ANKLE ARM PRESSURE INDEX IN CORONARY ARTERIAL DISEASE PATIENTS IN A TERTIARY CARE CENTRE, AS COMPARED WITH NORMAL POPULATION.

Dissertation submitted to

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DEPARTMENT OF GENERAL MEDICINE

Coimbatore Medical College Hospital,

Coimbatore.

CERTIFICATE

This is to certify that the Dissertation entitled "Ankle arm pressure index in coronary arterial disease patients in tertiary care centre, as compared with normal population." here with submitted by Dr. S.VENGOJAYAPRASSAD, Post graduate in General Medicine, Coimbatore Medical College to the Tamilnadu Dr.M.G.R Medical University is a record of a bonafide research work carried out by him under my guidance and supervision from March 2009 to November 2009.

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DECLARATION

I solemnly declare that the Dissertation titled "ANKLE ARM PRESSURE INDEX IN CORONARY ARTERIAL DISEASE PATIENTS IN A TERTIARY CARE CENTRE, AS COMPARED WITH NORMAL POPULATION." was done by me at Coimbatore Medical College and Hospital during the period from March '09 to November '09 under the guidance and supervision of Prof. Dr. M.Ramaswamy, MD.

This dissertation is submitted to the Tamil Nadu Dr. M.G.R Medical University towards the partial fulfillment of the requirement for the award of MD Degree (Branch I) in General Medicine.

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Aim of the study

AIM OF STUDY

The objectives of the study are:

1) To study the prevalence of low Ankle brachial pressure index in people with coronary arterial disease in patients of Coimbatore Medical College when compared with general population of same locality.

2) To find out whether ABPI is a significant individual risk factor for coronary arterial disease.

Introduction

INTRODUCTION

American heart association prevention conference V described Ankle brachial pressure index (ABPI) test as a “simple, inexpensive, noninvasive measure” of peripheral arterial disease and stated that an abnormal ABI “provides incremental coronary and all cardiovascular disease risk assessment information”. Measurement of ABPI has been recommended to improve cardiovascular risk assessment in individuals in individuals at “intermediate or higher risk of coronary arterial disease (CAD) on basis of traditional risk factor assessment” (1).although several studies have demonstrated that ABPI <0.9 predicts future CAD mortality, there is little data regarding the utility of ABPI as a screening test in individuals for whom physicians actually order non invasive test for cardiovascular risk prediction.

So, this study was performed to find the prevalence of low ABPI (<0.9) in clinical cases of coronary arterial disease patients and compare it with those who were free of disease clinically in the same group of population.

Low ABPI reflects peripheral arterial disease of lower limbs, and is used as a tool in treating an ischaemic limb, due to any cause, most common

of which is atherosclerosis. Epidemiological studies have demonstrated that subclinical cardiovascular disease in one vascular bed is associated with the presence of clinical disease in another bed, as well as with subsequent cardiovascular and total mortality. As, coronary arterial disease also shares a common etiology of atherosclerosis with peripheral arterial disease, ABPI can be used to predict its risk. Individuals with peripheral arterial disease of the lower extremities are among the highest-risk vascular patients. Therefore, presence of peripheral arterial disease is an indicator of widespread atherosclerosis in other vascular territories such as the coronary, carotid, and cerebrovascular arteries [2 , a-d] .

Review of literature

REVIEW OF LITERATURE

Clinical manifestation of peripheral arterial disease confirmed by reduced ankle-brachial pressure index (ABPI) ranges from the common asymptomatic disease, to the less prevalent intermittent claudication, to the relatively rare critical limb ischemia with rest pain, ulceration or gangrene . Even if peripheral arterial disease does not cause typical claudication, it reduces walking speed and walking endurance (3). Regardless of the clinical symptoms, reduced ABPI is a sign of hemodynamic disturbance in the arterial supply of the lower limbs, which is strongly associated with atherosclerosis in the coronary and carotid territories (4). Thus, peripheral arterial disease is associated with increased mortality due to myocardial infarction and ischemic stroke. Several studies described 2-3-fold greater mortality in patients with peripheral arterial disease in comparison with age-matched controls with normal ABPI; patients with peripheral arterial disease had a 5-year mortality of about 30% (5-10). Increasing severity of peripheral arterial disease, expressed as diminishing ABPI, progressively reduces survival (7-10).

Most previously studied cohorts were either patients referred for non-invasive vascular testing (7) or patients with known risk factors such as hypertension (9) or hyperlipidemia (5). .(metlika study)

ANKLE BRACHIAL PRESSURE INDEX

The Ankle Brachial Pressure Index (ABPI) is the ratio of the blood pressure in the lower legs to the blood pressure in the arms. Compared to the arm, lower blood pressure in the leg is a symptom of blocked arteries (peripheral vascular disease). The ABPI is calculated by dividing the systolic blood pressure in the arteries at the ankle and foot by the higher of the two systolic blood pressures in the arm.

MEASUREMENT OF ABPI:

Figure 1: EQUIPMENTS USED.

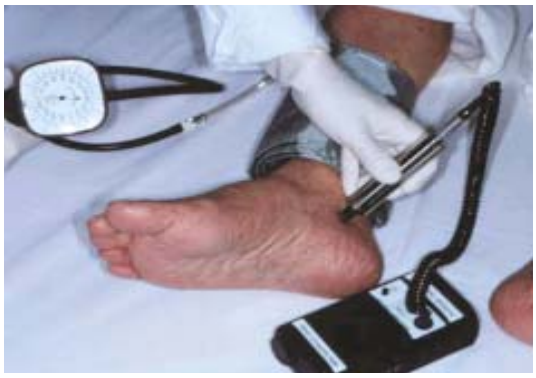


Figure 2: Procedure

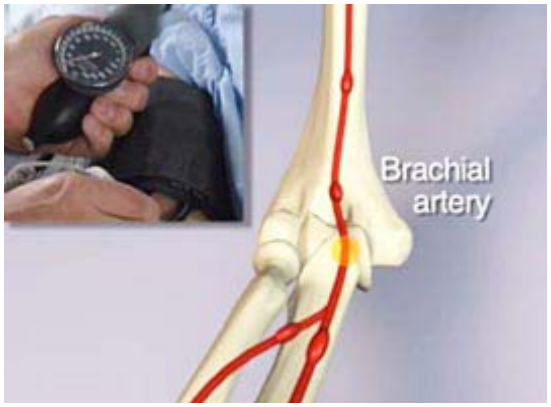


Figure 3: Measurement in arm.

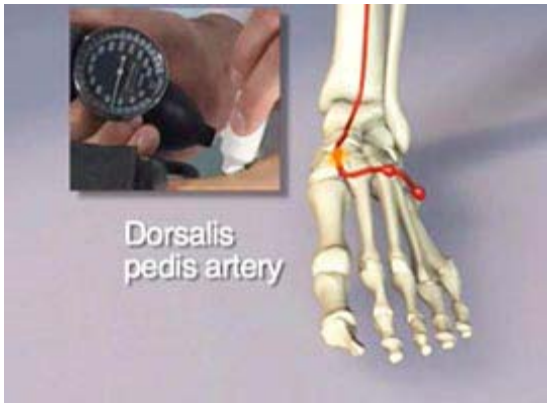


Figure 4: Measurement in leg.

A Doppler ultrasound blood flow detector, commonly called Doppler Wand or Doppler probe, is used to register the peripheral pulse while a sphygmomanometer (blood pressure cuff) is inflated over the artery until the pulse ceases, proximal to the Doppler probe. The cuff is slowly deflated, and the corresponding sphygmomanometer pressure at the instant the pulse returns provides the systolic blood pressure reading, for the given artery.

The higher of the left and right arm brachial artery pressure is generally used in the assessment. The pressures in each foot's artery and dorsalis pedis artery are measured with the higher of the two values used as the ABPI for that leg. [12]

$$\boldsymbol{ABPI = P_{Leg} / P_{Arm}}$$

Where P_{Leg} is the systolic blood pressure of dorsalis pedis or posterior tibial arteries and P_{Arm} is the highest of the left and right arm brachial artery pulse pressure

The ABPI test is a popular tool for the non-invasive assessment of PVD. Studies have shown the sensitivity of ABPI is 90% with a corresponding 98% specificity for detecting hemodynamically significant

(Serious) stenosis >50% in major leg arteries, defined by angiogram[13].

Palpation of peripheral pulses should be a routine component of all physical examination and should include assessment of the femoral, popliteal, and pedal vessels. It should be noted that pulse assessment is a learned skill and has a high degree of interobserver variability, with high false-positive and false-negative rates. The dorsalis pedis pulse is reported to be absent in 8.1% of healthy individuals, and the posterior tibial pulse is absent in 2.0%. Nevertheless, the absence of both pedal pulses, when assessed by a person experienced in this technique, strongly suggests the presence of vascular disease.

In contrast to the variability of pulse assessment and the often nonspecific nature of information obtained via history and other components of the physical exam, the ABI is a reproducible and reasonably accurate, noninvasive measurement for the detection of PAD and the determination of disease severity .

However, ABPI has known issues:-

- ABPI is known to be unreliable on patients with arterial calcification (Hardening of the arteries) which results in less or incompressible arteries[14], as the stiff arteries produce

falsely elevated ankle pressure, giving false negatives[15]). This is often found in patients with diabetesmelitus[16] (41% of PAD patients have diabetes[17]), renal failure or heavy smokers. ABPI values >1.3 should be investigated further regardless.

- Performing ABPI is time consuming[18].
- Resting ABPI is insensitive to mild PAD[19]. Treadmill tests (6 minute) are sometimes used to increase ABPI sensitivity[20], but this is unsuitable for patients who are obese or have co-morbidities such as Aortic aneurysm, and increases assessment duration.
- Lack of protocol standardisation[21], which reduces intra-observer reliability[22].
- Skilled Operators are required for consistent, accurate results[23].

Interpretation of results

In a normal subject the pressure at the ankle pulses is slightly higher than at the elbow (there is reflection of the pulse pressure from the vascular bed of the feet, whereas at the elbow the artery continues on some distance to the wrist). The ABPI is the ratio of the highest ankle to brachial artery pressure and an ABPI of greater than 0.9 is considered normal ,free from significant PAD.

However, an ABPI value greater than 1.3 is considered abnormal, and suggests calcification of the walls of the arteries and incompressible vessels, reflecting severe peripheral vascular disease.

Provided that there are no other significant conditions affecting the arteries of the leg, the following ABPI ratios can be used to predict the severity of PAD as well as assess the nature and best management of various types of leg ulcers:[12]

TABLE-1

ABPI value	Interpretation
above 1.3	Abnormal (Vessel hardening from PAD)
1.0 - 1.3	Normal range
0.9 - 1.0	Acceptable
0.8 - 0.9	Some arterial disease
0.5 - 0.8	Moderate arterial disease
under 0.5	Severe arterial disease

Lower limb ischaemia, resulting from atherosclerosis, is a common finding

in middle-aged and elderly people. Its prevalence is significantly higher in diabetic patients than in non-diabetic patients. Around5% of adults who were older than 40 years of age had PAD, and two-thirds had no symptoms. The prevalence of the disease is 1.8 times among diabetic patients than non-diabetic patients, thus early detection of the disease in people at risk would help in early management. Screening of PAD of the lower limb was performed utilising different ways, such as history suggestive of lower limb claudication, palpation of foot pulses, and measuring ABPI by Doppler US.(6,7,10) Relying on the history of intermittent claudication alone to make

a diagnosis of PAD, or even as a screening method before further detailed examination, may cause many cases to be missed because of common co morbid problems that may cause leg pain.(11,12) The same applies for palpating foot pulses, as 8% of the dorsalis pedis and 2% of the posterior

tibial arteries are not palpable in healthy individuals, but detectable by Doppler US. ABI is an easy and objective way of evaluating lower limb blood flow. In fact, it was also shown that the PAD screening score using a

hand-held Doppler US provides the greatest diagnostic accuracy. (14, 15)

Predictor of atherosclerosis mortality

Though, ABPI is mainly used in detecting and grading the severity of stenosis of vessel in peripheral arterial disease patients, Studies in 2006 suggest that an abnormal ABPI may be an independent predictor of mortality, as it reflects the burden of atherosclerosis.[24] [25] this is based on the fact that, a systemic process like atherosclerosis, which is the most important cause of coronary events, also involves the peripheral vessels. This can be made use of , in predicting the future coronary events early and halt the actual occurrence of a major catastrophe bye appropriate intervention, either pharmacological or life style modifications.

