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Original Research Article

Electrophysiological Study in Patients of Coronary Artery and Asymptomatic Peripheral Arterial Disease

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Abstract

Atherosclerosis remains one of the major causes of death and premature disability in developed countries.It is a chronic inflammatory disease which may cause obstructions of the coronary, cerebral and peripheral arteries.The goal of this study to establish association between ankle brachial index(ABI) and nerve conduction study (NCS) with extent of coronary artery disease.Seventy eight patients (39 malesand 39 females)were studied. Seventy eight healthy volunteers match in age and sex were enrolled and accepted as a control group, the age distribution for study group ranged from (45-75 years).All patients were admitted to our hospital for elective coronary angiography with no symptoms of peripheral arterial disease and negative history of diabetic mellitus. For all patients and control the ankle brachial index(ABI) was measured and biochemical assessment (lipid profile) finally the electrophysiological test of the lower limbs peripheral nerve (Motor and Sensory) wasdone in the electrophysiological department. This study concluded that there is an association between ABI and NCS of lower limbs in patients with coronary and asymptomatic peripheral arterial disease, 41 % of patient with CAD was found to have asymptomatic peronealmononeuropathy.

Key words: Electrophysiology, Asymptomatic, Peripheral Arterial Disease.

الـخـلاصـــة

إن مرض تصلب الشرايين أصبح مشكلة كبيرة في كافة أنحاء العالم، وله علاقةبزيادة المرضية والفناء.إن الهدف من هذه الدراسة هو تحديد مدى العلاقة بين مؤشر ضغط الكاحل العضدي, دراسة توصيل العصب معشدة أمراض الشريان التاجيه أو الاكليلية .

العدد الكلي لمجموعة الدراسة(١٥٨)مشارك .منهم(٧٨) مريض مصاب بانسداد الشرايين التاجية,مقسمينإلى مجاميع حسب عدد الشرايين المغلقة (١,٢,٣ أمراض الشرايين) . كل مجموعه ثابتة تتكون من ٢٦ مريض ,١٣ رجال و١٣ نساءو (٧٨) أصحاء كمجموعة سيطرة تتكون من (٣٩ رجال و ٣٩ نساء) الصفات السريرة ,الشدة ونتائج فحص أشعة اكس لأمراض الشرايين التاجية التي تم تحديدها .سريريا تم عمل استبيان لجمع بيانات المشاركين والتي تتضمن : الاسم ,العمر ,الجنس ,تاريخ مرض القلب الاقفاري, تاريخ مرض الشرايين المحيطية,التدخين المفرط ,تاريخ المريض الطبي(مرض السكري وارتفاع ضغط الدموقياس مؤشر الكاحل العضدي للأطراف السفلىمعو دراسة التوصيل العصبي نختار العصب الربلي لتحديد الطريق الحسي والعصب الشظوي لتحديد وظيفة العصب الحركي :زمن الوصول السعه سرعة التوصيل تقاس لكلا العصبين.

هذه الدراسة استنتجت بأن هنالك علاقة ما بين مؤشر الضغط الكاحلي العضدي ودراسة التوصيل العصبي للأطراف السفلى لمرضى الشرايين التاجية والمحيطية .٤١% من مرضى الشرايين التاجية تبين بان لديهم اختلال وظيفي في العصب الشظوي الغير مصحوب بأعراض.

الكلمات المفتاحية :التغيرات الكهروفسيولوجية، مرضى الشرايين المحيطية،غير مصحوب بأعراض.

