Overview and Integration of Cellular Metabolism

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Lecture 59: Energy metabolism and Nutritional disorders, Protein Energy Malnutrition and Dietary Fibres

Hello everyone, welcome to the penultimate lecture on Overview and Integration of Cellular Metabolism. We are in class number 59 and today we will be covering energy metabolism, nutritional disorders, protein energy malnutrition, dietary fiber.

So these are the concepts that you can expect from today's class. We will be discussing nutritional indices, we will be discussing the various food items and the role we will be discussing about dietary fibers, glycemic index, nitrogen balance and various nutritional indices regarding to nitrogen balance and how to formulate a diet as well as many nutritional disorders. Now I would like to say that this slide has got a lot of content that is covered ok. However as you know many different types of audience are consuming content via LPTL platform.

So the factual information contained in this slide will cater to a lot of audience, special nutritionists and dieticians alright. However I will orate my slide keeping competitive examinees in mind. So maybe I will be breezing through few contents, but you are free to pause the slide, note whatever information is available because anything and everything might appear important in your clinical practice alright. But I will be highlighting every aspect that can come as a potential question. So to start with our first area of discussion will be nutritional indices and the very first nutritional index that we will be discussing is calorific value.

Now you all know the definition of calorie that is the amount of heat required to raise the temperature of 1 gram of water by 1 degree that we have already read in our physics classes right and for medical purposes we represent this value in kilocalorie because so much of calories are involved. So how do we determine the calorific value of any ingredient? It is by completely oxidizing that said ingredient in a bomb calorimeter. This is an MCQ how do you measure calorific value and similarly nutrient will also be oxidized in presence of oxygen and it will be burnt completely oxidized in a bomb

calorimeter and thus the calorific value which is also known as energy density for that nutrient can be achieved. Well this is the standard value and there is a difference between what exactly the calorific value is obtained experimentally that is in vitro and it is in vivo alright this is what we get in our body. And you know multiple food items have got multiple calorific value I mean many food items have got the characteristic calorific value it is not possible to memorize each and everything right.

So luckily in today's date we can simply browse there are multiple websites that are available that will give you a specific food item with respect to your specific region for example in India something is available Bengal gram it may not be available in Africa their fava beans are available for example so you can check each and every items calorific value because it will be very important when you formulate diet. So all these principles will be required in later part of our discussion. Next index respiratory quotient how you can define it is a quotient means it is a ratio ratio of what carbon dioxide eliminated to oxygen consumed alright it is a dimensionless coefficient because since both carbon dioxide produced and utilized and liters per gram they mutually cross out each other. So different nutrients have got different respiratory quotient or RQ for example, carbohydrates have got an RQ of 1 what does it mean it means it indicates that each gram of oxygen consumed 1 gram of carbon dioxide is produced alright for a unit of carbohydrate. Similarly fats have got 0.

7 and proteins have got 0.8 however as you know in our diet everything is mixed up so an ideal balance that the respiratory quotient is 0.8 it is actually 0.82 to 0.85, but for exam purpose if the values are very close 0.

6, 0.7, 0.8, 0.9 the answer will be 0.8. You need to know something that whenever fat utilization increases RQ decreases so fat component when it is more in diet I mean when its utilization is more RQ will be less this is observed in diabetes in the lattice because carbohydrate consumption is hampered without insulin carbohydrate cannot be consumed there is excess carbohydrate in blood I mean glucose in blood, but it cannot be consumed there ketolysis happens alright ketone bodies are utilized and that is when the RQ is actually the lowest.

So RQ is lowest during ketolysis it is low in diabetic patients compared to normal individuals. One important trivia or quiz or MCQ whatever you need to you can say is oxygen consumption is measured by benedict Roth apparatus this is the benedict Roth apparatus this is how it look like is an illustration. So you should remember these points with respect to RQ. Next BMR basal metabolic rate you might be knowing what is BMR in that case you can very well skip to the next slide, but here I will be telling you few very important information that you need to know regarding definition. It is the energy

expense or spend or required by the body of an awake individual very important one is to be awake during rest what kind of rest physical emotional digestive rest alright to maintain what basic physiological function such as respiration circulation and cell production I am sitting just like that very lazy I am very close to BMR alright.

