Problem-Based Assignment: **Obesity/Metabolic Syndrome**

1. **What is obesity/metabolic syndrome? What is the specific pathophysiology of obesity?**

Obesity, the process of fat accumulation, is defined as an excess of body fat clinically determined by a body mass index (BMI) of 30 or greater calculated as weight/height. Another method of determining obesity is through calculation of percent total body fat using measurements of skin fold thickness, bioelectrical impedance, or underwater weighing. In terms of percent total body fat, obesity is defined as 25% or greater in females and 30% or greater in males. Abdominal obesity, another marker of obesity and the greatest risk factor for metabolic syndrome, is defined as a waist circumference of 102 cm or greater in men and 88 cm or greater in women.

Although genetic influence exists, obesity is generally caused by high-fat diet and inactivity. Abdominal fat is particularly harmful because abdominal fat cells produce hormones and other chemicals that affect the body system-wide. Adiponectin, for example, is a hormone released by abdominal fat cells that affects the body’s response to insulin. Abdominal fat cells also produce cytokines which promote insulin resistance and low-level chronic inflammation. Additionally, the proximity of abdominal fat to the portal vein increases this type of fat’s harmful effects by releasing free fatty acids that are carried to the liver through the portal vein causing increased cholesterol levels.

Type II diabetes and atherosclerotic cardiovascular disease (ASCVD) are two risk factors of obesity, with ASCVD having the biggest consequences on a person’s health. Risk factors that predispose a person to ASCVD are the conditions collectively referred to as metabolic syndrome. Metabolic syndrome is present in an individual with three or more of the following:

- Blood pressure of 135/85 mmHg or greater
- Fasting blood sugar of 100 mg/dL or greater
- Waist circumference of 40 inches or greater in males or 35 inches or greater in females
- LDL cholesterol level under 40 mg/dL in males, under 50 mg/dL in females
- Triglyceride level of 150 mg/dL or greater

The effects of obesity on general health are numerous. Obesity can cause symptoms of tiredness, breathlessness, back pain, arthritis, sweating, poor sleep, depression, and menstrual disorders. Diseases and conditions that can develop as a result of obesity include diabetes, hyperlipidemia, hypertension, MI, stroke, and cancer. Symptoms from obesity are usually not seen before the age of 40.

**Medical Consequences of overweight and obesity (Lean, 2000)**

<table>
<thead>
<tr>
<th>Physical symptoms</th>
<th>Metabolic problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathlessness</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Varicose veins</td>
<td>Non-insulin dependent diabetes</td>
</tr>
<tr>
<td>Back pain</td>
<td>Hypercoagulation</td>
</tr>
</tbody>
</table>
Obesity plays a role in cardiovascular disease in four ways: by accelerating atheroma and increasing thrombotic risks, by causing symptoms in individuals with healthy and/or diseased hearts, by mimicking cardiac symptoms (SOB, chest pain), and by compounding other risk factors. Endocrine cancer risks from obesity stem from elevated free estrogen caused by altered adipose tissue activity and suppression of sex-hormone binding globulin. Poor diet in the obese may also play a role in other types of cancers such as colon cancer. Obesity increases the risk of ischemic heart disease and stroke because of the effects of weight gain (abdominal fat specifically) on hypertension, hyperlipidemia and increased coagulation.

2 What history, PE, and lab tests could be used to diagnose obesity/metabolic syndrome in each member of the Q family?

**Hx:**

Ask about a personal history of the following: Type 2 DM, hypertension, insulin resistance, hyperlipidaemia, or HIV infection

Drug history: A thorough history of current and previous medications, including glucocorticoids, antipsychotics, and anti-HIV therapy, should be obtained.

Family history: Any family history of cardiovascular disease (angina, MI, stroke, claudication), Type 2 DM, hyperlipidaemia, Obesity, PCOS, or lipodystrophy should be documented (We know DQ’s family hx that would predispose her to metabolic syndrome)
Social history: Patients should be asked about their general lifestyle, including exercise habits, diet, alcohol intake, and smoking. *(All members of Q family have risk by observing exercise habits and diet, AQ needs to be observed for ETOH intake, DQ for smoking)*

**PE:**

Examination should include measurement of BP, BMI, and waist and hip circumferences, and calculation of the waist-to-hip ratio, as these are essential criteria for the diagnosis of metabolic syndrome.