A brief overview of atherosclerosis and coronary arterial disease may be important in understanding the significance of ABPI in detecting the occlusive process.

ATHEROSCLEROSIS:

Atherosclerosis is a disease affecting arterial blood vessels. It is a chronic inflammatory response in the walls of arteries, in large part due to the accumulation of macrophage white blood cells and promoted by low density (especially small particle) lipoproteins (plasma proteins that carry cholesterol and triglycerides) without adequate removal of fats and cholesterol from the macrophages by functional high density lipoproteins(HDL), (see apoA-1 Milano). It is commonly referred to as a "hardening" or "furring" of the arteries. It is caused by the formation of multiple plaques within the arteries.[26]

The atheromatous plaque is divided into three distinct components:

1. The atheroma ("lump of porridge", from Athera, porridge in Greek,), which is the nodular accumulation of a soft, flaky, yellowish material at the center of large plaques, composed of macrophages nearest the lumen of the artery
2. Underlying areas of cholesterol crystals
3. Calcification at the outer base of older/more advanced lesions.

The following terms are similar, yet distinct, in both spelling and meaning, and can be easily confused: arteriosclerosis, arteriolosclerosis, and atherosclerosis. Arteriosclerosis is a general term describing any hardening (and loss of elasticity) of medium or large arteries (from the Greek Arterio, meaning artery, and sclerosis, meaning hardening); arteriolosclerosis is any hardening (and loss of elasticity) of arterioles (small arteries); atherosclerosis is a hardening of an artery specifically due to an atheromatous plaque. Therefore, atherosclerosis is a form of arteriosclerosis.

Atherosclerosis, though typically asymptomatic for decades, eventually produces two main problems: First, the atheromatous plaques, though long compensated for by artery enlargement (see IMT), eventually lead to plaque ruptures and clots inside the artery lumen over the ruptures. The clots heal and usually shrink but leave behind stenosis (narrowing) of the artery (both locally and in smaller downstream branches), or worse, complete closure, and, therefore, an insufficient blood supply to the tissues and organ it feeds. Second, if the compensating artery enlargement process is excessive, then a net aneurysm results.

These complications of advanced atherosclerosis are chronic, slowly

progressive and cumulative. Most commonly, soft plaque suddenly ruptures (see vulnerable plaque), causing the formation of a thrombus that will rapidly slow or stop blood flow, leading to death of the tissues fed by the artery in approximately 5 minutes. This catastrophic event is called an infarction. One of the most common recognized scenarios is coronary thrombosis of a coronary artery, causing myocardial infarction (a heart attack). Even worse is the same process in arteries to the brain, commonly called stroke. Another common scenario in very advanced disease is claudication from insufficient blood supply to the legs, typically due to a combination of both stenosis and aneurysmal segments narrowed with clots. Since atherosclerosis is a body-wide process, similar events occur also in the arteries to the brain, intestines, kidneys, legs, etc.

Causes

Atherosclerosis develops from low-density lipoprotein molecules (LDL) becoming oxidized (ldl-ox) by free radicals, particularly oxygen free radicals (ROS). Blood in arteries contains plenty of oxygen and is where atherosclerosis develops. Blood in veins contains little oxygen where atherosclerosis rarely develops. When oxidized LDL comes in contact with

an artery wall, a series of reactions occurs to repair the damage to the artery wall caused by oxidized LDL. The LDL molecule is globular shaped with a hollow core for carrying cholesterol throughout the body for making brain tissue, vitamin D, etc. Cholesterol does not dissolve in water. Blood is 70% water. The only way cholesterol can move in the bloodstream is to be carried by LDL.

The body's immune system responds to the damage to the artery wall caused by oxidized LDL by sending specialized white blood cells (macrophages and T-lymphocytes) to absorb the oxidized-LDL. Unfortunately, these white blood cells are not able to process the oxidized-LDL, and ultimately grow then rupture, depositing a greater amount of oxidized cholesterol into the artery wall. This triggers more white blood cells, continuing the cycle.

Eventually, the artery becomes inflamed. The cholesterol plaque causes the muscle cells to enlarge and form a hard cover over the affected area. This hard cover is what causes a narrowing of the artery, reduces the blood flow and increases blood pressure.

Some researchers believe that atherosclerosis may be caused by an

infection of the vascular smooth muscle cells. Chickens, for example, develop atherosclerosis when infected with the Marek's disease herpes virus.[27] Herpes virus infection of arterial smooth muscle cells has been shown to cause cholesteryl ester (CE) accumulation.[28] Cholesteryl ester accumulation is associated with atherosclerosis.

Symptoms

Atherosclerosis typically begins in early adolescence, and is usually found in most major arteries, yet is asymptomatic and not detected by most diagnostic methods during life. The stage immediately prior to actual atherosclerosis is known as sub clinical atherosclerosis. The majority of the process leading to sub clinical atherosclerosis can happen without our knowing it, especially given the large variety of risk factors.[29] Autopsies of healthy young men who died during the Korean and Vietnam Wars showed evidence of the disease.[30][31] It most commonly becomes seriously symptomatic when interfering with the coronary circulation supplying the heart or cerebral circulation supplying the brain, and is considered the most important underlying cause of strokes, heart attacks, various heart diseases including congestive heart failure, and most cardiovascular

diseases, in general. Atheroma in arm, or more often in leg arteries, which produces decreased blood flow, is called peripheral artery occlusive disease (PAOD).

Most artery flow disrupting events occur at locations with less than 50% lumen narrowing (~20% stenosis is average).

Atherogenesis

Atherogenesis is the developmental process of atheromatous plaques. It is characterized by a remodeling of arteries involving the concomitant accumulation of fatty substances called plaques. One recent theory suggests that, for unknown reasons, leukocytes, such as monocytes or basophils, begin to attack the endothelium of the artery lumen in cardiac muscle. The ensuing inflammation leads to formation of atheromatous plaques in the arterial tunica intima, a region of the vessel wall located between the endothelium and the tunica media. The bulk of these lesions is made of excess fat, collagen, and elastin. At first, as the plaques grow, only wall thickening occurs without any narrowing, stenosis of the artery opening, called the lumen; stenosis is a late event, which may never occur and is often the result of repeated plaque rupture and healing responses, not just the

atherosclerosis process by itself.

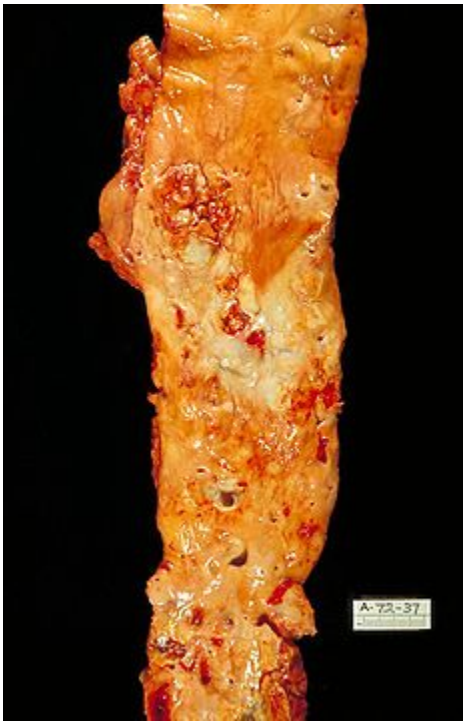
Cholesterol is delivered into the vessel wall by cholesterol-containing low-density lipoprotein (LDL) particles. To attract and stimulate macrophages, the cholesterol must be released from the LDL particles and oxidized, a key step in the ongoing inflammatory process. The process is worsened if there is insufficient high-density lipoprotein (HDL), the lipoprotein particle that removes cholesterol from tissues and carries it back to the liver.

The foam cells and platelets encourage the migration and proliferation of smooth muscle cells, which in turn ingest lipids, become replaced by collagen and transform into foam cells themselves. A protective fibrous cap normally forms between the fatty deposits and the artery lining (the intima).

These capped fatty deposits (now called 'atheromas') produce enzymes that cause the artery to enlarge over time. As long as the artery enlarges sufficiently to compensate for the extra thickness of the atheroma, then no narrowing ("stenosis") of the opening ("lumen") occurs. The artery becomes expanded with an egg-shaped cross-section, still with a circular opening. If the enlargement is beyond proportion to the atheroma thickness,

then an aneurysm is created. [32]

Visible features



Severe atherosclerosis of the aorta. Autopsy specimen.

Although arteries are not typically studied microscopically, two plaque types can be distinguished [26]:

1. The fibro-lipid (fibro-fatty) plaque
2. The fibrous plaque (under the intima)

The calcification deposits, after they have become sufficiently

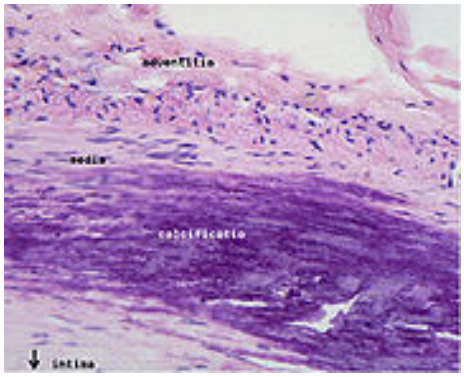
advanced, are partially visible on coronary artery computed tomography or electron beam tomography (EBT) as rings of increased radiographic density, forming halos around the outer edges of the atheromatous plaques, within the artery wall. On CT, >130 units on the Hounsfield scale {some argue for 90 units) has been the radiographic density usually accepted as clearly representing tissue calcification within arteries. These deposits demonstrate unequivocal evidence of the disease, relatively advanced, even though the lumen of the artery is often still normal by angiographic or intravascular ultrasound.

Rupture and stenosis

Although the disease process tends to be slowly progressive over decades, it usually remains asymptomatic until an atheroma obstructs the bloodstream in the artery. This is typically by rupture of an atheroma, clotting and fibrous organization of the clot within the lumen, covering the rupture but also producing stenosis, or over time and after repeated ruptures, resulting in a persistent, usually localized stenosis. Stenoses can be slowly progressive, whereas plaque rupture is a sudden event that occurs specifically in atheromas with thinner/weaker fibrous caps that have become

"unstable."

If the fibrous cap separating a soft atheroma from the bloodstream within the artery ruptures, tissue fragments are exposed and released, and blood enters the atheroma within the wall and sometimes results in a sudden expansion of the atheroma size. Tissue fragments are very clot-promoting, containing collagen and tissue factor; they activate platelets and activate the system of coagulation. The result is the formation of athrombus (blood clot) overlying the atheroma, which obstructs blood flow acutely. With the obstruction of blood flow, downstream tissues are starved of oxygen and nutrients. If this is the myocardium (heart muscle), angina (cardiac chest pain) or myocardial infarction (heart attack) develops.



Microphotography of arterial wall with calcified (violet colour) atherosclerotic plaque (haematoxillin & eosin stain)

Areas of severe narrowing, stenosis, detectable by angiography, and to

a lesser extent "stress testing" e.g. ABPI, have long been the focus of human diagnostic techniques for cardiovascular disease, in general. However, these methods focus on detecting only severe narrowing, not the underlying atherosclerosis disease.

