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The importance of adipose tissue

SSC Lipid work

1. Distinguish between emulsion particles and micelles in relation to the process of fat digestion and absorption.

The process of the digestion and absorption of fats relies upon the ability of the body to create an ampipathic molecule from a one, which is insoluble when taken in within the diet. Lipids are hydrophobic in nature, and as a result of this, when they enter the digestive system they are insoluble in the aqueous environment. For this reason, emulsion particles are created during the process of emulsification. This process breaks up the fat globules into smaller particles with a greater surface area for attack by enzymes. The emulsion particles are therefore small particles of lipid surrounded by bile salts, which help to prevent the re-aggregation of the lipid. It is from the emulsion particle that digestion can then be conducted as this process has now increased the surface are for lipases to work on the triacylglycerol (TAG). Colipases also help in the digestion of the TAG from the emulsion particles as they bind to the lipase enzymes and help to keep them at the surface of the emulsion particle thereby increasing their catalytic activity.

Micelles are the products of the digestion of TAG. After digestion, the resulting monoglycerides and fatty acids associate with bile salts and phospholipids to form micelles. The key differences between micelles and emulsion particles are the size of both, micelles being much smaller, and in the region of 4-7nm compared to the larger emulsion particle (1µm). The micelles also differ in their role in the digestion and absorptive process. Micelles transport monoglycerides and fatty acids to the surface of the enterocyte where they can be absorbed. Without the micelle particle, the contents could not be absorbed, as they are still insoluble and hydrophobic. The micelles themselves are not absorbed into the enterocyte, (where they will diffuse across the membrane), it is simply the content of the micelle that is.

2. Describe in detail **TWO** roles for bile salts in fat absorption and digestion.

Bile salts (BS) are bio-surfactants (Maldonado-Valderrama et al, 2010) playing critical roles in the digestion and absorption of fat through their ability to help to emulsify the fats present in the food due to the presence of the hydrophilic side and the hydrophobic side of the bile salt anion. In accordance with the literature, BS's are so-called facial amphiphiles showing a molecular structure that is very distinct from classical surfactants. (Maldonado-Valderrama et al, 2010)

These two areas of differing polarity can therefore enable the bile salts to surround the triglycerides taken in through ingenstion, and form micelles. It is within these micelles that the TAG gets transported through the body. The hydrophilic side of the bile salt faces the outside of the micelle and the hydrophobic side of the bile salt faces the TAG in the centre of the structure. This dispersion of TAG into micelles increases the surface area for which pancreatic lipase can act, which is responsible for breaking down the TAG into diacylglycerol (DAG) and fatty acids, monoacylglycerol (MAG) and fatty acids and finally glycerol and fatty acids.

Due to the presence of positively charged phospholipids such as lecithin making up the structure of the bile salts, the hydrophilic sides of the bile salts and thus, of the micelle particles are positively charged. This therefore prevents the re-aggregation of fat droplets through stabilizing their presence thereby improving the bioavailability of lipid soluble nutrients. (The second role of bile in fat digestion) The literature also highlights the importance of the bile salts in reducing the absorption of saturated fats, cholesterol and trans fats. (Bauer et al, 2005)

3. Describe **TWO** conditions which might give rise to free glycerol being formed in the intestine during TAG digestion?

As the digestion of TAG is related to the length of time that lipases have to access the TAG molecule and in which to exert their function, and break the biochemical bonds between the molecules, the factors which will effect the products of digestion, whether these be, DAG and free fatty acids, MAG and free fatty acids or glycerol and free fatty acids will be dependent on the length of time the TAG has in the intestines (Mu and Høy, 2003**).** Therefore, any disease which increases the length of time of the TAG in the intestine should, in theory, lead to increased levels of free glycerol being formed as this is the final break down product from TAG digestion. Therefore, two conditions which increase the access of enzymes to the TAG include cancer of the bowel, (Prentki and Madiraju, 2008) which would provide an obstruction in the bowel and therefore increase the duration of time that the digestive products remain present, irritable bowel syndrome (IBS) would also increase the length of time that food is present, therefore increasing the time for which lipases can act to break down the food further. Other conditions could include constipation or crones disease.

