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PROTEIN MALNUTRITION

Details

Written by Richard Hillman, M.D.

Published: 17 July 2009

The Dec. 1992 issue of the Organic Acidemia Association Newsletter printed an article on protein malnutrition written by Dr. Hillman of the University of Missouri, Columbia. I asked Dr. Hillman to adapt the article for our Newsletter. He kindly answered my request.

It is important for parents and older children with MSUD to understand the basics of protein nutrition. This knowledge helps in understanding the importance of the diets and formulas (medical foods) for persons with MSUD. If you have questions on this subject, please discuss it with your nutritionist or doctor.

Malnutrition (or under-nutrition) can involve any of the groups of nutrients that are necessary to sustain life and to maintain growth in infants and children. It may involve protein, calories, minerals, or the co-factors for enzymes that we usually ingest as vitamins. Children can have a generalized lack of all nutrients, or a deficiency of a specific nutrient or group of nutrients.

In most children with MSUD, because of the nature of the disorder and its dietary therapy, nutritional problems usually involve proteins and their component parts, the amino acids. For that reason, this discussion will be limited to protein and amino acid malnutrition.

Proteins are associated with all forms of life and have many different functions in the body. Proteins act as catalysts for most chemical reactions, as the structural support system which holds everything together; as hormones, as antibodies, and as carriers of other vital substances in the blood stream.

Proteins are formed by joining component parts, called amino acids, into chains. The human body does not have the ability to produce some of these amino acids and they must be ingested from vegetable or animal sources. These eleven amino acids are called essential amino acids. They include the three branched-chain amino acids, leucine, isoleucine and valine. An additional nine amino acids are necessary to make proteins. Because the human body can make these, they are considered non-essential amino acids.

Some of these amino acids are made from essential amino acids, others from carbohydrates or fats. Although some essential amino acids are stored in the body, the amount that is stored is only adequate for a few days of fasting in an adult, and is totally inadequate to sustain growth in an infant or child.

When proteins are ingested from any source, they are broken down into individual amino acids. With very little exception, only the amino acids can be absorbed. Since the amino acids are the same in animals or vegetables, the source of protein is usually not important. It is important, however, that an adequate amount of all the essential amino acids be present. A normal adult consumes about 100 gm of protein each day and recycles about 70 gm of body protein. Each day about 10 gm of protein is lost in the stool, so about 160 gm of amino acids are utilized daily.

To understand the treatment of MSUD, it is necessary to know the varying fates of amino acids once they are absorbed into the body. Amino acids can be used: 1) to make new proteins and cells; 2) to make other important compounds needed by the body; 3) as a source of energy.

Firstly, amino acids are incorporated into new proteins. Body proteins and body cells are constantly replaced. However, different proteins and cells turn over at very different rates. Some have to be replaced in very short periods of time (hours) and some need only be replaced after very long periods (months or even years). Also the need for amino acids to make proteins varies with the body's growth and activity. Thus, if a person ingests a relatively constant amount of protein, some of time the amino acids will not be needed and will be burned for energy.

Secondly, some amino acids are used to make other important compounds within the body. These include genetic material, compounds that serve to excrete wastes, and many of the chemicals that make the nervous system work.

When amino acids are present in excess, or when they cannot be utilized because of imbalances (discussed later), they undergo a third fate. This is the breakdown of amino acids into organic acids to be used as energy. Most children with organic acidemias have blocks in their ability to "burn" organic acids and these accumulate. In MSUD these are the compounds which produce the acidosis and give the distinctive odor.

How much protein is necessary? Many different techniques have been used to estimate the protein requirement in a healthy human. Despite the variation that comes from different methodology, it is estimated that the so-called average man, weighing 70 kgs. (154 lbs) needs about 0.5 gms of protein per kg per day to maintain his/her body. To be safe, a minimum of 56 gm of protein or roughly 0.75 gms per kg per day is recommended. In comparison, the needs of the growing child are much higher. At birth, the child needs over 2.0 gms per kg per day to maintain growth. This amount gradually decreases with age but is always higher than the adult figure until growth ceases after puberty. The present recommendation of the World Health Organization is to maintain 1.8 gms per kg per day in the growing child after the newborn period. Other groups have recommend more.

