

BioMedical Approach for Autism

Basics

Defeat Autism Now (DAN) Model!!

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This document is intended to provide simple basic guidelines of implementing the biomedical approach available to help children and adults with autism. BioMedical approach may not help every child, but they have helped thousands of children improve, sometimes dramatically. The document is based on the DAN conferences attended and excellent book “Autism: Effective Biomedical treatments” by Jon Pangborn Ph.D, and Sidney Baker, MD published by the Autism Research Institute. Document generally follows the DAN! philosophy, which involves trying to treat the underlying causes of the symptoms of autism, based on the medical testing, scientific research, and clinical experience, with an emphasis on nutritional interventions. It is recommended to do under a doctor’s supervision.

The document includes the following sections:

- Rainbarrel Theory of Autism
- Clean up the diet
- Causes of autistic behaviors
- Autism and the gut
- Gluten and casein free diet
- Feingold diet
- Enzymes
- Essential fatty acids
- Antioxidants & Oxidative stress
- Probiotics
- Chelation – removal of heavy metals

Autistic Kids

Autistic kids are individuals – treat the individual’s problems. Autism is not a single entity.

There is no one specific cause, no approved drug, nor one single intervention or treatment approach for autism.

These kids are medically sick with immunological, gastrointestinal/nutritional, metabolic and neurological disorders.

Each child is unique and requires a comprehensive treatment approach inclusive of BioMedical Interventions.

Rainbarrel Theory of Autism

The development of the autism has been described in terms of the filling up of a rainbarrel. With too many rainfalls or a long duration of one or more rainstorms, then the barrel fills up and overflows, manifesting in the onset of regressive autism.

These rainfalls may be represented by toxic, immunologic, biochemical, and/or environmental insults, triggers, or stressors. With ongoing and cumulative rainfalls cascading into the barrel, it can quickly fill up and ultimately overflow with the presentation of the Clinical symptoms commonly associated with autism.

The goal of implementing a biomedical approach is designed to identify specific rainfalls and then with treatment actually remove bucketfuls of water, lessening the overall load of water (stressors) found in the barrel. This results in stopping any further overflow but also provides improvement in the child’s overall health and medical condition.

BioMedical Treatment Does it Help

“By implementing the DAN Biomedical approach these children can be greatly helped medically, behaviourally ,and cognitively by proper diagnosis and treatment of their underlying medical conditions” By Jaquelyn MacCandless, M.D.

Behavioral intervention such as Applied Behavior Analysis (ABA), can also be very helpful to children with autism, and are recommended to be used in conjunction with biomedical treatments. Other therapies like speech, occupational, sensory integration, physical therapy and a good educational program can be very important. Biomedical therapy may help improve the efficacy of these other interventions, by improving brain and body health and making it easier for the child to learn.

Clean up the diet

Goal: Daily bowel movements. Adding digesting enzymes with meals will be beneficial. Start high potency probiotics (acidophilus and bifidus). Start treatment for dysbiosis depending on symptoms and labs. Check for high ammonia and treat accordingly.

Resources for Diets

- Gluten free/casein free diet: www.gfcfdiet.com
- Talk About Curing Autism (TACA): www.tacanow.org
- Dana's View: www.danasview.net
- Low oxalate diet: www.trying_low_oxalates@yahoo.com

Preservatives and Additives

- Try to avoid preservatives, additives, and dyes.
- Your body is a sophisticated machine. Food is fuel for your body. Would you put gas in your car with additives and preservatives that made it run terribly?
- MSG, aspartame, hydrolyzed protein and soy protein extract are excitotoxins. An excitotoxin is a toxic molecule that stimulates nerve cells so much that they are damaged or killed.
- Sodium nitrite is a suspected carcinogen and very toxic. It is an eye and respiratory tract irritant. Buy nitrite/nitrate-free lunchmeats and hot dogs and store in the freezer

Soy and Corn

- Common allergen among autistic children
- Soy has high amounts of phyto-estrogens, plant-based chemicals that mimic estrogen
- Corn is difficult to digest, especially with an injured gut.
- Soy and corn are two of the most common genetically modified crops.

Genetically Modified Foods

(GMO Genetically Modified Organisms)

- Genetically engineered (GE) means that the genes and DNA have been altered in that food item.
- Effects of these changes have not been fully tested.
- European countries have restricted GM foods and require clear labeling, while GMO crops require no labeling in the U.S.
- Farmers like the genetically engineered crops, which are sold under the brand name Roundup Ready, because they can spray Roundup herbicide directly over those fields, killing the weeds while leaving the crops intact. Before GMO seeds, crops could not tolerate the herbicides, so they would till the land or have people hand-weed to control the weeds
- Most common Roundup Ready crops include soybeans, corn, canola, cotton, and alfalfa
- Why would spraying more chemicals on our food be better?