**Neuro:** Cognitive decline may be seen in elderly

**Eye:** corneal arcus and xanthelasma (yellow plaques on eyelids secondary to lipid deposition)

**Skin:** hirsutism, acne, and acanthosis nigricans (a skin disorder characterized by hyperpigmentation and hyperkeratosis, occurring mainly in the folds of the skin in the axilla, groin, and back of the neck)

**Liver:** hepatomegaly, fatty liver

**Renal:** Chronic Kidney Disease (CKD) frequently seen

**Sleep:** observe for signs of sleep apnea

**Females:** polycystic ovary

The cardiovascular system, the respiratory system, and the abdomen should be thoroughly examined

**Lab Test**

Three or more is a diagnosis of Metabolic Syndrome:

- Abd obesity: men >40 inches, women >35 inches
- hypertriglyceridemia: >150 mg/dl OR treatment of hyperlipidemia
- Low HDL: men <40 mg/dl, women <50 mg/dl
- HTN: BP > 130/85 OR on antihypertensives
- Fasting glucose (FBG): >100 mg/dl OR taking insulin or hypoglycemic medications

Because so many other disorders or tied to a diagnosis of metabolic syndrome, it would be good practice to get baseline of many body systems

**Renal function:** Serum urea, creatinine, and electrolytes should be measured, as nephropathy and renal failure are common clinical features in metabolic syndrome, especially in those with impaired glucose levels.

**Liver function tests:** Aminotransferases should be measured, as metabolic syndrome is frequently associated with nonalcoholic fatty liver disease leading to elevated ALT and AST.
(Patients with elevated aminotransferases and metabolic syndrome should be referred to a hepatologist)

**Urinalysis:** This may show increased albumin excretion, indicating diabetic or hypertensive nephropathy.

**Thyroid function tests:** Hypothyroidism is often associated with dyslipidaemia and should be excluded at initial assessment.
As for the Q family, all members AQ, DQ, and HQ all would be diagnosed with metabolic syndrome.

3. What non-pharmacologic treatments would you recommend for each member of the Q family? Specifically, what dietary, exercise, and other strategies would you recommend for these patients and for patients similar to members of the Q family? Would you recommend surgical interventions for obesity in any of these family members? If yes, what would you recommend and why?

**Dietary**

The Q family need adjustments to both their dietary intake and their physical activity levels. The sedentary lifestyle of the Q family increases the risk for major health problems such as cardiovascular disease, diabetes, and cancer. The 3 adult members of the Q family are all considered obese according to the CDC. Although the ages of the three members of the Q family vary, decreasing their caloric intake is needed for weight loss. Changing their diets is the first step to weight loss.

Both AQ and HQ have elevated cholesterol levels. Foods with higher levels of fiber help decrease cholesterol levels in the bloodstream. Foods such as berries, oats, and beans naturally have a high level of fiber. Substituting berries instead of sugars in whole grain cereals and can help cut down cholesterol and sugar. The Q family should eat at least 5 portions of fruits/vegetables a day. Fruit salads are a good alternative in eating a variety of fruits. Foods that help decrease cholesterol according to Prevention Magazine are fish and omega 3 fatty acids. These foods include: almonds, walnuts, other nuts, avocados, spinach and tea. Replacing ground beef with ground turkey (a leaner meat) cuts down cholesterol levels. Replacing meats with lean chicken or fish can help the family adjust to healthier eating habits. According to the Oxford Journal eating oily fish, such as mackerel, herring, pilchards, or salmon, at least once or twice a week promotes cardiovascular health.

Other dietary suggestions include: baking, boiling or steaming foods instead of frying to help cut down fat intake. Avoiding cheese and foods with high levels of fats such as full fat milk or cream. Replacing those cheeses with low fat yogurts or cottage cheese can help the Q family adhere to their new diet. The Q family has a very busy lifestyle, however preparing meals in advance can help cut down the consumption of convenient foods that have high levels of fat, sugars and sodium. Preparing fruits and vegetables for snacking instead of those with high levels of sugar and sodium can cut down calorie intake.

Alcohol consumption increases. More than 21 units of alcohol, which is 10 ml of pure alcohol is considered excessive, according to the Oxford Journal. Cutting down the alcohol intake for AQ is important since decreasing alcohol consumption aids in weight loss for AQ.

**Exercise**

A realistic goal is weight loss of 1–2 lbs (0.5–1 kg) per week, according to the Oxford Journal and reaching that goal when BMI is 25. Most exercise routines for weight loss include aerobic and strength training. Aerobic exercises according to Mayo clinic include: brisk walking, mowing the lawn, aerobic dancing and running. 75 minutes of vigorous aerobic activity per week or 150 minutes of moderate aerobic activity per week is minimally required for weight loss. Strength training, according to Mayo clinic include: weight lifting, rock climbing and heavy
gardening. A good investment for the Q family may be a treadmill or eliptical. These are good options for AQ who loves to watch TV and sports. He can hop on the treadmill and watch TV at the same time. Perhaps DQ can join a dance class twice a week to make her exercise routine more enjoyable. Both AQ and DQ can take the dog for a walk together or walk to HQ’s house instead of driving. HQ does no aerobic exercise. Most of her hobbies and job are activities that require minimal movement. Her history of bilateral knee arthritis makes it difficult for her to perform rigorous exercises. A low impact aerobic activity such as water aerobics can help HQ become more active and help with weight loss. HQ’s family lives only two blocks away. When visiting her family, HQ can take a brisk walk instead of drive. Or even better, HQ can bike, if able, to her daughter’s house.