All of these listed protein requirements in man are based on the assumption that the ingested protein is ãbalancedä and contains adequate amounts of all the essential amino

acids. The standard for an ideal protein is the casein in human milk. It is assumed that the ratio of amino acids in human milk is ideal and all computations of the ãqualityä of protein are made by comparison of the amino acids with those in casein. Thus, it is recommended that vegetarians eat beans with grains because the mixture of the two sources of protein provides amino acids in roughly the balance found in milk. Remember that only the amount of amino acids is important, not their source or sources.

Balance of amino acids is important because of the way that proteins are made. Proteins are manufactured like a long set of beads. Each bead is an amino acid in a particular pattern. The amino acids are added one at a time so that if the next amino acid is missing the process stops. If a particular amino acid is in short supply, even if all other amino acids are present in excess, the body cannot replace its proteins. The amino acids that can not be used to make protein are then used for energy. Under-nutrition with a single amino acid is functionally equivalent to total protein malnutrition.

How does this relate to protein malnutrition in children with MSUD? All people must ingest enough amino acids to maintain their body proteins, and, in children, to allow for growth. Because the newborn grows so rapidly, the diet of an infant with MSUD may not be very different from other infants (all amino acids are used for growth). Indeed, some infants with MSUD will not become ill until their growth rate slows at several months of age.

Most people can eat protein in excess because any extra can be burned to provide energy. The child with MSUD cannot burn a particular group of amino acids without producing a toxin (the organic acids) that can made them quite ill. However, they still need enough of the amino acid for maintainence and growth.

Thus, those caring for these children are faced with a difficult balancing act of providing just enough of the branched chain amino acids, but not too much. The requirements for these amino acids can be quite low in children with MSUD. In many cases, complete protein must be limited or a deficiency of the other essential amino acids would occur if they are not given by some other means. The special formulas provide the other amino acids as well as the vitamins and minerals that may be deficient on such a very limited diet. The balancing act is particularly difficult in infants and children because they do not grow at a constant rate, or if they have been sick, may have a period of rapid "catch-up" growth. It can be very difficult in older individuals because they may refuse to take the special formulas. Particularly during the early years the diet can only be regulated by constantly monitoring growth and blood levels of amino acids.

Because proteins and cells turn over at different rates, different parts of the body and different proteins are affected at different times in children with under-nutrition. The single most sensitive index of protein nutrition is growth (length, not weight). Usually growth rate will fall before many other problems are seen. Often skin problems (rashes or breakdown) will occur as an early sign particularly in areas that are irritated for other reasons. Gastro-intestinal (GI) problems are common because the surface of the intestine is one of the most rapidly replaced cell surfaces in the body. GI problems can then make the condition worse by leading to poor absorption of nutrients. If the condition continues long enough, the bodyâs ability to fight infection may decrease.

It is impossible to maintain these children without constantly monitoring them in some

fashion. Their amino acid needs are not constant. A flexible dietary prescription to meet the needs of the individual child is crucial. Overall, the increasing success in maintaining children with MSUD on these strange and difficult diets without malnutrition is a tribute to the art and science of the parents, nutritionists, and physicians who care for them.

FAMILY HISTORIES - JASON KENDALL

Details

Written by Joyce Brubacher

Published: 17 July 2009

Jesse and Jason are twins. Jason has MSUD, Jesse does not. Following is an account of Jason's diagnosis and progress as written by his mother, Deborah Kendall in a letter to me on Jan. 9, 1993. Thanks for allowing me to share this with our readers, Deborah.

I have been in possession of a Newsletter from your group for quite some time, but have been hesitant to write. The following is a brief history of our experience with MSUD.

Jason was born October 10, 1989 at 30 weeks gestation. He was second of twins and our fourth child (all boys). His first months were marked with what, in retrospect, were classic symptoms of the disease (poor feeding, lethargy, unresponsiveness, irritability, etc.), but all his symptoms were written off to prematurity. His progress was always a little slower than his brother's, but the difference became more pronounced at approximately 15-18 months. By 22 months, our doctor (family practitioner) felt that Jason's developmental delay was severe enough to warrant evaluation by a specialist. (I had asked about the strong odor of body fluids a couple of times, but was told it was probably due to "body chemistry.")