Greater than 75% lumen stenosis used to be considered by cardiologists as the hallmark of clinically significant disease because it is typically only at this severity of narrowing of the larger heart arteries that recurring episodes of angina and detectable abnormalities by stress testing methods are seen. However, clinical trials have shown that only about 14% of clinically-debilitating events occur at locations with this, or greater severity of narrowing. The majority of events occur due to atheroma plaque rupture at areas without narrowing sufficient enough to produce any angina or stress test abnormalities. Thus, since the later-1990s, greater attention is being focused on the "vulnerable plaque."[34]

Though any artery in the body can be involved, usually only severe narrowing or obstructions of some arteries, those that supply more critically-important organs are recognized. Obstruction of arteries supplying the heart muscle results in a heart attack. Obstruction of arteries supplying

the brain results in a stroke. These events are life-changing, and often result in irreversible loss of function because lost heart muscle and brain cells do not grow back to any significant extent, typically less than 2%.

Over the last couple of decades, methods other than angiography and stress-testing, like ABPI etc, have been increasingly developed as ways to better detect atherosclerotic disease before it becomes symptomatic. These have included both (a) anatomic detection methods and (b) physiologic measurement methods.

Examples of anatomic methods include: (1) coronary calcium scoring by CT, (2) carotid IMT (intimal media thickness) measurement by ultrasound, and (3) ABPI.

Examples of physiologic methods include: (1) lipoprotein subclass analysis, (2) HbA1c, (3) hs-CRP, and (4) homocysteine.

The example of the metabolic syndrome combines both anatomic (abdominal girth) and physiologic (blood pressure, elevated blood glucose) methods.

Advantages of these two approaches: The anatomic methods directly

measure some aspect of the actual atherosclerotic disease process itself, thus offer potential for earlier detection, including before symptoms start, disease staging and tracking of disease progression. The physiologic methods are often less expensive and safer and changing them for the better may slow disease progression, in some cases with marked improvement.

Disadvantages of these two approaches: The anatomic methods are generally more expensive and several are invasive. The physiologic methods do not quantify the current state of the disease or directly track progression. For both, clinicians and third party payers have been slow to accept the usefulness of these newer approaches.

Physiologic factors that increase risk

Various anatomic, physiological & behavioral risk factors for atherosclerosis are known.[35] These can be divided into various categories: congenital vs acquired, modifiable or not, classical or non-classical. The points labelled '+' in the following list form the core components of "metabolic syndrome".

Factors add to each other multiplicatively, with two factors increasing the risk of atherosclerosis fourfold.[36] Hyperlipidemia,

hypertension and cigarette smoking together increases the risk seven times.[36]

Modifiable

- Having Diabetes[36] or Impaired glucose tolerance (IGT) +
- Dyslipoproteinemia[36] (unhealthy patterns of serum proteins carrying fats & cholesterol): +
    - High serum concentration of low-density lipoprotein (LDL, "bad if elevated concentrations and small"), and / or very low density lipoprotein(VLDL) particles, i.e., "lipoprotein subclass analysis"
    - Low serum concentration of functioning high density lipoprotein (HDL "protective if large and high enough" particles), i.e., "lipoprotein subclass analysis"
    - An LDL:HDL ratio greater than 3:1
- Tobacco smoking, increases risk by 200% after several pack years [36]
- Having high blood pressure +, on its own increasing risk by 60%[36]
- Elevated serum C-reactive protein concentrations[36]

Nonmodifiable

- Advanced age [36]
- Male sex[36]
- Having close relatives who have had some complication of atherosclerosis (e.g. coronary heart disease or stroke)[36]
- Genetic abnormalities,[11] e.g. familial hypercholesterolemia

Lesser or uncertain

The following factors are of relatively lesser importance, are uncertain or nonquantitated:

- Being obese] (in particular central obesity, also referred to as abdominal or male-type obesity) +
- A sedentary lifestyle[36]
- Postmenopausal estrogen deficiency[36]
- High carbohydrate intake[36]
- Intake of trans fat[36]
- Elevated serum levels of triglycerides +
- Elevated serum levels of homocysteine
- Elevated serum levels of uric acid (also responsible for gout)
- Elevated serum fibrinogen concentrations

- Elevated serum lipoprotein(a) concentrations [36]
- Chronic systemic inflammation as reflected by upper normal WBC concentrations, elevated hs-CRP and many other blood chemistry markers, most only research level at present, not clinically done.[37]
- Stress[36] or symptoms of clinical depression
- Hyperthyroidism (an over-active thyroid)
- Elevated serum insulin levels + [38]
- Chlamydia pneumoniae infection[36]

Dietary risk factors

The relation between dietary fat and atherosclerosis is a contentious field. The USDA, in its food pyramid, promotes a low-fat diet, based largely on its view that fat in the diet is atherogenic.

The role of dietary oxidized fats / lipid peroxidation (rancid fats) in humans is not clear. Laboratory animals fed rancid fats develop atherosclerosis. Rats fed DHA-containing oils experienced marked disruptions to their antioxidant systems, as well as accumulated significant amounts of peroxide in their blood, livers and kidneys.[41] Rancid fats and oils taste very bad even in small amounts; people avoid eating them.[44] It is

very difficult to measure or estimate the actual human consumption of these substances.[45] In addition, the majority of oils consumed in the United States are refined, bleached, deodorized and degummed by manufacturers. The resultant oils are colorless, odorless, tasteless and have a longer shelf life than their unrefined counterparts.[46]This extensive processing serves to make peroxidated, rancid oils much more elusive to detection via the various human senses than the unprocessed alternatives.

The French paradox is the observation that despite having a diet similar to those United States in terms of fat intake, rates of heart disease are lower in France. There is evidence to suggest the French paradox is due to underestimation of the rates of heart disease in France.[47]

Prognosis

Lipoprotein imbalances, upper normal and especially elevated blood sugar, i.e., diabetes and high blood pressure are risk factors for atherosclerosis; homocysteine, stopping smoking, taking anticoagulants (anti-clotting agents), which target clotting factors, taking omega-3 oils from fatty fish or plant oils such as flax or canola oils, exercising and losing weight are the usual focus of treatments that have

proven to be helpful in clinical trials. The target serum cholesterol level is ideally equal or less than 4mmol/L (160 mg/dL), and triglycerides equal or less than 2mmol/L (180 mg/dL).Diabetes is alone atherogenic.

Treatment

If atherosclerosis leads to symptoms, some symptoms such as angina pectoris can be treated. Non-pharmaceutical means are usually the first method of treatment, such as cessation of smoking and practicing regular exercise. If these methods do not work, medicines are usually the next step in treating cardiovascular diseases, and, with improvements, have increasingly become the most effective method over the long term. However, medicines are criticized for their expense, patented control and occasional undesired effects.

Statins

Statins have shown ~25% comparative mortality reduction in clinical trials, although one study design, ALLHAT, [48] was less strongly favorable.

The newest statin, rosuvastatin, has been the first to demonstrate regression of atherosclerotic plaque within the coronary

arteries by IVUS(intravascular ultrasound evaluation).[33]

The success of statin drugs in clinical trials is based on some reductions in mortality rates, however by trial design biased toward men and middle-age, the data is as, as yet, less strongly clear for women and people over the age of 70[49]. The ASTEROID trial has been the first to show actual disease volume regression[33] (see page 8 of the paper, which shows cross-sectional areas of the total heart artery wall at start and 2 years of rosuvastatin 40 mg/day treatment); however, its design was not able to "prove" the mortality reduction issue since it did not include a placebo group, the individuals offered treatment within the trial had advanced disease and promoting a comparison placebo arm was judged to be unethical.

Primary and Secondary Prevention—Studies

Combinations of statins, niacin, intestinal cholesterol absorption-inhibiting supplements (ezetimibe and others, and to a much lesser extentfibrates) have been the most successful in changing common but sub-optimal lipoprotein patterns and group outcomes. The first of the large secondary prevention comparative statin/placebo treatment trials was the Scandinavian Simvastatin Survival Study. (4S) [50] with over 15 more

extending through the more recent ASTEROID [51] trial published in 2006. The first primary prevention comparative treatment trial was AFCAPS/TexCAPS [52] with multiple later comparative statin/placebo treatment trials including EXCEL.[53], ASCOT[54] and SPARCL.[55] [56] While the statin trials have all been clearly favorable for improved human outcomes, only ASTEROID showed evidence of atherosclerotic regression (slight). For both human and animal trials, those which have shown evidence of disease regression had all utilized more aggressive combination agent treatment strategies, nearly always including niacin.[35]

Diet and dietary supplements

Vitamin B3, AKA niacin, in pharmacologic doses, (generally 1,000 to 3,000 mg/day), sold in many OTC and prescription formulations, tends to improve (a) HDL levels, size and function, (b) shift LDL particle distribution to larger particle size and (c) lower lipoprotein(a), an atherosclerosis promoting genetic variant of LDL.

Caldwell B Esselstyn Jr. MD has had an article published in Preventive Cardiology 2001; 4: 171-177 in which he has published angiograms showing regression of atherosclerosis brought about by a very

low fat vegan diet in some cases with cholesterol lowering medications.[57]

Dietary supplements of Omega-3 oils, especially those from the muscle of some deep salt water living fish species, also have clinical evidence of significant protective effects as confirmed by 6 double blind placebo controlled human clinical trials[citation needed].

In animals Vitamin C deficiency has been confirmed as an important role in development of hypercholesterolemia and atherosclerosis, but due to ethical reasons placebo-controlled human studies are impossible to do.[58] Vitamin C acts as an antioxidant in vessels and inhibits inflammatory process.[59] It has therapeutic properties on high blood pressure and its fluctuation,[60][61] and arterial stiffness in diabetes.[62] Vitamin C is also a natural regulator of cholesterol[63] and higher doses (over 150mg/kg daily) may confer significant protection against atherosclerosis even in the situation of elevated cholesterol levels.[64][65]

The scale of vitamin C benefits on cardiovascular system led several authors to the theory, that vitamin C deficiency is the primary cause of cardiovascular diseases.[66] The theory was unified by twice Nobel prize winner Linus Pauling and Matthias Rath. They discuss several metabolic and

genetic predispositions and their pathomechanism.[67]

Trials on Vitamin E have been done, but they have failed to find a beneficial effect, for various reasons, but for some patients at high risk for atherosclerosis there may be some benefits.[68]

Menaquinone (Vitamin K2), but not phylloquinone (Vitamin K1), intake is associated with reduced risk of CHD mortality, all-cause mortality and severe aortic calcification.[69][70][71]

It has been suggested that excess iron may be involved in development of atherosclerosis[72][73], but one study found reducing body iron stores in patients with symptomatic peripheral artery disease through phlebotomy did not significantly decrease all-cause mortality or death plus nonfatal myocardial infarction and stroke.[74] Further studies may be warranted.

Surgical intervention

Other physical treatments, helpful in the short term, include minimally invasive angioplasty procedures that may include stents to physically expand narrowed arteries[75] and major invasive surgery, such as bypass surgery, to

create additional blood supply connections that go around the more severely narrowed areas.

Prophylaxis

Patients at risk for atherosclerosis-related diseases are increasingly being treated prophylactically with low-dose aspirin and a statin. The high incidence of cardiovascular disease led Wald and Law[76] to propose a Polypill, a once-daily pill containing these two types of drugs in addition to an ACE inhibitor, diuretic, beta blocker, and folic acid. They maintain that high uptake by the general population by such a Polypill would reduce cardiovascular mortality by 80%. It must be emphasized however that this is purely theoretical, as the Polypill has never been tested in a clinical trial.

Because many blood thinners, particularly salicylates such as warfarin and aspirin thin the blood by interfering with Vitamin K, there is recent evidence that blood thinners which work by this mechanism can actually worsen arterial calcification in the long term even though they thin the blood in the short term.[77][78] [27][28]

Recent research

An indication of the role of HDL on atherosclerosis has been with the rare Apo-A1 Milano human genetic variant of this HDL protein. Methods to increase high-density lipoprotein (HDL) particle concentrations, which in some animal studies largely reverses and remove atheromas, are being developed and researched.

