Original Article

DOI: 10.56016/dahudermj.1108002

DAHUDER Medical Journal
e-ISSN: 2791-9250

Comparison of cardiac risk factors in patients with primary nephrotic syndrome and secondary amyloidosis

Osman Cüre[1], Teslime Ayaz[2], Kuddusi Cengiz[3]

[1]Department of Rheumatology, Recep Tayyip Erdogan University, Faculty of Medicine, Rize, Turkey
[2]Department of Internal Medicine, Recep Tayyip Erdogan University, Faculty of Medicine, Rize, Turkey
[3]Department of Nephrology, Ondokuz Mayıs University, Faculty of Medicine, Samsun, Turkey

ABSTRACT

Objectives: To investigate the risk factors of proteinuria on the development of atherosclerosis in primary nephrotic syndrome and secondary amyloid cases and to determine the differences in these disease groups that are well matched in terms of age, gender, arterial blood pressure levels, glomerular filtration rate and body mass index.

Methods: The patient groups were selected in such a way that the protein levels in the 24-hour urine were exactly the same. 29 patients with nephrotic syndrome, 30 patients with secondary amyloidosis and 30 control groups were included in the study. C-reactive protein, fibrinogen, total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, lipoprotein a, apolipoprotein Al, B, E, glomerular filtration rate and 24-hour protein in the urine were compared between the patient and control groups

Results: In patient groups; total cholesterol, triglyceride, low-density lipoprotein, lipoprotein -a, apolipoprotein A, B, E and fibrinogen levels were found to be very high compared to the control group, while high-density cholesterol levels were lower($p < 0.01$). When both disease groups are compared; total cholesterol, triglyceride, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, apolipoprotein A, B, E levels were higher in the nephrotic syndrome group than in the secondary amyloidosis group($p < 0.05$). However, there was no difference between the patient groups in terms of C-reactive protein, fibrinogen and lipoprotein a levels ($p > 0.05$).

Conclusions: Atherosclerotic risk factors are quite high in proteinuria nephrotic syndrome and secondary amyloid patient groups, and patients with amyloidosis should be closely monitored for other atherosclerotic risk factors in addition to amyloid accumulated in the organs.

Keywords: Nephrotic Syndrome, SecondaryAmyloidosis, Cardiovascular Risk factors

Proteinuria has been shown to be associated with cardiovascular diseases, dyslipidemia, and hypertension. [1] Myocardial infarction risk is increased 5-6 times in patients with nephrotic proteinuria. [2] Proteinuria accelerates atherosclerosis by causing endothelial dysfunction, inflammation, dyslipidemia and hypercoagulability. Nephrotic syndrome is a disease characterized by a tendency to severe proteinuria, hypoalbuminemia, hyperlipidemia, edema and hypercoagulability. For this reason, there are many studies in the literature showing that the risk of atherosclerosis and coronary artery disease increases in Nephrotic syndrome. [3] Secondary amyloidosis is another disease that causes nephrotic proteinuria due to renal involvement. The risk of cardiovascular disease increases due to amyloid deposition, inflammation, and complications of Nephrotic syndrome in amyloidosis. In studies, both

Received: *April 23, 2022;* ***Accepted:*** *July 28, 2022;* ***Published Online:*** *July 29, 2022*

How to cite this article: *Cüre O, Iltar U, Ayaz T, Cengiz K. Comparison of cardiac risk factors in patients with primary nephrotic syndrome and secondary amyloidosis. DAHUDER M J 2022, 2(3):92-97*

Address for correspondence: *Osman CÜRE, Department of Rheumatology, Recep Tayyip Erdogan University, Faculty of Medicine, Rize, Turkey. E-mail: creosman61@gmail.com. Phone: +90 535 293 23 39*

cardiac and vascular system effects were reported in primary amyloidosis cases. Cardiovascular involvement has been reported at a rate of 54-100% in primary amyloid cases and 10% in secondary amyloid cases. [3-5] There are many publications showing the relationship between Nephrotic syndrome and cardiovascular disease very well. [3, 6, 7] Onthe other hand, there are very few studies on atherosclerotic risk factors in patients with secondary amyloidosis with proteinuria. [8] In our study, we aimed to compare atherosclerotic risk factors between patients with secondary amyloid and Nephrotic syndrome and to investigate the relationship of proteinuria with dyslipidemia and other atherosclerotic risk factors.