The neurologist we were referred to (Dr. Joseph Casadonte, All Children's Hospital, St. Petersburg, FL) ordered a number of tests, including a CT scan and an MRI, both of which indicated a metabolic disorder. After several blood tests, Jason was diagnosed with MSUD, and we were referred to Dr. Terry DeClue, a metabolic specialist at the University of South Florida, Tampa. Dr. DeClue gave us a more detailed diagnosis of Intermediate MSUD with enzyme activity of 1%. Both Dr. DeClue and Pilar Goldstein, Jason's dietitian, have been God-sends. They have been with us each step of the way and are always available to help with any problem or to answer any question no mater how trivial.

Because Jason was diagnosed at such a late age (2 years), some permanent damage had already taken place. We do not know his long range developmental outlook. When diagnosed at 24 months, Jason tested at approximately a 9 month level, developmentally. After starting treatment, the change was immediate and very dramatic. When re-evaluated at 36 months, he tested at approximately a 22 month level; so his progress thus far has

been very good.

We pray that Jason's health will continue to be good; no illness related hospitalizations since birth, only minor illnesses; and that his developmental progress will continue at its present pace. We include him in all of our activities and strive to make his life as "normal" as possible. Jason is a great blessing to us and has taught us that sometimes the Lord sends his greatest blessings through our worst experiences.

We would be interested in hearing from other families whose children were diagnosed at a later age. We are interested in how their developmental progress compares with children who were diagnosed at an early age. Also, if there are any other "home school" families in the group, we would love to hear from them. We are looking forward to hearing from you and being a part of the support group.

FAMILY HISTORIES - AN ANGEL FROM HEAVEN

Details

Written by Joyce Brubacher

Published: 17 July 2009

Reuben and Martha Newswanger are the parents of Lois who has classic MSUD. Martha is the daughter of Ivan and Katie Fox whose 10th child was their only child with MSUD. Now Martha is challenged with her first child, and finds her previous experience with her sister very helpful.

"She looks like an angel," I said to my husband one morning. Hair freshly washed, hanging just below her shoulders, a blue dress which matched her eyes; she was an angel sent down from Heaven, entrusted in our care by a loving Father above.

Lois, our first child, was born on March 25th of 1991. A dream come true; we were joyous as we took our little girl home the next evening. After a night only new parents experience, we were ready to settle down to a routine of baby needs.

Since I have a sister with MSUD, we were aware that we should be concerned. Arrangements were made to send a blood sample directly to Dr. Holmes Morton as this was a high risk baby. Reuben, my husband, had not taken a carrier screening test, and he referred to these hassled arrangements made by my parents a few weeks before the baby was due, as making a big issue out of this.

Before we left the hospital, the baby's doctor told us we should call his office if we hadn't heard from them by 2:00 the next day. At 1:00 the next day, after an attempt to breast feed the baby (she had a really hard suck, and I was so sore since I didn't have milk yet) I

remembered the doctor's words. The phone rang. It was the doctor's nurse saying the MSUD test was positive, and we should come to his office right away.

Not until I hung up the receiver did the words sink in. There were many questions then which are still unanswered, but our lives have been enriched.

With the extra special care all of her 21 months, she has so far been spared a hospital stay. Much credit goes to Dr. Holmes Morton at The Clinic for Special Children and Dr. Duane Dilling, our family doctor. My parents, Ivan and Katie Fox, have also been a great help and stand-by support. I realize I cannot fully know how it is for new parents who are unfamiliar with MSUD.

A while ago, while paging through my pack of copied Newsletters from "before our time", I was reading the June 1989 Newsletter and felt compelled to share our story. We feel thankful for this blessing bestowed on us. The care of MSUD is different from what it had been; in so many ways:

1. The 2,4-DNPH and Ketostix; ways of monitoring levels at home; have only been positive twice so far. Neither was during a sickness. We also depend on checking pH levels.
2. The faster, accurate blood test work in the first year, readily gives the parents assurance and helps the doctor direct a strict monitoring program. We do not have to deal with an irritable, high-strung baby. If the 2,4-DNPH gets even slightly cloudy, or if the child gets more hyper, we can do something about it.
3. So many newly introduced foods also make this diet more interesting and challenging for the mother. We have learned that in order for the child to have an appetite for other foods, the right amount of formula is important. Formula is filling. On a well day, Lois will take 22-26 ounces of formula; MSUD Diet Powder. This is less than when she was a baby and not eating other foods. She'll drink formula at various times during the day and some with each meal.

   For breakfast she may have hashed potatoes, Cream of Rice with honey and Farm Rich, and also a dry cereal or raisins. I can use plenty of substitutes!

