Umbilical hernia may also be a sequel of metabolic syndrome

Mehmet Rami Helvaci (1)
Orhan Ayyildiz (1)
Orhan Veli Ozkan (2)
Mustafa Cem Algin (2),
Abdulrazak Abyad (3)
Lesley Pocock (4)

(1) Specialist of Internal Medicine, MD
(2) Specialist of General Surgery, MD
(2) Middle-East Academy for Medicine of Aging, MD
(3) medi+-WORLD International

Correspondence:
Mehmet Rami Helvaci, MD
07400, ALANYA, Turkey
Phone: 00-90-506-4708759
Email: mramihelvaci@hotmail.com

ABSTRACT

Background: We tried to understand whether or not there is a relationship between umbilical hernia and metabolic syndrome.

Methods: Consecutive patients with an umbilical hernia and/or a surgical operation history for umbilical hernia were studied.

Results: There were 46 patients with umbilical hernia with a mean age of 62.0 years, and 73.9% of them were females. The hernia patients were heavier than the controls (85.1 versus 73.1 kg, p=0.001). Body mass index of them was also higher (33.6 versus 29.1 kg/m², p=0.000). Although the prevalence of hypertension (HT) was higher in the hernia group (50.0% versus 27.3%, p<0.01), mean values of triglyceride and low density lipoproteins and prevalence of white coat hypertension (WCH) were lower in them (p<0.05 for all). Although the prevalence of diabetes mellitus and coronary artery disease were also higher in the hernia group, the differences were non-significant probably due to the small size of the study group.

Conclusion: There are significant relationships between umbilical hernia and terminal consequences of metabolic syndrome including obesity and HT, probably on the bases of prolonged inflammatory and atherosclerotic effects beside pressure effect of excessive fat tissue on abdominal muscles. The inverse relationships between obesity and hypertriglyceridemia and hyperbetalipoproteinemia may be explained by the hepatic fat accumulation, inflammation, and fibrosis induced relatively lost hepatic functions in obese individuals. Similarly, the inverse relationship between obesity and WCH may be explained by progression of WCH into HT in obese individuals. So obesity may actually be a precirrhotic condition for the human body.

Key words: Umbilical hernia, metabolic syndrome, obesity, hypertriglyceridemia, hyperbetalipoproteinemia

Introduction

Due to the prolonged survival of human beings, systemic atherosclerosis may be the major health problem in this century, and its association with physical inactivity, excess weight, smoking, and alcohol is collected under the title of metabolic syndrome (1, 2). The syndrome is characterized by a low-grade chronic inflammatory process on vascular endothelium all over the body (3). The inflammatory process is accelerated by some factors including sedentary lifestyle, excess weight, smoking, alcohol, chronic infection and inflammation, and cancers (4, 5). The syndrome can be slowed down with appropriate non-pharmaceutical approaches including lifestyle changes, diet, exercise, cessation of smoking, and withdrawal of alcohol (6). The syndrome contains reversible indicators including overweight, white coat hypertension (WCH), impaired fasting glucose, impaired glucose tolerance (IGT), hyperlipoproteinemias, alcohol, and smoking for the development of irreversible consequences including obesity, hypertension (HT), type 2 diabetes mellitus (DM), chronic obstructive pulmonary disease, cirrhosis, chronic renal disease, peripheral artery disease, coronary artery disease (CAD), and stroke (7). In another perspective, the metabolic syndrome may be the most important disease of the human lifespan, decreasing its quality and duration, at the moment. The syndrome has become increasingly common all over the world, for instance 50 million people in the United States are affected (8). The syndrome induced accelerated atherosclerotic process all over the body may be the leading cause of early aging and premature death for both genders. For example, CAD is the leading cause of death in developed countries. On the other hand, umbilical hernias are also common pathologies in society both in adults and children. We tried to understand whether or not there are some statistically significant relationships between umbilical hernia and reversible parameters and irreversible consequences of the metabolic syndrome in the present study.