METHODS

Thirty patients diagnosed with secondary amyloidosis, 29 patients diagnosed with nephrotic syndrome, and 30 healthy volunteers as the control group were included in the study among the patients investigated for proteinuria in the nephrology outpatient clinic. Demographic characteristics, blood pressure and body mass index (BMI) of the three groups were recorded. Complete blood count at diagnosis, total cholesterol, triglyceride, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), apo-lipoproteinA1 (apo- A1), apo-lipoprotein-B (apo-B), apo-lipoprotein E (apo-E), lipoprotein-(a) [Lp-(a)], C- reactive protein (CRP), fibrinogen, urinalysis and 24-hour urine protein amount and creatinine clearance were calculated. Electrocardiography and chest X-ray were taken. Tissue biopsies were performed with patient consent for the etiology of secondary amyloidosis and nephrotic syndrome. Patients with high blood pressure and taking cholesterol-lowering drugs were not included in the study.

Statistics

Chi-square Test, Analysis of Variance (Post hoc Bonferonni), Spearman Correlation Analysis, Kruskal Wallis Test and Mann Whitney U test were used to evaluate the data. Statistical significance level was taken as $p < 0.05$ in the analyzes.

RESULTS

The secondary amyloidosis group consisted of 12 females and 18 males, with a mean age of 46.5 ± 14.2 years. The nephrotic syndrome group consisted of 12 females and 17 males, with a mean age of 45.3 ± 13.3 years (Tablo 1). The control group consisted of 15 females and 15 males, with a mean age of 45.4 ± 5.7 (37-55) years. In the etiology of secondary amyloidosis was detected Crohn's disease in 1(3%), Rheumatoid arthritis (RA) in 2(7%), Bechet's disease in 3(10%), Bronchiectasis in 4(13%), Tuberculosis in 8(27%), Familial Mediterranean Fever (FMF) in 12(40%) of the cases. In the etiology of nephrotic syndrome was detected focal segmental glomerulonephritis (FSGN) in 4(13%), membranous glomerulonephritis (MGN) in 6(17%), diffuse proliferative glomerulonephritis (DPGN) in 6(20%), membranoproliferative glomerulonephritis (MPGN) in 14(47%) of the cases. There was no statistically significant difference between the three groups in terms of gender, age, smoking and BMI ($p > 0.05$). There was a statistically significant difference between the nephrotic syndrome and control group cases in terms of triglyceride ($p < 0.05$), total cholesterol ($p < 0.001$), albumin, fibrinogen, CRP, LDL-C, HDL-C apo-Al, apo B, apo E, Lp (a) and GFR ($p < 0.01$). There was a statistically significant difference between the nephrotic and control group cases in terms of triglyceride ($p < 0.05$), total cholesterol ($p < 0.00$l), HDL-C, LDL-C, albumin, fibrinogen, CRP, apo-Al, apo B, apo E, Lp (a), and GFR ($p < 0.01$). There was a statistically

Table 1. General Clinical Characteristics of Study Subjects (Mean + standard deviation, $p > 0.05$)

	NS n: 29	AA n: 30	Control n: 30
Age (year)	45.3 ± 13.3	46.5 ± 14.2	45.4 ± 5.7
Female/male	12 / 17	12 / 18	15/ 15
Proteinuria (g/L)	5.0 ± 2.3	5.0 ± 2.1	-
Creatinine (mg/dl)	1.1 ± 0.4	1.0 ± 0.4	0.7 ± 0.3
Cigaret(packet/year)	6 (20.4%)	7 (23.3%)	8 (26.6%)
BMI (kg/m^2)	23.8 ± 4.5	25.1 ± 4.8	24.4 ± 3.8