   When I start preparing lunch or supper, she'll want part of a rice cake. She thoroughly enjoys her lunch of potatoes and a vegetable with added butter. She just started eating plain fruit, although she had liked fruit jam.

   For supper I make her a homemade soup, potato or tomato, etc., or more handy; diluted Campbell's soups with low protein rusks for her crackers.

   Last, but not least, there are many things that add different flavors to a meal. Children's tastes vary. Lois is no bread eater yet, but I am glad she started liking her cookies.
4. They can grow the way they should; normal and healthy, mentally and physically. Lois was sitting alone at 4 1/2 months, crawling at 6 months, and walking at 10 months and 1 week old. We started her on baby rice cereal and applesauce at 4 months of age. To this day, she is a terrific eater!

At 20 months she would sit patiently lacing and unlacing her shoes; sometimes to Mom's disgust. Now at 21 months, she's potty trained and saying some three-word sentences. She weighs 33 lbs. and is 34 1/2 in. tall (her daddy is 6 ft. 2 inches!). To us, Lois is just like any typical, almost-2-year-old. She just needs her own special foods.

We feel thankful that God saw fit to bless us with another baby girl. Karen was born on July 9th of 1992. These two girls get compared more so than other sisters. Each day still has its struggles, but we have so much to be thankful for. We are just like any normal, healthy family!

FAMILY HISTORIES - JULIA SAUNDERS

Details

Written by Julia Saunders

Published: 17 July 2009

My most humble apologies to Julia. I was eager to print an account of her accomplishments and had asked Julia several times to write for the Newsletter. At the Symposium last year, her mother handed me this letter written by Julia on June 2, 1992. How I managed to put it in a wrong file and forget it, I'll never understand. So I am printing it now, although the news is a little outdated. Julia will be graduating from college with a degree in communications on May 8. Congratulations Julia, and thanks for sharing with our support group so we can rejoice with you.

Hi, my name is Julia Saunders and I'm a senior at Grand Canyon University in Phoenix, Arizona. I'm a communications major and a history minor. I was originally going to be an elementary school teacher, but due to the stress and amount of work involved in pursuing this degree, I decided to switch majors in December, 1991.

College has not been easy, but I've learned a lot. I've maintained a GPA of 2.92 for the last semester and plan on graduating next May with honors. I plan on pursuing a career in journalism and am going to grad school in the fall of 1995 to obtain a masters in journalism and education.

This summer I am taking Group Discussion, Desktop Publishing, and Advanced Composition. I work parttime in the bookstore on campus. I enjoy working on campus because it is fun, and I have easier access to the computer lab and the library. It also makes getting to know people easier.

I was born September 4, 1969 to Patrick and Phoebe Saunders, who already had a fourteen month old daughter with MSUD. I was tested for the disease when I was a week old. Upon discovery that I, too, had the rare metabolic disease, I was taken to the University of Colorado Medical Center and spent the first three months of life there.

I'm now twenty-two years old and lead a relatively healthy life, except for an occasional cold, flu, or allergy attack. This spring had been the worst for my allergies. In February, I had a hard time breathing and went to my doctor. She told me that it may be asthma and put me on an inhaler. I went back several times and was told that I had a slight case of asthma brought on by allergies, so I use two different inhalers. One prevents the attacks and the other helps me breathe easier when an attack hits.

SHAYLA AND HER MRI

Details

Written by Joyce Brubacher

Published: 17 July 2009

Shayla had an MRI taken at the University of Michigan Medical Center on Jan. 14, 1993 for the purpose of research. Her doctor, Dr. Richard Allen, reported no MRI abnormalities. The white and gray matter and ventricular size were all normal. Her dental braces did degrade some of the signals around the base of the brain and brain stem. The results were nonetheless adequate to prove 99% normal. Shayla gives this account of her "ordeal."

When my Mom first talked about taking an MRI, I imagined a big, scary machine. These experiences didn't bother me when I was younger but now that I'm older I was uneasy that the test might hurt me or cause damage. I had a queasy stomach on the way to the medical center, because I was very worried, but I didn't tell Mom.

I wanted Mom to come in with me for the test. She planned to until she learned she would have to undress, put on a gown, and remove all the pins from her hair. She didn't think it was that necessary. I thought it was!