Why Organic?

- Our children are extremely sensitive to toxins in the environment.
- Organic farmers do not use synthetic pesticides and fertilizers.
- Pesticides are poison that contribute to auto-immune diseases and other health problems.
- Only way to guarantee your food is GMO free.
- Just because you don't see the pesticides, does not mean they are not there. Would you feel differently about your food if you saw them spray Raid on your produce in the store before you bought it?

Does "Natural" Mean Organic?

- Natural and organic are not interchangeable. Other healthy practices such as free-range, hormone-free, and natural may appear on labels, however they may not be considered organic.
- Only food labeled "organic" has been certified as meeting USDA organic standards.
- Crops labeled organic are grown in fields that must be free from prohibited pesticides and fertilizers for a minimum of three years.

Eating an Organic Diet Economically

- Good idea to wash your produce, but you cannot wash away all the pesticides.
- Farmers have different protocols, so some produce may have higher levels of pesticides than others.
- Farmers markets are a great place to find organic produce
- Look for labels such as "transitional produce" or "pesticide free," which is usually from a farm awaiting organic certification.
- Hothouse-grown produce is usually pesticide free.
- Minimize exposure to pesticides in foods by limiting purchases of non-organic foods to those with the lowest pesticide residue.

Produce Typically With Higher Levels Of Pesticides

➤ Peaches, strawberries, apples, grapes, pears, nectarines, cherries, raspberries, spinach, green beans, celery, potatoes, bell peppers, winter squash

Produce Typically With Lower Levels of Pesticides

➤ Oranges, lemons, plums, kiwi, mangoes, papaya, avocado, broccoli, cauliflower, asparagus, onions, peas, cabbage

Causes of some autistic behaviors

| Clostridia Issues | Treatment |
|---|---|
| <p>Symptoms</p> <ul style="list-style-type: none"> - Aggressive - Temper - Agitation - Irritable - Very foul stools - Mucus in stools - Severe diarrhea following antibiotic use | <p>Probiotics, High potency single strain Sacchyromyces Boulardi</p> <p>Antibiotics</p> <ul style="list-style-type: none"> - Vancomycin - Metronidazole (Flagyl) <p>HBOT</p> |
| Parasities | |
| <p>Symptoms</p> <ul style="list-style-type: none"> - Bizzare behaviors - Insatiable appetite - Aggressive - Worse at full moon - Picking, biting, licking, itching, grinding - Fecal smearing - Restlensess | <p>Probiotics</p> <p>Antiparastic Drugs</p> <ul style="list-style-type: none"> - Flagyl - Mebendazole <p>Natural Remedies</p> <ul style="list-style-type: none"> - Wormwood - Black walnut - Clove - Pumpkin seeds - Coconut oil |
| Yeast | |
| <p>Symptoms</p> <ul style="list-style-type: none"> - Foggy thinking - Spacey - Inappropriate laughter - Sugar cravings - Poor sleep - Frequent diaper rash - Frequent urination - History of frequent antibiotics | <p>Limit carbs, sugar, yeast</p> <p>Probiotics</p> <p>Sacchyromyces Boulardi</p> <p>Zinc, Molybednum</p> <p>Antifungals</p> <p>Drugs</p> <ul style="list-style-type: none"> - Nystatin, Ampho B - Fluconazole - Itraconazole - Ketoconazole <p>Herbs</p> <ul style="list-style-type: none"> - Berberine - Grapefruit Seed Extract - Oil of oregano - Pau d'Arco - Garlic |
| | |