Whenever I am doing something it is more BMR is I mean the energy expenditure is exceeded than BMR ok and whenever I have fallen asleep it is reduced ok. So how can we measure BMR there are multiple method among them indirect calorimetry is the best method it is the most accurate method ok. There are multiple methods for example, bioelectrical impedance DEXA dual energy absorptiometry even body temperature can give us some idea about BMR, but that is less accurate the most accurate it is indirect calorimetry and the original equation that is Harris-Barre equation is actually historical it is what we mostly relate in text books it is the equation which define BMR in the first place, but later it has been modified I mean there are more accurate predictive equations now which can predict the basal metabolic rate based on our weight and height ok. Next what are the factors affecting body I mean basal metabolic rate these are all the factors that can affect basal metabolic rate age it is very high during active growth when growth stops BMR reduces ok. Sex males have more BMR temperature it BMR is high in cold much of the energy spent to thrive against the chilling environment ok.

Exercise increase and fever both increases BMR and hormonal status ok if there is in hormonal imbalance that also affects BMR for example, BMR becomes low in hypothyroidism and Addison's disease there are multiple other disorders, but these two are the most important similarly BMR becomes high in hyperthyroidism pheochromocytoma all this condition that lead to hyperdynamic circulation alright. Next index that we need to know is SDA specific dynamic action also termed as thermic effect of food or diet induced thermogenesis DET. So, the from these names it is very evident what does it mean means the energy expenditure beyond the BMR above the basal metabolic rate due to consumption of food. So, why do we need excess energy to when we consume food basically to digest to absorb transport and store the food material alright. It is a schematic diagram where you can see lipids actually very I mean increases the heat or a increases the energy expenditure very low compared to very less compared to carbohydrates and proteins, proteins have got the maximum SDA alright.

So, these things have to be kept in mind the SDA that is energy expenditure due to I mean for digestion has also to be kept in mind for micro adjustment of calorie whenever we are prescribing diet again we will keep that in mind this point should be kept in mind when we are formulating diet in a later parts of our discussion. So, that was all about nutritional index. Next we come to important nutritional ingredient. So, what is the first most important ingredient carbohydrate alright. Why carbohydrate we know a lot of

carbohydrate we have discussed chemistry we have discussed the metabolism integration in detail.

Main thing you need to know carbohydrate should consist of about 60 to 65 percent of the total calorie. It should contribute to that much calorie among the total diet ok that is known you have you must have read this in your school lessons alright majority of the diet consist of carbohydrate approximately 60 to 65. What we need to know now after we have I mean prior to you completing this course is carbohydrates also contribute to dietary fibre we are here to focus the role of dietary fibres in metabolism alright. So, what are dietary fibre they are actually indigestible carbohydrate ok. Indigestible carbohydrate are called dietary fibre the indigestible components of carbohydrate are called dietary fibres what do they help in they actually help in increasing the normal motility of GIT ok.

There are multiple factors we will be discussing again. So, it you know it is due to the dietary fibre which is actually beneficial to us and western diets that have got less dietary fibres have got higher incidence of diseases like colon cancer compared to Indians Indian diet average an average Indian diet has got lot of vegetables and fibres that is why the incidence of colon cancer is less compared to western countries ok. So, how does dietary fibre help us? Number one they maintain a healthy digestive system by increasing the bulk of stool mind its soluble dietary fibres they increase I mean they absorb water due to osmotic effect and they help in regularizing bowel movement and prevent constipation very important first and very most important point. Next what it does due to an increasing volume ok, it leads to a feeling of fullness and due to that it helps in controlling appetite we do not feel like eating again soon if a previous diet has got a more in I mean heavy dietary fibre content ok. And thus it prevents over weight ok weight management I mean those who are planning to reduce weight systematically should include a lot of dietary fibre in their diet ok.