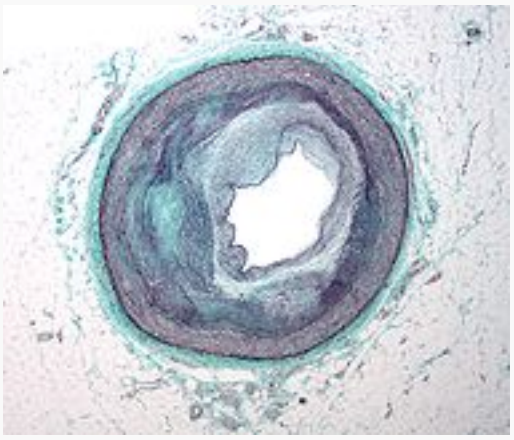
Niacin has HDL raising effects (by 10 - 30%) and showed clinical trial benefit in the Coronary Drug Project.However, increasing HDL by any means is not necessarily helpful. For example, the drug torcetrapib is the most effective agent currently known for raising HDL (by up to 60%). However, in clinical trials it also raised deaths by 60%. All studies regarding this drug were halted in December 2006.[79]The ERASE trial is a newer trial of an HDL booster which has shown promise.[80]

- The actions of macrophages drive atherosclerotic plaque progression. Immunomodulation of atherosclerosis is the term for techniques which modulate immune system function in order to suppress this macrophage action.[81].

Some controversial research has suggested a link between atherosclerosis and the presence of several different nanobacteria in the

arteries, e.g.,Chlamydophila pneumoniae, though trials of current antibiotic treatments known to be usually effective in suppressing growth or killing these bacteria have not been successful in improving outcomes.[82]

CORONARY ARTERIAL DISEASE:



Micrograph of a coronary artery with the most common form of coronary artery disease (atherosclerosis) and marked luminal narrowing. Masson's trichrome.

Coronary artery disease (CAD)(or atherosclerotic heart disease) is the end result of the accumulation of atheromatous plaques within the walls of the coronary arteries[83] that supply the myocardium (the muscle of the heart) with oxygen and nutrients. It is sometimes also called coronary heart disease (CHD), but although CAD is the most common cause of CHD, it is not the only cause.

CAD is the leading cause of death worldwide.[84] While the symptoms and signs of coronary artery disease are noted in the advanced state of disease, most individuals with coronary artery disease show no evidence of disease for decades as the disease progresses before the first onset of symptoms,

often a "sudden" heart attack, finally arises. After decades of progression, some of these atheromatous plaques may rupture and (along with the activation of the blood clotting system) start limiting blood flow to the heart muscle. The disease is the most common cause of sudden death[85], and is also the most common reason for death of men and women over 20 years of age[86]. According to present trends in the United States, half of healthy 40-year-old males will develop CAD in the future, and one in three healthy 40-year-old women.[87] .

CAD is associated with smoking, diabetes, and hypertension. A family history of early CAD is one of the less important predictors of CAD. Most of the familial association of coronary artery disease are related to common dietary habits. Screening for CAD includes evaluating high-density and low-density lipoprotein (cholesterol) levels and triglyceride levels. Despite much press, most of the alternative risk factors including homocysteine, C-reactive protein (CRP), Lipoprotein (a), coronary calcium and more sophisticated lipid analysis have added little if any additional value to the conventional risk factors of smoking, diabetes and hypertension.

However, there is a term in medicine called “Cardiac Syndrome X”, which describes chest pain (Angina pectoris) and chest discomfort in people who

do not show signs of blockages in the larger coronary arteries of their hearts when an angiogram (coronary angiogram) is being performed[88].

No one knows exactly what causes “Cardiac Syndrome X” and it is unlikely to have a single cause. Today, we speculate that the major contributing factor to “Cardiac Syndrome X” is “microvascular dysfunction”. The term “microvascular” refers to very small blood vessels and, in this case, very small arteries (arterioles, capillaries) of the heart.

The large majority of women have the garden variety of coronary artery disease. Rarely, women with “Cardiac Syndrome X” have typical anginal syndromes that are not associated with the presence of atherosclerotic plaques; that is, the localized blockages are absent. Scientists speculate that the blood vessels in these women are diffuse abnormal. Some have falsely claim that the entire lining of the artery becomes thickened throughout, making the plaques flush with the wall of the artery without any scientific proof. On cardiac catheterization their coronary arteries appear smooth-walled and normal, though they may look "small" in diameter. By the way: in general, female coronary arteries (like all arteries) are somewhat smaller than in males.

It is not completely clear why women are more likely than men to suffer from "Syndrome X"; however, hormones and other risk factors unique to women may play a role[89].

Risk factors

The following are confirmed independent risk factors for the development of CAD:

1. Hypercholesterolemia (specifically, serum LDL concentrations)
2. Smoking
3. Hypertension (high systolic pressure seems to be most significant in this regard)
4. Hyperglycemia (due to diabetes mellitus or otherwise)
5. Type A Behavioural Patterns, TABP. Added in 1981 as an independent risk factor after a majority of research into the field discovered that TABP's were twice as likely to exhibit CAD than any other personality type.[citation needed]
6. Hemostatic Factors[92]: High levels of fibrinogen and coagulation factor VII are associated with an increased risk of CAD. Factor VII levels are higher in individuals with a high intake of dietary fat.

Decreased fibrinolytic activity has been reported in patients with coronary atherosclerosis.

7. Hereditary differences in such diverse aspects as lipoprotein structure and that of their associated receptors, homocysteine processing/metabolism, etc.
8. High levels of Lp(a):[citation needed]

Significant, but indirect risk factors include:

- Lack of exercise, Stress , Diet rich in saturated fats, Diet low in antioxidants ,Obesity, Men over 60, Women over 65[93]

Risk factors can be classified as

1. Fixed: age, sex, family history
2. Modifiable: smoking, hypertension, diabetes mellitus, obesity, etc.

Prevention

Coronary artery disease is the most common form of heart disease in the Western world. Prevention centers on the modifiable risk factors, which include decreasing cholesterol levels, addressing obesity and hypertension, avoiding a sedentary lifestyle, making healthy dietary choices, and stopping smoking. There is some evidence that

lowering homocysteine levels may contribute to more heart attacks (NORVIT trial). The World Health Organization (WHO) recommends "low to moderate alcohol intake" to reduce risk of coronary artery disease although this remains without scientific cause and effect proof.[94]

An increasingly growing number of other physiological markers and homeostatic mechanisms are currently under scientific investigation. Patients with CAD and those trying to prevent CAD are advised to avoid fats that are readily oxidized (e.g., saturated fats and trans-fats), limit carbohydrates and processed sugars to reduce production of Low density lipoproteins,triacylglycerol and apolipoprotein-B. [95] [96] [97] [98] [99] It is also important to keep blood pressure normal, exercise and stop smoking.

Menaquinone (Vitamin K2), but not phylloquinone (Vitamin K1), intake is associated with reduced risk of CAD mortality, all-cause mortality and severe aortic calcification.[100][101][102]

Therapy - Principles of Treatment

Therapeutic options for coronary artery disease today are based on three principles:

- 1. Medical treatment - drugs (e.g. cholesterol lowering medications,

beta-blockers, nitroglycerin, calcium antagonists, etc.);

- 2. Coronary interventions as angioplasty and coronary stent-implantation;
- 3. Coronary artery bypass grafting (CABG - coronary artery bypass surgery).

Recent research efforts focus on new angiogenic treatment modalities (angiogenesis) and various (adult) stem cell therapies.

A 2006 study by the Cleveland Clinic found a region on Chromosome 17 was confined to families with multiple cases of myocardial infarction.

Since the 1990s the search for new treatment options for coronary artery disease patients, particularly for so called "no-option" coronary patients, focused on usage of angiogenesis[46] and (adult) stem cell therapies. Numerous clinical trials were performed, either applying protein (angiogenic growth factor) therapies, such as FGF-1 or VEGF, or cell therapies using different kinds of adult stem cell populations. Research is still going on - with first promising results particularly for FGF-1[47][48] and utilization of endothelial progenitor cells.

SCREENING TESTS:

Various screening tests are available to detect CAD, ranging from simple biochemical tests to complex radiological scoring systems. Each of the test has its own advantages and limitations. One such test is ABPI evaluation, which can effectively screen patients for CAD, easily and cost effectively.

Materials and Methods

MATERIALS AND METHODS:

DURATION: MARCH 2009 *to* NOVEMBER 2009.

METHOD:

ABPI was compared between 100 patients with clinical cardiovascular disease versus 100 controls taken from patients attending Coimbatore medical college and general population of Coimbatore respectively. ABPI <0.9 was taken as cut off, as it has a sensitivity of 90% in detecting peripheral vascular disease, which may also reflect similar pathology in other vascular bed, like coronary arteries. Prevalence of APBI less than 0.9 was compared and analysed between the two study populations.

The ABPI was measured according to a standard protocol. Vascular lower limb examination was done, by feeling the foot pulses (dorsalispedis and posterior tibial arteries), and identifying the best palpable one. ABPI was measured, by using the sphygmomanometer and a sonic aid hand-held Doppler probe (GIMA Ultrasound Technology Ltd, UK), utilizing the best-identified note of foot arteries and measuring its index in relation to the brachial artery. The ABI measurements were

compared between the two groups, with special concentration on patients with hypertension, diabetes , hypertension, smoking, PAD etc as comorbid associations of atherosclerosis.

chi-square test was used to compare percentages. A p-value of ≤ 0.05 was considered statistically significant.

STUDY POPULATION:

PATIENTS: 100(50 men and 50 women) randomly selected coronary arterial disease patients (as evidenced by prior medical records, recent biochemical, ECG, echocardiographical data etc) attending cardiac department of coimbatore medical college were screened for ABPI.

CONTROLS: Age and sex matched controls, hundred in number from general population, who showed no symptoms or signs of coronary arterial disease.

SPECIAL REMARKS: Other confounders of CAD , like hypertension. Diabetes, dyslipidemia ,genetic predispositions, smokers etc were not matched .These were taken as separate variables for statistical analysis.

EXCLUSION CRITERIA:

Patients who were acutely ill or significantly morbid.

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discussion

OBSERVATIONS, RESULTS AND ANALYSIS:

RELATIONSHIP OF CORONARY ARTERIAL DISEASE TO ABPI:

Of the 100 patients with coronary arterial disease, 34% had a ABPI value below 0.9. ABPI in normal range of 0.9 to 1.2 was found in 58% of total. Another 8% had ABPI in higher range, which is usually associated with calcification of the vessel, which again is a risk for coronary arterial disease.

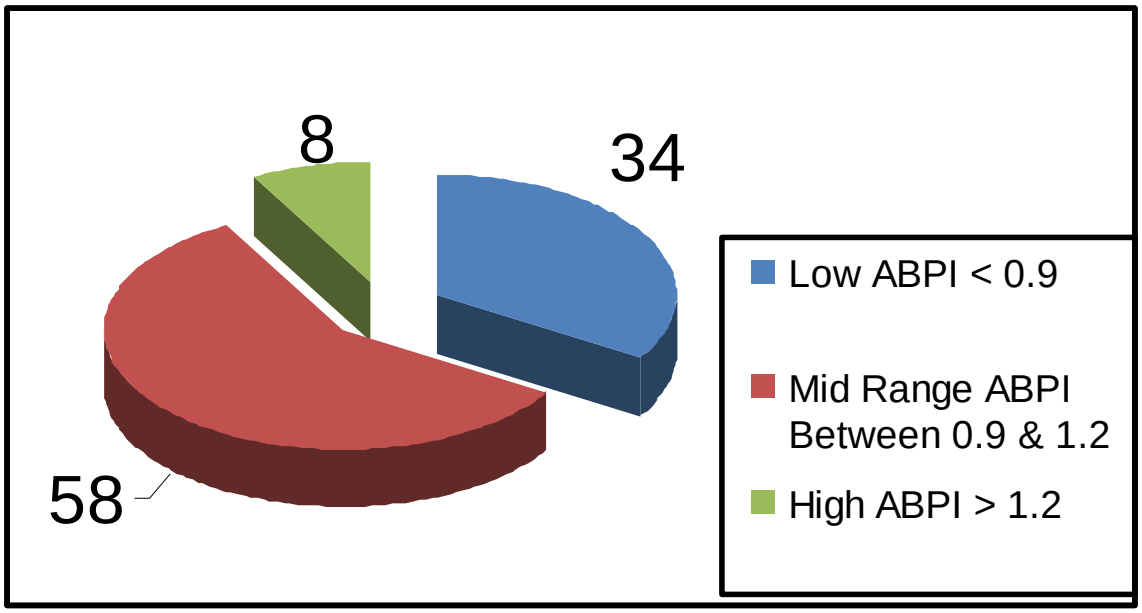


FIGURE 1 : ABPI vs. CAD

The people in the control group had significantly lesser numbers falling in the abnormal range.77% percentage of people had ABPI in the normal range. Only 11% of people had ABPI in the range of ischaemic limb, i.e. below 0.9. Though 12 % had a higher ABPI value, it should be because of the prevalence of higher age and the comorbid conditions in the group.

