Correlation between the Serum Alkaline Phosphatase and the Severity of Coronary Artery Disease in Patients with Chronic Stable Angina Pectoris

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Abstract: Objectives: The principal objective of this study is to assess correlation between the serum alkaline phosphatase level and the severity of coronary artery disease in patients with chronic stable angina. **Patients and methods:** This study (prospective) included finally 200 patients who presented to Dar Alshefaa hospital _Cairo _ Egypt, for elective coronary angiography within the time period from November 2015 to August 2016. At the beginning of the study 270 patients then 70 patients were excluded from the study for various causes (50 patients HCV,15 had CKD, 3 patients HBV, and 2 patients had obstructive jaundice). **Results:** The mean age of the study group was 57.020±9.475years and 46 patients (23 %) were females. In our study population, 126 patients (63%) were suffering from diabetes mellitus (all type II), 142(71%) had arterial hypertension, and 129 (64.5%) were smokers. The mean body mass index (BMI) of the study group was 32.895±5.671kg/m2. The Canadian Cardiovascular Society classification of Angina (CCS) class was: II in 89 patients (44.50%), III in 111 patients (55.50%) According to (LVEF) we divided study patients into three groups: -

A. Patients with (LVEF) (>50%) was noticed in 99 patients 49.5%.
B. Patients with midrange (LVEF)(40-49%) was noticed in 78 patients (39%).
C. Patients with heart failure with reduced (LVEF) (<40%) was noticed in 23 patients (11.5%). According to serum alkaline phosphatase level we divided study patients in to 3 groups:

A. 95 patients (47.50%) with low normal ALP level(<63 IU/L).
B. 75 patients (37.50%) with midrange ALP level (63-78 IU/l).
C. 30 patients (15%) with high normal ALP level (>78 IU/L). According to Gensini score we divided study patients in to 4 groups:

A. 31 patients (15.50%) were having score zero according to Gensini score.
B. 64 patients (32%) were having mild CAD with score ranging from 1to 15 on Gensini score.
C. 75 patients (37.5%) were having moderate CAD with score ranging from 16 to 30 on Gensini score.
D. 30 patients (15%) were having severe CAD with score more than 30 on Gensini score.

On comparing three groups according to serum ALP level, there was a significant relation between serum ALP level and GENSINI score. **Conclusion:** There was significant correlation between serum ALP and HTN, DM, smoking positive ECG findings LVEF, presence of SWMA, LVEDD, LVESD, patient C.A. score, patient serum creatinine level, patient serum creatinine level. There was significant correlation between Gensini score and HTN, DM, smoking positive ECG findings LVEF, presence of SWMA, LVEDD, LVESD patient C.A. score. There was a significant relation between serum ALP level and Gensini score.

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1. Introduction

Intense attention has focused on the search of biomarker with an effective predictor value in patients with coronary artery disease (CAD). Recent data demonstrated that the measurement of high-sensitive C reactive protein, a representative inflammatory marker, could not predict 41% of ST-elevation myocardial infarction (MI) patients, which suggested the need to identify the additional relevant markers based on the novel pathophysiological mechanisms***(Cristell et al., 2011).***

Since vascular calcification contributes to cardio-vascular risk in various population subsets, markers of vascular calcification can be an attractive option. Several studies showed that markers of mineral metabolism such as phosphate are linked with an

adverse cardiovascular outcome ***(Detrano et al., 2008)(Dhingra et al., 2007).***

Recently, it was suggested that alkaline phosphatase (ALP) plays a pivotal role in mineral metabolism and might be a molecular marker of vascular calcification***(Weiss et al., 1988) and (Johnson et al., 2006).***

Indeed, ALP is a membrane-bound metallo enzyme that catalyses the hydrolysis of organic pyrophosphate, an inhibitor of vascular calcification***(Schoppet et al., 2008).***

Accordingly, the role of ALP has been highlighted in terms of its effects on vascular disease. Recently, several studies reported a significant link between ALP and adverse outcome in patients with chronic kidney disease or those under haemodialysis ***(Regidor et al., 2008).*** Furthermore, two recent papers showed that higher ALP levels are associated with an excess risk of death among survivors of stroke or MI***(Ryu et al., 2010) (Tonelli et al., 2009).***

Considering that vascular calcification contributes to atherosclerosis, vascular hardening, and ageing, serum ALP levels may also be linked with poor vascular fate in overall patients with CAD as well as MI survivors***(O'Neill et al., 2006).***

2. Materials and methods

This study (prospective) included finally 200 patients who presented to Dar Alshefaa hospital _Cairo _ Egypt, for elective coronary angiography within the time period from November 2015 to August 2016. At the beginning of the study 270 patients then 70 patients were excluded from the study for various causes (50 patients HCV, 15 had CKD, 3 patients HBV, and 2 patients had obstructive jaundice).