It can help in reducing calorie intake. Next manages glucose levels because of the same thing number one it is preventing excess consumption of food right. Next it also slows down absorption of glucose. So, due to both of these factors number the first and the second factor it is actually helping diabetes patients. So, diabetic diet should have a lot of fibre content alright not only patient of diabetics those who are prediabetic those who are at risk even dietary fibres can help them as a part in essential part in their diet.

Next what they do they help in reducing I mean research studies have shown the dietary fibres reduce LDL. LDL you know it is a it is also termed as harmful or bad cholesterol because it I mean leads to impairment of cardiovascular health. So, cardiovascular health is improved when there is an excess or adequate amount of fibre in diet alright

nothing in excess is good adequate is essential low is harmful. Next gut microbiota gut microbiota is a branch in it is own. Now it has been shown that gut microbiome come I mean contributes to effective functioning of all organ system.

So, healthy gut microbiome gut microbiota if it is maintained it will help in improving immune function better nutrient absorption how does dietary fibre help that it helps as a pre biotic it is a food for intestinal bacteria alright. So, keeping all these points in mind it if you suddenly want to include I mean yesterday were not including dietary fibres now after attending today's class you are conscious and now you are increasing dietary fibre you should increase that gradually alright not one of a all of a sudden you are increasing a hell lot of dietary fibres it will be problematic. So, you can take the help of professional dietician to consult them to a gradually increase dietary fibres increase amount of soluble dietary fibre soluble indigestible carbohydrates in your diet also drink plenty of water along with that for your digestive comfort ok. So, here is a chart this is the actual I mean schematic representation of a dietary fibre their long chains of insoluble carbohydrates ok our body does not have the required enzymes to break them. So, cellulose hemicellulose lignin pectin this is showing their chemical nature and what are their physiological effects in I mean if you can I mean if you are including some of them that actually contributes to all the one or all of those features that I already just mentioned alright.

So, you can memorize them for MCQ purpose, but mind it the functions of all of them are more or less close to each other. So, this is how dietary fibre is actually affecting the metabolism. So, you can see what it is doing number it is increasing in terminal viscosity it is reducing gastric emptying alright, micronutrient absorption I told you it is slowing down absorption. So, postprandial glycemia the immediate rise of glucose after food is reduced ok. So, it decreases insulin secretion insulin sensitivity is increased mind it ok.

How insulin sensitivity is increased it is actually I mean the dietary fibres can be fermented into short chain fatty acids ok and that actually decreases hepatic glucose production and free fatty acid breakdown ok. We do not need gluconeogenesis in that way. Thus insulin sensitivity is increased, but insulin secretion is decreased not only that there are intrinsic effects of dietary fibres which are actually decreasing the energy palatability by increasing the chewing and mastication. So, what it leads to it leads to a satiation early satiety you feel like full even if you are not full. So, by decreasing the energy intake it actually promotes fat oxidation and decreases fat storage right.

So, post absorptive hypoglycemia is also decreased because insulin secretion is decreased. So, all of these factors ultimately is contributing to a decreased body weight ok. So, a big if you get a long question on effect of dietary fibres on energy metabolism

you can memorize and quote this diagram. If you miss out one or two points it is not that much penalizable, but just make sure your fundamental concepts are right ok. Next a very important part of carbohydrate carbohydrates in diet is glycemic index.

We must know glycemic index if we are prevailing to prepare a good diet. So, what is glycemic index you already know glucose tolerance. Glucose tolerance means when we prescribe or when we inject or feed glucose to any individual there is a rise of glucose I mean with time. It goes up on the first hour it comes down in the second hour and then goes back to normal third hour or beyond right. So, a glycemic index of any food or any carbohydrate is tested by comparing this area under curve or this glucose tolerance curve of 50 gram of that carbohydrate compared to what 50 gram of glucose will have done as a reference food ok.

