Inguinal hernia may not have a chronic low-grade inflammatory background on vascular endothelium

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Abstract

Background: Probably metabolic syndrome is a chronic low-grade inflammatory process of vascular endothelium, and there is not enough knowledge about its association with inguinal hernia in the literature.

Methods: Consecutive patients with an inguinal hernia and/or a surgical repair history of inguinal hernia were collected into the first, and age and sex-matched controls were collected into the second, group.

Results: The study included 56 cases with inguinal hernia and 80 cases of controls. Mean age of hernia cases was 45.8 years, and 85.7% of them were male ($p<0.001$). Interestingly, 46.4% of the inguinal hernias were on the right and 30.3% of them were on the left sides ($p<0.05$), and 23.2% of them were located, bilaterally. When we compared the groups according to mean weight, height, body mass index (BMI), triglyceride, and low density lipoproteins (LDL) values and prevalences of smoking, white coat hypertension (WCH), hypertension (HT), diabetes mellitus (DM), and coronary artery disease (CAD), there was not any significant difference according to any parameter in between ($p>0.05$ for all).

Conclusion: Although umbilical hernia may significantly be related with metabolic syndrome with a higher prevalence with advanced age, obesity, and females, we did not find any relationship between inguinal hernia and mean weight, height, BMI, triglyceride, and LDL values and prevalences of smoking, WCH, HT, DM, and CAD. So inguinal hernia may not have a chronic low-grade inflammatory background on vascular endothelium with a higher prevalence in male gender, younger ages, and right side predominance, without any effect of excess weight.

Key words: Inguinal hernia, endothelial inflammation, metabolic syndrome, obesity

Please cite this article as: Helvaci M. et al. Inguinal hernia may not have a chronic low-grade inflammatory background on vascular endothelium. World Family Medicine. 2018; 16(2): 32-36.
DOI: 10.5742/MEWFM.2018.93238

Introduction

Due to the prolonged survival of human beings, systemic atherosclerosis may be the major health problem in this century, and its association with sedentary lifestyle, excess weight, smoking, and alcohol is collected under the heading of metabolic syndrome (1, 2). The syndrome is characterized by a chronic low-grade inflammatory process on vascular endothelium in the whole body (3). The inflammatory process is particularly accelerated by some factors including sedentary lifestyle, excess weight, smoking, alcohol, chronic inflammations and infections, 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 parameters including overweight, white coat hypertension, impaired fasting glucose, impaired glucose tolerance, 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, peripheric artery disease, coronary artery disease (CAD), and stroke (7). In another perspective, the metabolic syndrome may be the most significant disease of human beings decreasing quality and duration of human lifespan 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 atherosclerosis in whole body may be the leading cause of end-organ failure, early aging, and premature death for both genders. For example, CAD is the leading cause of death in developed countries. Although sedentary lifestyle, excess weight, smoking, alcohol, chronic inflammations and infections, and cancer induced chronic low-grade inflammation on vascular endothelium may terminate with significant health problems, there is not enough knowledge about effects of the inflammatory process on inguinal hernia in the literature.

Material and Methods

The study was performed in the Internal Medicine Polyclinic of the Mustafa Kemal University between March 2007 and January 2010. Consecutive patients with an inguinal hernia and/or a surgical repair history of inguinal hernia were collected into the first, and age and sex-matched control cases were collected into the second group. We excluded cases above the age of 70 years to avoid debility induced weight loss in elder individuals. 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, acute or chronic renal failure, chronic liver disease, hyper- or hypothyroidism, and 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 Internist instead of verbal expressions. Weight in kilograms is divided by height in meters squared (9). Office blood pressure (OBP) was checked after a 5-minute rest in seated position with the mercury sphygmomanometer on three visits, and no smoking was permitted during the previous 2 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 a 10-minute education session about proper blood pressure (BP) measurement techniques (10). The education included recommendation of upper arm while discouraging wrist and finger devices, using a standard adult cuff with bladder sizes of 12 x 26 cm for arm circumferences up to 33 cm in length and a large adult cuff with bladder sizes of 12 x 40 cm for arm circumferences up to 50 cm in length, and taking a rest at least for a period of 5-minutes in the seated position before measurement. 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 OBP of 140/90 mmHg or greater but mean HBP of lower than 135/85 mmHg, and masked HT as 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 antidiabetic medications were defined as diabetics. An oral glucose tolerance test with 75-gram glucose tolerance test was performed in cases with a FPG level between 100 and 125 mg/dL, and diagnosis of cases with a 2-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 56 cases with the inguinal hernia and 80 cases in the control groups. Mean age of the inguinal hernia cases was 45.8 years, and 85.7% (48 cases) of them were male ($p<0.001$). Interestingly, 46.4% of the inguinal hernias were on the right and 30.3% of them were on the left sides ($p<0.05$), and 23.2% of them were located, bilaterally. When we compared the two groups according to the mean weight, height, BMI, triglyceride, and LDL values and prevalences of smoking, WCH, HT, DM, and CAD, there was not any statistically significant difference according to any parameter in between ($p>0.05$ for all) (Table 1 - next page).

