

MYOCARDIAL INFARCTION, ASSOCIATED RISKS AND POSSIBLE PREVENTIVE MEASURES

ABSTRACT

Ischemic heart disease is a deficiency in the blood supply to the heart muscle which can be caused by an obstruction to, or even a narrowing of the coronary arteries. Myocardial infarction (Heart attack) associated with certain types of risk factors. The aim of this study was to evaluate the risk factors of myocardial infarction (Heart attack) in heart patients, such as age, high cholesterol, hypertension, male gender, diabetes, family history and smoking status. These risk factors are important indicator of myocardial infarction. The present descriptive study undertaken at Akram Hospital, Quetta, Balochistan, Pakistan was aimed to determine the risk factors in MI patients. There were total 50 patients with myocardial infarction (35 males, 15 females). Patients were showing typical classical risk factors. The MI patients were diagnosed by ECG (electrocardiogram) method, specific blood test (troponin) and chest x-ray method. A significantly increased risk of myocardial infarction was associated with these classical risk factors. The study shows patients of MI have usually these factors. Risk of MI continuously increased if the following factors are not controlled. Relatively close association of myocardial infarction was observed with studied risk factors.

KEYWORDS Ischemia, Myocardial infarction, Atherosclerosis, Hypercholesterolemia, Hypotension

INTRODUCTION

Pathophysiology of a Myocardial Infarction

Ischemia is a term which is used to describe the deficiency in blood supply to any part of the body. In ischemic heart disease there is a deficiency in the blood supply to the heart muscle which can be caused by an obstruction to, or even a narrowing of the coronary arteries. This in turn reduces the supply of nutrients and oxygen to the heart muscle. Without an optimum oxygen supply the heart muscle is unable to function efficiently Boersma et al., (2003).

The narrowing and hardening of arteries is caused by degenerative changes and also the build up of cholesterol and other fatty deposits which occur in the vessel wall. Plaques which then develop and subsequently become fibrotic' (the formation of an abnormal amount of fibrous tissue in an organ or part as the result of inflammation, irritation, or healing) is through a process known as atherosclerosis. The atherosclerotic plaque slowly builds up in the inner lining of a coronary artery. The presence of the plaques causes the linings of the artery walls to become roughened and this in turn reduces the size of the lumen and eventually closed it. As circulation slows down there is a strong possibility of thrombus formation. Should a coronary artery become totally blocked oxygen to the area of muscle concerned will then become cut off and the subsequent damage to the tissue concerned is known as a myocardial infarction.

In a partial occlusion by a thrombus a vasospasm (a sudden constriction of a blood vessel, causing a reduction in blood flow) may occur which can lead to total obstruction

An embolus may form due to part of the thrombus breaking away which then flows through the coronary artery where it will eventually lodge itself in one of the smaller branches eventually blocking that vessel. Restriction in blood supply and a shortage of oxygen can cause damage and/or death of heart muscle tissue. Some infarctions are subendocardial (beneath the endocardium) which affects only the inner third to one half of the heart muscle. Most infarctions however are transmural which means that all three layers of the heart are involved and it usually occurs in the left ventricle, Saleh et al., (2006).

In left-sided congestive heart failure the left ventricle weakens and cannot empty which results in decreased cardiac output to the system which in turn leads to pressure elevation in the left atrium and pulmonary vessels and capillaries, the ensuing decreased renal blood flow stimulates rennin-angiotensin and aldosterone secretion the resulting high pressure in the pulmonary capillaries leads to the exudation of fluid into the pulmonary interstitial tissue and alveoli which causes pulmonary congestion or edema. In right-sided congestive heart failure the right ventricle weakens and cannot empty which also results in decreased cardiac output and the secretion of rennin-angiotensin and aldosterone however, this leads to a backup of blood into the systemic circulation via the venae cavae. The increased venous pressure results in edema in the legs, liver and abdominal organs, Tsai, (2005). Risk factors for atherosclerosis are generally risk factors for myocardial infarction