Introduction

Cardiovascular disease (CVS) is the leading cause of mortality worldwide, atherosclerosis is the most common form of cardiovascular disease; it is usually manifested clinically as the coronary artery disease (CAD), peripheral arterial disease(PAD) and cerebrovascular disease. The major risk factors are smoking, alcohol intake, hyperlipidemia, diabetes, hypertension, obesity, positive family history. Unhealthy diet, sedentary and stressful lifestyle [1]. Atherosclerosis is a systemic disease involving the entire arterial tree. Patients with symptomatic lesions in one vascular territory have additional atherosclerotic lesions, which are often asymptomatic, in other vascular regions [2].Peripheral arterial disease (PAD) is one of the most common clinical manifestations of systemic atherosclerosis, it associated with cardiovascular disease (CVD) and CVD risk factor [3].The presence of PAD among patients with coronary arterial disease (CAD) is associated with more progressive atherosclerosis and adverse cardiovascular outcomes [4, 5].

Peripheral arterial disease detected by using the ankle– brachial index (ABI), which is a simple, inexpensive, non-invasive tool that correlates well with angiographic disease severity and functional symptoms. Ankle brachial index has demonstrated that it can differentiate between normal and angiographically-diseased limbs with a sensitivity of 97% and a specificity of 100% [6]. From another hand Patients with PAD may develop a broad range of peripheral neurological manifestation including pain and sensory deficiencies due to chronic ischemia mostly involving the lower limbs [7].Insufficient blood supply secondary to atherosclerotic peripheral arterial disease cause ischemic hypoxia that leads to peripheral neuropathy [8, 9].

Materials and Methods

Study population

A case-control study was conducted inShahid AL- Mehrab Catheter and Marjan teaching hospital in Babylon/Iraq.Carried out between 7 Feb., 2014 to 31 Aug., 2014.The total number was 156 participants (78 patients with chronic artery disease (patients with acute coronary syndrome excluded from the study), and underwent elective coronary artery angiography(CAG) in the Catheter Center was performed by standard techniques,based on angiographic finding ,the cardiologists evaluated each coronary angiography, the patients were classified to the three groups according to the number of obstructed vessels (1,2 and 3vessels disease) each group consistent of 26 patients:13 males and 13females and (78) healthy control consistent of (39 males and 39 females) and the all participants gave informed consent.Clinical characteristics, the severity, and angiographic findings of coronary artery disease were reviewed. Clinically a questionnaire was used to collect participant's data that includes: name, age, gender, history of ischemic heart disease, history of PAD, past medical history of diabetesmellitus (DM).

Coronary Angiography

This was done by specialist interventional cardiologist to appraise extent and severity of coronary artery disease, after screening for renal function and hepatitis C virus and human immunesuppresser virus (HIV), via the femoral approach with 5F or 6F catheter Omnipaque 300 (iohexol 647mg,trometamol 1.2 mg) was a contrast used in all of the cases [10].Significant coronary disease was defined as at least a 70% reduction in the internal diameter of coronary arteries or ≥50% reduction in the internal diameter of left main coronary artery [11].

Ankle Brachial index measurement

Mercury Blood pressure (BP) cuff was applied to both arms respectively to measure brachial systolic blood pressure and then to both ankles respectively tomeasure ankle systolic blood pressure. Systolicblood pressurewas measured by using handheld Doppler device, according to the current guidelines of the American Heart Association (AHA), ABI is a ratio of the higher systolic blood pressures of the two ankles arteries of that limbs to the highest of the two systolic blood pressures

of the upper limbs. The main exclusion's criteria are the presence of symptoms of PAD and the presence of diabetes mellitus. Peripheral arterial disease was determined on the basis of an ABI <0.9 in at least one leg was required for patients to be diagnosed.

Biochemical assessment

After 12-hours of fasting, venous blood was collected from participants and then data were reviewed: total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and fasting blood sugar (FBS)

Nerve conduction study

Electroneurography was considered as a gold standard measurement for the peripheral nerve function for both lower extremities. Sural nerve was chosen to assess sensory pathway and peroneal nerve to assess motor function: latency, amplitude and conduction velocity were measured for both nerves.