4. What is the importance of colipase in the fat digestion process?

Colipase is important due to the fact that it opens the active site of the PTL enzyme so that it can work in digestion of TAG. It also protects pancreatic lipase from denaturation from bile salts.

5. Describe TWO conditions which might result in steatorrhoea

Any disease which decreases the transit time of TAG through the intestine will lead to less time for the absorption of fats and this in turn will lead to steatorrhoea. Such diseases which can do this include celiac disease, as patients with celiac disease show an irregularity in the patterning of their small intestine, with a reduction in the number of villi present. This in turn means that the transit time of fats though the small intestine will be reduced leading to lower levels of absorption. (Townley et al, 1964)

Another condition which could be linked with steatorrhoea includes gallstones. (Simpson and Broek, 2008) Gallstones block the release of bile salts from the bile duct and as a result, this can decrease the absorption of fats from the diet due to the inability to emulsify the fat and to increase the surface area on which lipases act.

6. Where and how is lipoprotein lipase (LPL) localised in white adipose tissue?

In white adipose tissue LPL is localized in the luminal surface of the plasma membrane. The

enzyme is synthesized and secreted by cells of many varieties, most commonly adipose and muscle parenchymal cells. Once LPL has been synthesisted it migrates to the luminal surface of endothelial cells. Here it is anchored in the plasma membrane through attachment to heparan sulfate proteoglycans. (Casanovas et al, 2007) After a short period of time, the enzyme is degraded in a pathway called the endothelium-plasma-liver pathway. Hormones such as catecholamines modulate the expression of LPL and this in turn affects the tissues ability to metabolise and utilize TAG.

7. Explain how and why LPL activity in white adipose tissue decreases during starvation but increases in the heart.

LPL activity and secretion is controlled by the presence of insulin. In the presence of insulin, i.e. when blood glucose concentrations are high, in a well-fed state, LPL will be transcribed and LPL will be secreted onto the plasma membrane surface of adipocytes so that TAG can be stored for later usage.

During starvation, insulin levels are low, this means LPL will not be transcribed and thus, its cell surface expression in adipocytes and muscle cells will be reduced. This in turn will lead to higher levels of circulating TAG which can be taken up by the heart tissue as they will require the TAG to use it as a respiratory substrate during the low levels of glucose, i.e. during starvation.

8. What are trans-unsaturated fatty acids and where do they occur?

Trans-unsaturated fatty acids are fatty acids which are unsaturated, i.e. they have one or more double boned carbon molecules in their structure (carbon-carbon bonds). The presence of the double bond leads to a lower number of hydrogen atoms being present in the molecule as the double bond takes the place of two hydrogen molecules. The trans component of the molecules name comes from the fact that the two groups, which are present on either side of the double bond, are on opposite sides of the bond, which leads to a straight chain being formed.

The tans-unsaturated fatty acids are found in trace amounts of meat and dairy products from ruminants. These trans-fats are also found in hydrogenated fats and oils. They are not a requirement of the body and are considered to be inconsistent with good health, leading to diseases such as coronary heart disease (CDH).

9**. How do TFAs modify LCAT activity?**

lecithin:cholesterol acyltransferase (LCAT) is important in the creation of HDL and in the maintenance of the concentration of HDL. LCAT is the enzyme which is responsible for transferring an acyl group from phosphatidylcholine to the cholesterol which is free in the plasma. LCAT however, esterifes cis-fatty acids much more realidly than it does trans fatty acids. This is thought to be because of the positional specificity of the enzyme. The cis-fatty acids, fit into the active site of the LCAT and allow the esterification to occur and the subsequent combination of the fatty acids into HDL particles. Trans-fatty acids however have a different three-dimensional configuration, which impairs the action of the enzyme, thus preventing it from performing its role.

