allergy in the infant resolve
  - Identical symptoms occur during food challenge
  - Symptoms again disappear on elimination of all sources of the suspect food
  - In suspected CMA, lactose intolerance must be ruled out

# Identification of Food Allergies: Stage 1: Food and Symptom Record

For a 5-7 day period, record the child's:

- Intake of all:
  - Foods
  - Infant formulae
  - Supplements
  - Beverages
  - Medications
- Include the **time** at which each was taken, **amount** taken, and **ingredients**
- The **intensity** of the child's symptoms rated on a scale of 0 - 4
- **What time** the symptoms occur
- **How long** they last

## Stage 2: Elimination Diet

### Based on:

- Detailed medical history
- Analysis of exposure diary
- Any previous allergy tests
- Foods suspected by the parents or guardian
- Formulate diet to exclude all suspect allergens and intolerance triggers
- Provide excluded nutrients from alternative sources

# Foods Most Frequently Causing Allergy

1. Egg

» white

»yolk

2. Cow's milk

3. Peanut

4. Nuts

5. Shellfish

6. Fin fish

7. Wheat

8. Soy

9. Beef

10. Chicken

11. Citrus fruits

12. Tomato



# Selective Elimination Diets

- Certain conditions tend to be associated with specific food components
- Suspect food components are those that are probable triggers or mediators of symptoms
- Examples:
  - Eczema: **Highly allergenic foods**
  - Migraine: **Biogenic amines**
  - Urticaria/angioedema: **Histamine**
  - Chronic diarrhea: **Disaccharides**
  - Asthma: **Cyclo-oxygenase inhibitors; Sulphites**
  - ADHD: **Artificial food colours (e.g. tartrazine)**

# Food Allergy and Eczema

- Representative study (Burks et al 1998):
  - 165 children with eczema
  - Mean age 4 years
  - 7 foods accounted for 89% of positive challenges

Milk	Egg	Peanut	Soy
Wheat	Fish	Tree nuts	
  - 27% of subjects also exhibited gastrointestinal symptoms
  - Other studies show similar results

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# Atopic Eczema/Dermatitis Syndrome: (AEDS)

- Food allergy has a role in at least 20% of AEDS in children under 4 years
- In IgE-mediated cow's milk allergy with AEDS, resolution of CMA occurs in 90% by 4 years of age, but AEDS may persist
- Non-IgE-mediated CMA usually resolves by 1 year
- 45% develop sensitivity to other foods at the same time
- Reactions to aeroallergens develop in:
  - up to 28% by 3 years
  - up to 80% by puberty

# Basic Hypoallergenic Elimination Diet

- Only listed foods are allowed
- No vitamin supplements or non-essential medications
- GRAINS:                      White rice  
                                         Tapioca
- FRUITS:                        Pears; pear juice  
                                         Cranberries; cranberry juice
- VEGETABLES:                Squash (all varieties)  
                                         Carrots  
                                         Parsnips  
                                         Lettuce
- MEAT:                         Lamb  
                                         Wild game  
                                         Turkey

# Basic Hypoallergenic Elimination Diet

- MEAT Lentils
- SUBSTITUTES: Split pea  
Garbanzo beans (chick peas)
- FLAVOURINGS: Sea salt
- BEVERAGES: Distilled water in glass containers
- OILS  
Canola oil  
Olive oil  
Safflower oil
- OTHER Agar-agar (Make jelly dessert s)

## Duration of the Elimination Diet

- A selective elimination diet with nutritionally equivalent substitutes is followed for four weeks
  - Four weeks seems to be optimum for remission of symptoms and for elicitation of symptoms on challenge
- The “Basic Hypoallergenic (few foods) Diet” is nutritionally inadequate and should not be followed for longer than 10 to 14 days

# Expected Results of Elimination Diet

- Symptoms sometimes worsen on days 2-4 of elimination
- By day 5-7 symptomatic improvement is experienced
- Symptoms disappear after 10-14 days of exclusion



# Challenge

- Use incremental dose challenge (SIDC) to each eliminated food in its purest form to determine:
  - Immediate reaction
  - Delayed reaction
  - Degree of tolerance (dosage)
- *Do not test any food suspected to have caused a severe or an anaphylactic reaction except under medical supervision in a facility equipped for resuscitation*

# Challenge

- The basic elimination diet, or therapeutic diet, continues during this phase
- Challenge the breast-fed infant through mother's milk as previously described
- Add foods causing no adverse reaction when all tests in a single food category have been tested
  - e.g. Add milk when all tests in the “milk category” have been completed

# Diagnosis of Food Allergy in the Infant

## Stage 3: Challenge

- Challenge is implemented two to four weeks after elimination of all suspect food allergens
  - Before feeding, smear the food on the infant's cheek and observe for reddening
  - Place a drop of the food on outer border of infant's bottom lip; observe for 20 minutes for reddening, irritation
  - Place a drop on the infant's tongue and monitor for symptoms for an hour

# Incremental Dose Challenge

## Day 1:

- **Morning:** Give a small quantity of the test food  
Wait four hours, monitoring for adverse reaction; if no symptoms:
- **Afternoon:** Give double the quantity of test food eaten in the morning.
- Wait four hours, monitoring for any adverse reactions; if no symptoms:
- **Evening:** Give double the quantity of test food eaten in the afternoon