- **Other Strategies**
  Other strategies for weight loss in obese women are group therapies. Groups such as weight watchers and Jenny Craig can help DQ and HQ lose the weight with support, according to the Oxford Journal. Since obese women are more likely to commit suicide than non obese women, according to the Oxford Journal, joining a group therapy can emotionally help these two women. We know that DQ may have stress factors since she has been having insomnia and difficulty sleeping.

- **Surgical interventions**
  According to the Oxford Journal of Medicine, InnocAiT, surgical intervention should only be done when all attempts of weight loss with dietary and exercise changes have failed and when BMI is over 40, morbidly obese. There are several kind of surgical interventions, according to Web MD, including restrictive and malabsorptive/ restrictive. Restrictive surgeries are those that restricts the size of the stomach leading to a smaller intakes. Two types of restrictive surgeries include: adjustable gastric banding, which is usually safer, done laparascopically and reversible; and sleeve gastrectomy, which is also done laparascopically and removes up to 75% of the stomach. Sleeve gastrectomies are less invasive and less risky than gastric bypass but they are not reversible.

Malabsorptive/Restrictive surgeries are gastric bypass and biliopancreatic diversion. Both of these surgeries are more invasive and carry higher risks. Gastric bypass can be done both under a laparoscope or open. The surgeon divides the stomach into two parts which seals off the lower section from the upper section. The upper part of the stomach is attached to the lower section of the small intestine, leaving less calories to be absorbed in the body. In biliopancreatic diversion, up to 70% of the stomach is removed and bypasses more parts of the smaller intestines. Biliopancreatic diversions can also be done under a laparscope but are more common to be open. With gastric bypass, risks of dumping syndrome are very common. This is because food is “dumped” into the small intestines faster than normal. Symptoms of dumping syndrome include: nausea, bloating, sweating, pain, and diarrhea. With biliopancreatic diversion, the risk of developing dumping syndrome is lower since a major portion of the stomach is removed. However, biliopancreatice diversion and gastric bypass increases the risk of having a post-op hernia. Surgical repair for the hernia is often necessary. Also, with the malasorptive/restrictive surgeries, there is an increase risk of infection, blood clotting, gallstone formation and in less than 5% death, according to WebMD.
With the four surgery types mentioned, the least invasive would be the gastric binding. If all members of the Q family fail to lose weight even with dietary and exercise changes, surgical intervention may be an option. AQ would be the best candidate for surgical intervention since he is relatively young and is morbidly obese. His BMI of 45.9 makes him a good candidate for surgical intervention. If he cannot lose the weight on his own, he qualifies for surgical intervention, according to the Oxford Journal. DQ, on the other hand, has a BMI of 39 and is not morbidly obese and would not be advised to have surgical intervention. However, DQ has another comorbidity. Type II diabetes puts her at risk for heart attack and stroke which makes her a good candidate for weight loss surgery. She is also a smoker, however, which can pose a problem for intubation and atelectasis and pneumonia after surgery. If DQ stopped smoking and could not lose weight with diet and exercise changes, surgery may be a good decision. The best option for DQ would be gastric banding. HQ has many risk factors that would increase risk of morbidity if she had surgical intervention. A 75 year old with an enlarged heart, HTN and other medical conditions may not recover from surgery. Although HQ’s BMI is 54.9 and is considered morbidly obese, surgical intervention is not advised for her.

4 What pharmacologic treatments would you recommend (if any) for each member of the Q family? If you would recommend any Rxs, be specific as to dosages, duration of treatment, potential risks or side effects, and costs of Rxs.

If changes in lifestyle, e.g.; diet and exercise modification outlined in question # 3 fail to elicit the reduce the health risk factors and improve health outcomes for the Q family then pharmaceutical agents should be considered. Specifically, medications to control cholesterol levels, lipids, and high blood pressure as these three components are intrinsic to metabolic syndrome. Patients who meet criteria for metabolic syndrome should have their LDL’s reduced below 70mg/dl. Total cholesterol should be less than 200. There are several therapies available for hypercholesterolemia. Statins (HMG-CoA reductase inhibitors), bile acid sequestrants, fibrates, niacin, cholesterol absorption inhibitors, omega-3 fatty acids.