Table 2. Mean (mean ± standard deviation) and P values of Atherosclerotic Risk Factors among Nephrotic Syndrome. Secondary Amyloidosis and Control Group Cases

	Nephrotic syndrome n: 29	*P* Value	Secondary Amyloid n: 30	*P* Value	Control n: 30
Age (year)	45.3 ± 13.2	> 0.05	46.5 ± 14.2	> 0.05	45.4 ± 5.7
Creatinine (mg/dl)	1.1 ± 0.4	> 0.05	1.0 ± 0.4	> 0.05	0.7 ± 0.3
Albumine (mg/dl)	2.4 ± 0.4	< 0.01	2.3 ± 0.7	< 0.01	4.1 ± 0.3
CRP (mg/dl)	34.1 ± 24	< 0.01	38.6 ± 28.7	< 0.01	3.5 ± 1.5
Fibrinogen (mg/dl)	444.7 ± 221.3	< 0.01	466.4 ± 44.3	< 0.01	211.5 ± 47.5
Total cholesterol (mg/dl)	310.0 ± 85.5	< 0.001	252.0 ± 90.0	< 0.001	145.0 ± 24
Triglyceride (mg/dl)	211.0 ± 68.6	< 0.05	178.2 ± 56.0	< 0.05	10 1.0 ± 25
HDL-C (mg/dl)	44.1 ± 7.5	< 0.01	39.3 ± 14.2	< 0.01	54 ± 11.9
LDL-C (mg/dl)	229.5 ± 84.3	< 0.01	184.3 ± 87.2	< 0.01	78.9 ± 17.3
Lp (a) (mg/dl)	66.1 ± 23.9	< 0.01	60.1 ± 29.7	< 0.01	16.7 ± 6.3
Apo-Al (mg/dl)	119.7 ± 22.6	< 0.01	104.8 ± 30.4	< 0.01	148.5 ± 22.1
Apo-B (mg/dl)	182 ± 49.9	< 0.01	156.5 ± 64.7	< 0.01	61.2 ± 7.7
Apo-E (mg/dl)	6.0 ± 3.03	< 0.01	5.4 ± 1.9	<0.01	4.0 ± 1.4
GFR (ml/min)	83.9 ± 15.2	< 0.01	83.4 ± 16.8	< 0.01	101.3 ± 4 ± 7

significant difference among the cases with amyloid and nephrotic syndrome in terms of triglyceride ($p < 0.05$), total cholesterol ($p < 0.001$), apo-Al, apo B, apo E, HDL-C and LDL-C ($p < 0.01$). There was no significant difference in terms of GFR, albumin, fibrinogen, CRP and Lp (a) ($p > 0.05$, Tablo 2). There was a significant positive correlation between proteinuria and nephrotic syndrome (n: 29) patients in

Table 3. Correlation and P values between Proteinuria and Atherosclerotic Risk Factors in Nephrotic Syndrome, Secondary Amyloid, Secondary Amloid and Nephrotic Syndrome Cases