Inclusion criteria:

All patients presented for elective coronary angiography are eligible for inclusion in this study.

Exclusion criteria:

1) Viral hepatitis (HBV or HCV):

This is done by detecting Hepatitis B surface antigen (HBsAG) and Hepatitis C antibody test (HCVab).

2) Liver cirrhosis:

Cirrhosis of the liver is the end stage of a complex process, resulting from hepatocyte injury and the response of the liver, which leads to partial regeneration and fibrosis of the liver (Friedman et al., 2014).

3) Obstructive Jaundice:

It is a condition in which there is blockage of the flow of bile out of the liver. This results in redirection of excess bile and its by-products into the blood, and bile excretion from the body is incomplete. Bile contains many by-products, one of which is bilirubin, a pigment derived from dead red blood cells (Marrelli et al., 2009).

Bilirubin is yellow, and this gives the characteristic yellow appearance of jaundice in the skin, eyes, and mucous membranes.

Symptoms of obstructive jaundice include yellow eyes and skin, abdominal pain, and fever. Any type of obstruction that blocks the flow of bile from the liver can cause obstructive jaundice. Most commonly, gallstones create the blockage. Other causes of obstruction include inflammation, tumors, trauma, pancreatic cancer, narrowing of the bile ducts.

This was determined by full detailed history, clinical examination and measuring serum level of Total billirubin and direct billirubin.

4) History of advanced liver malignancy:

It is a cancer that originates in the liver. Liver tumors are discovered on medical imaging equipment (often by accident) or present themselves symptomatically as an abdominal mass, abdominal pain, yellow skin, nausea or liver dysfunction.

This was done by Ultrasonography and by measuring Alpha feto protein level.

5) Patients diagnosed as bone malignancy:

This was done by screening of the complaining patients with X-ray.

6) Patients with chronic kidney disease (CKD):

The glomerular filtration rate (GFR) is the amount of blood filtered by the kidney's glomerulus into the Bowman's capsule per unit of time (Matsushita et al., 2010).

GFR (mL/min/1.73 m2) = 175 × (Scr) × (Age) × (0.742 if female) × (1.212 if African American).

GFR over 90mls/min/1.73m2 is normal unless there is other evidence of kidney disease.

The equation does not require weight or height variables because the results are reported normalized to 1.73 m2 body surface area, which is an accepted average adult surface area.

7) Patients with active lymphoma and blood malignancies:

Complete blood count (CBC) was done routinely to all patients presented for elective coronary angiography. This common blood test measures the amount of various types of blood cells in a sample of your blood. Blood cancers may be detected using this test if too many or too few of a type of blood cell or abnormal cells are found.

8) Patients with congestive heart failure:

Full detailed history and clinical examination were done to all patients in our study group (American Heart Association 2011).

9) Pregnant females: Pregnancy test was done to all women in the child bearing period.

10) Patients with evidence of active infection: Full history and clinical examination was done to

exclude the following signs and symptoms of active infection.

Fever (this is sometimes the only sign of an infection).

Chills and sweats.

Change in cough or a new cough.

Sore throat or new mouth sore.

Shortness of breath.

Nasal congestion.

Stiff neck.

Burning or pain with urination.

Unusual vaginal discharge or irritation.

Increased urination.

Redness, soreness, or swelling in any area, including surgical wounds and ports.

Diarrhea.

Vomiting.

New onset of pain.

A) Approval of Al-Azhar university ethical committee was obtained.

B) Informed consent was obtained for all patients.