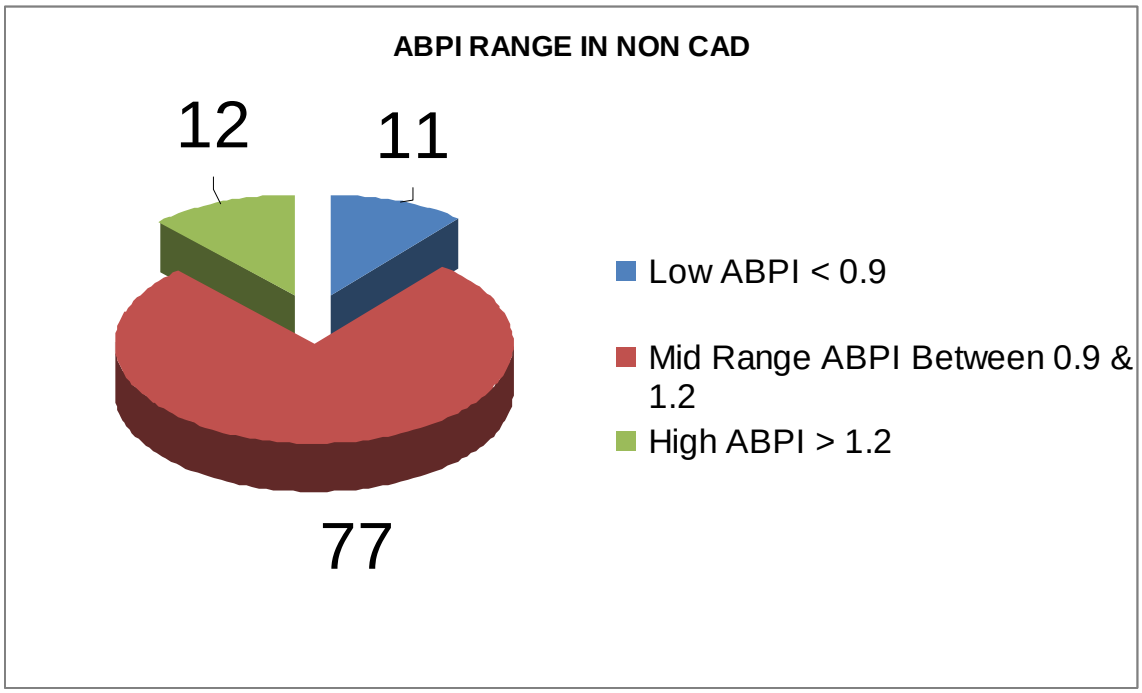
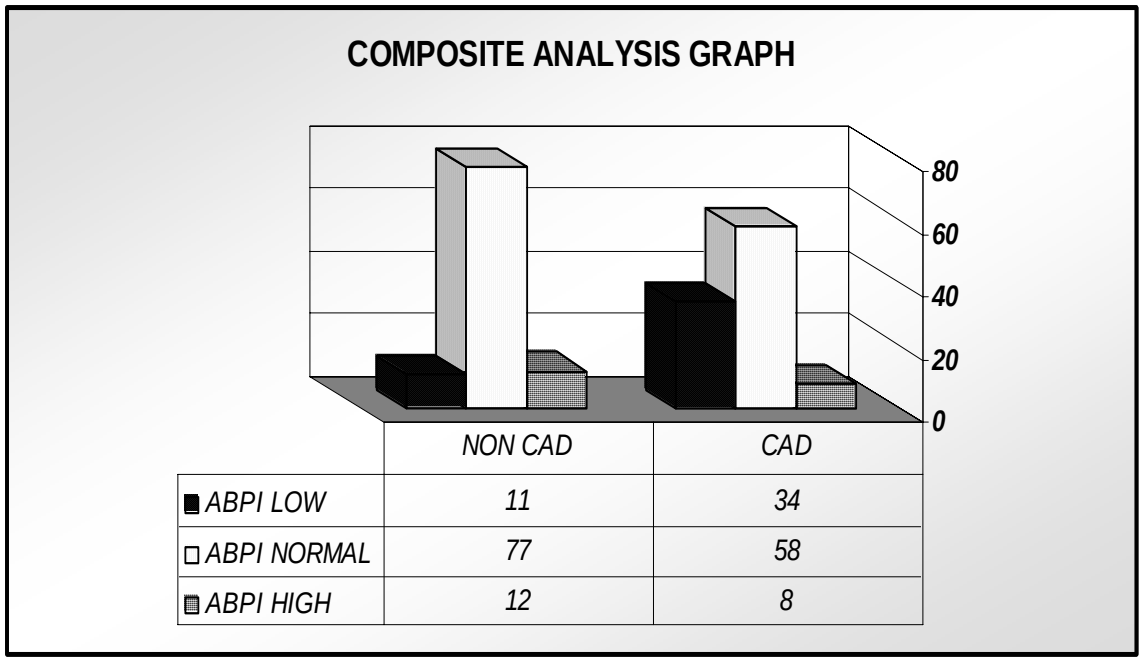


FIGURE 2 : ABPI vs. non CAD

FIGURE 3 : ABPI in CAD vs. non CAD.



	NON CAD	CAD
ABPI LOW	11	34
ABPI NORMAL	77	58
ABPI HIGH	12	8

Figure 3 shows the comparison of low ABPI in CAD vs. non CAD group. There is a significant increase of low ABPI in CAD group. It was found that, in students chi square the value was statistically significant. The correlation coefficient was 0.239 and pearsons coefficient was 0.239. This further confirms that the null hypothesis (there is significant difference between ABPI levels in CAD and nonCAD groups) is true.

EFFECT OF AGE ON ABPI

The effect of age on ABPI in both groups was studied. With higher age, more numbers were seen in the abnormal ABPI range .The trend line was plotted. It was seen that, in the coronary arterial disease patients, people with lower age had abnormal ABPI readings compared to the normal patients .

FIGURE 4 a : Age vs. ABPI (Control group)

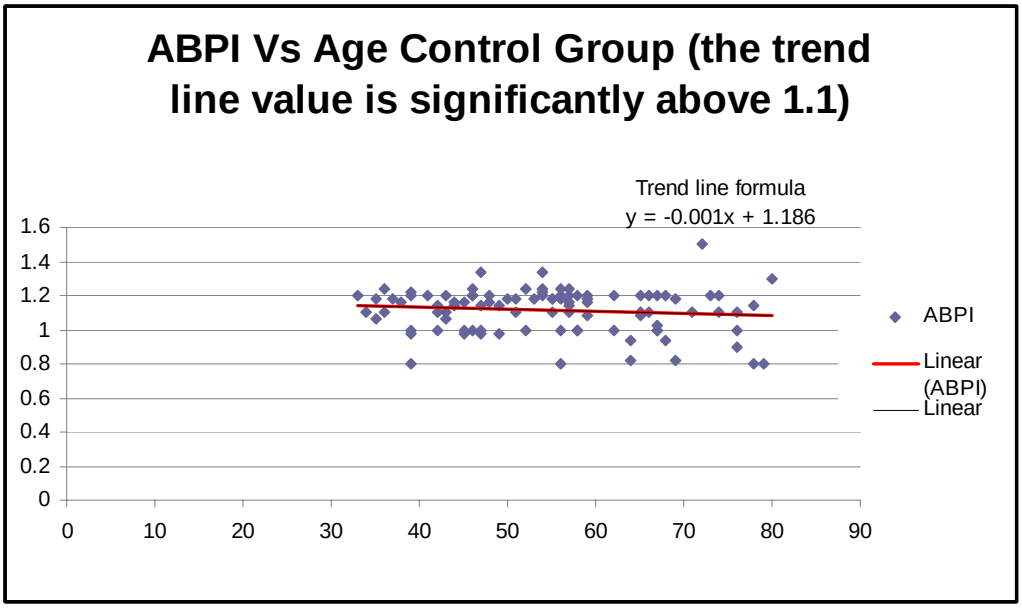
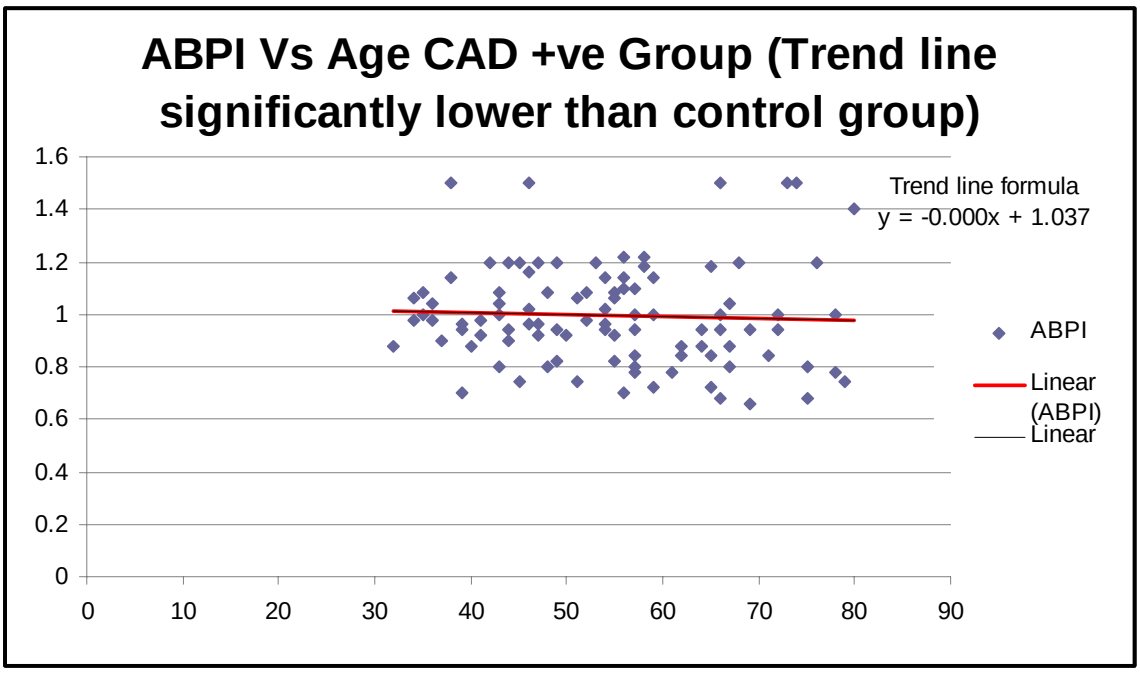


FIGURE 4 b: Age vs. ABPI (CAD Group)



ANALYSIS OF OTHER COMORBID CONDITIONS IN THE STUDY

RELATION OF HYPERTENSION WITH THE STUDY GROUPS

80 people in the CAD group had hypertension, as compared to 44 in non CAD group (Figure 5a). The prevalence of low ABPI in CAD group was increased when compared to non CAD group.33.75% in hypertensive CAD group had low ABPI as compared to 15.90% in the hypertensive non CAD group.

Lowest prevalence was in the nonhypertensive, non CAD group, where the incidence was just 7%.

The highest prevalence was noted in the hypertensive CAD group, where it formed 33.75% of the group, as seen in figure 5b.

FIGURE 5a: Hypertensive Chart in real numbers.