	Proteinuria (g/L)		
	Nephrotic syndrome	**Secondary Amyloid**	**Secondary Amyloid and Nephrotic Syndrome**
Cr (mg/L)	r = 0.01. $p > 0.05$	r = 0.24. $p >$ o.o5	r = 0.15. $p > 0.05$
Alb (mg/dl)	r = -13. $p > 0.05$	r = -0.49. $p < 0.01$	r = -0.34. $p < 0.01$
CRP (mg/dl)	r = 0.01. $p > 0.05$	r = 0.38. $p > 0.05$	r = 0.22. $p > 0.05$
Fibrinogen (mg/dl)	r = -0.01. $p > 0.05$	r = 0.13. $p > 0.05$	r = 0.08. $p > 0.05$
Total cholesterol (mg/dl)	r = 0.35. $p < 0.05$	r = 0.46. $p < 0.05$	r = 0.54. $p < 0.001$
Triglyceride (mg/dl)	r = 0.28. $p > 0.05$	r = 0.23. $p > 0.05$	r = 0.35. $p < 0.01$
HDL-C (mg/dl)	r = 0.05. $p > 0.05$	r = -0.49. $p > 0.05$	r = 0.10. $p > 0.05$
LDL-K (mg/dl)	r = 0.38. $p > 0.05$	r = 0.38. $p < 0.05$	r = 0.48. $p < 0.001$
Lp (a) (mg/dl)	r = 0.07. $p > 0.05$	r = 0.07. $p > 0.05$	r = 0.02. $p > 0.05$
ApoA1 (mg/dl)	r = 0.18. $p > 0.05$	r = 0.14. $p > 0.05$	r = 0.07. $p > 0.05$
Apo-B (mg/dl)	r = 0.09. $p > 0.05$	r = 0.25. $p > 0.05$	r = 0.30. $p < 0.05$
Apo-E (mg/dl)	r = 0.08. $p > 0.05$	r = 0.38. $p < 0.05$	r = 0.23. $p > 0.05$
GFR (ml/min)			r = 0.15. $p > 0.05$

There is a weak correlation between r (correlation coefficient) = 0.00-0.24, moderate relationship r = 0.25-0.49, strong relationship r = 0.50-0.74, strong relationship r = 0.75-1.

terms of total cholesterol (r = 0.35, $p < 0.05$). There was no relationship between other parameters. There was a significant positive correlation between proteinuria and secondary amyloid (n: 30) group cases in terms of total cholesterol (r = 0.46, $p < 0.05$), LDL-C (r = 0.38, $p < 0.05$) and apo E (r = 0.35, $p < 0.05$. There was no correlation between other parameters. When proteinuria with nephrotic syndrome and secondary amyloidosis group cases (n: 59) were compared, there was a significant positive correlation in terms of total cholesterol (r = 0.54, $p < 0.001$), LDL-C (r = 0.4. 8, $p < 0.001$), triglyceride (r = 0.35, $p < 0.001$) and apo B (r = 0.30, $p < 0.05$). There was a significant negative correlation for albumin (r = -0.34, $p < 0.01$, Tablo 3).