C) All patients were subjected to the following:

a) Full history taking:

With special emphasis on age, sex, risk factors for coronary artery disease (DM, HTN, Smoking, Dyslipidemia and Family history), history of liver, renal diseases, history of bone, blood malignancies, history of any symptoms of active infection and menstruating history among females in child bearing period.

b) Full clinical examination:

General examination:

With special emphasis on weight, height, body mass index (BMI), heart rate, blood pressure, lower limb oedema, skin colour and hepatomegally.

Local examination:

Scar of previous coronary artery bypass graft surgery (CABG), S3, distended neck veins and bilateral basal lung crackles.

E) Canadian Angina Score:

All patients were subjected to Canadian angina score according to the magnitude of chest pain from their history (Campeau L. Grading of Angina Pectoris, 1976).

Class I: Ordinary activity such as walking or climbing stairs does not precipitate angina.

Class II: Angina precipitated by emotion, cold weather or meals and by walking up stairs.

Class III: Marked limitations of ordinary physical activity.

Class IV: Inability to carry out any physical activity without discomfort, anginal symptoms may be present at rest.

F) Electrocardiography (ECG):

12 Lead ECG was done to all patients in our study group to detect rate, rhythm, axis, any conduction disturbances, any ST segment deviation, Q waves of previous STEMI, and R wave progression.

G) Echocardiography (ECHO):

Transthoracic echocardiography was performed to all patients using a General Electric VIVID S5 (G.E. VingMed, Netherland) with a 3.4 MHZ multifrequency transducer.

This was used to assess the following:

Dimensions of different chambers and great vessels (Roberto et al., 2015).

Valvular lesions, specially mitral regurgitation which may be secondary to papillary muscle dysfunction or left ventricular dilatation.

Assessment of left ventricular systolic function.

In the presence of segmental wall motion abnormality, ejection fraction was evaluated by eye balling and also calculated by Simpson's rule in apical four chambers and apical two chambers view.

Segmental wall motion abnormality was assessed in apical views (four chambers, two chambers and apical long axis) and in parasternal short axis at different levels of left ventricle (papillary muscle, midcavitary and apical).

H) Laboratory investigations:

Venous sample from anticubital vein was withdrawn from all patients on admission before starting of medication and the following were done:

Serum alkaline phosphatase:

Specimen of 1ml serum while the patient is fasting was collected into serum gel container and was centrifuged within two hours of collection.

Normal values among our laboratory was 30 up to 115 IU/L. This was done using AU 480 Beckman Coulter using ALP Beckman Coulter Kits.

All patients in our study was subdivided according to Alkaline Phosphatase levels in to three tertiles (Lowest <63 IU/L, Middle 63-78 IU/L, Highest >78 IU/L) (Jun-Bean et al., 2013).

Serum kidney function tests:

Normal Urea level was 10-50 mg/dl.

Normal Creatinine level was 0.3-1.3 mg/dl.

Hepatitis markers:

This was done using ELISA test by AXIOM Germany machine.

Complete blood count (CBC).

Serum billirubin level:

Normal value of Total Billirubin 0.2-1 mg/dl.

Normal value of Direct Billirubin up to 0.2 mg/dl.

Human alpha fetoprotein:

AFP is measured in nanograms per milliliter (ng/mL). An AFP level of less than 10 ng/mL is normal for adults.

An extremely high level of AFP in your blood greater than 500 ng/mL could be a sign of liver tumors.

Pregnancy test in menstruating female.

I) Coronary angiography (CA):

Coronary angiography was performed using Seldinger technique via femoral approach, using 6F catheter with non-ionic, low-osmolar, iodinated contrast agent, and visualizing coronary arteries in ordinary views with at least two perpendicular views to assess the site, type and the severity of the lesions.

The severity of CAD was documented for each patient according to their Gensini score.

Gensini Scoring System

It is a scoring system which allocate a numerical value for the degree of stenosis in a coronary artery and a multiplication factor that depends on which coronary artery is involved and where the stenosis is located in the coronary artery (Gensini et al., 1975) and (Morito et al., 2008).

This scoring system has been used in several studies to establish a correlation between the severity of CAD and other factors.

It grades narrowing of the lumen of the coronary artery and scores it as:

1 for 1-25% narrowing.
2 for 26-50% narrowing.
4 for 51-75% narrowing.
8 for 76-90% narrowing.
16 for 91-99% narrowing.
32 for a completely occluded artery.