The factors are diabetes (with or without insulin resistance) the single most important risk factor for ischaemic heart disease (IHD), tobacco smoking, hypercholesterolemia (more accurately hyperlipoproteinemia, especially high low density lipoprotein and low high density lipoprotein), high blood pressure, family history of ischaemic heart disease (IHD), obesity (defined by a body mass index of more than 30 kg/m², or alternatively by waist circumference or waist-hip ratio), age: Men acquire an independent risk factor at age 45, Women acquire an independent risk factor at age 55; in addition individuals acquire another independent risk factor if they have a first-degree male relative (brother, father) who suffered a coronary vascular event at or before age 55. Another independent risk factor is acquired if one has a first-degree female relative (mother, sister) who suffered a coronary vascular event at age 65 or younger. Alcohol Studies show that prolonged exposure to high quantities of alcohol can increase the risk of heart attack Males are more at risk than females, Wilson PW et al., (1998).

The onset of symptoms in myocardial infarction (MI) is usually gradual, over several minutes, and rarely instantaneous. Chest pain is the most common symptom of acute myocardial infarction and is often described as a sensation of tightness, pressure, or squeezing. Chest pain due to ischemia (a lack of blood and hence oxygen supply) of the heart muscle is termed angina pectoris. Pain radiates most often to the left arm, but may also radiate to the lower jaw, neck, right arm, back, and epigastrium, where it may mimic heartburn. Levine's sign, in which the patient localizes the chest pain by clenching their fist over the sternum, has classically been thought to be predictive of cardiac chest pain, although a prospective observational study showed that it had a poor positive predictive value. Marcus GM, et al., (2007).

The general appearance of someone suffering from a myocardial infarction may vary according to the symptoms he/she is experiencing. The patient may be comfortable to restless and in severe distress with an increased respiratory rate. Their skin may be pale and cool to touch and this may indicate vasoconstriction. Some patients may also experience a low grade fever and blood pressure may be either elevated or decreased and their pulse irregular, Tsai, (2005).

The WHO criteria were refined in 2000 to give more prominence to cardiac biomarkers. According to the new guidelines, a cardiac troponin rise accompanied by either typical symptoms, pathological Q waves, ST elevation or depression or coronary intervention are diagnostic of MI. Alpert JS et al., (2000)

The first line in the treatment on site of a myocardial infarction is usually oxygen, aspirin, glycerol trinitrate and an analgesia such as morphine, which is classically the favoured pain relief drug of choice due to its ability to dilate blood vessels which will aid in blood flow to the heart, however it is important to note that morphine can also cause hypotension (abnormally low blood pressure). The functions of myocardial contractility are quickly lost due to the depletion of oxygen supply however should blood supply be restored within the first (20) minutes it may be possible to prevent irreversible damage. Inflammation can begin to subside after a period of 48 hours and heart functioning can resume if blood supply to the outer area of inflammation has been maintained. Therefore if treatment has not been given quickly or effectively the area of infarction may increase. Due to the fact that myocardial fibres do not regenerate fibrous tissue replaces tissue in the area of necrosis this process may take up to at least 6 to 8 weeks to form scar tissue depending on

the size of the lesion. The necessity of a rapid response is perhaps the reason that now in many areas GP' (physician whose practice consists of providing ongoing care covering a variety of medical problems in patients of all ages, often including referral to appropriate specialists) and paramedics are now trained to administer these prior to transporting the client to hospital, Boersma et al., (2003).

The body's fight or flight response to anxiety occurs in the neurotransmitters in the brain. The structures involved are the cerebral cortex, the Limbic System which includes the hypothalamus, hippocampus, amygdale and cingulum, the thalamus, locus ceruleus and raphe nucleus. The neurotransmitters are serotonin, noradrenalin and gamma amino butyric acid. The body's reaction during anxiety is a physiological response to a stressor which is mediated through the hypothalamus and locus cereleus. This stimulates the initial activation of the sympathetic nervous system. This in turn triggers the subsequent activation of the pituitary adrenal axis. When someone is in an unstimulated state, the actions of the neurons in the locus ceruleus are minimal. Once a novel stimulus is perceived, it is relayed from the sensory cortex of the brain through the thalamus to the brain stem. This increases the rate of noradrenergic activity within the locus ceruleus, and the person becomes alert. If the body perceives a threat, there is a more prolonged and intense discharge of the locus cereleus activates the sympathetic division of the autonomic nervous system. Norepinephron is released due to the activation of the sympathetic nervous system. The physiological changes which follow constitute a major part of the acute stress response, such as increased heart and respiratory rate, sweating and shunting of blood to muscles. The hypothalamic-pituitary-adrenal axis plays a very important part in the acute stress response. The hypothalamic-pituitary-adrenal axis (HPA) and the autonomic nervous system are activated in response to stressful stimuli, Young et al., (2004).

