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Original Article

Left renal atrophy

Ramazan Davran, Mehmet Rami Helvaci, Mursel Davarci

Medical Faculty of The Mustafa Kemal University, Antakya

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Abstract: Background: We tried to understand whether or not there is a higher risk of left renal atrophy in human being. Methods: All patients applying to the Hematology Service with any underlying complaint were studied. Results: The study included 2,417 cases (1,248 females). The mean ages were 47.3 versus 50.7 years in females and males, respectively ($p<0.000$). There were 33 cases (1.3%) with the left renal atrophy against five cases (0.2%) with the right ($p<0.001$). The left renal atrophy cases have splenomegaly (SM) in 51.5%, thalassemia minors (TMs) in 30.3%, sickle cell diseases (SCDs) in 27.2%, myeloproliferative disorders in 18.1%, chronic lymphocytic leukemia in 6.0%, cirrhosis in 6.0%, solid organ malignancies in 6.0%, chronic obstructive pulmonary disease in 3.0%, multiple myeloma in 3.0%, and Waldenström's macroglobulinemia in 3.0%. Similarly, the right renal atrophy cases have SM in 20.0%, TMs in 40.0%, and SCDs in 20.0%. Conclusion: Left renal atrophy may be significantly higher than the right side in human being. Aortic pressure induced flow disorders in the left renal vein, structural anomalies of the left renal vein, and possibly the higher arterial pressure of the left kidney due to the shorter distance to the heart as an underlying cause of atherosclerosis may be some of the possible causes. Due to the stronger arterial wall protecting itself from compression and high prevalences of SM and left varicocele in population, SM induced flow disorders of the left renal vein may be the most common cause.

Keywords: Left renal atrophy, splenomegaly, left renal vein, atherosclerosis

Introduction

Atherosclerosis, but not venosclerosis, is an inflammatory process due to the higher arterial pressure that causes chronic endothelial damage in a lifelong period. It may be the major cause of aging and end-organ failures in human body [1, 2]. Probably, it is a systemic and irreversible process initiating at birth, and accelerated with many factors. The accelerating factors known for today are collected under the heading of metabolic syndrome. Some reversible components of the syndrome are overweight, hypertriglyceridemia, hyperbetalipoproteinemia, dyslipidemia, white coat hypertension, impaired fasting glucose, impaired glucose tolerance, and smoking for the development of terminal consequences such as obesity, diabetes mellitus, hypertension, coronary heart disease, chronic obstructive pulmonary disease (COPD), cirrhosis, chronic renal disease (CRD), peripheric artery disease, stroke, and other end-organ failures [3-8]. On the other hand, nephrons are the basic functional units of the kidney located in the renal parenchyma, and renal atrophy is characterized by shrinkage of kidney due to loss of nephrons. Several primary renal diseases and acute or chronic pyelonephritis may cause renal atrophy. Renal atrophy may also be teminated by the obstruction of urinary tract due to an increased pressure on it. Obstructive uropathy causes a higher urinary pressure within the kidneys causing damage to the nephrons. Although the presence of several possible causes, the most common cause of renal atrophy may be the systemic atherosclerosis, and CRD due to the metabolic syndrome is common in elderlies. Sickle cell diseases (SCDs) is another accelerated systemic atherosclerotic process, and the higher prevalence of CRD in SCD patients may also indicate the underlying atherosclerotic background of CRD [9]. We tried to understand whether or not there is a difference according to renal atrophy between the left and right sides in human body in the present study.

Material and methods

The study was performed in the Hematology Service of the Mustafa Kemal University

Table 1. Left renal atrophy cases with associated disorders

Variables	Prevalence
Splenomegaly	51.5% (17)
Thalassemia minors	30.3% (10)
Sickle cell diseases	27.2% (9)
Chronic myeloproliferative disorders	18.1% (6)
Chronic lymphocytic leukemia	6.0% (2)
Cirrhosis	6.0% (2)
Solid organ malignancies	6.0% (2)
Chronic obstructive pulmonary disease	3.0% (1)
Multiple myeloma	3.0% (1)
Waldenstrom's macroglobulinemia	3.0% (1)
Cyst hydatid	3.0% (1)