The positional specificity of the double bond is essential in how the TFA affects the activity of the LCAT (Subbaiah et al, 1998). It is thought that the presence of the carbon-carbon double bond in the 2' position inhibits LCAT to the greatest extent. In addition to the length of the carbon chains in the fatty acids. (Subbaiah et al, 1994) When the length of the carbon chain is increased beyond a certain threshold level, the TFA is not a suitable substrate for the LCAT, because the cis double bond reduces the length of the fatty acid molecule, however, a trans fatty acid double bond does not reduce the chain length as much, causing steric hindrance to the molecule and rendering it an unlikely substrate for the enzymes use and thus leading to an overall reduction in the number of HDL particles created.

10. What is the normal level of cholesterol in the blood?

When measuring cholesterol levels in the blood, it is thought that the total cholesterol/HDL ratio is the best measure to take for clinical purposes as it is more indicative of cardiovascular disease than a measure of the total cholesterol (TC) is. The amount of HDL and LDL in the blood are added together, this number for all practical purposes, and this indicates the amount of total cholesterol. For men an acceptable ratio of TC/HDL is 4.5 or below, and women is 4.0 or below.

In addition to the above, the average total normal levels of cholesterol level in the UK is 5.5mmol/l for men and 5.6mmol/l in women. However this is considered to be high and optimally the total cholesterol should be under 5.0mmol/l.

LDL levels in a normal individual should be less than 3.0mmol/l. according to NICE guidelines. (NICE, 2010)

11. What is the problem in familial hypercholesterolemia (FH) and what are the consequences?

Familial hypercholesterolemia (FH) is an autosomal dominant disorder, meaning that any individual who has one affected/disease allele will show a phenotype which expresses the condition. The presence of the diseased allele causes problems in an effected individuals cholesterol balance. FH causes an elevation in the level of both total cholesterol and low-density lipoprotein cholesterol (LDLc). (Ueda, 2005)

The problems found in FH arise due to the association of FH with the development of premature coronary artery disease (CAD) due to the absence of/ or the incredibly low level of expression of functional lipoprotein (LDL) receptors.

The LDL receptor gene is located on the short arm of chromosome 19, comprising a total of 860 amino acids. The LDL receptor is important for the uptake of LDL in the liver and is responsible for the removal of approximately 70% of LDL from the blood through the binding of the receptor to one of two ligands which are expressed on the surface of the LDL molecule: apolipoprotein B-100 (apoB-100) and apoE.

ApoE is present on the surface of most of the circulating lipoproteins including very low-density

lipoprotein (VLDL), chylomicrons, intermediate-density lipoprotein (IDL), and a subclass of high-density lipoprotein (HDL). In some cases, some mutations which are seen in patients with FH may still be able to uptake some LDL into the liver, as the mutation spares the affinity of the receptor for ApoE, thereby allowing the uptake of LDL into the hepatocytes. (Kane and Havel, 2001)

Over 700 different mutations in the LDL receptor gene have been found and published, all of which have differing effects on the functioning of the receptors encoded by the gene. The phenotypes range from a complete lack of receptor expression or functionality to approximately 25% of normal receptor activity. (Goldstein and Brown, 2001)
The literature lists five classes of mutations including: Class 1 mutations which includes null alleles resulting in the complete absence of the LDL receptor, class 2 mutations which show an expression of defective transport alleles, which disrupt normal folding of the receptor and cause either failure in transport to the cell surface or successful transport of truncated, mutated receptors. Class 2a mutations completely block the transport of the receptor from the endoplasmic reticulum to the Golgi apparatus. Class 2b mutations result in a partial blockade of transport of the receptor from the endoplasmic reticulum to the Golgi apparatus. Class 3 includes defective binding alleles that affect binding of LDL and, in some cases, binding of VLDL as well. Class 4 includes defective internalization alleles that affect the concentration of normal receptors in clathrin-coated pits for internalization by the hepatocyte and class 5 includes defective recycling alleles that prevent dissociation of the receptor and the ligand and thereby interrupt recycling of the receptor. (Pisciotta et al, 2006)

As previously mentioned, the overall effect of the disease is determined to the extent at which the individual is incapable of removing LDL from the circulation, which in turn, imparts their probability of developing early onset CHD, with the highest risk been observed in those with completely abolished function of the LDL receptor.