The score is then multiplied by a factor according to the importance of the coronary artery as follows:

Left main system lesion is 5.
Proximal LAD and proximal LCX is 2.5.
Mid LAD lesion is 1.5.
Distal LAD, mid and distal LCX and RCA lesion is 1.
Any branch is 0.5.

In the Gensini score method, the coronary arteries were divided into 11 segments and their score are from 0 to 72 based on the intensity of stenosis which includes:

Normal coronary arteries (0 score).
Mild CAD (0-15 scores).
Moderate CAD (16-30 scores).
Severe CAD (31-72 scores).

Statistical analysis

The data were presented as mean ± SD for continuous variables and as percentage for categorical variables. Continuous variables had been compared by unpaired t-test. For non numerical data, Chi – square test had been used.

A P-value of,0.05 was considered statistically significant.

Statistical analysis was performed using the MedCalc 13 Software (Mariakerke, Belgium).

3. Results

Study population:

This study (prospective) included finally 200 patients who presented to Dar Alshefaa hospital _Cairo _ Egypt, for elective coronary angiography within the time period from November 2015 to August 2016.

Patients characteristics

Demographic characteristics:

The study included two hundred (200) patients who presented to, Dar Alshefaa hospital for elective coronary angiography within the time period from November 2015 to August 2016.

Baseline patient criteria: (Table 1).

The mean age of the study group was 57.020±9.475 years and 46 patients (23%) were females.

In our study population, 126 patients (63%) were suffering from diabetes mellitus (all type II), 142(71%) had arterial hypertension, and 129 (64.5%) were smokers.

The mean body mass index (BMI) of the study group was 32.895±5.671kg/m^2.

Table (4): Basic demographic data

Variable	n=200
Age (years)	57.02±9.475
Sex (female) n(%)	46(23)
Diabetes n (%)	126(63)
Hypertension (%)	142(71)
Smoker n (%)	129(64.5)
BMI (kg/m2)	32.895±5.671

BMI: Body Mass Index

Baseline clinical data: (figure 15).

The Canadian Cardiovascular Society classification of Angina (CCS) class was:

II in 89 patients (44.50%).
III in 111 patients (55.50%).

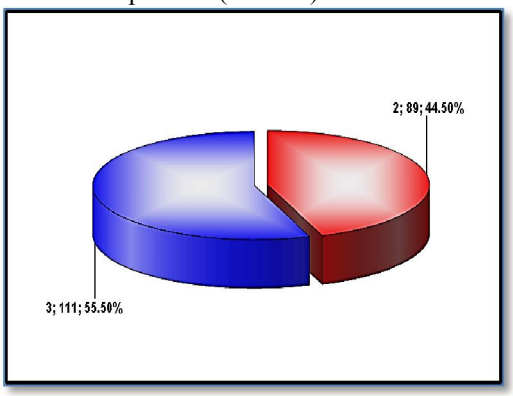
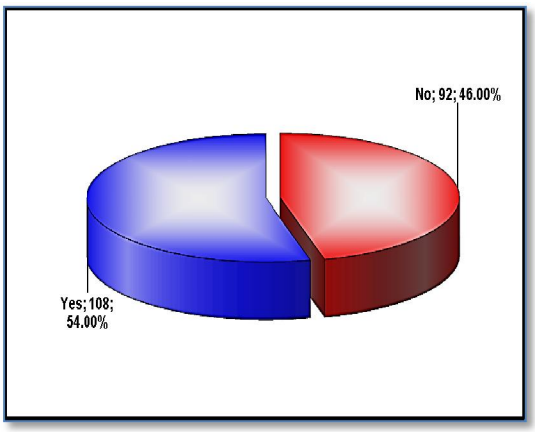


Fig. (16): Classification according to The Canadian Cardiovascular Society classification of Angina (CCS) class.

The Canadian Cardiovascular Society classification of Angina.

ECG criteria on examination (table 1).

108 patients (54%) had ECG changes in the form of ST segment deviation, Q waves of previous STEMI.