So, this is the glycemic index curve you can see the food with high glycemic index. So, what is the what are the foods with high glycemic glycemic index that actually breaks down very quickly provides a lot of glucose and readily available sugar for example, all your favorite fast food french fries and processed foods canned beverages all those things ok very high glycemic index. Compared to that what are the foods with medium glycemic index those break down slowly not that much faster compared to food with high glycemic index our whole grain roti chapati bread are example of medium glycemic index food and fruits are very good example of low glycemic index food ok. They take a long time to break and deliver the glucose to the blood stream. So, if this is the curve comparing 0 hour 1 hour and 2 hour the rise and fall of glucose is very steep in foods with high glycemic index that is harmful food with lower glycemic index are always preferred ok.

So, area under curve of food of interest divided by area under curve of glucose 50 gram of each multiplied by 100 is the glycemic index again dimensionless. So, we can also get idea about glycemic index of many foods from these websites ok. There are multiple websites that are available I have quoted one from Harvard university and one from commonwealth foods ok I mean very well health dot com ok. You do not need to do much ok in your search engine you can just type glycemic index of foods and all these websites will prop up ok. These are peer reviewed websites the information are pretty accurate you are free to check in what foods are you consuming what is the total glycemic index you had today till you are attending this class ok very interesting.

Let us go ahead we now move on to lipids in diet. Lipids in diet lipids actually give us a concentrated source of energy why do we need lipid it is essential to absorb or for metabolism of all the fat soluble vitamins and essential fatty acids that are required by the body they needs to be met ok. 10 percent of the calories or 20 gram per day should

be provided by lipid that volume in that amount increases during pregnancy and lactation. So, special condition we need to keep in mind when formulating a diet ok. Visible fat actually means the fat that you know that these are fat lipid oil butter margarine etcetera that you are eating cheese those do contain fats and lipids ok oils.

What is invisible fat? That is fat that is present in other ingredients that you may not be aware of the fat that is present in egg, fish, meat, cereal, nut, oil seed whatever food you are consuming they will have some amount of fat. For example, cereal have got 1 gram of fat per 100 gram. So, if you are meticulously monitoring the amount of fat that you are taking these things should be considered. Luckily nowadays there are multiple applications or apps that actually will break down the total amount of nutritional ingredient that you consume you just need to incorporate the name of the food item and all the subsequent items will be broken down and will be shown right. So, one thing we need to know that is trans fatty acid.

What is trans fatty acid? You know cis double bond and trans double bond when the double H bond is present on the single side it is cis when it is present on both side it is known as trans H the on the double bond right on the both side of the double bond. So, trans fatty acid are actually harmful why they aggravate insulin resistance they adversely affect the endothelial function why when trans fatty acid is produced it is produced when edible also hydrogenated. Why edible also hydrogenated to increase the shelf life to prevent any rancidity process dairy product for example, margarine has got high trans fatty acid ok. They lower HDL than they elevate LDL.

So, harmful in all way alright. Mind it saturated fatty acid saturated fat raise serum cholesterol while unsaturated fat lowers it. So, we actually prefer unsaturated fatty acid in diet poly unsaturated fatty acid that is PUFA are preferred, but as I told you earlier nothing in excess is good right. So, the ideal content lipids should be about 15 to 20 percent total calorie that I told you sometimes 10 to 15 depends on the diet formulation and among them 20 to 30 percent may be poly unsaturated fatty acid. Why only this why not more because excess poly unsaturated fatty acid PUFA will is actually injurious they have a chance to produce free radical is a phenomenon that is known as lipid peroxidation by which excess free radicals may be produced and they may lead to damage ok. ROS reactive oxygen species I have discussed many times this term will be excess if excess PUFA is in diet.

Ideally the ratio of saturated fatty acid to monounsaturated fatty acid to PUFA should be 1 is to 1 is to 1. Also in to monitor the cholesterol intake which should be less than 250 mg per day right that was all about lipid we move on to protein. So, proteins are essential building blocks right and we have studied essential amino acid means amino

acid which needs to be mandatorily provided from outside. So, we need some protein in diet all right. How much 10 to 15 percent of the total energy is derived from protein ok and we need to keep that in mind.