Results

Coronary artery disease is associated with lower ABI ($p<0.01$) in compare with control group for both genders as shown in table(1). There is no significant association ($p>0.05$) between cholesterol level and CAD. There is a significant association between increasing level of (TG,LDL) and CAD ($p<0.01$) in compare with control group for both genders. There is no association ($p>0.05$) between three subgroups of CAD patients and(HDL, LDL and TG) levels as in tables(2and 3). The results of nerve conduction studies in CAD patients with asymptomatic PVD as follows:Peroneal nerve distal motor latency (DML) showed no significant differences ($p>0.05$) in both genders, while the statistical analysis of decreasing amplitude and conduction velocity (CV) revealed high significant difference ($p<0.01$) in comparison with the control groups for both genders. There is no statistical difference ($p>0.05$) between distal latency, amplitude, and conductive velocity of sural nerve sensory in coronary artery disease patients when compare with the control group as shown in tables (4 and 5).

Regarding the relation between CAD and focal nerve involvement figure (1): 32 patients (41%) have common peroneal neuropathy and 7 patients (8.9%) have sural neuropathy. Out of 32 patients with peroneal neuropathy 17 patients (56%) have three-vessel disease.

Table 1: Relation between Extent of Coronary Artery Disease and Ankle Brachial Index

Variable		Extent of Coronary Artery Disease			Healthy subjects
		1 VD (Group1)	2 VD (Group2)	3 VD (Group3)	Control (Group4)
ABI	Male	0.81 ± 0.22 (A)	0.74 ± 0.11 (A)	0.65 ± 0.84 (A)	1.08±0.62 (B)
	Female	0.83± 0.85 (A)	0.76 ± 0.15 (A)	0.66± 0.15 (A)	1.11± 0.43 (B)

VD=Vessel Disease
ABI: Ankle Brachial Index
-Values are mean ±stander deviation(SD).
-The values with different capital letter
mean significant at 0.0l level.
-The values with same letters are not significant at 0.05 level.

Table 2: Relation between Extent of Coronary Artery Disease, Total cholesterol (mmol/L) and Triglyceride (mmol/L)

Variable		Extent of Coronary Artery Disease			Healthy Control
		1 VD (Group 1)	2 VD (Group 2)	1VD (Group 3)	Control (Group4)
TC (mmol/L	Male	4.23±0.37 (A)	4.43±0.46 (A)	4.21±0.58 (A)	4.01±0.61 (A)
	Female	4.45±0.60 (A)	4.50±0.17 (A)	4.35±0.60 (A)	4.03±0.42 (A)
TG (mmol/L)	Male	3.87±1.52 (A)	4.25±1.12 (A)	4.51±1.46 (A)	2.74±1.03 (B)
	Female	3.91±1.46 (A)	4.42±1.87 (A)	4.60±1.66 (A)	2.89±1.25 (B)

VD: Vessel Disease
TC: Total cholesterol
TG: Triglyceride
-Values are mean ±stander deviation(SD).
-The values with different capital letter mean significant at 0.0l level.
-The values with same letters are not significant at 0.05 level.

Table 3: Relation between Extent of Coronary Artery Disease and High Density Lipoprotein – Cholesterol (HDL-C) (mmol/L) and Low Density Lipoprotein –Cholesterol (LDL-C) (mmol/L)

Variable		Extent of Coronary Artery Disease			Healthy subjects
		1 VD (Group1)	2 VD (Group2)	3 VD (Group3)	Control(Group4)
HDL-C (mmol/L)	Male	0.66±0.16 (A)	0.62±0.08 (A)	0.60±0.13 (A)	1.05±0.27 (B)
	Female	0.73±0.14 (A)	0.68±0.15 (A)	0.66±0.27 (A)	1.11± 0.30 (B)
LDL-C (mmol/L)	Male	3.51±1.21 (A)	3.38±1.03 (A)	3.76±1.32 (A)	2.18±0.52 (B)
	Female	3.72±0.76 (A)	3.60±0.54 (A)	3.92±1.09 (A)	2.33±0.73 (B)

VD: Vessel Disease, LDL Low density lipoprotein, HDL High density lipoprotein
-Values are mean ±stander deviation(SD).
-The values with different capital letter mean significant at 0.0l level.
-The values with same letters are not significant at 0.05 level.