A cortisone releasing hormone (CRH) and an adrenocorticotrophic hormone (ACTH) are then secreted in response to stress. The ACTH then stimulates the adrenal cortex to secrete a group of hormones called glucocorticoids, and the main hormone in this group is cortisol. These hormones promote the breakdown of glycogen to glucose in the liver, which in turn promotes more glucose uptake into the cells. The major functions of glucocorticoids within the HPA axis are 2-fold: (i) to alter metabolic processes in a manner that provides the energy needed to combat the stressful stimuli, and (ii) to recover homeostasis. In general, the glucocorticoids help the body resist and overcome stress, Frazier, (2002).

Prior to care being planned, it is important in the assessment of the client to establish his/her reaction to their illness and involve him/her in the goals in order to reduce the individual's anxiety but to also accept the restrictions in their lives that may now ensue with regards to their illness. Huffman, (2006)

MATERIALS & METHODS

Descriptive study spanning over six months from August 2011 to February 2012 was conducted in the cardiology ward in Akram hospital Quetta. The study population includes 50 patients consisting of 35 males and 15 females having Heart attacks (myocardial infarctions). The majority of patients belonged to middle socioeconomic group. A questionnaire based study which determines the risk factors and causes due to heart attack ratio increases among peoples. Different questions about the type of heart disease, causes of heart attack like age, gender, family history, cholesterol range, diabetes range and hypertension range were included. There are also the questions about heart attack diagnosis and treatment. The diagnosis of myocardial infraction was based on finding of characteristic electrocardiograph changes, cardiac enzyme elevation, chest x-ray and angiography. Patients with diabetes, renal disease, and other chronic diseases were included.

Diagnostic Procedures

Electrocardiogram (ECG, EKG)

The electrocardiogram (ECG or EKG) is a noninvasive test that is used to reflect underlying heart conditions by measuring the electrical activity of the heart. By positioning leads (electrical sensing devices) on the body in standardized locations, information about many heart conditions can be learned by looking for characteristic patterns on the EKG.

ECG diagnosis two types of heart attack:

- STEMI - the ST Elevation Myocardial Infarction
- NSTEMI - the Non-ST Elevation Myocardial Infarction

STEMI

STEMI is an acronym meaning "ST segment elevation myocardial infarction," which is a type of heart attack. This is determined by an electrocardiogram (ECG) test. Myocardial infarctions (heart attacks) occur when a coronary artery suddenly becomes at least partially blocked by a blood clot, causing at least some of the heart muscle being supplied by that artery to become infarcted (that is, to die). Heart attacks are divided into two types, according to their severity. A STEMI is the more severe type. It is usually recognized by characteristic changes it produces on the ECG. One of those ECG changes is a characteristic elevation in what is called the "ST segment." The elevated ST segment indicates that a relatively large amount of heart muscle damage is occurring (because the coronary artery is totally occluded), and is what gives this type of heart attack its name.

NSTEMI

NSTEMI is an acronym meaning "non-ST segment elevation myocardial infarction," which is a type of heart attack. This is determined by an electrocardiogram (ECG) test. A NSTEMI is the less severe type. In a NSTEMI, the blood clot only partly occludes the artery, and as a result only a portion of the heart muscle being supplied by the affected artery dies. The NSTEMI does not produce characteristic elevation in the "ST segment" portion of the ECG. This means that in a NSTEMI, the artery is only partially blocked. A common problem when a patient has an acute coronary syndrome without ST segment elevation is deciding whether an actual heart attack is occurring or instead whether the patient is simply having unstable angina. Measuring cardiac enzymes, which reflect heart muscle damage, is an important tool in making this distinction.