# Incremental Dose Challenge

## Day 2:

- Do not give any of the test food
  - Continue the elimination diet
- Monitor for any adverse reactions during the night and day.  
This may be due to a delayed reaction to the test food
- If an adverse reaction to the test food occurs at any time during the test: *STOP*.
  - Do not continue the test food
- Wait 48 hours *after all symptoms have subsided* before testing another food

# Incremental Dose Challenge

## Day 3:

- *If no adverse reactions* have been experienced proceed to a new food
- **If the results of Day 1 and/or Day 2 are unclear :**
  - Repeat Day 1, using the same food, the same test protocol, but larger doses of the test food
- **Day 4:**
  - Monitor for delayed reactions as on Day 2

# Management of Food Allergy

## Stage 4: Maintenance Diet

- The ideal feeding regimen for an allergic baby is mother's breast milk devoid of all of mother's and infant's food allergens
- If baby is allergic to milk, protein hydrolysate infant formulae may be tolerated; however they are expensive and bitter-tasting
- Some hydrolysate formulae can induce anaphylaxis because of large molecular weight peptides

# Infant Formulae



- Many infant formulas are casein-predominant and others are whey-predominant
  - Cow's milk allergic infant should not be given either type
- Partially hydrolysed whey formula (Good Start®) contains milk allergens and should not be used in the management of established cow's milk allergy
- Soy protein allergy is most commonly seen in children with cow's milk protein allergy
  - Soy-based formula is not recommended for milk-allergic babies



# Infant Formulae



- Extensively hydrolysed casein formulae (e.g. Enfalac Nutramigen®, Alimentum®, Enfalac Pregestamil®) are usually tolerated
- Some infants with skin and respiratory IgE-mediated CMA may have serious reactions to them
- Elemental formulae (Neocate [USA and UK]; Profylac® [Europe]) may be tolerated
- No cow's milk hydrolysate formula should be considered completely safe for all children with IgE-mediated CMA
- Introduction should be conducted with caution, using incremental dose challenge and diluted formula



## Management of CMA as a Model

- Elimination of all milk and all foods containing cow's milk proteins
- Children allergic to bovine serum albumin may not tolerate beef; initially eliminate all sources of beef
- Breast milk of mothers following a diet devoid of cow's milk protein is the ideal food
- In the small number of infants intolerant to lactose, breast milk may have to be pre-treated with lactase enzyme. Breast-feeding should not be discontinued.

# Hidden Sources of Cow's Milk Antigens

- Casein is used as a food **emulsifier**
- Whey is used as a food **fortifier**
- Margarines may contain whey and/or casein
- Many prepared and processed foods contain milk proteins and may not have ingredient labels;

## Examples:

Breads

Cereals

Pastas

Soups

Frozen chips

Gravy and sauce mixes

Sausages

Canned meats

Desert toppings

# Hidden Sources of Cow's Milk Antigens

- Foods containing “flavouring” may contain lactalbumin
- “Lactose” may contain  $\alpha$ -lactalbumin and  $\beta$ -lactoglobulin
- Leather may be sprayed with casein after it has been tanned
- Casein may be found in a number of non-food items e.g.

Artists' paints

Contraceptive foams

Cosmetics

Home permanents

Photoetching chemicals

Industrial glue

Insect spray

Leather finishes

Paper coating

Particle board

Pet food



# General Guidelines for Maintenance Diets

- Avoid all sources of the allergen
- Become familiar with terms that indicate the presence of the allergen in manufactured foods
- Contact the manufacturer if unsure of ingredients
- Make quite sure that all the nutrients in the excluded food(s) are replaced by appropriate substitutes
- Consult a registered dietitian for information and supervision of the child's diet

# Examples of Products and Ingredients Indicating the Presence of Milk

## **Milk and milk products**

- Milk
- Cheese
- Cottage cheese
- Yoghurt
- Butter
- Buttermilk
- Ice cream
- Sherbet
- Cream
- Curd

## **Terms on food labels**

- Casein
- Caseinate
- Whey
- Lactalbumin
- Lactoglobulin
- Milk solids
- Lactose
- Lactulose

# Important Nutrients in Milk

- *Important Macronutrients:*
  - Proteins
  - Fats
  - Carbohydrate
- *Important Micro-nutrients*
  - Calcium
  - Phosphorus
  - Vitamin D
  - Vitamin B12
  - Potassium
  - Riboflavin
  - Pantothenic acid
  - Vitamin A
  - Vitamin E
- (vitamin D and A are added as fortification).

# Rechallenge Schedule

## FOOD

## RECHALLENGE

Egg

After 12 to 18 months of avoidance.

Milk

If response is still positive: every 2 to 3 years

Wheat

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Soy

After 1 year of avoidance.

If response is still positive: every 2 years

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Peanut

After 3 years of avoidance.

Shellfish

If response is still positive: every 2 to 3 years

Fish

Nuts

Seeds

***RECHALLENGE ONLY UNDER CLOSE  
MEDICAL SUPERVISION IF FOOD  
SUSPECTED TO CAUSE ASTHMA OR<sup>48</sup>  
ANAPHYLAXIS***