Table 4: Relation between ankle brachial index and sural nerve conduction parameter in Coronary artery disease patients

Nerve test	Sensory parameter	Gender	Coronary artery disease patients			Healthy control
			ABI 0.9-0.7	ABI <0.7-0.5	ABI <0.5	ABI 0.9-1.3
Sural Nerve	Latency (m/sec)	male	2.72±0.32 (A)	2.88±0.32 (A)	2.90±0.26 (A)	2.13±0.93 (A)
		female	2.60±0.60 (A)	2.67±0.37 (A)	2.85±0.39 (A)	2.05±0.68 (A)
	Amplitude (mV)	male	18.14±4.57 (A)	18.21±3.33 (A)	17.60±4.66 (A)	18.68±4.18 (A)
		female	18.31±3.15 (A)	18.23±2.11 (A)	17.92±3.14 (A)	18.74±4.83 (A)
	Conduction velocity (m/sec)	male	43.61±1.45 (A)	43.50±1.51 (A)	43.16±1.66 (A)	44.13±2.77 (A)
		female	44.17±2.69 (A)	43.90±1.81 (A)	43.53±1.30 (A)	44.84±2.69 (A)

-Values are mean ±stander deviation(SD).
-The values with different capital letter mean significant at 0.0l level.
-The values with same letters are not significant at 0.05 level

Table 5: Relation between ankle brachial index and peroneal nerve conduction parameter in coronary artery disease patients

Nerve test	Motor parameter	Gender	Coronary artery disease patients			Healthy control
			ABI 0.9-0.7	ABI <0.7-0.5	ABI <0.5	ABI 0.9-1.3
Peroneal Nerve	Latency (m/sec)	male	3.60 ± 0.53 (A)	3.71 ± 0.70 (A)	3.92 ± 0. (A)	3.32 ± 0.99 (A)
		female	3.54±0.55 (A)	3.56 ± 0.44 (A)	3.60 ± 0.42 (A)	3.14± 0.34 (A)
	Amplitude (µV)	male	2.10 ± 0.83 (A)	2.08 ±1.20 (A)	2.04 ± 1.02 (A)	3.84 ± 1.40 (B)
		female	2.18±0.59 (A)	2.31± 0.70 (A)	2.14±0.90 (A)	3.97 ± 1.69 (B)
	Conduction velocity (m/sec)	male	40.35 ±1.45 (A)	40.08 ± 3.56 (A)	39.54±2.52 (A)	42.36 ± 5.52 (B)
		female	40.56 ± 2.63 (A)	40.14 ± 3.40 (A)	39.98±3.50 (A)	42.72 ± 4.50 (B)

-Values are mean ±stander deviation(SD).
-The values with different capital letter mean significant at 0.0l level.
-The values with same letters are not significant at 0.05 level.