Table 1: Characteristic features of the study cases

Variables	Cases with inguinal hernia	*p*-value	Control cases
Number	56		80
Male ratio	***85.7%***	Ns*	85.0%
Mean age (year)	***45.8 ± 14.6 (18-70)***	Ns	45.9 ± 13.6 (18-68)
Prevalence of smoking	48.2%	Ns	47.5%
Mean weight (kg)	76.5 ± 13.7 (42-108)	Ns	79.4 ± 13.2 (50-116)
Mean height (cm)	169.3 ± 8.5 (137-189)	Ns	170.8 ± 7.6 (153-188)
Mean BMI† (kg/m²)	26.5 ± 4.1 (17.7-38.0)	Ns	27.2 ± 4.4 (17.7-38.7)
Mean triglyceride (mg/dL)	160.6 ± 89.1 (50-381)	Ns	144.0 ± 79.8 (49-385)
Mean LDL‡ (mg/dL)	118.2 ± 26.9 (53-171)	Ns	128.6 ± 34.7 (54-239)
Prevalence of WCH§	32.1%	Ns	35.0%
Prevalence of HT‖	19.6%	Ns	12.5%
Prevalence of DM¶	10.7%	Ns	20.0%
Prevalence of CAD**	1.7%	Ns	6.2%

*Nonsignificant (p>0.05) †Body mass index ‡Low density lipoproteins §White coat hypertension ‖Hypertension ¶Diabetes mellitus **Coronary artery disease

Discussion

Probably obesity is found among one of the irreversible endpoints of the metabolic syndrome, since after development of obesity, nonpharmaceutical approaches provide limited benefit either to heal obesity or to prevent its complications. Overweight and obesity probably lead to a chronic low-grade inflammation on vascular endothelium that is associated with many coagulation and fibrinolytic abnormalities suggesting that excess weight may cause a prothrombotic and proinflammatory state (12). The chronic inflammatory process is characterized by lipid-induced injury, invasion of macrophages, proliferation of smooth muscle cells, endothelial dysfunction, and increased atherogenicity (13, 14). Elevation of C-reactive protein (CRP) levels in serum carries predictive power for the development of atherosclerotic end-points (15, 16), and overweight and obesity are considered as strong factors for controlling of CRP concentration in serum, because adipose tissue produces biologically active leptin, tumor necrosis factor-alpha, plasminogen activator inhibitor-1, and adiponectin. So adipose tissue is involved in the regulation of cytokines, and individuals with overweight and obesity have elevated CRP levels in serum (17, 18). 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, fasting plasma glucose and serum total cholesterol levels were all elevated with the increased BMI values (19). Similarly, prevalences of CAD and ischemic stroke increased with an elevated BMI value in another study (20). On the other hand, the chronic low-grade inflammatory process 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 (21). Eventually, the risk of death from all causes including cardiovascular diseases and cancers increased throughout the range of moderate to severe weight excess for both genders in all age groups (22).

Hernias develop when an internal part of the body pushes through a weakness in the muscle or surrounding tissue wall. They can even occur anywhere in the abdominal region. The most common kinds of abdominal hernias are inguinal, femoral, incisional, umbilical, and hiatal hernias. In many cases, abdominal hernias cause just a few symptoms. However they may even cause an obstruction in the bowel and interrupt the blood supply of the intestines as medical emergencies. Due to the potential risk of these complications, surgery is usually recommended to repair the hernias. The exception is umbilical hernias since the risks of complications are thought too small to justify surgery for them. Inguinal hernias are the most common types of hernias in both genders in adults (up to 75% of all abdominal hernias), and they are the second in frequency after the umbilical hernias in infants and children. While