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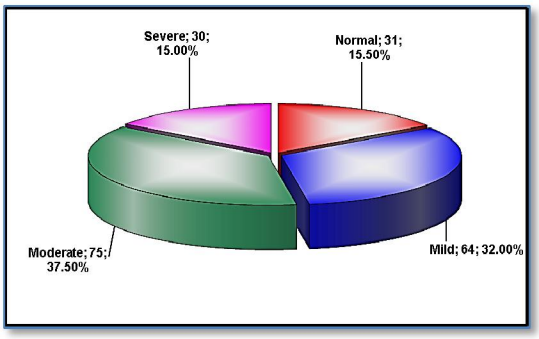

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Echocardiographic data on examination: (table 2)

The mean left ventricular end diastolic diameter (LVEDD) was 53.235±6.72 mm.

Mean end systolic diameter (LVESD) was 40.26±7.895 mm.

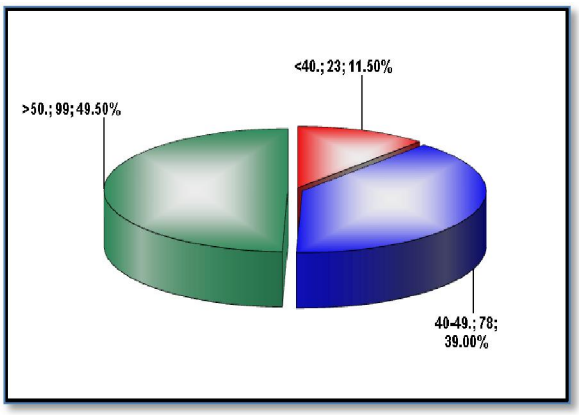
Mean ejection fraction (EF) was 51.01±9.758%.

According to (LVEF) we divided study patients into three groups: -

A. Patients with (LVEF) (>50%) was noticed in 99 patients 49.5%.

B. Patients with midrange (LVEF)(40-49%) was noticed in 78 patients (39%).

C. Patients with heart failure with reduced (LVEF) (<40%) was noticed in 23 patients (11.5%).



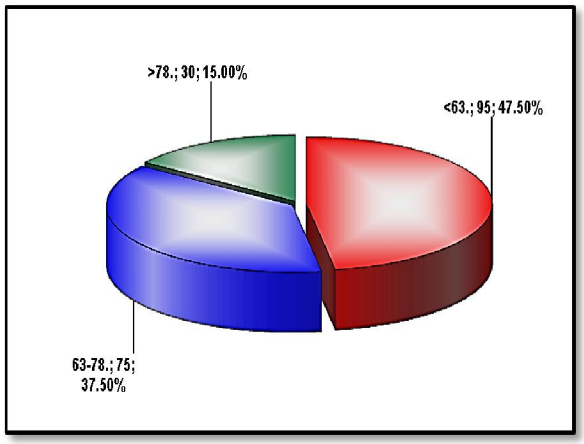


Fig. (20): Classification according to ALP level in plasma.

LVEDD means left ventricular end diastolic dimension, LVESD means left ventricular end systolic dimensions, EF means ejection fraction.

Serum Alkaline Phosphatase level (table 3):

According to serum alkaline phosphatase level we divided study patients in to 3 groups: -

A. 95 patients (47.50%) with low normal ALP level(<63 IU/L).

B. 75 patients (37.50%) with midrange ALP level (63-78 IU/l).

C. 30 patients (15%) with high normal ALP level (>78 IU/L).

As regard base line criteria (table 6):

On comparing base line characteristics between the three groups of patients as regard ALP level:-

There was no difference regarding patient gender and patient age.

There was significant correlation between serum ALP and HTN (p<0.001*), DM (p<0.001*), smoking (p<0.001*).

Table (6): Classification according to age, sex, DM, smoking & ALP

		A.L.P.								Chi-Square	
		<63.		63-78.		>78.		Total			
		N	%	N	%	N	%	N	%	X2	P-value
Sex	Female	27	28.42	16	21.33	3	10.00	46	23.00	4.557	0.102
	Male	68	71.58	59	78.67	27	90.00	154	77.00		
HTN	No	46	48.42	12	16.00	0	0.00	58	29.00	35.812	<0.001*
	Yes	49	51.58	63	84.00	30	100.00	142	71.00		
DM	No	56	58.95	18	24.00	0	0.00	74	37.00	42.688	<0.001*
	Yes	39	41.05	57	76.00	30	100.00	126	63.00		
Smoker	No	53	55.79	17	22.67	1	3.33	71	35.50	36.031	<0.001*
	Yes	42	44.21	58	77.33	29	96.67	129	64.50		

As regard patient ECG criteria: -

There was a significant relation between serum ALP level and positive ECG findings (p<0.001*).