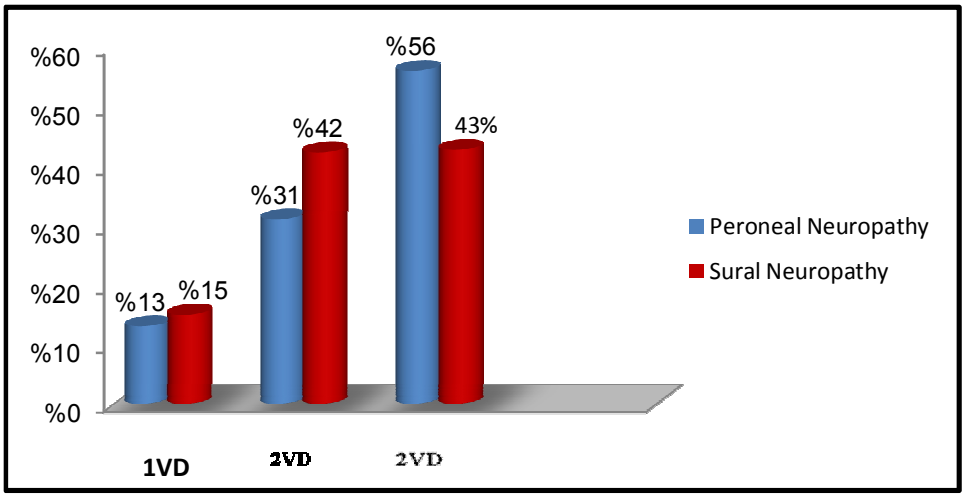

Figure 1: The Percentage of Peroneal and Sural Neuropathy in Coronary Artery Disease Patients
VD: Vessel Disease

Discussion

The data of Table (1) illustrated highly significant decrease in ABI in CAD patients when compared with control group for both genders were agreement with [12-15]. Peripheral arterial disease is a manifestation of atherosclerosis [16],there is a strong correlation between ankle-brachial pressure index (ABI) with the presence and severity of atherosclerosis in the coronary arteries and that was demonstrated by several studies. [17].The ankle brachial index was widely accepted as a useful tool for the identification of asymptomatic PAD and as an important marker for systemic atherosclerosis [18].

This information provides scientific evidence to support early vascular screening of patients with CAD who are at a greater risk of having PAD (14). The study revealed no significant association in cholesterol level and CAD patients groups when compared with the control group for both genders ($p>0.05$).This results were seen in previous studies [19]above findings are expected as most of these patients are receiving cholesterol lowering agents (20).While there is high significant increase in triglyceride level (TG) and LDL-C and decrease high density lipoprotein-cholesterol(HDL-C) in CAD patients (male &female) when compared with control group tables(2 and 3) same results were reported in previous literatures[21-24]. Low HDL cholesterol and high triglycerides are each the independent risk factor for CAD [25].

In our analysis the peroneal nerve distal motor latency (DML) showed no significant differences ($p>0.05$) in both genders, while the statistical analysis of decreasing amplitude and conduction velocity (CV) revealed high significant difference ($p<0.01$) in comparison with the control groups for both genders. There is no statistical difference ($p>0.05$) between distal latency, amplitude, and conductive velocity of sural nerve sensory in coronary artery disease patients when compare with the control group as shown in table (4 and 5) and the high percentage peroneal neuropathy was reveled in patient with three vessels disease as shown in figure (1). Mc Dermet *et al* [26] compared nerve function study with lower extremity ischemia; after adjusting age and gender; study showed decrease in peroneal never conduction velocity and increase in the amplitude in non-diabetic patient with sever peripheral vascular disease.Garg, *et al* [27] demonstrates that poorer lower extremity nerve function is associated with greater functional impairment and more adverse calf muscle characteristics in individuals with PAD. It is unclear why there was not an association between the ABI and sural

nerve function. One possibility is that the sural nerve benefits from collateral blood supply to a greater degree compared with the peroneal nerve [26].

Peripheral nerve needs intact blood supply to preserve normal function, maintaining sufficient oxygen and nutrition supply are required for peripheral nerve to function properly. Insufficient blood supply secondary to peripheral vascular disease and atherosclerosis cause ischemic hypoxia that leads to peripheral neuropathy [8, 9]. Thus Demyelination could be induced by chronic ischemia pathological alterations in chronic ischemic neuropathy may be due to the combined effects of acute ischemia/reperfusion and chronic hypoxia [28].

Conclusion

This study concluded that there is an association between ABI and NCS of lower limbs in patients with coronary and asymptomatic peripheral arterial disease, 41 % of patient with CAD were found to have asymptomatic peronealmononeuropathy,

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