However when adequate carbohydrate is present in diet the amino acids that are available that are produced by breaking down a protein are not utilized to form energy. They are utilized to either synthesize proteins or to synthesize other non essential amino acids ok. So, this is known as protein sparing effect of carbohydrate if you have got more carbohydrate you can spare some protein in diet. However during starvation amino acid may act as energy sources that have already been discussed because starvation metabolism has been discussed in detail. So, this is a chart showing recommended protein allowance among various age group and special cases.

So, there is a case for children up to 10 years adolescent boys, adolescent girls, adult pregnancy, lactation this values you need to memorize for multiple choice question purposes. And this also might vary from country to country and even state to state or even hospital to hospital institute to institute based on your diet formulary. So, be mindful you can stick to one standard WHO standard and code that as a reference when you are answering in exams ok. So, regarding the protein intake as per WHO it is 0.

7 to 0.75 to 0.8 gram per kg body weight per day ok. Why it is required for synthesis of all the essential amino acids that should be supplied ok essential amino acid should be supplied in diet for that we need protein because proteins will be broken down the components the essential amino acid will be broken down the proteolytic enzymes and from them non essential amino acid will be synthesized. In reality only three amino acid are dispensable means even if there is no protein in diet alanine aspartate and glutamate can be synthesized from pyruvate oxalacetate and alpha ketoglutarate. So, these are the direct products of transamination of these where three very important intermediates of carbohydrate metabolism. For synthesis of all other non essential amino acid we need some or the other essential amino acid alright. So, even if those amino acids are semi essential or non essential some form of protein needs to be provided in diet in order to synthesize them from some or the other source ok.

However, these precursor are available in plenty. So, now let us talk about nitrogen balance right. So, nitrogen balance deals about protein you know nitrogen the main source of nitrogens are proteins the amino acid the amino component of nitrogen. So, we need to eat protein in order to tackle the loss of protein. So, what is nitrogen? Obligatory nitrogen loss means the loss we cannot control loss in feces, loss in urine, loss via skin at approximately equals to 22 gram of protein. Also some amount of protein is required for synthesis of other protein that is not protein turnover and that is actually

very high in case of active growth.

So, adolescent pregnancy lactation convalescence that is healing from any illness nitrogen requirement is very high or nitrogen use is very high therefore, nitrogen requirement should be very high they should be supplemented with excess protein nitrogen. However as growth stops protein requirement also decreases. So, this is the nitrogen balance equation intake should be equal to urine plus feces plus tool I mean skin alright. The loss through those should be equated with the intake when those are the same body supposed to be optimal nitrogen balance. When nitrogen balance them I mean the excretion exceeds bodies in negative nitrogen balance, when excretion is less when the intake is more body said to be in positive nitrogen balance ok.

So, what are the factors that affect nitrogen balance? Growth you see all these factors growth, hormonal influence, pregnancy or healing as I told you whenever there is an active growth synthesis anabolism in body there will be positive nitrogen balance. So, nitrogen balance will be more or positive in this case. Hormones of course, certain hormones, hormones affect either ways for example, corticosteroid can cause a negative nitrogen balance whereas, hormones anabolic hormones like growth hormone, insulin, androgen they promote positive nitrogen balance. And conditions that are debilitating that are leading to weight loss, acute illness, chronic illness, protein deficiency all those cases are leading to negative nitrogen balance.

So, we need to be very mindful. So, how can we calculate the nutritional value of protein? It is very easy actually if you think in a way we can give protein as the only source of nitrogen to an animal and then calculate the weight gain it can be done in experimental animals ok. So, there are multiple essential nitrogen indices that should be learnt ok. So, we will be discussing four of them biological value NPU that is net protein utilization, chemical score of protein and digestibility coefficient of protein. The first two biological value definition retained nitrogen by absorbed nitrogen into 100 all of these are dimensionless. So, how do we calculate retained nitrogen? Nitrogen intake minus nitrogen output very easy and what is nitrogen output? Urine plus fecal and how we can calculate absorbed nitrogen? Nitrogen intake minus nitrogen that is excreted in feces ok.