the inguinal hernias are much more common in men, they also develop in women with a prevalence of 10% (23). They develop due to a weakness, tear, gap, or opening in the muscular wall of the groin around the inguinal canal region. As a result of this opening in the muscular wall, contents of the abdomen including intestines may protrude by creating a localized bulge or pain. Inguinal hernias may be congenital or acquired. Acquired hernias are the result of repetitive pressure, strain, or injury due to the further weakening of structural integrity and function of the abdominal wall. The process in acquired cases may be acute or chronic, developing slowly over a period of time. Inguinal hernias are also classified as direct or indirect according to their anatomic direction of travel into the inguinal canal. Purely congenital hernias are often called indirect hernias, whereas acquired hernias are referred to as direct hernias. Although femoral hernias occur more often in women, women still get more inguinal hernias than femoral ones. Every year in England, 70.000 surgical operations are required to repair inguinal hernias (24). They can occur at any age, but they are primarily age-related, so older the age, higher the risk of getting an inguinal hernia. Similarly, mean age of the inguinal hernia cases was 45.8 years in the present study, and 85.7% of them were male ($p<0.001$). As an opposite finding to varicocele (25), the inguinal hernias were significantly more common on the right side (46.4% versus 30.3%, $p<0.05$), and 23.2% of them were located, bilaterally. Inguinal hernias are further divided into indirect inguinal hernias (2/3 of all), in which the inguinal canal is entered via a congenital weakness at the internal inguinal ring, and the direct inguinal hernias (1/3 of all), where the hernia contents push through a weak spot in the posterior wall of the inguinal canal. The indirect inguinal hernias are congenital hernias and much more common in men due to the way males develop in the womb. In a male fetus, the spermatic cord and both testicles descend from an intraabdominal location into the scrotal sac through the inguinal canal. Sometimes the entrance of the inguinal canal at the inguinal ring does not close as it should just after birth, leaving a weakness in the abdominal wall. Fat or part of the small intestine slides through the weakness into the inguinal canal, causing an indirect hernia. In females, an indirect inguinal hernia is caused by the female organs or the small intestine sliding into the groin through a weakness in the abdominal wall. Premature infants are especially at a higher risk for the indirect inguinal hernias because there is less time for the inguinal canal to close. On the other hand, direct inguinal hernias develop gradually due to continuous stress on the muscles. They are caused by connective tissue degeneration, which causes weakening of the abdominal muscles during adulthood. Although the high prevalence of inguinal hernia in society, its predisposing factors are not clearly known, yet. According to the literature, sudden muscular strains, heavy lifting, straining during constipation, and chronic coughing may cause pressure on the abdominal muscles and worsen the hernia. Similarly, we were not able to find any association between the inguinal hernia and metabolic parameters including mean weight, height, BMI, triglyceride, and LDL values and prevalences of smoking, WCH, HT, DM, and CAD in the present study ($p>0.05$ for all). The right side predominance of inguinal hernia cases may also indicate absence of a systemic inflammatory background of the pathology.

Although the inguinal hernia is not related with the parameters of the metabolic syndrome, the umbilical hernia may highly be related with the syndrome. In a previous study, the mean age of the umbilical hernia patients was 62.0 years, and 73.9% of them were female (26). Whereas the mean age of the inguinal hernia cases was 45.8 years, and 85.7% of them were male in the present study that may also indicate the absence of any association of the inguinal hernia with the metabolic syndrome since the syndrome is much more common with obesity, and obesity is much more common in advanced age and in females. Similarly, the umbilical hernia patients were heavier than the controls (85.1 versus 73.1 kg, $p= 0.001$) and BMI of them was also higher, significantly (33.6 versus 29.1 kg/m2, $p= 0.000$) (26). Although the prevalence of HT was higher in the umbilical hernia cases (50.0% versus 27.3%, $p<0.01$), mean triglyceride and LDL values and prevalence of WCH were lower in them ($p<0.05$ for all) (26). Although the prevalences of DM and CAD were also higher in the umbilical hernia patients, the differences were nonsignificant probably due to the small size of the umbilical hernia group. So 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.

As a conclusion, although the umbilical hernia may significantly be related with the metabolic syndrome with a higher prevalence in advanced age, obesity, and females, we did not find any relationship between inguinal hernia and mean weight, height, BMI, triglyceride, and LDL values and prevalences of smoking, WCH, HT, DM, and CAD. So inguinal hernia may not have a chronic low-grade inflammatory background on vascular endothelium with a higher prevalence in males, younger ages, and right side predominance, without any effect of excess weight.

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