I climbed on a stool to lay on a long, narrow table which looked much too small for me. They pushed me toward the machine, which was as big as I excepted it to be. It reminded me of the igloo I made one time in school. I entered into the hole of a long, narrow tunnel where something like a football helmet was put over my head. Then the nurse gave me ear plugs to put in my ears since I previously had damage to my eardrum. I soon found out why. When they turned on the camera, it made a very loud noise. It sounded like a bass drum or the boom of thunder during a storm. The noise was interrupted at intervals to let me rest for a few minutes at a time. It was not fun!

I had to lay very still for an hour. If I moved, the pictures would get blurry and they would have to take them over. I did not want that! I was glad I could see through the football helmet glass and see the nurse who was giving me the test. That helped keep me from getting claustrophobia.

I was afraid I couldn't lie still for that long, so they gave me a sedative. It didn't put me to sleep because I fought it. They told me I would come out of the other end of the tunnel, and I believed them. I wanted to be awake when that happened!

They had been teasing me, and I was taken out of the tunnel the same way I went in. I learned that this procedure was not dangerous and I could have relaxed and found it interesting. I hope others will not be afraid if they need to have an MRI.

MSUD AND TRAVELING

Details

Written by Joyce Brubacher

Published: 17 July 2009

At the 12th Conference of the Association for Neuro-Metabolic Disorders held in Ann Arbor MI on Oct. 17, 1992, the mother of a child with PKU, Karen Riggle, told of her experience traveling to England and living there for several months. She learned problems can be encountered when taking formula from one country to another.

Medical foods can be confiscated by custom officials or subjected to a high value tax or customs duty. To ship medical foods, you need someone to receive them and they could still be confiscated. (The Parmar family from England, who attended our Symposium last year had their formula confiscated by US customs. It caused some very uneasy times for them.)

Karen solved her problem with the help of Ross Laboratories, who supply Maximaid XP, the formula she uses. Since it is made in Liverpool, England, arrangements were made to have it supplied more directly. She needed a prescription from her doctor because the same brand name formula was a little different in that country. They learned it was easier to take low protein foods with them even though they were available in England.

It is wise to plan ahead to avoid problems at customs. Check with your medical professionals for help with formula and special foods.

PERSONALLY FROM THE BRUBACHERS

Details

Written by Wayne, Joyce & Shayla Brubacher

Published: 17 July 2009

Shayla is spreading her wings - she obtained her drivers license. I asked her how it felt to drive alone for the first time. I thought it might have been a little scary. She said, "IT WAS GREAT!" She is a part-time volunteer at a local nursing home and enjoys helping with activities for older persons. Although she is not quite at the 23 year old maturity level, it is wonderful, but scary, to see her attaining independence.

Shayla had been experiencing some headaches, dizziness, weakness and problems at times with her eyes. She passed out one day in the shower. Random tests showed very low sugar levels. Eating smaller meals more frequently seems to be alleviating the problem. We are puzzled as to why this problem developed. Our local doctor thinks it may be the result of her weight gain over the last several years. Have others experienced anything similar?

During the middle of April, two phone calls again confirmed the importance of early diagnosis of MSUD. One call was from a genetics counselor asking for information for a family whose very sick child was just diagnosed at 1¸ wks. of age. The other was from Sandy Kiel telling of the birth on April 12 of a healthy 10 lb. baby boy named Jesse Ryan.

Sandy had an amniocentesis at 4 months of pregnancy. She and her husband Carl knew this baby would have MSUD. The medical center in Ann Arbor had prepared her local doctors and hospital personnel so that all went smoothly. Jesse was started on Mead Johnson MSUD Diet Powder on the first day of life. On the second day 10 cc of evaporated milk were added and 5 cc were given 3 times a day for the rest of the week. He has been a very contented baby in contrast to their two year old Jenna who was diagnosed through the Michigan State screening program at 5 days of age and was very fussy until her levels were under control. (See Jenna's history in the Nov. 91 issue.) Jesse's leucine level stayed in the 2 mg/dl range the first 24 hrs., and he was continuing to do very well at one week of age. In contrast, Jenna's leucine soon elevated to over 20mg/dl.

Starting a baby on MSUD formula immediately after birth is the best prevention of problems for these children. Few have this benefit. It requires prenatal screening or testing immediately at birth for at risk infants. It is unfortunate that carrier screening research is hindered due to lack of funding. There is work for us to do. All children with MSUD should have the opportunity to live normal, healthy lives. Let us work toward this goal.