| | |
|---|--|
| Strep Issues | |
| Symptoms <ul style="list-style-type: none"> - Repetitive - Ritualistic - Verbal tics - Obsessive - Compulsive - Verbal stims - Frequent strep infections - Frequent bacterial infections | Probiotics Xylitol Antibacterial Herbs <ul style="list-style-type: none"> - Goldenseal - Artemesia - Neems |
| Viral Issues | |
| Symptoms <ul style="list-style-type: none"> - Easy Fatigue - Visual issues <ul style="list-style-type: none"> o Squinting o Divergent gaze o Poor eye contact - Cold sores - Warts - History of regression after MMR or other live viruses | Antiviral Agents <ul style="list-style-type: none"> - Olive leaf extract, elderberry - Caprylic acid - High Dose of Vitamin A Antiviral Drugs <ul style="list-style-type: none"> - Acyclovir - Valacyclovir - Famvir - Imunovir Immune support <ul style="list-style-type: none"> - Low Dose Naltrexone - Red. Glutathione - Zinc - Immune Modulators |
| High Ammonia | |
| High elevated rule out urea cycle disorder Midly elevated consider possible causes <ul style="list-style-type: none"> - Dysbiosis - Recent infection - Liver stress - High protein diet or supplementation - BH4(tetrahydrobiopterin deficiency) Symptoms <ul style="list-style-type: none"> - Irritability - Aggression - Headache - Head-banging - Hyperactive | Avoid excess protein in diet Activated charcoal Fiber Yucca BH4 |
| Sleep Issues | |
| | Melatonin 0.5 mg to 3 mg Magnesium 200mg to 400 mg GF/CF diet |

| | |
|--|--|
| | <p>Fix the gut 5HTP Herbs; Milk Thistle, Valerian, Chamomile Tea</p> |
| <p>Diarrhea Children with diarrhea can have anywhere from 1-6 (or more in severe cases) of yellow(or just about any color) , foul smelling movements per day. They can be just about any consistency. This is an indication of having problems with digestion, absorption, food sensitivities, as well as dysbiosis(bad bugs growing in the bowels)</p> | <p>Gluten free casein free corn-free soy free diet Specific carbohydrate Digestive enzymes Anti-fungals Antibiotics Probiotics Anti-parasites Address food allergies Fiber Zinc Oral immunoglobulins Secretin Natural anti-inflammatory agents</p> |
| <p>Constipation Huge hard stools Small pebbles compressed together Infrequent stooling such as 1 every 2 or more days Foul smelling Pellets Foul Breath/body odor Behavioral changes</p> | <p>Enema EFA Plus Magnesium Citrate Smooth move tea(on occasion) Fiber Vitamin C (high dose) Oxypowder.com</p> |
| | |

Autism and the GUT:

Fats, carbs and proteins are digested differently. Autistic kids can have problems with all three. Maldigestion can lead to the nutrition deficits, increase allergic response to foods, pain and inflammation, dysbiosis and immunologic response, increased mucosal permeability, uptake of toxins and false neurotransmitters. (morphine acting)

What is a leaky gut and what is its connection with autism?

One of the most fundamental players in our health is our bodily microbial flora. A human body is like a planet inhabited by huge numbers of various micro-creatures. Our digestive system, eyes, skin, respiratory organs co-exist with trillions of invisible micro-life, making one ecosystem. A healthy adult carries 1.5 to 2kg of bacteria in the gut. All these bacteria are not just a chaotic microbial mass, but a highly organized microworld with certain species predominating and controlling others. The number of functions they fulfilled is vital to us. Essential or beneficial flora is the most important group and the most numerous in a healthy individual. These bacteria are often referred to as our indigenous friendly bacteria. Transitional bacteria are those which we swallow daily with food and drink. When the gut is well protected by beneficial bacteria, this group of microbes goes through our digestive tract without doing any harm. However, if the population of the beneficial flora is damaged and not functioning well, this group of microbes can cause disease. A baby is born with a sterile gut full of beneficial bacteria. Various reasons have greatly damaged the should be healthy gut flora of the mother, and hence the baby, causing inflammation and leakage of the gut:

- * lack of good nutrients in diets as a result of eating abundant processed food (pathogenic microbes thrive on processing carbohydrates and sugar)
- * reduced breast feeding
- * overexposure to antibiotics as a medicine or in farming
- * overexposure to chemicals, toxin in the environment and in food processing
- * a "too clean or sterilized environment" reduces the strength of our immune system upon challenge

A child born with an immature immune system is much more vulnerable to various infections (chest, ear, sore throats) and allergies (food allergies, eczema and asthma).

Worse of all, a leaky gut becomes a source of toxicity. These toxins get absorbed through the gut lining into the blood stream and carried to the brain. Many of these toxins are able to cross the blood-brain barrier and interfere with the normal brain function. As a result, the child develops learning problems or learning disabilities.

In real life, we see a great deal of overlap between allergies and developmental disorders. For example, children who are hyperactive/ADHD/dyspraxia are often suffering from eczema and asthma. Autistic children commonly have digestive problems, and severe allergies. The root, at least partly, goes to the poorly developed immune system and gut flora.