DISCUSSION

The relationship between proteinuria with cardiovascular mortality and morbidity has been known for a long time.9 Proteinuria increases cardiovascular mortality and morbidity 5-85 times due to endothelial dysfunction, lipoprotein metabolism disorder, decrease in GFR, hypercoagulability and inflammation. [1, 2, 10-12] Although cardiovascular mortality and morbidity in nephrotic syndrome is well known [1, 7, 13,] studies showing CV mortality and morbidity in secondary amyloidosis, which can cause nephrotic syndrome are very few. [8] According to our knowledge, there is no study comparing atherosclerotic risk factors in both groups. In our study; in 29 patients with nephrotic syndrome, 30 patients with secondary amyloidosis, and 30 completely healthy people, who were almost equal in terms of age, gender, smoking, BMI and proteinuria, as atherosclerotic risk factors CRP, fibrinogen, total cholesterol, triglyceride, LDL-C, HDL-C, Lp(a), apo Al, apo B and apo E levels were measured. In both disease groups, serum total cholesterol, triglyceride, LDL-C, Lp(a), apo Al, apo B, apo E, CRP and fibrinogen atherosclerotic risk factors were significantly higher than the control group, but serum HDL-C levels were lower. This part of our study shows that proteinuria increases atherosclerotic risk factors and is compatible with studies in the literature. [12, 14] In the second part of our study; When NS and secondary amyloid patients were compared in terms of atherosclerotic risk factors, serum total cholesterol, triglyceride, LDL-C, HDL-C, apo Al, apo B and apo E levels were higher in the group nephrotic syndrome compared to the secondary amyloid group [(total cholesterol, triglycerides, LDL-C, HDL-C, apo Al, apo B and apo E. There was a statistically insignificant increase in serum Lp, (a) level in the nephrotic syndrome group compared to the secondary amyloid group. In the literature, nephrotic syndrome has been studied extensively in terms of atherosclerotic risk factors, cardiovascular diseases and mortality-morbidity. In terms of atherosclerotic lipid levels, our study was compatible with most studies in the literature on nephrotic syndrome atherosclerotic risk factors. [7, 12, 15] Although secondary amyloidosis is more common in our country, studies showing atherosclerotic risk factors are scarce in the domestic and foreign literature. [8] The effect of proteinuria on atherosclerosis and arteriosclerotic risk factors has been known for many years. [6, 16] Our study is one of the few studies that we believe can be very useful in comparing secondary amyloidosis and nephrotic syndrome, showing the effect of atherosclerotic risk factors, the relationship between proteinuria and risk factors, apart from the amyloid material accumulating in the organs in secondary amyloidosis. Many factors play a role in the atherosclerotic process: abnormalities in lipid metabolism, endothelial dysfunction, inflammatory and immunological events. [8, 17] These factors involved in the pathogenesis are also frequently found in patients with nephrotic syndrome. Hyperlipidemia and abnormalities in lipoprotein metabolism have been known in nephrotic syndrome for a long time, and it is known that increased hepatic synthesis and decreased catabolism are responsible for its pathogenesis. [18] Although the importance of blood lipids has been demonstrated, the absence of hyperlipidemia in some of the patients has increased efforts to evaluate other risk factors, and studies conducted for this purpose have shown the importance of inflammatory markers such as high-sensitive CRP, and markers with hemostatic function such as lipoprotein(a), homocysteine, and fibrinogen. All stages of atherothrombosis are characterized by inflammation. It is also a process involving fatty streak formation, early phase of atherogenesis, endothelial cells, inflammatory cytokines and leukocytes. Thrombotic complications in plaque are associated with local and systemic inflammation. It has been determined that high-sensitive CRP levels are associated with myocardial infarction, stroke, peripheral arterial disease and sudden cardiac death. However, if the levels are > 10mg/L in sequential measurements, it is associated with inflammation and it is recommended to be investigated accordingly. [19] In