12. Describe three ways by which you could reduce blood cholesterol levels.

As cholesterol is taken in through the diet, the simplest way to reduce blood cholesterol levels would be to reduce the intake of cholesterol by choosing foods which were lower in cholesterol. This would mainly involve eating lower quantities of meat and animal products, eggs, cheese etc and choosing lower fat alternatives. Increasing the intake of fibre in the diet can help to remove cholesterol from the body through the faeces, and medications such as statins, bile acid sequestrants, nicontinic acid, and fibric acids can all be used to reduce cholesterol. (National Heart, Lung and Blood Institute, 2006)

13. Explain how adrenaline and insulin regulate the triacylglycerol-fatty acid cycle.

Adrenaline and insulin are two hormones which impact upon the rate at which glucose is taken into an adipose cell.

In the presence of adrenaline, there is a requirement for glucose by the muscles of the body and by the brain so that it may function in order to help the animal in the ‘fight or flight’ state. This

means, there is a decreased requirement for the storage of glucose in the cell and an increased need for lipolysis to occur to provide the energy required. Adrenaline has receptors on the surface of triacylglycerol molecules. The binding of adrenaline to these receptors initiates a cascade reaction, through the use of G-protein coupled receptors and the cAMP pathway. This ultimately leads to the phosphorylation of hormone sensitive lipase (HSL) by the Protein kinase (PKA) which acts on the TAG present in the adipocyte to break down the lipid store and release fatty acids and glycerol. These two products enter the blood wherein they can be used as a respiratory substrate in the mitochondria to provide energy via beta-oxidation (Fatty acids). In the presence of high amounts of fatty acids, the body will start to syntheses ketone bodies in the liver to supply fuel for the CNS. In addition to the action of adrenaline indirectly on HSL, through PKA, adrenaline also indirectly acts upon perilipin which is a protein found on the surface of a TAG droplet. This protein has a protective function, and prevents it from being broken down too rapidly, however, PKA phosphorylates perilipin, which causes the protein to 'drop off' the surface of the TAG droplet. This allows a greater surface area for attack by HSL, which leads to an increased rate of break down of TAG. This breakdown is of course regulated by the presence of insulin and through the intrinsic ability of G-proteins to regulate their own activity through the hydrolysis of GTP to GDP (which, when bound to the G-protein, restores it to its inactive form).

Insulin will be present in the well-fed state, in the presence of high concentrations of glucose in the blood. The binding of glucose to its receptors on the cell surface of an adipocyte causes the glut4 receptor to come to the cell surface membrane where it will transport glucose into the cell. This will then go via fructose-1,6-bisphosphate to dihydroxyacetone phosphate (DHAP) to form phospholipids which will in turn to used to make DAG and then TAG (the storage molecule of lipid in the cell). The presence of insulin also negatively regulates lipolysis through activation of the phosphadiesterase, which turns off PKA, thereby affecting the activity of HSL. Insulin also activates a protein phosphatase and de-phosphorylating HSL, again, inhibiting its action.

Hence, through the use the two hormones: insulin and adrenaline, the body can maintain blood glucose homeostasis.

14. Why is it crucial that WAT has no glycerol kinase activity?

In order to avoid a futile cycle which uses ATP without the production of any products, it is essential for WAT to have no glycerol kinase activity. If WAT had such activity then the glycerol which was produced from the break down of TAG would be phosphorylated by glycerol kinase and would then form a substrate for the synthesis of TAG once more. Therefore there would be no benefit gained from the breakdown of TAG. Without the presence of glycerol kinase in the WAT this means that the glycerol phosphate which is used to synthesise TAG must come from the glucose taken into the adipocyte, thereby ensuring that a futile cycle is not created and ATP is not spent without a gain.