Gluten free and Casein Free Diet

64 % of kids have shown improvements in the Gluten Casein Free.

The Autistic Network for Dietary Intervention (based in United States) and Defeat Autism Now (DAN) highly recommends that parents try the gluten-free, casein-free diet for at least 3 months. It may take that long to see results, and you MAY NOT cheat. Gluten is virtually everywhere, hidden in thousands of foods you would never think of: soups, sauces, candy, cereals, breads, pastas, cookies, etc. Likewise, casein is present in ALL forms of dairy, including but not limited to, cheese, creams, many sauces, butter, yogurt, ice cream, anything with whey, caseinate, etc.

The gluten-free, casein-free diet is challenging, but it may make a tremendous difference. Let it be said that this diet will not affect every child, and may not have dramatic effects if it does. Parents should read related literature, consult your doctor and other parent friends as much as possible. Worries, hesitation and half-heartedness are the worst enemies to any successful experimentation. Once you decide that you would like to give it a go, there are a lot of resources (food substitutes, books, support network) that can help you getting through this. Most people will first eliminate casein (all dairy products) and then gradually eliminate gluten (all wheat, rye, barley, and oat products). What is of utmost importance is to realize that the diet is all or nothing.

Before we discuss this special diet, we have to understand what has gone wrong. Briefly, gluten is a protein, and so is casein. Gluten is a protein fraction found in all wheat, rye, barley, and most oat products. Casein is a protein fraction found in all dairy products. To most autistic children, gluten and casein are the equivalent morphine. These undigested peptides leak out into the bloodstream through small holes in the gut (permeability), and attach to the opiate receptors of the autistic's brain and affect the functioning of the brain and other receptors. Essentially, many autistic children are "drugged" on wheat and milk products, as if they were on a morphine drip.

Although parents have been reporting a connection between autism and diet for decades, there is a lack of widely accepted documented researches. However, there is now a growing body of research that shows that certain foods seem to be affecting the developing brains of autistic children, causing or aggravating autistic behaviors. This is not because of allergies, but because many of these children are unable to properly break down certain proteins.

Feingold Diet

Phenols & Salicylates

Higher level of phenols or salicylates can affect children on autism spectrum. Thus it is very important to know which foods are with high phenols & salicylates.

Phenols: Is a type of chemical and all foods have phenols, some foods have high phenols while some have less. When phenols cannot be processed out, they build up in the body exerting a toxic effect. The PST sulfation pathway is necessary for breakdown and removal of certain toxin (like phenols) in the body. The child with PST (Phenol sulphur-transferase) has trouble processing them. So it is important to reduce the HIGHLY phenolic foods. By doing this the child will not get overloaded in trying to process the phenols it is getting anyway. Salicylate is also a type of phenol. The detoxification pathway processes phenolic compounds such as salicylates, artificial colorings, artificial flavourings and preservatives.

Phenols Symptoms:

Children who eat a large quantities of phenolic foods or foods containing salicylates or additives can experience some of these negative side effects:

- Laughing at in appropriate time (at night or when something is not funny.)
- strange rashes that appear on the body
- erratic behaviors and moods
- self stimulatory behaviors
- night awakenings
- Have a difficult time with their stools (with constipation, diarrhea or undigested foods.)
- headaches
- dark circle under eyes, red face/ears, diarrhea

Dr Feingold observed that there is a link between certain foods and additives, which effect some individuals' behaviors and ability to learn.

Feingold diet can be implemented with the combination of GF/CF diet, which can help reduce child's hyperactivity, improve attention, focus. Etc

Foods Not Allowed on the Feingold Diet (partial list)*

| | | |
|---------------|-----------------|---------------|
| Almonds | cucumbers | peppers |
| apples | and pickles | (bell, chili) |
| Apricots | Currants | plums, prunes |
| berries (all) | Grapes, raisins | tangerines |
| Cherries | nectarines | Tea |
| cloves | Oranges | tomatoes |
| coffee | | peaches |

**Reactions to these foods are based on unconfirmed reports, not*

Foods Allowed on the Feingold Diet (partial list)

Fruits - Allowed

| | | |
|------------|----------|------------|
| banana | honeydew | papaya |
| Cantaloupe | kiwi | Pears |
| dates | Lemons | pineapple |
| grapefruit | mangoes | watermelon |

Vegetables - allowed

| | | |
|-------------------|-----------|--------------|
| bean sprouts | celery | Potatoes |
| beans (all types) | Kale | spinach |
| beets | lentils | Squash |
| broccoli | Lettuce | sweet corn |
| Brussels sprouts | mushrooms | sweet potato |
| cabbage | Onions | zucchini |
| carrots | Okra | radish |
| Cauliflower | Peas | Eggplant |

Banana, mangoes, watermelon : high in sugar, so we need to be careful.