As regard patients patient echocardiographic criteria: -

There was a significant relation between serum ALP level and LVEF (p<0.001*), presence of SWMA (p<0.001*), LVEDD (p<0.001*), LVESD (p<0.001*).

As regard patient Canadian angina score:-

There was a significant relation between serum ALP level and patient C.A. score (p<0.001*).

Table (7): Classification according to sex, HTN, DM, smoking, ECG, SWMA, EF, C.A Score & ALP

		A.L.P.								Chi-Square	
		<63.		63-78.		>78.		Total			
		N	%	N	%	N	%	N	%	X2	P-value
Sex	Female	27	28.42	16	21.33	3	10.00	46	23.00	4.557	0.102
	Male	68	71.58	59	78.67	27	90.00	154	77.00		
HTN	No	46	48.42	12	16.00	0	0.00	58	29.00	35.812	<0.001*
	Yes	49	51.58	63	84.00	30	100.00	142	71.00		
DM	No	56	58.95	18	24.00	0	0.00	74	37.00	42.688	<0.001*
	Yes	39	41.05	57	76.00	30	100.00	126	63.00		
SMOKER	No	53	55.79	17	22.67	1	3.33	71	35.50	36.031	<0.001*
	Yes	42	44.21	58	77.33	29	96.67	129	64.50		
ECG	No	89	93.68	3	4.00	0	0.00	92	46.00	165.777	<0.001*
	Yes	6	6.32	72	96.00	30	100.00	108	54.00		
SWMA	No	90	94.74	1	1.33	0	0.00	91	45.50	176.919	<0.001*
	Yes	5	5.26	74	98.67	30	100.00	109	54.50		
EF	<40.	0	0.00	1	1.33	22	73.33	23	11.50	288.962	<0.001*
	40-49.	2	2.11	68	90.67	8	26.67	78	39.00		
	>50.	93	97.89	6	8.00	0	0.00	99	49.50		
C.A. Score	2	85	89.47	3	4.00	1	3.33	89	44.50	148.197	<0.001*
	3	10	10.53	72	96.00	29	96.67	111	55.50		

As regard patient kidney function tests: -

There was a significant relation between serum ALP level and patient serum creatinine level (p<0.001*), serum urea level (p<0.001*).

Table (8): Classification according to age, B.M.I, renal function, LV Systolic function, GENSINI SCORE & ALP

	A.L.P.			ANOVA		TUKEY'S Test		
	<63.	63-78.	>78.					
	Mean±SD	Mean±SD	Mean±SD	F	P-value	I&II	I&III	II&III
Age	56.305±9.838	57.827±8.467	57.267±10.770	0.550	0.578			
B.M.I.	31.747±4.871	33.773±5.942	34.333±6.728	3.921	0.021*	0.052*	0.072	0.888
Creat	0.812±0.110	0.995±0.134	1.200±0.083	140.309	<0.001*	<0.001*	<0.001*	<0.001*
Urea	42.516±6.197	45.640±7.315	53.867±6.750	32.630	<0.001*	0.008*	<0.001*	<0.001*
LVEDD	51.589±4.418	52.587±7.543	60.067±6.570	22.798	<0.001*	0.540	<0.001*	<0.001*
LVESD	35.705±5.670	41.787±6.323	50.867±5.575	79.018	<0.001*	<0.001*	<0.001*	<0.001*
EF	59.758±5.335	45.373±3.061	37.400±3.578	400.560	<0.001*	<0.001*	<0.001*	<0.001*
GENSINI Score	7.074±5.693	20.853±5.135	63.500±24.572	317.706	<0.001*	<0.001*	<0.001*	<0.001*

Gensini score:

According to Gensini score we divided study patients in to 4 groups:

A. 31 patients (15.50%) were having score zero according to Gensini score.
B. 64 patients (32%) were having mild CAD with score ranging from 1to 15 on Gensini score.
C. 75 patients (37.5%) were having moderate CAD with score ranging from 16 to 30 on Gensini score.
D. 30 patients (15%) were having severe CAD with score more than 30 on Gensini score.