Next NPU net protein utilization very easy retained by intake the amount of nitrogen that is retained to the ratio of amount of nitrogen that is taken multiplied by 100 that is NPU. Next we should know about the concept of limiting amino acids. You know certain amino acids are deficient in one or more I mean certain proteins are deficient in one or more amino acid ok. And if that particular protein is fed to an experimental animal it will fail to grow and that amino acid that is actually causing the limitation is

known as limiting amino acid ok.

This is the concept of limiting amino acid. We study the weight gain when feeding that only amino acid to the experimental animal. So, how can you overcome that? We can overcome that easily by a thing that is known as mutual complementation or supplementation of amino acid. We will select a protein which has got an amino acid that may not be present in other amino acid we can combine. For example, cereals are deficient in lysine, but rich in methionine ok. On the other hand pulses are deficient in methionine, but rich in lysine.

So, we can combine them. So, I mean common Indian diet rice and dal, chapati and dal when they are combined we can see they are behaving equally to a top class protein. So, the proteins which actually promote growth good well good growth that is known as first class protein where proteins that are limiting are known as second class protein they do not have all the essential amino acids. Now, when we can combine two second class protein their behavior act as the first class protein. So, this is the protein which has got all other all the essential amino acid ok. So, thus supplementation of protein may be seen in weight gain that is that has lead to weight gain animals thus proving the phenomena of complementary supplementation of medicine.

Next we see there is a list ok. These are the limiting amino acid in this these are the food items and the list says what amino acids are limiting and what amino acids can what foods can actually complement them if they are the sole source of component in diet. Next two scores that we are discussing chemical score of protein. So, how do we detect the chemical score? Milligram of limiting amino acid in 1 gram of test protein by milligram of the same amino acid in 1 gram of egg albumin multiplied by 100 right. Next digestibility coefficient of protein nitrogen absorbed by total nitrogen of the protein alright. So, how do we calculate total nitrogen absorbed again total nitrogen in the protein by nitrogen excreted in the feces ok.

So, these index indices are confusing if we just learn the monoflunar. So, it is extremely important you write them you practice them over and over again that way you can be very clear. Next part of our discussion will involve formulation and prescription of diet ok. So, number one rule see these rules can vary again from institute to institute, but more or less the general principles are same ok. So, what are the general rules? First the diet should be balanced. So, what are the principle general principle? Number one individually tailored ok it should not be same for everyone, number one you are prescribing a diet it has to have a variation.

It should be realistic and sustainable you cannot give some item that may not be that

may sound very good on day one, but on long term someone will give it up. So, it has to be realistic and sustainable, it has to be well balanced, the ingredients need to be well planned, we need to focus on the amount of carbohydrates to protein is to fat, it should be simple and locally available palatable. We should also consider limiting amino acid from considering essential amino acids cereal plus protein, total calorie intake, correct and balanced energy expenditure we should take into amount the SDA, we should provide adequate amount of nutrients macro and micro nutrients for example, iron calcium specially for Indian diet these sources are limited in Indian foods and absorption of Indian I mean Indian food habit hampered their absorption. So, they need to be supplemented in diet, they should include aliquotrophage that is dietary fiber and they should have variety not all the same should be same every day and they should be changed regularly.

So, regular monitoring and reviewed periodically should be done ok. This is number one general rule that should always be followed. The next thing is to determine what is the exact amount of nutrition or the calorie or the protein and calorie that is needed by the individual. It will vary from case to case what is our goal. So, diet should be goal oriented. If we are trying to treat an under nutrient case to gain weight, we should adjust the diet in such a way so that it has got excess 5 kilo calorie per kg body weight that has to be adjusted till ideal weight is achieved.