Table 2. Right renal atrophy cases with associated disorders

Variables	Prevalence
Splenomegaly	20.0% (1)
Thalassemia minors	40.0% (2)
Sickle cell diseases	20.0% (1)

between March 2007 and July 2013. All patients applying for the service were enrolled into the study. A check up procedure including serum iron, total iron binding capacity, serum ferritin, hepatic function tests, markers of hepatitis viruses A, B, and C and human immunodeficiency virus, and an abdominal ultrasonography was performed. Renal atrophies and cases with splenomegaly (SM) were detected ultrasonographically. Thalassemia minors (TMs) are diagnosed by serum iron, total iron binding capacity, serum ferritin, and the hemoglobin electrophoresis via high performance liquid chromatography (HPLC) method. SCDs are diagnosed by the hemoglobin electrophoresis via HPLC. The criterion for diagnosis of COPD is post-bronchodilator forced expiratory volume in 1 second/forced vital capacity of less than 70% [10]. Cirrhosis is diagnosed with hepatic function tests, ultrasonographic findings, ascites, and histologic procedure in case of requirement. Finally, the left and right renal atrophy cases were compared according to the general prevalences in the Hematology Service and associated disorders with them. Mann-Whitney U test, Independent-Samples t test, and comparison of proportions were used as the methods of statistical analyses.

Results

The study included 2,417 cases (1,248 females and 1,169 males). The mean ages of them were 47.3 ± 20.1 (8-105) versus 50.7 ± 20.4 (6-105) years in females and males, respectively ($p<0.000$). Interestingly, there were 33 cases (1.3%) with the left renal atrophy against only five cases (0.2%) with the right ($p<0.001$) among the study cases. The female ratios were 39.3% (13) and 40.0% (2) in the left and right renal atrophy cases, respectively ($p>0.05$). The left renal atrophy cases have SM in 51.5% (17), TMs in 30.3% (10), SCDs in 27.2% (9), myeloproliferative disorders including polycythemia vera, chronic myelocytic leukemia, and essential thrombocytosis in 18.1% (6), chronic lymphocytic leukemia in 6.0% (2), cirrhosis in 6.0% (2), solid organ malignancies in 6.0% (2), COPD in 3.0% (1), multiple myeloma in 3.0% (1), Waldenström's macroglobulinemia in 3.0% (1), and cyst hydatid in 3.0% (1), of them (**Table 1**). Similarly, the right renal atrophy cases have SM in 20.0% (1), TMs in 40.0% (2), and SCDs in 20.0% (1) of them (**Table 2**).

Discussion

TMs are chronic hemolytic anemias, and 1.6% of the population are heterozygous for alpha- or beta-thalassemias in the world [11]. So TMs are probably the most common cause of SM in population. Interestingly, we detected the prevalences of TMs as 30.3% and 40.0% in the left and right renal atrophy cases, respectively, in the present study. They are autosomal recessively inherited disorders as in SCDs. It results from unbalanced hemoglobin synthesis caused by decreased production of at least one globin polypeptide chain (alpha, beta or delta). Alpha-thalassemias result from decreased alpha chain synthesis and beta-thalassemias from decreased beta chain synthesis. A mild to moderate anemia induced tissue hypoxia, bone marrow hyperactivity due to the chronic hemolytic process, splenic hyperactivity and SM, cardiopulmonary hyperactivity, and growth retardation may develop in the TMs.

SCDs are accelerated systemic atherosclerotic processes initiating at birth [12, 13], and by which we can observe final consequences of the systemic atherosclerosis nearly 30 or 40 years earlier in the life. SCDs are caused by homozygous inheritance of the hemoglobin S