Table (9): Classification according to GENSINI SCORE.

GENSINI SCORE		
	N	%
Normal	31	15.50
Mild	64	32.00
Moderate	75	37.50
Severe	30	15.00
Total	200	100.00

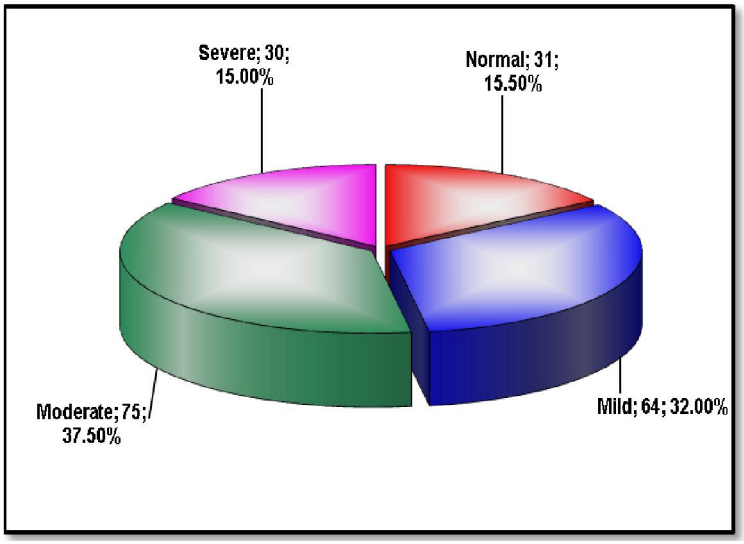


Fig (21): Classification according to GENSINI SCORE

As regard base line criteria (table 9):

On comparing base line characteristics between the four groups of patients as regard Gensini score:-

There was no difference regarding patient gender and patient age.

There was significant correlation between Gensini score and HTN (p<0.001*), DM (p<0.001*), smoking (p<0.001*).

Table (10): Correlation between GENSINI Score, HTN, DM, Smoking, ECG, SWMA, EF & ALP:

		GENSINI SCORE										Chi-Square	
		Normal		Mild		Moderate		Severe		Total			
		N	%	N	%	N	%	N	%	N	%	X2	P-value
Sex	Female	12	38.71	15	23.44	16	21.33	3	10.00	46	23.00	7.307	0.063
	Male	19	61.29	49	76.56	59	78.67	27	90.00	154	77.00		
HTN	No	18	58.06	28	43.75	12	16.00	0	0.00	58	29.00	37.890	<0.001*
	Yes	13	41.94	36	56.25	63	84.00	30	100.00	142	71.00		
DM	No	22	70.97	35	54.69	17	22.67	0	0.00	74	37.00	48.163	<0.001*
	Yes	9	29.03	29	45.31	58	77.33	30	100.00	126	63.00		
Smoker	No	21	67.74	32	50.00	17	22.67	1	3.33	71	35.50	38.902	<0.001*
	Yes	10	32.26	32	50.00	58	77.33	29	96.67	129	64.50		
ECG	No	31	100.00	59	92.19	2	2.67	0	0.00	92	46.00	173.607	<0.001*
	Yes	0	0.00	5	7.81	73	97.33	30	100.00	108	54.00		
SWMA	No	31	100.00	60	93.75	0	0.00	0	0.00	91	45.50	184.878	<0.001*
	Yes	0	0.00	4	6.25	75	100.00	30	100.00	109	54.50		
EF	<40.	0	0.00	0	0.00	1	1.33	22	73.33	23	11.50	297.269	<0.001*
	40-49.	0	0.00	1	1.56	69	92.00	8	26.67	78	39.00		
	>50.	31	100.00	63	98.44	5	6.67	0	0.00	99	49.50		
C.A. Score	2	28	90.32	58	90.63	2	2.67	1	3.33	89	44.50	155.216	<0.001*
	3	3	9.68	6	9.38	73	97.33	29	96.67	111	55.50		

As regard patient ECG criteria:-

There was a significant relation between Gensini score and positive ECG findings (p<0.001*).