our study, we found that CRP levels were high, indicating inflammation or infection, in both the secondary amyloidosis and nephrotic syndrome patient groups. The place of lipoprotein (a) in atherosclerosis and its relationship with both coronary and peripheral artery disease have been shown, and previous studies have shown that the levels of lipoprotein (a) increases in patients with nephrotic syndrome. [15, 20] The importance of endothelial dysfunction and inflammation has been increasingly recognized in recent years. The importance of endothelial dysfunction and inflammation has been increasingly recognized in recent years. Serum CRP level is the most studied inflammatory marker, and the relationship between increased levels and cardiovascular events has been shown in various studies. The same relationship has been shown with fibrinogen levels, which is also an acute phase reactant and plays a role in thrombus formation. [21] It has been suggested that endothelial dysfunction in nephrotic syndrome is involved in the atherosclerotic process as well as in protein leakage. The literature on secondary amyloidosis is limited, the studies on cardiac pathologies here were mostly conducted with primary amyloidosis (AL), and both cardiac and vascular system effects were reported. In our country, secondary amyloidosis is frequently seen, and there is not enough data on the changes in the cardiovascular system in this patient group. Although it has been previously reported that mortality is high in patients with renal failure with systemic amyloidosis, information about the causes of mortality is limited. In the study conducted by Sengul *et al*. in patients with secondary amyloidosis undergoing hemodialysis, they found the mortality to be high similar to diabetic patients and found that the most important causes of death were infection first and then cardiovascular causes. In the same study, it was shown that CRP and serum albumin were associated with mortality. [7] In a study by Cengiz *et al*., it was reported that atherogenic lipid and apolipoprotein levels were higher in patients with chronic renal failure (CRF) as a result of secondary amyloidosis than in healthy controls and non-amyloid CRF. [6] Secondary amyloidosis occurs due to underlying rheumatological diseases, chronic infections and inflammatory bowel diseases and is characterized by the accumulation of serum amyloid A (SAA) protein in tissues. Serum amyloid A protein, which is an acute phase reactant and whose level can increase up to 1000 times with inflammatory stimuli, is mainly synthesized in the liver in relation to HDL-C. However, studies conducted in recent years have shown that SAA protein is found in endothelium, atherosclerotic lesions, and smooth muscle cells. SAA protein found in atherosclerotic lesions is thought to play a role in lipid metabolism by causing uptake or excretion of lipids at the cellular level. It is thought that SAA protein may cause remodeling of vascular walls or plaques by causing collagenase synthesis from smooth muscles, apart from lipid metabolism. SAA protein can also affect thrombus formation by disrupting platelet aggregation and adhesion in the endothelium. [22] In our study, lipidprofile in the patient group with amyloidosis, similar to nephrotic syndrome, showed a significantly atherogenic feature compared to the control group. Lipoprotein (a), CRP and fibrinogen levels were higher in both patient groups compared to the control group, and there was no significant difference in the comparison of the patient groups. This may have been due to infections that we could not detect in the patient groups with nephrotic syndrome and secondary amyloidosis, although patients with infections were excluded from the study. In the third part of our study, the relationship between proteinuria and CV risk factors was evaluated. In the nephrotic syndrome group, serum total cholesterol, and among the secondary amyloid (n: 30) groups, total cholesterol, LDL-C and apo E levels were significantly positive, but with serum albumin levels in both patient groups had a negative correlation. There was no relationship between the two groups with other parameters. This difference in secondary amyloidosis could be due to amyloid material accumulating in the vascular structures. Between total (n: 59) cases of total nephrotic syndrome and secondary amyloid groups with proteinuria, in terms of total cholesterol, LDL-C, triglyceride and apo B had significant positive correlation, but there was a significant negative correlation with albumin. There was no relationship between other parameters. In conclusion, atherosclerotic risk factors were significantly higher in patients with proteinuria, nephrotic syndrome due to various causes, and secondary amyloid compared to the control group. In the study of Wencai Jiang *et al*., it was reported that the level of atherosclerosis increases as the level of proteinuria increases. [23] Our study is one of the few studies showing atherosclerotic risk factors in secondary amyloidosis. However, the limitation of our study is the insufficient number of cases. Further studies in larger case groups can give meaningful results.

CONCLUSION

Atherosclerotic risk factors are quite high in nephrotic syndrome and secondary amyloid patient groups with proteinuria, and patients with amyloidosis should be closely monitored in terms of other atherosclerotic risk factors in addition to amyloid accumulating in the organs. In addition, we believe that in diseases progressing with proteinuria, primary disease treatment and atherosclerotic risk factors and proteinuria should also be treated. Multicenter studies with more case series are needed to prove our study.

Authors' Contribution

Study Conception: OC, TA, KC,; Study Design: OC, TA, KC,; Supervision: OC, TA, KC,; Materials: OC, TA, KC,; Data Collection and/or Processing: OC, TA, KC,; Statistical Analysis and/or Data Interpretation: OC, TA, KC,; Literature Review: OC, TA, KC,; Manuscript Preparation: OC, TA, KC and Critical Review: OC, TA, KC.

Conflict of interest

No potential conflicts of interest relevant to this article were reported.

Acknowledgements

We are grateful to all treating physicians in our center for collaboration and the data collection.

Financing

There is no source of financial support or funding.