Dr Feingold recommends that sweeteners such as sorbitol, mannitol, and xylitol should be used cautiously and only in moderations, as they can cause diarrhea. He stated that, "One must be aware that not only refined cane sugar, but all the simple sugars, which include brown sugar, beet sugar, corn syrup, molasses and even honey, may play a role in behavior".

Salicylate Content of Foods....

Vegetables

| Very Low Salicylate | Low Salicylate | Medium Salicylate | High Salicylate |
|---------------------|-------------------|-------------------|-----------------|
| Cabbage | Beans sprouts | Sweet corn | Eggplant |
| Celery | Beans (all dried) | Baby squash | Radish |
| Lettuce | Beets | White potato | Zucchini |
| Lentils | Brussels sprouts | Okra | |
| | Broccoli(B) | Spinach (B) | |
| | Carrots | | |
| | Cauliflowers(B) | | |
| | Green beans | | |
| | Mushroom | | |
| | Onion | | |
| | Pumpkin | | |
| | Peas(B) | | |
| | | | |

(B): Items marked with a (B) contain naturally occurring benzoates and should be discontinued if symptoms are noted after eating the food.

Some kids react to green and orange foods like carrots, spinach.. so it is good idea to start with very low salicylate and observe the reactions like behaviors and stools. Add one at a time. Then move to low salicylate and so on...

Enzymes

We are all born with the ability to produce a finite number of enzymes during our lifetime. Every individual is different and depending upon each person's DNA this ability varies. Our body's organs produce either metabolic enzymes or digestive enzymes using this enzyme-making ability.

When we eat a meal, the requirements for digestive enzymes become a high priority. To meet the body's enzyme requirement, our body's enzyme-making machinery have to work overtime and often still can not meet the demand. Since digestion always takes precedence over nearly everything else, many body functions requiring metabolic enzymes are often shortchanged during these times. The result is a lower diseases-fighting capability and a general weakening of the body's ability to mend itself.

Enzymes are delicate lifelike substance found in all living cells whether animal or vegetable. They are energized protein molecules necessary for life. They catalyze and regulate nearly all biochemical reactions that occur within the human body. Enzymes turn the food we eat into energy and unlock this energy for use in the body. Our bodies naturally produce both digestive and metabolic enzymes as they are needed. Surplus enzymes can be stored by some organs for later use or used as a fuel for the brain.

Metabolic enzymes are produced by the liver, pancreas, gall bladder and other organs. They speed up the chemical reaction within the cells for detoxification and energy production. Every organ, every tissue, and all 100 trillion cells in our body depend upon the reaction of metabolic enzymes and their energy factor.

Digestive enzymes are secreted along the digestive tract to break food down into nutrients and waste. This allows nutrients to be absorbed into the bloodstream and the waste to be discarded. Human digestive enzymes include ptyalin, pepsin, trypsin, lipase, protease, and amylase. The body does not make cellulose, an enzyme necessary for proper digestion of fiber, so it must be introduced through the raw food we eat.

Food enzymes are introduced to the body through the raw foods we eat and through consumption of supplemental enzyme fortifiers. Raw foods naturally contain enzymes providing a source of digestive enzymes when ingested. However raw food manifests only enough enzymes to digest that particular food, and not enough to be stored in the body for later use. The cooking and processing of food destroys all of its enzymes. Since most of the foods we eat are cooked or processed in some way our bodies must produce the majority of digestive enzymes we require, unless we use supplemental enzymes aid in the digestive process.

WHAT IS DPP-IV?

DPP4, is easily deactivated by small amounts of toxins including mercury and organophosphates (pesticide sprays). DPP4 is needed to digest some peptides from casein and other substances that can have an opioid-like effect.

Dipeptidyl peptidase (DPP-IV) is a protein that has multiple functions in the body. It is known under different names depending on where it is found. When DPP-IV is on the surface of the T-cell (lymphocyte), it is called CD26, and supports immune function. When this enzyme is found on and imbedded on the epithelial brush boarder mucosal membrane of the intestinal tract lining it is known as DPP-IV. The use of a DPP-IV containing enzyme will support the digestion of casein-containing milk products as well as the protein in gluten-containing grains.