15. What is the fate of glycerol released from WAT following lipolysis?

The glycerol which is released enters the blood stream where it can then be used in the process of gluconeogenesis in the tissues of the body which have glycerokinase activity such as the kidneys.

(Berman et al, 2004)

16. What are ketone bodies and why are they important fuels in starvation?

Under low blood glucose concentrations, ketone bodies are produced by hepatocytes to be used as a respiratory substrate to provide energy through the breakdown of fatty acids. The fatty acids are broken down in the mitochondria of liver cells when there is a low blood glucose level observed. The process of beta-oxidation forms acetyl-CoA which would typically be oxidized in the citric acid cycle to yield NADH, $FADH_2$, GTP and ATP, however, if there is a low level of the other intermediates of the citric acid cycle such as oxaloacetate, acetyl-CoA cannot be combined to make citrate (the next molecule in the citric acid cycle) and instead, the acetyl-CoA is used to make ketone bodies via the intermediates: acetoacyl-CoA and β-hydroxy-β-methylglutaryl-CoA. They are transported from their site of synthesis in the liver to the CNS which makes the largest use of ketone bodies in the hypoglycemic condition due to the fact that fatty acids act as detergents in the CNS and therefore cannot be used as a respiratory substrate within the nervous system.

Ketone bodies are produced during ketogenesis in the mitochondria in the presence of low blood glucose levels. Ketone bodies are made from acetyl-CoA in the presence of high levels of NADH which come about due to the break down of fatty acids. In the presence of such, ketogenesis is initiated. The production of ketone bodies is an important biological reaction occurring when the level of glucose in the blood is low. This means that individuals can produce a respiratory substrate for their CNS in the absence of glucose.

Acetone (one of the three forms of ketone bodies, alongside acetoacetate and beta-hydroxybutyrate) is one of the byproducts of the decarboxylation of acetonacetate which occurs during ketone production. The production of acetone is responsible for the fruity smelling breath of individuals when they are in the fasted state. This is because acetone cannot be converted back into acetyl-CoA and is converted to glucose via pyruvate, (Cahill, 2006) excreted in an individual's urine or it is exhaled. This will be seen during the state of ketoacidosis. (American Diabetes Association, 2010) which is the situation when large volumes of ketone bodies accumulate within the blood in such a way that the pH of the blood drops and becomes acidic. As the functioning of the body relies upon enzymes which work at an optimal pH, this alteration of the blood pH has effects on the bodies ability to function and in extremes of this condition, ketoacidosis is seen to be fatal and is sometimes noted in untreated, type 1 diabetics. (Laffel, 1999)

17. What is the function of perilipin and how is it regulated?

Periipin is a surface protein which is found on the surface of TAG droplets in adipocytes of which there exist 3 different isoforms: A, B and C with type A being the most abundant (Brasaemle et al, 2009). The function of the protein is that of protection, 'coating' the TAG to protect it from breakdown by hormone sensitive lipases (HSL). Perilipin's presence on the TAG droplet is regulated by Protein Kinase A (PKA), which in turn is regulated by the presence of hormones such as adrenaline, glucagons and insulin/ following beta-adrenergic receptor activation. (Greenberg et al, 1991) In the presence of adrenaline or glucagon, adenylate cyclase

activates 3'5'cAMP which activates Protein Kinase A. PKA phosphorylates the perilipin protein on the surface of the TAG droplet, causing it to dissociate from the surface of TAG thereby increasing the surface area on which hormone sensitive lipase (HSL) can act to break down TAG into fatty acids and glycerol. In the absence of glucagons or adrenaline and such hormones and in the presence of insulin, PKA is not activated and therefore perilipin will not be phosphorylated. This means it will stay associated with the surface of the TAG droplet, decreasing the surface area on which HSL can act and therefore decreasing the breakdown of TAG.