Material and Methods

The study was performed in the Medical Faculty of the Mustafa Kemal University between March 2007 and January 2010. Consecutive patients with an umbilical hernia and/or a surgical operation history for umbilical hernia were collected in the first, and age and sex-matched controls were collected into the second group. Their medical histories including smoking habit, HT, DM, CAD, and already used medications were learnt, and a routine check up procedure including fasting plasma glucose (FPG), triglyceride, low density lipoproteins (LDL), and an electrocardiography was performed. Current daily smokers at least for the last six months and cases with a history of five pack-years were accepted as smokers. Insulin using diabetics and patients with devastating illnesses including malignancies, chronic renal failure, decompensated cirrhosis, uncontrolled hyper- or hypothyroidism, and congestive heart failure were excluded to avoid their possible effects on weight. Body mass index (BMI) of each case was calculated by the measurements of the Same Clinician instead of verbal expressions. Weight in kilograms is divided by height in meters squared (9). Office blood pressure (OBP) was checked after a five-minute rest in seated position with the mercury sphygmomanometer on three visits, and no smoking was permitted during the previous two hours. A 10-day twice daily measurement of blood pressure at home (HBP) was obtained in all cases, even in normotensives in the office due to the risk of masked hypertension after 10 minutes of education about proper blood pressure (BP) measurement techniques (10). A 24-hour ambulatory blood pressure monitoring was not required due to its equal effectiveness with HBP measurements (11). Eventually, HT is defined as a BP of 135/85 mmHg or greater on HBP measurements (10). WCH is defined as an OBP of 140/90 mmHg or greater but mean HBP of lower than 135/85 mmHg, and masked HT as an OBP of lower than 140/90 mmHg but mean HBP of 135/85 mmHg or greater (10). Cases with an overnight FPG level of 126 mg/dL or greater on two occasions or already taking anti-diabetic medications were defined as diabetics. An oral glucose tolerance test with 75-gram glucose was performed in cases with a FPG level between 100 and 125 mg/dL, and diagnosis of cases with a two-hour plasma glucose level of 200 mg/dL or higher is DM (9). A stress electrocardiography was performed in suspected cases, and a coronary angiography was obtained only for the stress electrocardiography positive cases. Eventually, mean weight, height, BMI, triglyceride, and LDL values and prevalences of smoking, WCH, HT, DM, and CAD were detected in each group, and results were compared in between. Mann-Whitney U Test, Independent-Samples T Test, and comparison of proportions were used as the methods of statistical analyses.

Results

The study included 46 patients in the umbilical hernia and 84 cases in the control groups. Mean age of the hernia cases was 62.0 years, and 73.9% (34) of them were female. Although the mean heights of the two groups were similar (157.4 versus 158.7 cm, p>0.05), the umbilical hernia patients were significantly heavier than the control cases (85.1 versus 73.1 kg, p= 0.001). Eventually, the BMI was also higher in the hernia patients (33.6 versus 29.1 kg/m2, p= 0.000). Interestingly, although the significantly higher mean weight and BMI of the hernia patients, the mean triglyceride and LDL values and prevalence of WCH were significantly lower in them (p<0.05 for all). On the other hand, prevalence of HT was significantly higher in the hernia group (50.0% versus 27.3%, p<0.01). Although the prevalences of DM and CAD were also higher in the hernia group, the differences were statistically non-significant, probably due to the small size of the study group (Table 1 - next page).
Umbilical hernias are common anomalies of the abdominal wall both in adults and children. The majority of scientists agree that most of the umbilical hernias in adults have an acquired origin, and only 10% of adults with umbilical hernias have the pathology, congenitally (12). In different series, umbilical hernias are more common in women both in infancy and adulthood, particularly in middle-aged multiparous women (12-14). Umbilical hernia is more common under the age of four and over the age of 50 years (13). It is particularly common in premature babies (up to 84%) and overweight children. According to the literature, its prevalence is around 2% in adults, and more common in patients with obesity, cirrhosis, congestive heart failure, chronic renal failure, and cancers (15). There are no major differences between the various ethnic groups in adults, supporting the possible acquired etiologies (13). Umbilical hernias occur when a part of the intestine protrudes through a weak spot in the abdominal muscles at the site of umbilicus. Babies are prone to this malformation because of the process of fetal development during which abdominal organs develop outside the abdominal cavity, and then, they return into the abdominal cavity through an opening which will become the umbilicus. Importantly, umbilical hernia must be distinguished from paraumbilical hernia, a defect in one side of the midline at the umbilical region in adults and from omphalocele in newborns. Most umbilical hernias close on their own by the age of one year, although up to 10% may take longer to heal. To prevent complications, umbilical hernias that do not disappear by the age of four years or those that appear during adulthood may need surgical repair. As occurs in other defects of the abdominal wall, the umbilical hernias may become incarcerated or strangulated, but the risk is low, since the underlying defect of the abdominal wall is larger than found in the inguinal ones. So the risk of incarceration is half of the inguinal hernias, but three times higher than the femoral ones in an American series (16). Incarceration is predominantly a female complication and up to 90% of incarcerated hernias of umbilicus occur in women with a mortality rate up to 25% (16). There is also a greater risk of incarceration in cirrhotics receiving medical treatment for ascites, carrying an implant of a peritoneo-venous shunt, or getting an evacuating paracentesis (17). Because of the significant associations of the umbilical hernias with decompensated cirrhosis, congestive heart failure, chronic renal failure, and cancers in the literature (14, 15), we excluded such terminal cases due to their possible effects on weight in the study. Interestingly, all of the above pathologies are found among terminal consequences of the metabolic syndrome. On the other hand, the higher prevalence of umbilical hernia in cases with decompensated cirrhosis may also support the pressure effect of in-
intra-abdominal fluid on abdominal muscles (18). Similar to the literature, we detected the female ratio as 73.9% in the umbilical hernia group, and the mean weight and BMI of them were significantly higher than the controls (85.1 versus 73.1 kg, p = 0.001 and 33.6 versus 29.1 kg/m2, p = 0.000, respectively).