Dietary issues and digestive aid options for Autism .. Jon Pangborn Ph. D

The DPP4 strategy is digestion of exorphin peptides in the gastrointestinal tract with synthetic (plant-extracted) DPP4 before they can be absorbed. If these exorphin peptides get into the blood, they can bind to cellular CD26 (the adenosine deaminase binding protein), worsening the adenosine situation. Better digestion also lessens amounts of dysbiotic, often pathogenic gut flora that contribute to intestinal inflammation in autism. Decreasing inflammation hopefully reduces the epigenetic influence on reduced methylation. Digestive enzymes complement dietary restrictions, but are not a substitute for such restrictions.

| <i>Intervention</i> | <i>Got better</i> | <i>No effect</i> | <i>Got worse</i> | <i>Responses</i> |
|--------------------------|-------------------|------------------|------------------|------------------|
| <i>Digestive Enzymes</i> | <i>56%</i> | <i>42%</i> | <i>3%</i> | <i>737</i> |

When digestive enzymes with DPP4 are used, the exposure to dietary opiate peptides is decreased as more casein and gluten are digested by the enzymes. This usually brings about a period of opiate-like withdrawal, which may last 5 to 10 days or longer in some cases. During this period, the individual may become more irritable or tantrum, develop hyperactivity, experience an increase in stimming or may present increased levels of inappropriate behavior or regression. Cravings for discontinued foods can occur which may potentiate these withdrawal symptoms.

Digestive enzyme dosage depends on the amount of food that's eaten, not the age or weight of the individual. Enzymes are **NOT** a substitute for an exclusionary diet. Most digestive enzymes designed for autism should be taken at the beginning of each meal.

Essential Fatty acids

Essential fatty acids are termed “essential” because they are necessary for human life. The major types of essential fatty acids are Omega-3 and Omega-6.

Ancient human diets contained a roughly 1:1 ratio of Omega-3 and Omega-6 fatty acids. However since, Omega-3 fatty acids spoil much faster than Omega-6, commercial food processors usually remove them or “hydrogenate” them to increase shelf life.

Today, our diets contain a roughly 1:15 ratio of Omega-3 to Omega-6 and thus we are very low in Omega-3 fatty acids.

In human diets, the major sources of omega-3 fatty acids is fish. As they contain two important types of Omega-3 fatty acids, EPA and DHA.

EPA and DHA

EPA is important in reducing inflammation (such as GI tracts of children with autism). DHA is critical to brain development, and 20% of an infant’s brain is made up of DHA. Both are critical to all cell membranes in the body; they regulate nutrients going into the cells, and waste leaving the cell. They also affect the release and reuptake of neurotransmitters.

Parent Assessment after Treatment with Fatty acids

| <u>Symptoms</u> | <u>Improvement</u> |
|---------------------------------------|----------------------------------|
| Abnormal Bowel Movement | 88%(88/106) |
| Hyper Irritability | 35%(35/106) |
| Limited Eye contact | 40% (27/106) |
| Social Withdrawal | 30%(31/106) |
| Short Attention Span | 20%(12/106) |
| Repetitive Movements, such as Rocking | 35%(80/106) |
| Speech Regression | Significant improvement (61/106) |

Overall, 68% responded to Essential Fatty acid

Antioxidants & Oxidative stress

When oxidants exceed the antioxidant defense, biological systems suffer oxidative stress, with damage to biomolecules and functional impairments.

What are Antioxidants?

Antioxidants are a group of compounds that are produced by the body and that occur naturally in many foods. They protect us from damage caused by the free radicals, which can injure healthy cells and tissues.

Free Radicals:

Oxygen can be a dangerous friend. The human body requires ample amounts of oxygen for metabolism, the breakdown of nutrients to create the energy for growth and other body activities. Without oxygen we cannot make energy. Yet the energy production of energy can wreak havoc in the body because it also produces free radicals.

Free radicals are unstable molecules that are created during normal metabolism and can damage cell structures and can ultimately lead to cancer, heart disease, and numerous other illnesses. Our body's antioxidant defense network's job is to maintain the right balance between the antioxidant and free radicals. Free radicals constantly form almost everywhere in the body at an astonishing rate. If free radicals are not quickly trapped, they can cause a great deal of trouble. The primary job of the antioxidant is to prevent antioxidants from being lost through oxidation. As one antioxidant saves the other, the cycle continues, ensuring that the body will maintain the right antioxidant balance.