REFERENCES

1. Berlyne GM, Mallick NP: Ischemic heart disease as a complication of nephrotic syndrome. Lancet:1969, 2;399-400.
2. Jaap AJ, Erik SGS, and Ton JR: Endothelial function in proteinuric renal disease. Kidney Int: 1999; 56 (Suppl. 71), S57-S61.
3. Stephan R. Orth, and Eberhard Ritz: The Nephrotic syndrome. N Engl J Med:1998; 338,1202-1211.
4. Robert R. L. Smith, Grover M. Hutchins: Ischemic heart diseasese conary amyloidosis of intramyocardial arteries. Am J Cardiology: 1979;44, 413-417.
5. Hamer J.p.m., S. Janssen, M.H. Van Rijswijkand K.I.L ie: Amyloid cardiomyopathy in systemic non-hereditary amyloidosis. Eu Heart J: 1992;13, 623-627.
6. David C. Wheeler, and David B. Bernard: Lipid abnormalities in the nephrotic syndrome: Causes, consequences, and treatment. American Journal of Kidney Disease: 1994;23, 331-346.
7. J Radhakrishan, A.S. Appel, A. Valeri, and Gerald BA: The nephritic syndrome, lipids and risk factors for cardiovascular disease. Am J Kidney Disease. 1993;22, 135-142.
8. Srinivas KV, Neverov NI, Kolunduk NV, Tambovtseva EV, Kozlova RI: Blood lipids in renal amyloidosis. Urol Nefrol (Mosk): 1993; (1), 28-31.
9. Kannel WB, Stampfer MJ, Castelli WP, Verter J: The prognostic significance of proteinuria. The Framingham study. Am Heart J: 1984;108,1347-1352.
10. Karen EP, Martin B, John T, Vıdya MA, Gordon DOL, and Angela CS. Endothelial dysfunction and inflammation in asymptomatic proteinuria. Kidney Int: 2003; 63, 624-633.
11. Christopher JD, Muriel JC, Michael M, J. Michael Boulton-Jones and Christopher JP: Increased atherogenicity of low — density lipoprotein in heavy proteinuria. Nephrol Dial Transplant: 1998; 13,1183-1188.
12. Ongajyooth L.Sirisalee K, Laohaphand T, Parichatiganond P, Shayakul C, Nilwarangkur S: Lipoprotein abnormalities in adult nephritic syndrome. J Med Assoc Thai:1993; 76(9),512-20.
13. Ordonnez JD, Hiatt RA, Killebrew EJ, Fireman BH: The increased risk of coronary heart disease associated with nephritic syndrome. Kidney Int: 1992;44,638-642.
14. Atman PO, Alaupovic P: Pathogenesis of hyperlipidemia in the nephritic syndrome. Am J Nephrol:1990;10 (Suppl 1) 69-75.
15. Stenvinkel P, Berglund L, Ericsson S, Alvestrand A, Angelin B, Eriksson M. Low density lipoprotein metabolism and its association to plasma lipoprotein(a) in the nephrotic syndrome. Eur J Clin Invest: 1997;2,167-77.
16. Christopher JD, Muriel JC, Michael C, J. Michael Boulton-Jones and Christopher JP: The atherogenic lipoprotein phenotype: small dense LDL and lipoprotein remnants in nephritic range proteinuria. Atherosclerosis: 2001; 157,211-220.
17. Veneracin GC, Nig F, Catherine AR, John L, Nancy RW, Frederick CD, and Godfrey SG: Influence of apoA-I and apoE on the formation of serum amyloid A-containing lipoproteins in vivo and in vitro. J. Lipid Research: 2004;45, 317-325.
18. Apel GB, Valeri A, Appel AS, Blum C: The hyperlipidemia of the nephritic syndrome. Am J Med: 1989;87 (5N), 45-50.
19. Macrae F. Linton, and Sergio Fazio: A Pratical approach to risk assessment to prevent coronary artery disease and its complications. Am J Cardiol:2003;92(suppl), 19-26.
20. Kronenberg F, Steinmetz A, Kostner GM, Dieplinger H: Lipoprotein(a) in health hand disease. Crit Rev Clin Lab Sci: 1996;33(6),495-543.
21. Ünlü Y, Karapolat S, Karaca Y, Kızıltunç A: Comparison of levels of inflammatory markers and hemostatic factors in the patients with and without peripheral arterial disease. Thrombosis