Cardiac enzymes tests

In the case when ECG does not give the accurate result that whether it is acute myocardial infarction or unstable angina cardiac enzymes test is an important tool to measure the level of these enzymes in the blood. These are the creatine phosphokinase (CPK, CK) and the protein troponin (TnI, TnT) in the blood. Low levels of these enzymes and proteins are normally found in our blood, but if person heart muscle is injured, such as from a heart attack, the enzymes and proteins leak out of damaged heart muscle cells, and their levels in the bloodstream rise.

Because some of these enzymes and proteins are also found in other body tissues, their levels in the blood may rise when those other tissues are damaged. Cardiac enzyme studies must always be compared with patient symptoms, patient physical examination findings and electrocardiogram (EKG, ECG) results.

Cardiac enzyme studies are done to determine whether the patient having a heart attack or a threatened heart attack (unstable angina) if patient has chest pain, shortness of breath, nausea, sweating, and abnormal electrocardiography result.

Rapid cardiac marker test device

Rapid Cardiac marker test is a sandwich immunoassay. When serum sample is added to sample pad, it moves through the conjugate pad and mobilizes gold antibody conjugate that is coated on the conjugate pad. The mixture moves along the membrane by capillary action and reacts with anti-cardiac marker antibodies that are coated on the test region. If cardiac markers are present at levels of cut-off level or greater, the result is the formation of a colored band in the test region. If there are no cardiac markers in the sample, the area will remain colorless. The sample continues to move to the control area and forms a pink to purple color, indicating the test is working and the result is valid.

Interpretation of results

Positive

If two colored bands are visible on any strip of the device within 15 minutes, the test result is positive and valid. The test result can be read as soon as a distinct colored band appears in the test area. Specimens containing very low levels of cardiac markers may develop two color bands over 15 minutes.

Negative

Test area has no color band and the control area displays a colored band, the result is negative and valid.

Invalid result

If a colored band does not form in the control region of any strip, the test result is invalid. The sample must be re-tested, using a new test device.

Chest x – ray (Chest Radiography)

This is another diagnostic method to diagnose heart problems and symptoms such as shortness of breath, a bad or persistent cough, chest pain or injury, fever.

RESULTS AND DISCUSSION

Worldwide, ischemic heart disease is assuming an increasing role as a major cause of morbidity and mortality. Coronary heart disease includes myocardial infarction and angina pectoris. This research study is about myocardial infarction and its major and minor risk factors which are discussing over here. Male gender and family history are the factors which are genetically determined. There are other risk factors like high blood cholesterol, high blood pressure, use of tobacco, obesity, age and diabetes mellitus, these factors can be modified through changes in life style and medications.

In this study it was found that at all ages men are more likely to develop atherosclerosis and coronary heart disease. There were 70% male and 30% female MI patients. Studies suggest that this difference is due to the higher blood levels of HDL in women than in men but it has been noticed that as the women get older the chances of occurring heart attack increase specially in post menopausal women.

Family history is also a very important risk factor. Heart diseases can be passed down the family tree. People whose siblings have a history of heart disease carry a much greater likelihood of developing heart disease themselves than if only their parents had the condition. The risk is greater if person's parents or siblings began having heart problems at a younger age. In this study there were 50% males and 20% females having the family history.

There is a direct relationship between aging and heart attack occurrence. As the age increase the risk of heart attack also increase. In current study it was found that risk of heart patient's increase as the age increase. There were 57% of males and 60% of females are located on highest range (55-65).

Heart attacks also occurred due to high cholesterol in blood because cholesterol is the major component of the plaques deposited in arterial walls. . Comparatively males having high cholesterol than female usually >290 mg/dL and in the following study male MI patients have higher percentage at >290 mg/dL range. 42% males and 26% females present at this range.

High blood pressure is a risk factor for developing atherosclerosis and heart attack. In this study 57% of males and 53% of females were present at 145- 90 rang which is consider as high blood pressure range.

Tobacco and tobacco smoke contain chemicals that cause damage to blood vessel walls, and increase the risk of heart attack. In the following study 80% affected male MI patients were smokers 20% MI patients were non smokers.