Glutathione

The most abundant antioxidant in the network is glutathione, which is produced by the body from three amino acids found in food: *glutamic acid*, *cysteine*, and *glycine*. Glutathione is found in virtually every cell and is an important weapon in the battle against free radicals. It is produced in the body and is the primary water-soluble antioxidant. In the antioxidant network, glutathione recycles the oxidized form of Vitamin C, restoring its antioxidant power. It is instrumental in the detoxification of drugs and pollutants and for healthy liver function.

Forms of Glutathione

Glutathione is present in the body in two forms: its reduced form, which is a potent antioxidant, and its oxidized form after it has been "used up" by the antioxidant defense network. In a healthy body, more than 90 percent of glutathione will be found in its antioxidant form. During times of illness or stress, levels of glutathione will plummet, a sign of oxidative stress. Although glutathione is sold as a supplement, there is much debate over how much glutathione actually passes through the intestine into the cells. Since it is a large molecule, it was once believed that it was too large to pass intact from digestive system into the cells. But it is clear now that small amounts of glutathione may pass from the GI tract to the bloodstream but probably not in a high enough concentration to be helpful, and certainly not enough to be transported to the cells that need it.

Why Glutathione is important?

Glutathione is the cell's primary antioxidant. It is found in the cell sap (the watery portion of the cell), there are several million times more glutathione molecules in the cells than vitamin E, the primary fat-soluble antioxidants. There are astonishingly high quantities of glutathione in the liver, where drugs, pollutants, alcohol, and other foreign substances are detoxified. Glutathione is not only constantly produced by the cells, but it is also tucked away in proteins, this reservoir of extra glutathione will be mobilized into action under oxidative stress. It is a thiol antioxidant as it contains a sulphur group. Whenever our body is under oxidative stress, glutathione immediately produces a series of enzymes that are essential for glutathione production. The easiest and best way to maintain optimal glutathione levels is to eat foods that contain the building blocks of glutathione, and to take lipoic acid supplements.

Glutathion Busters

Environmental toxins can sap our glutathione. These includes cigarette smoke and overly processed chemical-laden foods such as luncheon meats

Many children with autism have low levels of active glutathione, which is needed to protect the body from many toxins including toxic metals.

Treatment: There are many ways to increase active glutathione levels. They include:

1) Oral glutathione: Only about 10% of oral glutathione is absorbed, so this method is not very effective at raising body levels, but it may improve levels in the gut.

2) IV glutathione: The IV form is highly effective, but temporary, and it can be difficult to administer regularly to the child.

3) Vitamin C: 500 mg of vitamin C was found to raise RBC glutathione levels 50% in college students. Johnston et al, Vitamin C elevates red blood cell glutathione in healthy adults. *Am J Clin Nutr.* 1993 Jul;58(1):103-5.

4) TMG/Folinic Acid/methyl-B12: A study by James et al. found that 800 mcg of folinic acid and 1000 mg of TMG somewhat improved plasma glutathione levels in children with autism. Adding subcutaneous injections of methyl-Vitamin B12 (methyl-cobalamin) resulted in normalization of plasma glutathione levels.

James et al, Metabolic endophenotype and related genotypes are associated with oxidative stress in children with autism. *Am J Med Genet B Neuropsychiatr Genet.* 2006 Dec 5;141(8):947-56.

5) DMSA (chelation): Toxic metals such as mercury can greatly decrease the body's ability to make glutathione, so removing toxic metals by chelation seems to greatly help glutathione production.

Probiotics

The human gut contains a large number of bacteria (10x more gut bacteria than cells in the entire body). Most of these gut bacteria are beneficial, and help with food digestion, water balance, and limiting the growth of harmful bacteria and yeast.

Some children with autism have low levels of beneficial bacterial, and high levels of harmful bacteria and yeast. The harmful bacteria and yeast produce toxins that can severely affect mental functioning and behavior; alcohol is just one of many toxins that yeast can produce, and is a good example of a yeast toxin that can severely affect behavior. It seems that the best way to treat these problems is with a combination of antifungal diet, antifungal medications (if yeast are present) and probiotics (beneficial bacteria). These can help restore normal gut function.

One reason for dietary intervention in autism is to reduce the amount of undigested food that otherwise finds its way out to the lower small intestine and the large bowel. Undigested food in these locations promotes dysbiosis – the growth of abnormal and sometimes pathogenic flora. This in turn leads to mucosal inflammation, increased gut permeability, and entry of toxins and peptides to the bloodstream. Good-guy flora and dysbiotic, bad-guy flora are both killed by most antibiotics. The purpose of friendly flora supplements (probiotics) is to repopulate the gut with the good guys. If beneficial flora implant and flourish, then they can help keep the pathogens at bay.