18. What is the function of leptin?

Leptin is a hormone, which is responsible for the control of an individual's appetite and plays a central role in fat metabolism due to its ability to alter the body's intake of food substances. As the percentage of adipose tissue increases in the body, the levels of leptin increase which decreases appetite and desire to feed.

Leptin acts upon receptors which are found in the hypothalamus where it inhibits appetite by inhibiting the actions of neuropeptide Y which is a stimulus to feeding, it binds to the receptors of anandamide which is a neurotransmitter which stimulates feeding and finally, it promotes the synthesis of alpha-melanocyte-stimulating hormone which is an appetite suppressant. In the absence of leptin or the leptin receptors, individuals show uncontrolled food uptake which leads to obesity. Leptin is thought to be important in the signaling of energy balance and tells the brain that the individual has had enough to eat, producing the feeling of satiety. As the levels of leptin in the blood are proportional to adipose tissue levels, the circulating level of leptin provides an indication to the brain about the need for energy storage through providing information about the levels of fat stores the body has, this in turn allows the body to regulate appetite and metabolism.

Leptin has also been found to be important in the modulation of the immune response through modulating the activity of T cells in atherosclerosis. It is found to act on vascular endothelial growth factor (VEGF), allowing angiogenesis and thus accounting for atherosclerosis in obese individuals, although the evidence for this is not conclusive yet, as only a few animal disease models have been studied. (Knight et al, 2009)

In animals, leptin levels affect the reproductive ability of both male and female species, however this is thought to be less important in humans. Leptin levels do however, have reduce the levels of cancellous bone but increase cortical bone. This is thought to be due to the bodies requirement for a greater structure to support the increased body weight of obese individuals. As cortical bone is bigger, this would be one explanation for the evolution of this function of leptin. (Hamrick and Ferrari, 2007)

19. Explain how atherosclerotic plaques arise.

Atherosclerosis is the process in which the artery wall becomes thickened by the deposition of fatty plaques comprised of substances such as cholesterol and immune cells in the vessel wall leading to hardening of the vessel walls through eventual calcification of the artery. (Ross et al, 1999)

The first stage in the development of atherosclerotic plaques is the formation of "fatty streaks" in the vessel wall, comprised of macrophages containing LDL. The presence of the LDL build up in the vessel wall is thought to cause the macrophage invasion through the process of oxidation of the LDL particles and the release of free radicals in the endothelial cells. Leading to damage to the epithelial lining of the vessel walls, in part thought to be caused by the accumulation of the fatty deposits, immune cells such as monocytes, macrophages and lymphocytes invade the area, initiating an immune response. Their inability to clear the fatty deposits however, leads to the accumulation of large macrophages, which are comprised of LDLs, forming foam cells. (Finn et al, 2010) The inflammatory process leads to collagen and elastin fibres being laid down in the vessel wall, leading to occlusion of the artery through gradual narrowing of the lumen space. Calcification of the outer layer of plaque can occur, with the inner part remaining comprised of crystals of cholesterol and fatty substances. Any rupture of this outer layer will however, re-expose the inner content of the plaque which will contain immunogenic material, e.g. collagen, which will imitate the imbue response once again with the potential of eventually causing thrombi to form and to travel in the blood as emboli where they will go on to occlude a smaller blood vessel causing ischemic damage and potentially, death.