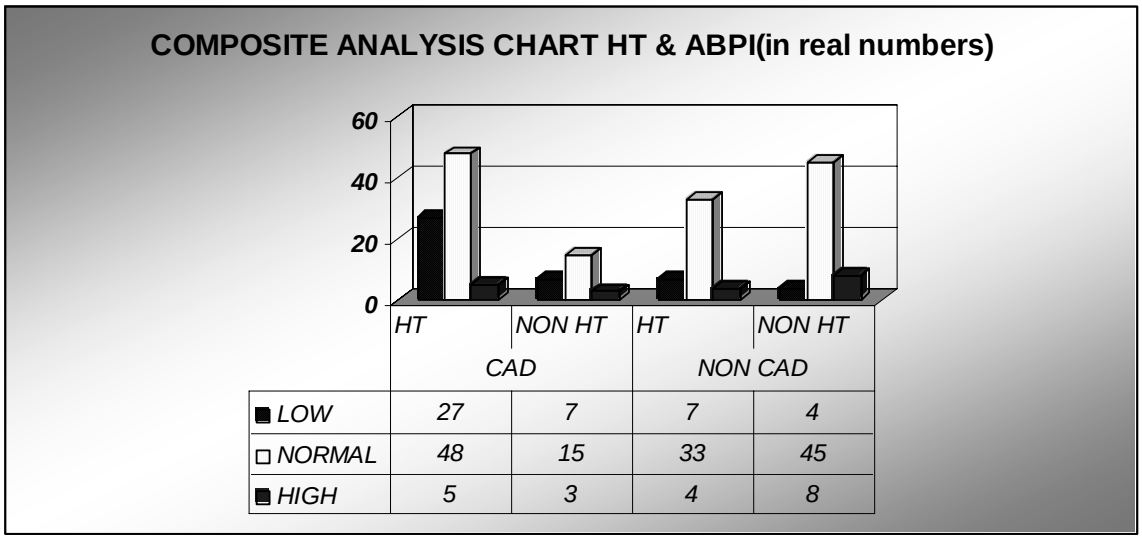
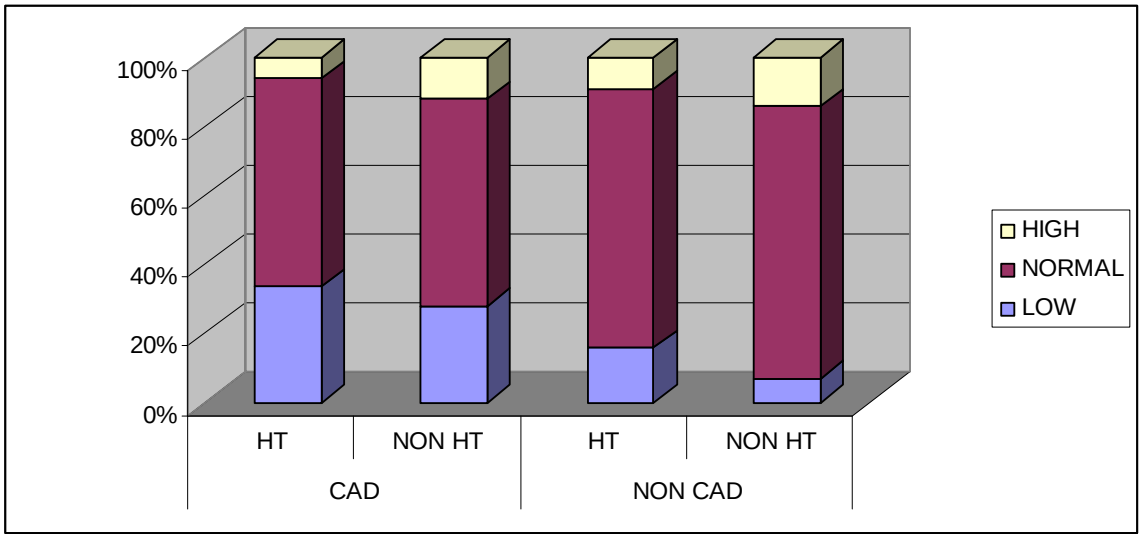


FIGURE 5b: Graph plotted in percentage prevalence of ABPI range in Hypertensives In both group



EFFECT OF DIABETES ABPI IN THE STUDY GROUP:

In the CAD group, 40% had diabetes.

In the non CAD group, 38% had diabetes.

Highest prevalence of low ABPI was found in CAD with diabetes, constituting 40%.(Figure 7) of 60(figure 6b) .Lowest prevalence of low ABPI was found in people without both diabetes or CAD, constituting 11%. (Figure 7) of 62 (figure 6a).

Figure 6a: ABPI in non-CAD as related to diabetic status

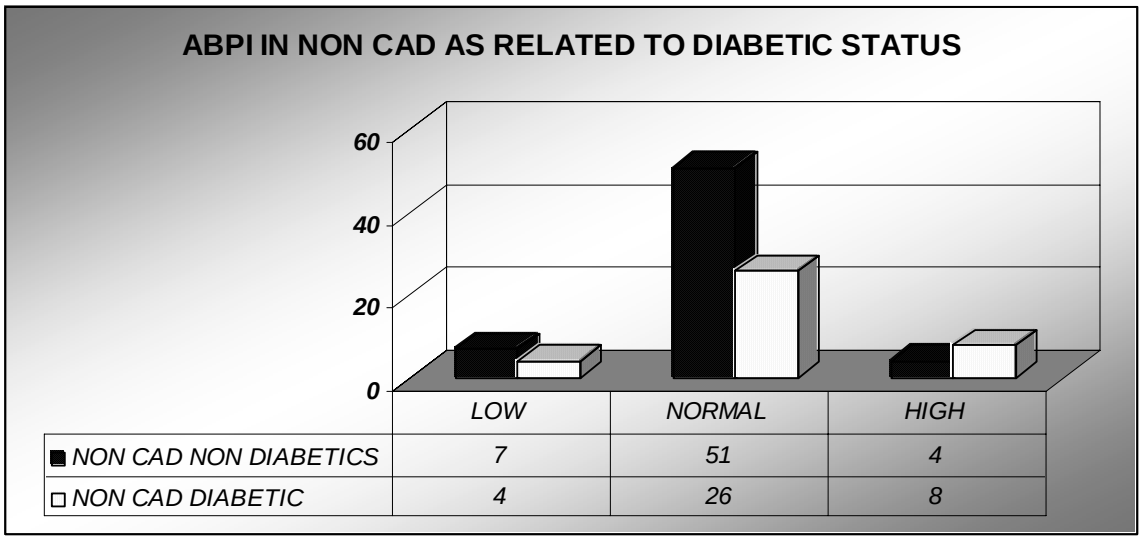


Figure 6b: ABPI in CAD patients related to diabetic status

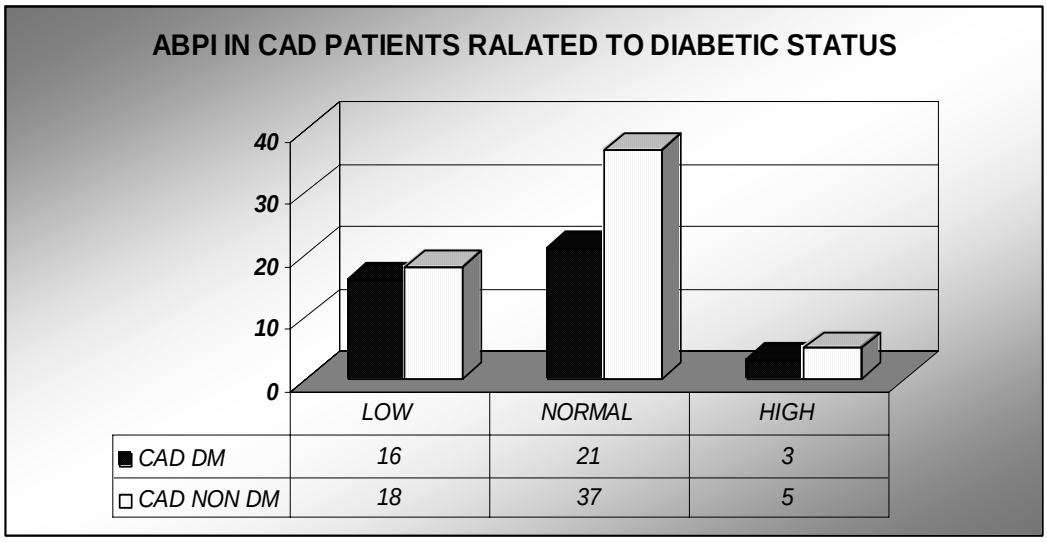
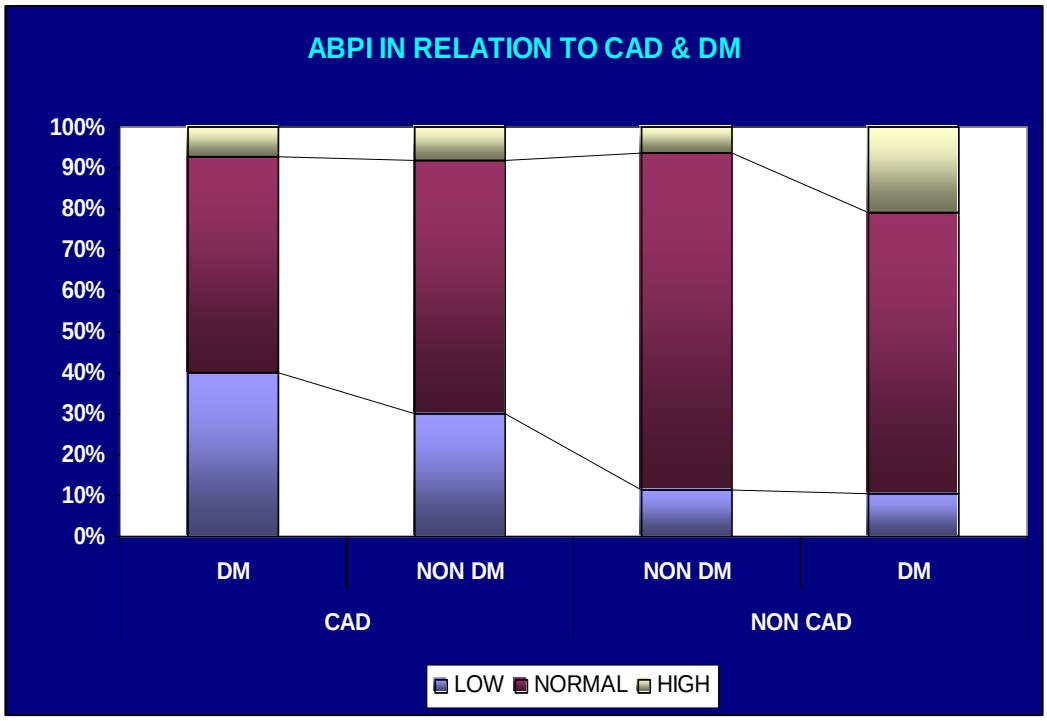


Figure7: ABPI in relation to CAD and DM in percentage.



EFFECT OF DYSLIPIDEMIA ON ABPI:

Prevalence of low ABPI in dyslipidemic individuals was in both groups was plotted.

46 of CAD group and 57 of the non CAD group had dyslipidemia.(figure 8a)

Of the dyslipidemics,33% of the CAD group and 35% of the non CAD group had low ABPI.

Only 11% had low ABPI in the people with did not have both dyslipidemia and CAD.