Blood pressure should be lower than 130/80. Some blood pressure medications offer more benefits than simply lowering blood pressure. For example, blood pressure drugs, specifically, ACE inhibitors have been found to also reduce the levels of insulin resistance and actually deter the development of type 2 diabetes. This is an important consideration when discussing the choice blood pressure drugs in the metabolic syndrome. Drug therapy for hyperglycemia in patients with metabolic syndrome typically begins with an insulin-sensitizing agent, such as metformin. Some literature suggests that metformin may help to reverse the pathophysiologic changes of metabolic syndrome. This includes when it is used in combination with lifestyle changes or with peroxisome proliferator-activated receptor agonists, such as the fibrates and thiazolidinediones, each of which may produce favorable metabolic alterations as single agents in patients with metabolic syndrome.
5 What educational interventions would you recommend for each member of the Q family and for patients like each member of the S family? Be very specific with your recommendations.

Weight loss is an important therapeutic strategy in all overweight or obese persons who have type 2 diabetes or are at risk for developing diabetes. Specific recommendations are the following (Klein et al., 2004):

- The primary approach for achieving weight loss is therapeutic lifestyle change, which includes a reduction in energy intake and an increase in physical activity.
- A moderate decrease in caloric intake (500-1,000 kcal/day) by reducing dietary fat and/or carbohydrates will result in a slow but progressive weight loss (1-2lb per week). For most patients, weight loss diet should supply at least 1,000-1,200 kcal/day for women and 1,200-1,600 kcal/day for men. However, for AQ and HQ who seem to have diabetes, special diet should be added. Additionally, dietary guidance should be tailored to each person, allowing for individual food preferences and approaches to reducing caloric intake.
- Physical activity is an important component of a comprehensive weight management program. Regular, moderate intensity physical activity enhances long-term weight maintenance. It is important to educate them role of regular activity on weight reduction furthermore prevention/treatment of other disease (e.g., diabetes, cardiovascular disease).

In addition, strategies should include changes to meal frequency, meal timing (e.g., breakfast), and guidance on food portions (Seagle, Strain, Makris, & Reeves, 2009). Strategies for portion control may include providing information on the energy content of regularly consumed food (e.g., energy content of 1/2c vs. one bowl of ice cream), use of premeasured foods (e.g., frozen entrees, 100-kcal snack packs), replacing higher energy-density food with lower energy-density food (e.g., cereal with milk for an evening snack), and/or reducing the energy density of food (e.g., increasing vegetable content of entree items).

To help manage body weight and prevent weight gain in adulthood, it is recommended to engage in 60 minutes of moderate-to-vigorous-intensity activity on most days of the week (Seagle et al., 2009).

Other education should include self-management of comorbid disease. For example, education on self check-up of glucose for diabetes should be included.

6 What health promotion strategies would you recommend for each member of the Q family? Be very specific here.

All Q-family members could benefit from some of the same techniques; such as developing exercise and diet plans. Each family member is inactive and overweight. Encouraging a low fat and low calorie diet that is full of nutritious foods is very important for these patients. Finding diets that include food the family enjoys may help increase adherence to the new diet.
We must also make sure that the family understands the importance of exercise on the body. We can help the family members come up with ways to incorporate physical activity into their daily lives. Developing a plan that encourages 5-10 minutes of activity for every hour of inactivity on top of cardiovascular exercise 3-5 times a week will help the family maintain a higher level of activity. Special considerations must be made for HQ because she has arthritis in her knees to ensure that she is not in any pain and will stick with her exercise plan.

Psychological treatments may also be necessary for the family to grasp the consequences of doing nothing to treat their obesity. Involving the family members in group therapy programs may be beneficial. It is very important for the family members to understand the effects of obesity, and more often than not, having a health care provider telling a patient to lose weight is ineffective. Perhaps the support of the community will help the Q family realize that they have a problem and that they can fix it. New research by the NHLBI suggests that weight loss and exercise time can be increased by the use of “mobile coaches.” Participants in the study were given mobile devices and taught how to enter their daily exercise and food logs into the device. Specially trained coaches analyzed the data and messaged the participants about what they are doing right and what they need to work on. The study found that leisure time went down, exercise time went up and the amount of fruits and vegetables eaten increased.

References


Centers for Disease Control: http://www.cdc.gov/obesity/index.html

Ferri’s clinical advisor Fred Ferri MD Mosby 2013 metabolic syndrome 680-681


International Diabetic Federation: http://www.idf.org/search/site/metabolic%20syndrome%20diagnosis


Mayo Clinic: http://www.mayoclinic.com/health/exercise/SM00109


Oxford Journal of Medicine, InnovAit Volume 1, issue 5, Pp. 387-397 http://rcgp-innovait.oxfordjournals.org/content/1/5/387.full#sec-4