20. Explain why diabetes mellitus (especially IDDM) is described as 'starvation in the midst of plenty'?

IDDM is described as starvation in the midst of plenty due to the fact that the cells of the body do not gain access to the glucose, which is present in the blood of the individual due to the lack of the production of insulin, which is responsible for the control of blood glucose. The inability of insulin to function means that the glucose taken in through the diet will not be taken into the cells and as a result, the body will feel as though it is starving despite there being lots of blood glucose around. In addition to this, the absence of insulin leads to the release of fatty acids from adipocytes, as the lipogenisis side of the fatty acid cycle is turned down and the lipolysis side of the cycle is increased. This means that fatty acids enter the blood stream, meaning both glucose and fatty acids are plentiful in the blood. In addition to this, the presence of fatty acids and glucose in the blood, causes the liver to begin the process of ketogenesis, producing ketone bodies as the presence of fatty acids makes the liver think that the glucose levels are low. Hence, starvation in the midst of plenty is the correct term to give to this occurrence, as there are plenty of each of the respiratory substrates: glucose, fatty acids and ketone bodies, however, due to the lack of insulin, these fuels cannot be utilized properly. Eventually, the presence of high levels of glucose in the blood can lead to peripheral neuropathy as the straight chain glucose molecules are reactive and cause immune responses to occur in the peripheral neurons. Ketoacidosis may also occur which will eventually be fatal for the individual.

21.Give four ways in which brown adipose tissue differs from WAT.

Brown adipose tissue is found in animals, which hibernate, and in the neonate to provide warmth through heat generation. This is important, as newborn animals are unable to shiver to keep their core body temperature to the required level for biochemical reactions to take place. Functionally, brown adipose tissues purpose is thermogenesis, whereas WAT is primarily present within the animal for energy storage purposes. Thus, brown adipose tissue differs from that of white adipose tissue (WAT) through the fact that, in WAT, each adipocyte will contain

one single, relatively large lipid droplet whereas in brown adipose tissue there are a larger number of smaller lipid droplets present. This therefore increases the surface area on which lipases and other enzymes can act and therefore increases the accessibility and the mobility of the fat stores. Brown adipose tissue has a much denser capillary network than that found in WAT to increase blood supply to the tissue to further increase heat production and mobilization around the body, and brown adipose tissue has a greater number of mitochondria than WAT which have un-coupled oxidative phosphorylation reactions, allowing the proton gradient to be used to generate heat energy instead of the intermediate energy source: ATP. This is done through the presence of he uncoupling protein: thermogenin (Gesta et al, 2007) which uncouples the protons from their regular route in oxidative phosphorylation in WAT.

22. Name three problems associated with being overweight.

The development of type II diabetes, coronary heart disease and osteoarthritis.

23. Why is intra-abdominal obesity associated with chronic low grade inflammation?

Adipose tissue secretes cytokines such as interleukin-6 (IL-6), tumour necrosis factor alpha (TNF-alpha) which lead to the tissues becoming infiltrated with immune cells such as monocytes and macrophages which in turn release their inflammatory markers and mediators, thereby amplifying the inflammatory process and leading to a chronic level of inflammation, due to the lack of clearance of the adipose tissue and thus, the constant release of immunogenic cytokines.

24. Describe three ways you would suggest to help obese patients lose weight.

Exercise: Increasing an individuals activity level will lead to an increased energy usage which would be greater than that used in a sedentary lifestyle. So long as this means that the energy expenditure is greater than the energy intake, the patient will lose weight. Exercise will help the individual to burn more energy through the process of muscle contraction, using energy supplied in the form of ATP through aerobic respiration.

Diet: Providing the patient with a healthy, balanced diet, which will mean reduced fat intake, will help the patient to lose weight. This diet needs to contain fewer calories than the individual requires sustaining their weight at its current level. Providing them advice with the importance of eating a variety of foods, including lean meat, fresh fruit and vegetables will help the individual to lose weight.

Medication or surgical intervention: In the absence of diet and exercise's ability to help the individual to lose weight, medication such as olistat, which inactivates pancreatic lipase leading to a lower level of absorption of fats from the diet to occur could be prescribed, and surgical interventions such as the fitting of a gastric band to reduce the stomach size and therefore reduce the amount of food an individual is capable of consuming is an option. Gastric bypassing is another option in which the food is re-directed straight into the intestine bypassing the stomach. This will affect the amount of food which the individual can digest and absorb, thereby reducing the amount of energy which the body absorbs and helping the individual to lose weight.

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