Obesity, pregnancy, ascites, or peritoneal dialysis induced abdominal wall distension may cause pulling of the abdominal muscles and deterioration of connective tissue over the umbilicus. Similarly, the frequent association of umbilical hernia with other abdominal wall defects may also support the possible etiologic role of biophysical changes (13). In a previous study of 291 cases with umbilical hernias, 42% of them were associated with another hernia, and 5% of them were associated with more than two hernias (13). For instance, abnormal dispositions of the umbilical fascia may be one of the factors contributing to herniation (19). Tendinous fibers coming from the muscles of both sides of the abdominal wall decussate obliquely at the linea alba, acquiring different levels of complexity (20). Simpler decussations may be found in cases with umbilical hernias in which the sac protrudes at the midline. Obesity, pregnancy, ascites, and peritoneal dialysis induced excess pressure on abdominal wall may facilitate rupture of the fibers which decussate in a simple fashion at the linea alba on the umbilicus. In contrast, patients with more complex (triple) decussations may present with paraumbilical hernias in the above conditions. On the other hand, recanalized umbilical veins and deterioration of connective tissue secondary to malnutrition may also facilitate the herniation in cirrhotic patients.

Obesity is probably found among one of the irreversible endpoints of the metabolic syndrome, since after development of obesity, non-pharmaceutical approaches provide limited success either to heal obesity or to prevent its complications. Overweight and obesity probably lead to a chronic and low-grade inflammation on vascular endothelium, and risk of death from all causes including cardiovascular diseases and cancers increases parallel to the range of weight excess in all age groups (21). The low-grade chronic inflammation may also cause genetic changes on the epithelial cells, and the systemic atherosclerotic process may decrease clearance of malignant cells by the immune system, effectively (22). Overweight and obesity are associated with many coagulation and fibrinolytic abnormalities suggesting that they cause a prothrombotic and proinflammatory state (23). The chronic inflammatory process is characterized by lipid-induced injury, invasion of macrophages, proliferation of smooth muscle cells, endothelial dysfunction, and increased atherogenicity (24, 25). For example, elevations of serum C-reactive protein (CRP) carry predictive power for the development of major cardiovascular events (26, 27). Overweight and obesity are considered as strong factors for controlling of CRP concentration in serum, since adipose tissue produces biologically active leptin, tumor necrosis factor-alpha, plasminogen activator inhibitor-1, and adiponectin, and it is involved in the regulation of cytokines, so individuals with overweight and obesity have elevated levels of CRP (28, 29). On the other hand, individuals with excess weight will have an increased circulating blood volume as well as an increased cardiac output, thought to be the result of increased oxygen demand of the extra tissue. The prolonged increase in circulating blood volume may lead to myocardial hypertrophy and decreased compliance, in addition to the common comorbidity of atherosclerosis and HT. In addition to the atherosclerosis and HT, prevalences of high FPG, high serum cholesterol, and low high density lipoproteins (HDL) were all raised with increases in BMI (30). Similarly, the prevalences of CAD and stroke, particularly ischemic stroke, increased with an elevated BMI in another study (31). Eventually, the risk of death from all causes including cardiovascular diseases and cancers increased throughout the range of moderate and severe excess weight for both genders in all age groups (21). The female predominance of the umbilical hernias in adults may also be explained by pregnancies and the higher prevalence of obesity in females. But hormonal status of females and some other factors should take additional roles in the process to be able to explain the high prevalence of umbilical hernias even in infancy. For example, varicose dilatations of the lower extremities are much more common in females, and most of them develop during labour, probably due to the vasodilative effects of estrogen. This vasodilatation may also disturb muscular structure of the abdominal wall in women in the process of umbilical hernias, as in recanalized umbilical veins in cirrhosis.