Similarly in case of over rate individual, we should reduce 5 kilo calorie per kg per day ok. These numbers are important and what is the ideal kilo calorie per kg per day? 30 to 35 kilo calorie per kg per day. So, we need to adjust depending on their physical activity occupation what they are doing, age, sex, health status everything right. So, these are the numbers for sedentary activity 30 percent of BMR, moderate work 50 percent heavy work, moderate work 40 heavy work 50 ok. Also pregnancy and lactation we need to consider what excess amount of kilo calorie should be added in that again it depend from country to country and you should consult your national guidelines for that.

Also one example calorie depending on excess what is the activity, what is the work I mean is you should take history what they exactly do or what is their goal. So, depending on many such online charts that are available also they are available in multiple textbooks, you can calculate the amount of extra nutrient that you need to include in order to maintain the balance or in order to adjust your weight loss or weight gain goal alright. Next what is the next rule? Calculate the proximate principles, proximate principles mean the total calorie that is needed in now the we know what activity they are doing whether it is overweight or under weight we now know the total amount that is needed right. So, next we need to adjust based on the amount of carbohydrate protein and fat, we already know what percentage should be there extra

other than that then we need to also add the pro I mean minerals, trace elements, vitamins, iron and calcium etcetera right. Any additional if it is needed roots and tubers can provide alright and we of course, I am repeating myself over and over again special condition pregnancy lactation or even diabetes should be considered when prescribing a diet because prescription diet is always goal oriented.

Next now that we know all of this now it is the time so that we can enlist the food items that are locally available based on their choices one by one we calculate what are the amount of energy that is available per food item. Similar food items can be grouped together that is in a food exchange someone can have roti one day and rice the next day to calculate variations similar items can be grouped together very important when prescribing or formulating a diet. And finally, when all of this is available they should be divided into three meals that is breakfast and lunch and supper. So, that actually are all covers all the principles that are needed for diet formulation. And finally, we move on to last phase of our lecture that is nutritional disorders common nutritional disorders include all of them obesity, starvation, protein energy malnutrition in the form of quasicor and marasmus anorexia nervosa bulimia nervosa vitamin deficiency disorder trace element deficiency disorder mind it whenever nutrition or some nutrient is absent in diet there will be deficiency disorders.

However, vitamins and minerals are not a part of this course we will not be discovering them there are other courses and future course may be this team will bring in order to cater that area ok. Malnutrition has been discussed in detail metabolic effects of starvation we all went through that class together right. Obesity also has been discussed in detail mind it malnutrition is generally synonymously used as under nutrition, but obesity that is over nutrition is also a type of mal or bad nutrition alright. So, that leaves us with the others ok. So, these are the few disorders which will be discussing today number one bulimia nervosa you do not need to know much it is again as part of behavioural eating defect ok.

Psychiatric disorder they often need professional help or therapy what happens in bulimia nervosa is an uncontrolled habit of eating after which the person or the individual becomes excess or conscious that they will gain weight and they use means of purging they use excess medication they reserve to vomiting. Very dangerous eating disorder it should it leads to many dreaded consequences in I mean symptoms and signs they should be easily treated and they lead to depression anxiety. So, mental health is jeopardized. So, in bulimia nervosa the person is eating more a contrasting situation, but yet psychiatric disorder is anorexia nervosa where there is a distorted perception of body weight. It is a very beautiful illustration that a lean and thin person perceives himself or herself as a it is mainly common in female population, but it can happen in males is they

think they are overweight and they reserve to extreme dietary habit they reserve to avoiding food items ok.

In order to maintain their health in order to maintain the lengthened condition, but what happens reality they are already emaciated. This is a very serious disorder again problem of mental health organ damage electrolyte imbalance weakened immune system and so many things that needs to be treated in a mental institute. Psychiatric health is required mental health treatment is required to treat anorexia nervosa alright. That leads us that leaves us with the last part of our discussion that is protein energy malnutrition this is a very serious disorder that is common in babies special in developing countries where there is a it is a term that is also known as earlier it was known as protein calorie malnutrition or PCM. There is a coincident lack of dietary protein and or energy why we say and or energy because there are subtypes in quasicor protein malnutrition is predominant by malnutrition we mean under nutrition alright very important it is also known as protein energy under nutrition.