FIGURE 8a: ABPI in CAD related to Dyslipidemia

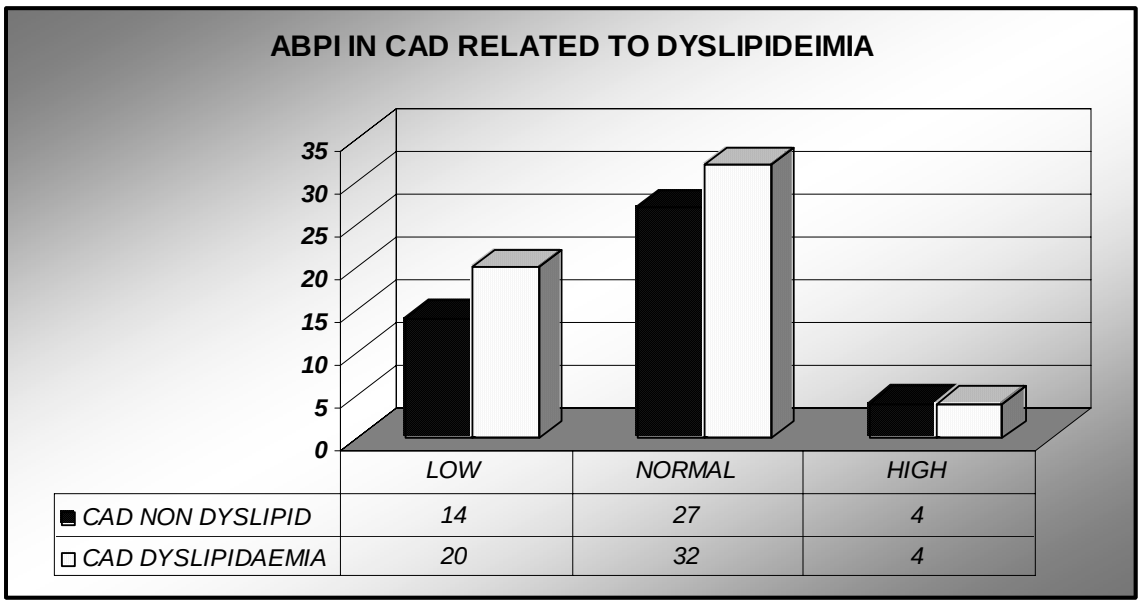
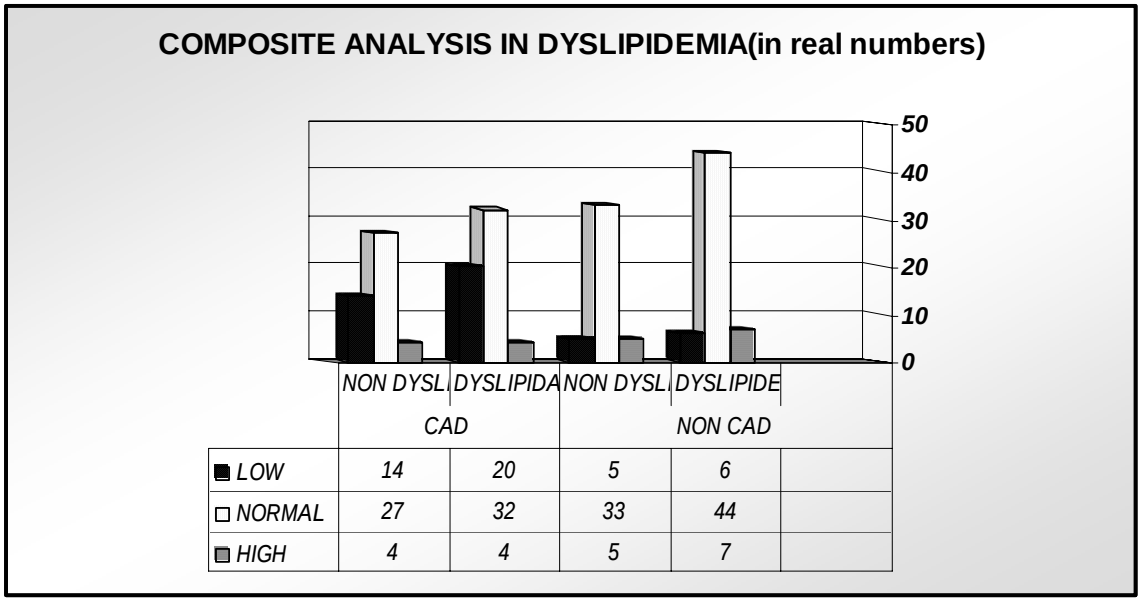


FIGURE 8b: Composite analysis in Dyslipidemia



Conclusion

CONCLUSIONS

- There is a definite increase in prevalence of low APBI in patients with coronary arterial disease in this study.
- The study can be conclude by the remark that low ABPI is an individual risk factor for CAD, due to its increased prevalence in CAD group.
- Increasing age has a lowering effect on ABPI, both in normal as well as patients with coronary arterial disease.
- Diabetes has significant impact on ABPI in patients with CAD as observed in the study .It can be concluded that a diabetic has definite risk of lowering ABPI as a isolated factor , which needs future study.
- Hypertension and Dyslipidemia were also found to increase the prevalence of low ABPI in coronary arterial disease patients. Dyslipidemia has definite role in CAD patient and low ABPI is an index which has been observed.
- I conclude, as an early observation, which is only a beginning and more to come in future as far as this study is considered.

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Annexure

ANEXURE 1 : MASTER CHART

Name	Age	Sex	ABPI	CAD	DM	Smoker	Dyslipidaemia	Hypertension
Sundari	32	F	0.88	Y	Y	N	N	N
Rosi	33	F	1.2	N	N	N	N	N
Vennila	34	F	0.98	Y	Y	N	Y	N
Manoranjitham	34	F	1.1	N	N	N	N	N
Stella	35	F	1	Y	N	N	N	Y
Sobika	35	F	1.06	N	N	N	Y	N
Kasthuri	36	F	1.04	Y	N	N	Y	N
Kavitha	36	F	1.1	N	N	N	N	N
Singari	37	F	0.9	Y	N	N	Y	Y
Banumathi	38	F	1.16	N	Y	N	N	N
Umarani	38	F	1.5	Y	Y	N	N	N
Baby	39	F	1	N	Y	N	Y	N
Jaya	39	F	0.96	Y	Y	N	N	N
Kannamal	39	F	0.98	N	N	N	N	N
Dhanabakium	41	F	0.92	Y	Y	N	N	Y
Selvi	42	F	1.14	N	Y	N	Y	N
Sangari	42	F	1.2	Y	Y	N	Y	Y
Savithri	42	F	1	N	Y	N	N	N
Jayalakshmi	43	F	1.08	Y	Y	N	N	Y
Sumathi	43	F	1.2	N	N	N	Y	Y
Karunambika	43	F	0.8	Y	Y	N	N	N
Kalaivani	44	F	1.16	N	N	N	Y	Y
Rani	44	F	0.94	Y	Y	N	Y	Y
Mahalakshmi	44	F	1.14	N	N	N	N	N
Rathinamani	44	F	1.2	Y	Y	N	N	N
Susanmary	45	F	0.98	N	N	N	Y	N
Ponnamal	45	F	0.74	Y	Y	N	Y	Y
Rathna	45	F	1	N	N	N	Y	Y
Gomathy	45	F	1.2	Y	Y	N	N	Y
Hema	46	F	1.2	N	N	N	Y	Y
Sangeetha	46	F	1.02	Y	Y	N	N	N
Kaladevi	46	F	1.24	N	N	N	N	Y
Kamalam	46	F	0.96	Y	Y	N	Y	Y
Rajakumari	47	F	1.34	N	Y	N	N	N
Sarala	49	F	0.82	Y	Y	N	N	Y
Jayanthi	50	F	1.18	N	N	N	N	Y
Saroja	50	F	0.92	Y	N	N	N	Y
Pichaimmalshanmugam	51	F	1.1	N	N	N	N	N
Indrani	51	F	1.06	Y	Y	N	Y	Y
Muthumari	51	F	1.18	N	Y	N	Y	N
Ilavarasi	52	F	1.08	Y	N	N	N	Y
Kanimoli	52	F	1.24	N	N	N	N	Y
Sowdesvari	52	F	0.98	Y	Y	N	Y	Y
Chandra	53	F	1.18	N	N	N	N	N
Bagyalakshmi	54	F	1.14	Y	Y	N	N	Y
Sarasvathy	54	F	1.22	N	Y	N	N	N
Padmini	54	F	0.94	Y	Y	N	Y	Y
Chellama	56	F	1.2	N	Y	N	Y	N

Veni	56	F	0.7	Y	Y	N	Y	Y
Parameshwari	56	F	0.8	N	N	N	Y	Y
Thangam	57	F	0.8	Y	Y	N	N	Y
Petchiathal	57	F	1.24	N	Y	N	N	N
Krishnaveni	57	F	1	Y	Y	N	Y	Y
Vimala	57	F	1.1	N	N	N	Y	Y
Maheswari	57	F	0.94	Y	N	N	Y	Y
Mary	57	F	1.14	N	N	N	Y	N
Janaki	57	F	1.1	Y	N	N	Y	Y
Kalyani	58	F	1	N	N	N	Y	Y
Valliyammal	58	F	1.22	Y	N	N	N	N
Chellakannu	59	F	1.18	N	N	N	N	Y
Rukmani	59	F	1.14	Y	Y	N	Y	Y
Papathi	59	F	1.16	N	Y	N	N	N
Marudhal	61	F	0.78	Y	Y	N	N	N
Philomina	62	F	1.2	N	Y	N	N	N
Arukkani	62	F	0.84	Y	Y	N	Y	Y
Rajammal	62	F	1	N	Y	N	Y	N
Devi	65	F	1.18	Y	N	N	Y	Y
Vadivambal	65	F	1.2	N	N	N	Y	Y
Karuppaye	65	F	0.72	Y	Y	N	Y	Y
Subbathal	65	F	1.o8	N	N	N	Y	Y
Padmavathy	66	F	1	Y	Y	N	Y	Y
Thogaimayil	67	F	1.2	N	Y	N	Y	N
Rajammal	67	F	0.88	Y	Y	N	Y	Y
Venmani	68	F	0.94	N	N	N	Y	Y
Thusimani	69	F	0.94	Y	Y	N	Y	N
Vijaya	69	F	0.82	N	N	N	Y	Y
Ponnuthai	71	F	0.84	Y	Y	N	Y	Y
Maragadham	71	F	1.1	N	N	N	Y	Y
Savithri	72	F	0.94	Y	Y	N	N	Y
Muniammal	73	F	1.2	N	N	N	Y	Y
Venkatalakshmi	74	F	1.5	Y	Y	N	Y	Y
Periyammal	74	F	1.1	N	N	N	Y	Y
Leela	75	F	0.68	Y	Y	N	Y	Y
Easwari	76	F	1	N	Y	N	N	N
Palaniammal	78	F	1	Y	Y	N	N	Y
Subbulakmi	78	F	1.14	N	Y	N	N	N
Jameela	80	F	1.4	Y	Y	N	N	Y
Thangamani	80	F	1.3	N	Y	N	Y	N
Mallamal	76	F	1.2	Y	Y	N	Y	Y
Rakkamal	76	F	0.9	N	N	N	Y	Y
Giriammal	34	F	1.06	Y	Y	N	Y	Y
Kriahnammal	35	F	1.18	N	N	N	Y	Y
Rajakumari	35	F	1.08	Y	Y	N	Y	N
Karuppammal	36	F	1.24	N	N	N	N	Y
Vanjithaayee	36	F	0.98	Y	Y	N	Y	Y
Vimala	37	F	1.18	N	N	N	N	N
Megamani	38	F	1.14	Y	N	N	N	N
Ummaiyam	39	F	1.22	N	Y	N	N	N
Kannatha	39	F	0.94	Y	Y	N	N	Y
Ramaaya	39	F	1.2	N	Y	N	Y	N
Sangareshvaran	39	M	0.7	Y	N	Y	N	N
Surendran	39	M	0.8	N	Y	Y	Y	N
Prabu	40	M	0.88	Y	N	Y	Y	Y