Both insulin dependent and non-insulin dependent diabetes (type 1 and 2, respectively) are associated with accelerated atherosclerosis throughout the body. In short this study high light that myocardial infarction is associated with these types of risk factors. Doctor usually recommends patients to adopt healthy life style specially those patients which have family history of heart problem and if patient is male. And those patients, who suffer from heart attack doctors usually recommend to avoid high fat, stop smoking and take a regular exercise to minimize the risk of myocardial infarction.

CONCLUSION

There is a direct relation ship between risk factor and myocardial infarction and factors can be varying from person to person, but these factors have a great impact on both males and females. Males are more likely to develop a heart problem than females while age increase the risk of heart attack. The study suggests that heart problem can be minimized by changing life style.

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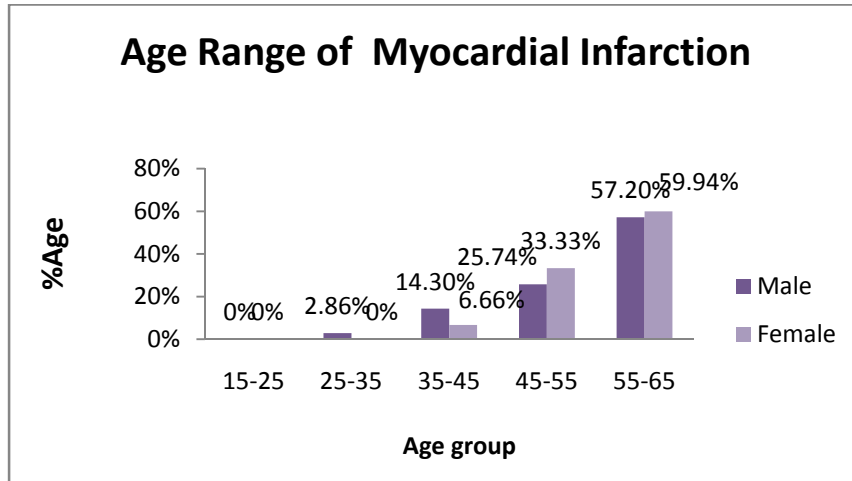


Fig 1: Risk of Myocardial Infarction in Relation to Age

Fig 1: represent the percentages of MI patients with respect to age. The following Fig 2: shows that at the range of 55-65 there are highest % of both males and females MI patients. By age 57% of males and 59% of females are present at this range. The lowest percentages of both males and females MI patients are located at 15-25 range. It has been suggested that as age increase the risk of occurring MI also increase.

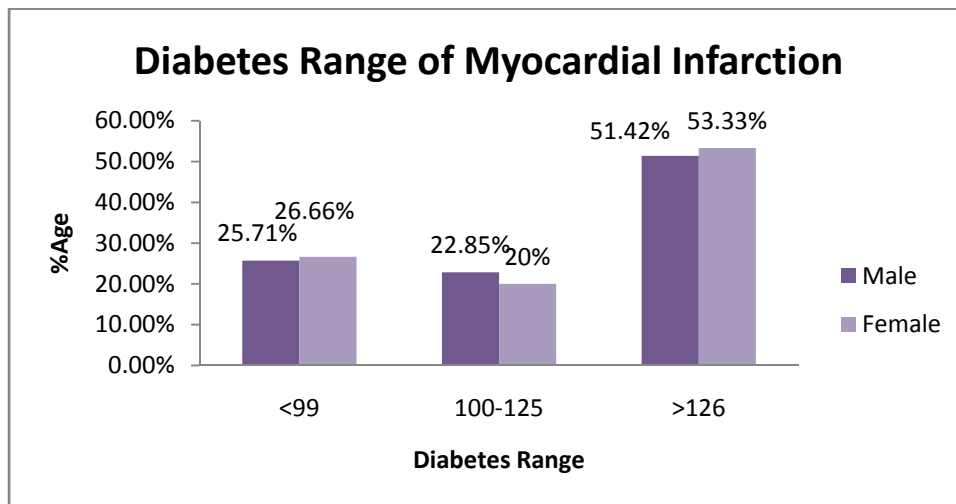


Figure 2: Risk of Myocardial Infarction in Relation to Diabetes

Fig 2: illustrate that 51% of males MI patients have the diabetes. And 53% of the female MI patients have diabetes. The range >126mg/dL at which these MI patients are present consider as established diabetes range. The 100-125mg/dL range considers early diabetes range. 22% of male MI patients and 20% of the female MI patients are present on this range.