As regard patients patient echocardiographic criteria:-

There was a significant relation between Gensini score and LVEF (p<0.001*), presence of SWMA (p<0.001*), LVEDD (p<0.001*), LVESD (p<0.001*).

As regard patient Canadian angina score:-

There was a significant relation between Gensini score and patient C.A. score (p<0.001*).

As regard patient kidney function tests: -

There was a significant relation between serum Gensini score and patient serum creatinine level (p<0.001*), serum urea level (p<0.001*).

Table (11): Correlation between Age, B.M.I, Renal function, LV Systolic function & ALP

	GENSINI SCORE				ANOVA	
	Normal	Mild	Moderate	Severe		
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	P-value
Age	55.613±9.790	56.875±9.818	57.600±8.571	57.333±10.813	0.334	0.801
A.L.P.	34.742±3.502	43.594±9.802	69.693±4.690	96.900±8.564	545.079	<0.001*
B.M.I.	32.871±4.674	31.313±5.001	33.480±5.708	34.833±7.096	3.198	0.025*
Creat	0.781±0.125	0.826±0.098	0.999±0.137	1.193±0.083	93.011	<0.001*
Urea	41.000±6.481	43.047±6.059	45.800±7.168	53.900±6.764	23.531	<0.001*
LVEDD	49.355±3.912	52.781±4.259	52.493±7.543	60.067±6.570	17.768	<0.001*
LVESD	32.677±6.369	37.203±4.705	41.760±6.331	50.867±5.575	59.745	<0.001*
EF	65.161±4.405	57.266±3.174	45.267±2.891	37.400±3.578	495.755	<0.001*

On comparing three groups according to serum ALP level, there was a significant relation between serum ALP level and GENSINI score.

Table (12): Correlation between ALP & GENSINI score:

GENSINI SCORE	A.L.P.								Chi-Square	
	<63.		63-78.		>78.		Total			
	N	%	N	%	N	%	N	%	X2	P-value
Normal	31	32.63	0	0.00	0	0.00	31	15.50	372.434	<0.001*
Mild	63	66.32	1	1.33	0	0.00	64	32.00		
Moderate	1	1.05	73	97.33	1	3.33	75	37.50		
Severe	0	0.00	1	1.33	29	96.67	30	15.00		
Total	95	100.00	75	100.00	30	100.00	200	100.00		

Table (13): specificity and sensitivity

ROC curve between ALP <78 and ALP >78					
Cutoff	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
>28	100.0	96.47	83.3	100.0	99.9%

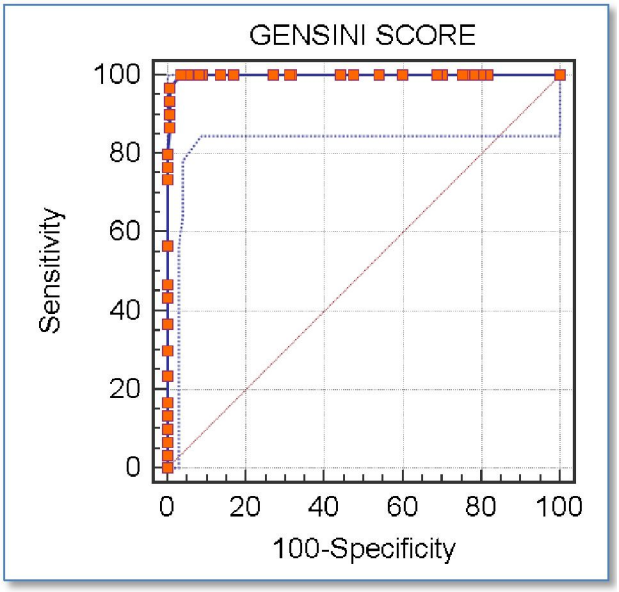


Fig. (22): Show specificity and sensitivity

Conclusion

- The study concluded that ALP is a marker of cardiometabolic risk, and there was significant correlation between serum ALP and HTN, DM, smoking positive ECG findings, LVEF, presence of SWMA, LVEDD, LVESD, patient C.A. score, patient serum creatinine level, patient serum creatinine level.
- There was a significant relation between serum ALP level and GENSINI score.

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