Probiotics flora have a shelf-life – they are dying off daily in the jar whether refrigerated or not (refrigeration helps considerably but doesn't stop this). Beware of brands that "don't require refrigeration".

Some of the Many probiotics contain only a few billion or less Colony Forming Units (CFU's), but some strong probiotics contain 30-75 billion CFU's, and some prescription probiotics contain up to 500 billion CFU's. The higher-dose products are more likely to be able to reach the gut and recolonize it with good bacteria. If high-dose probiotics continue to be needed, this may suggest pancreatitis or other serious dysfunction may be present.

Duration: Use a high dose initially, and then consider a lower maintenance dose.

Testing: One simple and very useful test is to look at the stool, since half of the stool is bacteria. The stool should be a medium/dark brown and well-formed, with 1-3 bowel movements/day.

Use Antibiotics only with great caution: One round of oral antibiotics typically kills off over 99% of beneficial gut bacteria, but has little or no effect on yeast or many types of bad bacteria, which then thrive due to lack of competition from beneficial bacteria. Oral antibiotics often cause overgrowths of bad bacteria and yeast, and are suspected as the cause of many of the gut problems in autism. Several studies have shown that children with autism had, on average, a much higher usage of oral antibiotics than typical children in their first few years of life.

Adverse response to Probiotics?

Despite our intention to use most probiotics for healing and maintenance of intestinal health, these organisms can displace other (dysbiotic) or pathogenic flora. Toxins from their die-off can evoke symptoms, and one course of remedial action is use of oral activated charcoal. Symptoms of headache, hyperactivity, temporary diarrhea, stinging and irritability are not uncommon but should resolve in a week or so if intestinal dysbiosis is the problem.

Chelation

Glutathione is the body's primary defense against mercury, toxic metals, and many toxic chemicals. Many autistic kids have low amount of active glutathione and a higher fraction of glutathione is oxidized (inactive). A low level of glutathione results in a higher body burden of toxins. Also, many children with autism had increased use of oral antibiotics in infancy, which alter gut flora and thereby almost completely stop the body's ability to excrete mercury. Normalizing glutathione, restoring gut flora, and removing toxic metals often results in reduction of the symptoms of autism.

Preparation for Treatment: Prior to beginning chelation, it is important to first prepare the body for it. This includes:

- 1) Reducing exposure to toxins (organic food, reverse osmosis water, no mercury fillings, avoiding pesticides, etc.).
- 2) Improving levels of essential vitamins and minerals
- 3) Improving glutathione levels
- 4) Treating gut dysbiosis

Testing:

There are several good ways to test for heavy metal toxicity. They include:

- 1) **Urinary porphyrins:** This test checks for abnormal levels of porphyrins in the urine, where different porphyrin levels appear to correlate with body burden of mercury, lead, or other toxic metals. See <http://www.labbio.net>
- 2) **Challenge dose:** Give a trial of DMSA or DMPS, and measure the level of toxic metals in the urine before and after taking it. A large increase indicates that the metals are present, and that the medication is helpful in removing them.

Hair, blood, and unprovoked urine testing only indicate recent exposure to toxic metals, and are NOT useful in determining past exposure. Children may have a high body burden but a low level in their current hair, blood, or urine.

Treatment: The chelation treatments recommended by DAN! include DMSA, DMPS, and TTFD.

DMSA: Oral DMSA is approved by the FDA for treating lead poisoning in children. Some of the compounded rectal suppositories also appear to increase excretion of toxic metals.

Safety: DMSA only slightly affects excretion of most essential minerals, so a basic mineral supplement can compensate for this. The exception is that the first dose of DMSA removes a significant amount of potassium (equivalent to that in a banana), and that is not included in mineral supplements, so 1-2 servings of fresh fruit or vegetables should be consumed to restore potassium levels. DMSA also significantly increases excretion of cysteine, so that should be supplemented before and/or during therapy.

DMSA has a small chance of increasing liver enzymes or decreasing blood cell count, so those should be monitored during treatment.

DMPS: DMPS is not approved by the FDA, but a physician may have it legally compounded for IV, oral, and rectal use, all of which increase excretion of toxic metals.

Safety: DMPS slightly increases the excretion of some essential minerals, so a basic mineral supplement is recommended to compensate for this loss. It is unknown if it causes a loss of potassium.

DMPS has a small chance of increasing liver enzymes or decreasing blood cell count, so those should be monitored during treatment.

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