Mani	41	M	1.2	N	N	Y	Y	N
Marappan	41	M	0.98	Y	N	Y	N	Y
Karthikeyan	42	M	1.1	N	N	Y	Y	N
Saminathan	43	M	1	Y	N	Y	N	N
Thanigachalam	43	M	1.06	N	N	Y	N	Y
Maheshan	43	M	1.04	Y	N	Y	N	Y
Rajeswari	43	M	1.1	N	Y	N	N	N
Balasubramani	44	M	0.9	Y	N	Y	N	Y
Ganesh	45	M	1.16	N	N	Y	Y	N
Marimuthu	46	M	1.5	Y	N	Y	Y	Y
Andhoni	46	M	1	N	Y	Y	Y	N
Arumugam	47	M	0.96	Y	N	Y	Y	N
Ragavendran	47	M	0.98	N	N	Y	Y	Y
Ramkumar	47	M	0.92	Y	N	N	Y	Y
Mayilsami	47	M	1.14	N	N	Y	Y	N
Natesan	47	M	1.2	Y	N	Y	Y	N
Nallaperumal	47	M	1	N	N	Y	Y	N
Harisankar	48	M	1.08	Y	N	Y	Y	Y
Vasu	48	M	1.2	N	N	Y	N	Y
Mylsamy	48	M	0.8	Y	N	Y	N	Y
Somasundaram	48	M	1.16	N	N	Y	N	N
Kittan	49	M	0.94	Y	N	Y	Y	Y
Manikandan	49	M	1.14	N	N	Y	N	Y
Sennimalai	49	M	1.2	Y	N	N	N	N
Chinnathambi	49	M	0.98	N	N	N	N	Y
Murugaiyan	51	M	0.74	Y	N	Y	N	Y
Kumaresan	52	M	1	N	Y	N	N	N
Narayanan	53	M	1.2	Y	N	Y	Y	Y
Devaraj	54	M	1.2	N	N	Y	N	Y
Raman kutty	54	M	1.02	Y	N	Y	N	N
Balamurugan	54	M	1.24	N	Y	Y	Y	N
Sundaraj	54	M	0.96	Y	N	Y	N	Y
Sengiah	54	M	1.34	N	Y	N	N	N
Loganaathan	55	M	0.82	Y	N	Y	N	Y
Mahalingam	55	M	1.18	N	N	Y	N	Y
Manickam	55	M	0.92	Y	N	Y	Y	Y
Jabeen	55	M	1.1	N	N	Y	Y	N
Krishnasamy	55	M	1.06	Y	N	Y	Y	Y
Lurdusamy	55	M	1.18	N	N	Y	Y	Y
Angappan	55	M	1.08	Y	N	N	Y	Y
Murugesan	56	M	1.24	N	Y	Y	Y	N
Aanand	56	M	1.1	Y	N	Y	N	N
Chokalingam	56	M	1	N	N	N	Y	Y
Nagaraj	56	M	1.22	Y	N	Y	N	N
Anbumani	56	M	1.18	N	N	N	Y	N
Ammasai	56	M	1.14	Y	N	Y	N	Y
Sivaram	57	M	1.16	N	N	Y	N	Y
Bellaram	57	M	0.78	Y	N	N	Y	Y
Bagyaraj	57	M	1.2	N	Y	Y	N	N
Abdul azeed	57	M	0.84	Y	N	Y	Y	Y
Muthukrishnan	58	M	1	N	N	Y	Y	N
Venugopal	58	M	1.18	Y	N	Y	Y	Y
Yesudas	58	M	1.2	N	N	N	Y	Y
Ramasamy	59	M	0.72	Y	N	Y	Y	Y
Jabamaalai	59	M	1.o8	N	Y	Y	Y	N

Vijayan	59	M	1	Y	N	Y	Y	Y
Thirumoorthy	59	M	1.2	N	N	Y	N	Y
Alauddin	60	M	.8	Y	N	N	Y	N
Parthibandayalammal	60	M	1	N	Y	N	Y	N
Gopal	60	M	1.18	Y	N	Y	Y	N
Chinappan	60	M	0.96	N	N	N	N	Y
Rathinasamy	61	M	0.9	Y	N	Y	Y	Y
Rayappan	61	M	1.2	N	Y	Y	Y	N
Raayan	62	M	0.88	Y	N	Y	Y	Y
Chellapan	63	M	1.16	N	N	Y	Y	Y
Purnam	64	M	0.88	Y	N	Y	Y	Y
Periasamy	64	M	0.94	N	Y	Y	Y	N
Dhandapani	64	M	0.94	Y	N	Y	N	Y
Muthukaruppan	64	M	0.82	N	Y	Y	N	N
Lakshman	65	M	0.84	Y	N	Y	Y	Y
Pugalendhi	65	M	1.1	N	Y	Y	Y	N
Ramajayam	66	M	0.94	Y	N	Y	N	Y
Vellingiri	66	M	1.2	N	Y	Y	N	N
Kalisamy	66	M	1.5	Y	N	Y	Y	Y
Jeevan	66	M	1.1	N	N	Y	Y	Y
Rasaiyah	66	M	0.68	Y	N	Y	N	N
Muthu	67	M	1	N	N	Y	N	Y
Karupsamy	67	M	0.8	Y	N	Y	N	Y
Aruchami	67	M	1.02	N	Y	Y	Y	N
Nataraj	67	M	1.04	Y	N	Y	Y	Y
Anbalagan	67	M	1	N	Y	Y	N	N
Mohandas	68	M	1.2	Y	N	Y	N	Y
Gurusamy	68	M	1.2	N	N	Y	Y	Y
Sanmuganathan	69	M	0.66	Y	N	Y	N	Y
Devasigamani	69	M	1.18	N	Y	N	N	N
Perumal	72	M	1	Y	N	N	N	Y
Ayyasamy	72	M	1.5	N	N	Y	Y	Y
Sadaiyappan	73	M	1.5	Y	N	Y	Y	Y
Annamalai	74	M	1.2	N	N	Y	Y	Y
Velumani	75	M	0.8	Y	N	Y	Y	Y
Kuppusamy	76	M	1.1	N	N	Y	Y	Y
Arogyaraj	78	M	0.78	Y	N	Y	Y	Y
Nanjappan	78	M	0.8	N	N	Y	Y	Y
Desing	79	M	0.74	Y	N	Y	N	Y
Shanthakumar	79	M	0.8	N	N	N	Y	Y
Ummaiyam	46	M	1.16	Y	N	N	N	N
Rangappan	46	M	1.2	N	Y	Y	N	N

ANEXURE 2: INFORMED CONSENT FORM

DEPARTMENT OF GENERAL MEDICINE , COIMBATORE MEDICAL COLLEGE HOSPITAL.

A COMPARATIVE STUDY OF RELATION OFAAI AND CARDIOVASCULAR DISEASE

Informed consent form for prospective participants

Principal Investigator: Candidate, Junior Resident.

Research Guide: Prof. Dr M Ramaswamy.MD Chief, Medical Unit – IV.

Organization: Department of Medicine, Coimbatore Medical College Hospital.

This informed consent form has two parts

PART – I INFORMATION SHEET (to share the information about the research with you)

PART – II CERTIFICATE OF CONSENT (for signatures if you agree to take part)

(You will be given a copy of the full informed consent form.)

PART – I INFORMATION SHEET

I, Dr Candiadate, Junior resident in Dept of Medicine invite you to join as participant in my research on arterial disease, which is a very common problem in our country. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me, the study doctor or the staff.

Arterial disease is a common disease due to narrowing of arteries and thereby decreasing blood supply to organs supplied. common example is heart attack. therefore it is important to recognize it early through noninvasive methods ,so that we can prevent major catastrophic events. we are doing this research to find out a simple cost

effective way of screening for coronary arterial diseases.

Diabetes mellitus is a disease in which the person has an abnormally elevated blood sugar levels due to decreased secretion of a hormone called insulin or due to resistance to its actions. This disease affects all the organ systems in the human body. In this study you will have to answer questions regarding your illness, undergo a physical examination, give blood for tests, and undergo an ultrasound scan of abdomen

You are being selected because we are inviting all adults with cardiovascular diseases attending our cardiology clinic to enroll in the study.Your participation in this research is entirely voluntary. It is your choice whether to participate or not. Whether you choose to participate or not, all the services you receive at this clinic will continue and nothing will change. You may change your mind later and stop participating even if you agreed earlier.

You will have to give details regarding your age, duration of disease, family history of the disease, any symptoms you are having at present, your past medical problems, surgeries and current medications. A doctor will examine you to look for any problems. Your height and weight will be recorded. All the data will be recorded in a proforma. Ten ml of blood will be drawn for doing various laboratory tests to know about the status of your disease. Any excess sample will be destroyed immediately after the laboratory tests are completed. Taking the blood sample will produce some pain and there may be slight redness at the site of puncture for a day or two. . You will be subjected to ultrasound scan of your abdomen

On the first day you will be asked about your problems, a doctor will check you up. You will also have to give the blood. You will be taken blood pressure in both upper and lower limbs using an instrument called Doppler. You will be taken an electrocardiography. You will be required to undress till your waist.

In total you will have to visit twice or thrice for the research purpose. By participating in this research it is possible that you may experience some discomfort as each of your visits will take longer than your usual bi-weekly follow up visits and will involve needle pricks to give blood samples.

If you participate in this research you will be having a thorough check up, which may reveal some unidentified problems in you. We will promptly start the treatment for them. Also by participating you are providing valuable data that will help doctors understand this disease better and ultimately serve the patients in a better way.

We will not be providing any money for participating in this research; you may incur more expense since you will have to visit the hospital more frequently.

It is possible that if others in the community are aware that you are participating in this research, they may ask you questions. We will not be sharing the identity of those participating in the research with anyone. The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will not be identified by your name but by a number. Only the researchers will know what

your number is and they will lock that information up with a lock and key. It will not be shared with or given to anyone except my research guide.

The knowledge that we get from doing this research will be shared with you before it is made widely available to the public. Confidential information will not be shared. There will be small meetings in the community and these will be announced. After these meetings, we will publish the results in order that other interested people may learn from our research

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact

Dr.candidate

Junior Resident,

Dept Of Medicine,

Coimbatore Medical College Hospital

Coimbatore – 18.

Phone – xxxxxxxxx

Prof .Dr. M Ramaswamy.MD.

Chief, Medical Unit –1V,

Dept Of Medicine,

Coimbatore Medical College Hospital,

Coimbatore- 18.

Phone – 9443366133.

This proposal has been reviewed and approved by the Ethics Committee of Coimbatore Medical College Hospital which is a committee whose task it is to make sure that research participants are protected from harm.

PART – II CERTIFICATE OF CONSENT

I have been invited to participate in research on CARDIAC DISEASE. I understand that it will involve answering a detailed questionnaire, undergoing a thorough physical exam, ECG, giving blood samples and two or three follow-up visits. I have been informed that the risks are minimal and may include only slight pain and redness at sight of needle prick. I am aware that there may be no benefit to me personally and that I will not be compensated monetarily. I have been provided with the name of a researcher who can be easily contacted using the number and address I was given for that person.

I have read the foregoing information or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research and understand that I have the right to withdraw from the research at anytime without in anyway affecting my medical care.

Name of the participant: _____

Signature of the participant: _____

Date: _____

(Day/Month/Year)

<u>If illiterate</u>

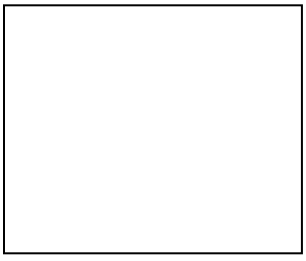
A literate witness must sign (if possible, this person should be selected by the participant and must have no connection to the research team)I have witnessed the accurate reading of the consent form to the potential participant, translated to his mother tongue, and the individual has had opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness: _____ AND Thumb print of participant

Signature of witness: _____

Date: _____

(Day/Month/Year)



I have accurately read or witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of the researcher: _____

Signature of the researcher: _____

Date: _____

(Day/Month/Year)

ANEXURE 3: ABBREVIATION

ABPI: Ankle brachial pressure index

CAD: Coronary arterial disease.

IVUS: Intravascular ultrasonography

PAD: peripheral arterial/vascular disease.

LDL: Low density cholesterol

HDL: High density cholesterol