Merasmus specific calorie intake is deficient and what is melasmic quasicor both I mean simultaneous protein and calorie are deficient it is the most severe form of malnutrition. You know the quasicor name it actually signifies these protein energy malnutrition disorders are very common in African countries and the term quasicor has been derived from a local language Ga tribe of Ghana which actually means the diseased of the deposed child it is of the earlier child means the sickness when the baby gets when a new baby is born why? In reality whenever the new baby is born all the taken all the I mean care is taken for the new baby and the old baby is not taken care of in such a way so that they undergo malnutrition right. So, what are the biochemical features the things that we are here for hypoalbuminemia happens in both special in quasicor and it value less than 2 gram per deciliter is a biochemical marker of quasicor. RBP retinal binding protein low immunoglobulin high due to increase infections fatty liver may be present in quasicor due to altered lipoprotein metabolism. Fat liver may not be present in marasmus serum free fatty acids usually high alright malnutrition body strength to utilize fats glucose tolerance is normal and decreased glucose potassium magnesium hypoglycemia hypokalemia hypomagnesemia.

In quasicor the total water content of the body increases up to 60 percent. So, the this is the difference I mean comparison compare and contrast between quasicor and marasmus. Marasmus younger babies less than 1 year it is a very severe form in younger, but quasicor I told you the older child some 1 to 5 years calorie deficiency marasmus protein deficiency in quasicor why it happens marasmus early winning repeated infection whenever we are early feeding the baby with winning food their absorption is not happening properly and malnutrition. Whereas in case of quasicor starchy diet after

winning creates a state of undercurrent malnutrition that is precipitated by an infection. Growth retardation is marked in case of marasmus, but not in quasicor attitude the child is irritable in case of marasmus and lethargic in case of quasicor. Appearance sunken eyes, eyes are inside and appear skin and bones you see in case of marasmus, but in case of quasicor the child may look plump it may actually falsely appear fat due to excess idiom or water content in the body.

Appetite is normal in marasmus, but anorexia that is a feeling of not I mean not willing to eat happens in quasicor. Other clinical features skin is dry in quas marasmus and there is a mosaic pattern that is known as pavement dermatitis present in quasicor. Here again sparse curly, curls may be lost in case of quasicor right. In case of marasmus there is muscle wasting whereas, in quasicor angular stomatitis, a chelosis are prominent muscle wasting is there, but it is hidden under the edema. Albumin as I told you both low in both cases, but less than 2 gram per dl is a sign of quasicor.

If we are I mean cortisol level that is increased in case of marasmus and decreased in case of cortisol level. So finally, what is the treatment of any type of protein allergy malnutrition? Supplementation with diet alright we need to supplement the calorie and the protein. For example, in case of India mixture of 3 parts of vegetable proteins or is a Bengal gram and one part of milk is very effective. Malnourished student tolerate fat very well.

So fat can be supplemented more and more initially to supplement alright. How we will know that protein allergy malnutrition is being treated specially in case of quasicor weight gain disappearance of edema, rise in serum albumin these are all the important markers of treatment of PM. And lastly what will happen if we do not treat PM, if we do not treat PM those are the sequelae that will lead to permanent and irreversible impairment both physical and functional there will be disability both mental and physical. So there will be mental retardation in babies not only that a history of PM in childhood may also affect intellectual abilities in adulthood. But the good thing is timely correction of moderate and mild cases may prevent any lifelong consequences. So, after this long class this is the conclusion we discussed about nutritional indices the nutritional value of all the food ingredients carbohydrate protein and lipids we discussed the role of dietary fibers we discussed glycemic index indices of nitrogen balance we discussed protein allergy malnutrition other nutritional disorders like anorexia and bulimia, narvosa.

These are my references for today's class and I thank you all for your patient hearing this was the 59th class this is the last time you are seeing me in this lecture session it was a wonderful journey to learn together to teach you all and of course, we will be seeing each other again in the live session. I thank you and we will see you there. Bye.