(Hb S). Hb S causes erythrocytes to change their normal elastic structures to hard bodies. Actually, the name should be 'Rigid Cell Induced Chronic Endothelial Dysfunction Syndrome' since we can not observe the sickle cells in the peripheric blood samples of cases with additional TMs, easily. So, the rigidity of erythrocytes is the main problem instead of their shapes or severity of anemia. The rigidity process is probably present in whole life but exaggerated with various stresses. The erythrocytes can take their normal elastic structures after normalization of the stresses, but after repeated attackes of rigidity, they become hard bodies, permanently. The rigid cells induced chronic endothelial damage causes tissue ischemia, infarction, and end-organ failures even in the absence of obvious vascular occlusions on the chronic background of edematous and damaged endothelium all over the body. Probably, there is not any organ in the body that can protect itself from damage of the rigid cells. The digital clubbing and recurrent leg ulcers may also indicate the chronic tissue hypoxia in such individuals. Due to the reversibility of digital clubbing and leg ulcers with the hydroxyurea treatment [14], the chronic endothelial damage is probably prominent at the microvascular level as in diabetic microangiopaties, and reversible with some extent. Although large arteries and arteriols are especially important for blood transport, capillaries are more important for tissue oxygenation. So passage of the rigid cells through the endothelial cells particularly cause damage on the capillaries. Reversibility of the process may probably be more in early years of the life but it gets an irreversible nature by time. SM is also frequent in early years of the life due to the edematous and swollen endothelium in the spleen. But the ischemic process terminates with tissue fibrosis and shrinkage all over the body as in autosplenectomy. The case of right renal atrophy together with the SCDs may also be explained by the mechanism in the present study. Eventually, the mean survivals were 42 and 48 years for males and females for the SCDs in the literature [15]. On the other hand, anemia probably is not the cause of the end-organ failures in the SCDs, since we can not observe any shortened survival in the TMs although the presence of a moderate anemia.

Varicocele is a dilatation of pampiniform venous plexus within scrotum. It occurs in 15-20% of all males and 40% of infertile males, since researchers documented a recurrent pattern of low sperm count, poor motility, and predominance of abnormal sperm forms in varicocele cases [16, 17]. Varicoceles are much more common in the left side (nearly 80% to 90%) due to several anatomic factors including angle at which the left testicular vein enters the left renal vein, lack of effective antireflux valves at the juncture of left testicular vein and left renal vein, the nutcracker syndrome, and some other left renal vein anomalies such as passage behind the aorta [18, 19]. The nutcracker syndrome results mostly from the compression of the left renal vein between the abdominal aorta and superior mesenteric artery, although some other variants exist [20]. But according to our opinion, the higher prevalences of varicocele on the left side may mainly be a result of high prevalences of TMs and SM in population that may cause drainage problems in the left renal vein.

The accelerated atherosclerotic process can also affect the renal arteries, and may lead to poor perfusion of the kidneys leading to renal failure. The right renal artery is longer than the left because of the location of the aorta. Additionally, the right renal artery is lower than the left because of the position of the right kidney. So the left kidney possibly has a relatively higher arterial pressure due to the shorter distance to the heart as an underlying cause of endothelial damage and atherosclerosis. But according to our opinion, the accelerated atherosclerotic process alone can not explain the significantly higher prevalence of renal atrophy on the left side (1.3% versus 0.2%, $p<0.001$) in the present study. The left renal atrophy has also been reported in the literature [21]. On the other hand, the high prevalences of associated TMs (30.3%) and SM (51.5%) with the left renal atrophy cases may be important for the explanation, since spleen and left kidney are closely related organs which may also be observed with the development of varicose veins from the left renal vein at the splenic hilus in cirrhotics. Any pressure on the left kidney as in SM cases may cause torsion of the left renal vein, and prevents its drainage. We especially think about the drainage problems at the venous level due to the stronger arterial walls that can not be obstructed easily and the higher prevalence of varicocele in the left side in males [22, 23].

As a conclusion, the renal atrophy is significantly higher on the left side. Aortic pressure induced flow disorders in the left renal vein, structural anomalies of the left renal vein including nutcracker syndrome and passage behind the aorta, and possibly the higher arterial pressure of the left kidney due to the shorter distance to the heart as an underlying etiology of endothelial damage and atherosclerosis may be some of the possible causes. Due to the stronger arterial walls protecting themselves from compression and high prevalences of SM and left varicocele in population, SM induced flow disorders of the left renal vein may be the most significant cause among all.

Disclosure of conflict of interest

None to declare.

Address correspondence to: Dr. Ramazan Davran, Medical Faculty of The Mustafa Kemal University, 31100, Serinyol, Antakya, Hatay, Turkey. Tel: 00-90-326-2291000; Fax: 00-90-326-2455654; E-mail: ramazandavran@gmail.com

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