There are also some hepatic consequences of excess weight. Nonalcoholic fatty liver disease (NAFLD) is a term used to define a spectrum of disorders characterized by macrovesicular steatosis which occurs in the absence of consumption of alcohol in an amount considered to be harmful to the liver. Since the chance of NAFLD is directly proportional to BMI and there is a high prevalence of excess weight in society, NAFLD is also becoming an important health problem all over the world. According to the literature, sustained liver injury will lead to progressive fibrosis and cirrhosis in 10 to 25% of affected patients (32). Excessive fat accumulation in hepatocytes is called hepatosteatosis. It progresses to NAFLD, steatohepatitis, fibrosis, cirrhosis, hepatocellular carcinoma, and hepatic failure. There are two histologic patterns of NAFLD including fatty liver alone and nonalcoholic steatohepatitis (NASH). NASH represents a shift from simple steatosis to an inflammatory component. Excess weight may be the main factor in exacerbating hepatic inflammation and fibrogenesis in NASH. NAFLD affects up to one third of the world population, and it has become the most common cause of chronic liver disease even in children and adolescents (33, 34). The recent rise in the prevalence of excess weight likely explains the NAFLD epidemic, worldwide (35). NAFLD is combined with a low-grade chronic inflammatory state, which results with hypercoagulability, endothelial dysfunction, and an accelerated atherosclerotic process (35). NAFLD shares many features of the metabolic syndrome as a highly atherogenic condition, and may cause hepatic inflammation and cellular injury especially at the endothelial level. Beside terminating with cirrhosis, NAFLD is associated with a significantly greater overall mortality as well as with an increased prevalence of cardiovascular diseases (34). Authors reported independent associations between NAFLD and impaired flow-mediated vasodilation and increased carotid artery intimal medial thickness as the reliable markers of subclinical atherosclerosis (34), so NAFLD may also be a predictor of cardiovascular disease (36). NAFLD may actually be considered as the hepatic component of metabolic syndrome since hepatic fat accumulation is highly correlated with the components of the syndrome (37). Interestingly, although the
presence of significant progression according to the BMI and body weight (p<0.000 for all) from the normal weight towards the overweight and obesity groups, and although the presence of a highly significant difference according to mean alanine aminotransferase (ALT) values between the normal weight and overweight groups (39.7 versus 53.5 U/L, p<0.001), the difference between the overweight and obesity groups was non-significant according to the mean ALT values in serum (53.5 versus 53.5 U/L, p>0.05) (38). As a similar trend, prevalence of dyslipidemia was significantly lower in the normal weight than the overweight groups (25.0% versus 45.2%, p<0.001), but there was a non-significant difference between the overweight and obesity groups, too (45.2% versus 37.5%, p>0.05) (38). These findings may also be explained by the hepatic fat accumulation, inflammation, and fibrosis induced relatively low hepatic functions in obese individuals. So obesity may actually be a precirrhotic condition in the body.

In another study (39), when the authors compared the sustained normotension (NT), WCH, and HT groups, prevalence of nearly all of the pathologies including obesity, IGT, DM, and CAD showed significant progressions from the sustained NT towards the WCH and HT groups, and the WCH group was found as a progression step in between. Except for the prevalence of overweight, prevalence of all of the other pathologies were significantly higher in the WCH than the sustained NT cases (39). The similar progressions were observed nearly in all of the pathologic conditions between the WCH and HT groups, too, but interestingly there was only one parameter, dyslipidemia, that showed higher prevalence in the WCH against the HT groups (39). The prevalence of dyslipidemia was the highest in the WCH group and it was 41.6% versus 19.6% (p<0.001) in the sustained NT and 35.5% in the HT groups (p>0.05) (39). Against a previous study indicating serum triglyceride and cholesterol levels did not differ significantly between the NT, WCH, and sustained HT cases in men in the literature (40), the similar results indicating higher prevalences of dyslipidemia in WCH cases were also observed in another study, previously (41). So the higher prevalence of dyslipidemia in the WCH group may explain the adverse effects of WCH on health, since the dyslipidemia comes with obesity, HT, DM, CAD, stroke problems in future. Again the lower prevalence of dyslipidemia in the HT group may be explained by the hepatic fat accumulation, inflammation, and fibrosis induced relatively lost hepatic functions in obese individuals, since the prevalence of obesity was significantly higher in the HT against the WCH groups (p<0.01) (39). So WCH and hyperlipoproteinemias may show accelerating trend of gaining weight. By this way, the detected higher prevalence of WCH even in the second (33.3%) and in the third decades (46.6%) (11), despite the lower prevalence of obesity in these age groups, may show the trend of gaining weight, and the WCH and hyperlipoproteinemias may be pioneer signs of obesity and many associated disorders in future.

As a conclusion, there are significant relationships between umbilical hernia and terminal consequences of the metabolic syndrome including obesity and HT, probably on the bases of prolonged inflammatory and atherosclerotic effects, beside the pressure effect of the excessive fat tissue on abdominal muscles. The inverse relationships between obesity and hypertriglyceridemia and hyperbetalipoproteinemia may be explained by the hepatic fat accumulation, inflammation, and fibrosis induced relatively lost hepatic functions in obese individuals. Similarly, the inverse relationship between obesity and WCH may be explained by the progression of WCH into HT in obese individuals. So obesity may actually be a precirrhotic condition for the human body.

References