Represent the remaining 25% male MI patients and 26% female MI patients have no diabetes and they are present at <99mg/dL range.

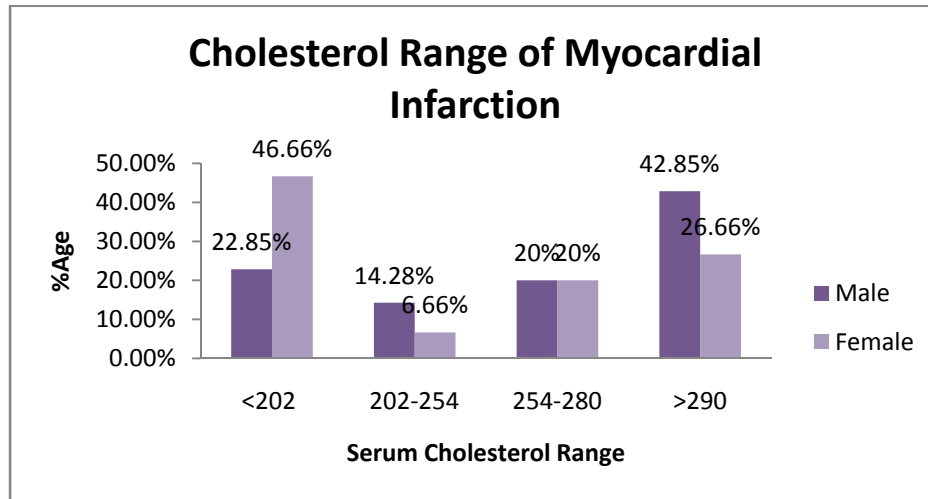


Fig 3: Risk of Myocardial Infarction in Relation to Total Serum Cholesterol Level in mg/dL

Fig 3: indicates the relative percentages of male and female MI patients at different cholesterol range. The following figure shows that male MI patients have higher percentage at >290 mg/dL range. 42% males and 26% females present at this range. Comparatively females have low cholesterol level than males. <202 mg/dL range consider as normal cholesterol range. There were 46 females MI patients present and only 22% males MI patients present which indicates that females usually have lower cholesterol level than males. The other three ranges consider as high cholesterol level ranges and both males and females MI patients were present on this range respectively.

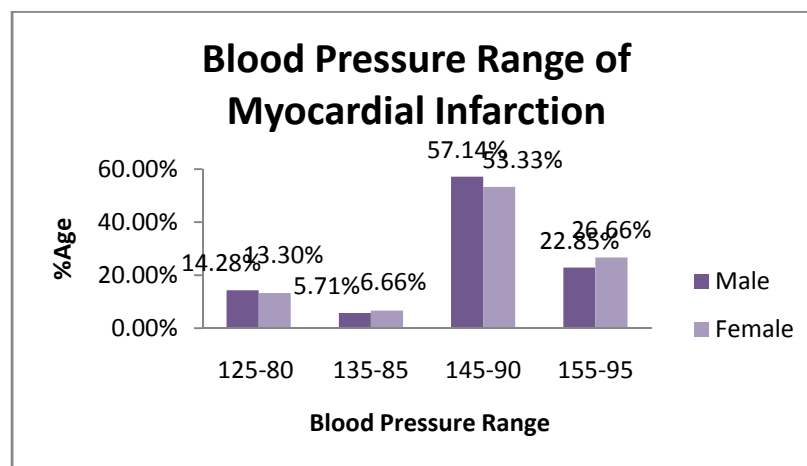


Figure 4: Myocardial Infarction in Relation to High Blood Pressure

Fig 4: represent the percentages of male and female MI patients in respect to high blood pressure. The following graph shows that MI patients usually have high blood pressure. The three ranges from 135-85 to 155-90 consider as high blood ranges. The 125-80 blood pressure range is considered as normal range.

The highest percentage of both male and female MI patients is located at 145-90.

At this range 57% of males and 53% of females are present. 14% of males and 13% of females MI patients are present on 125-80 range.

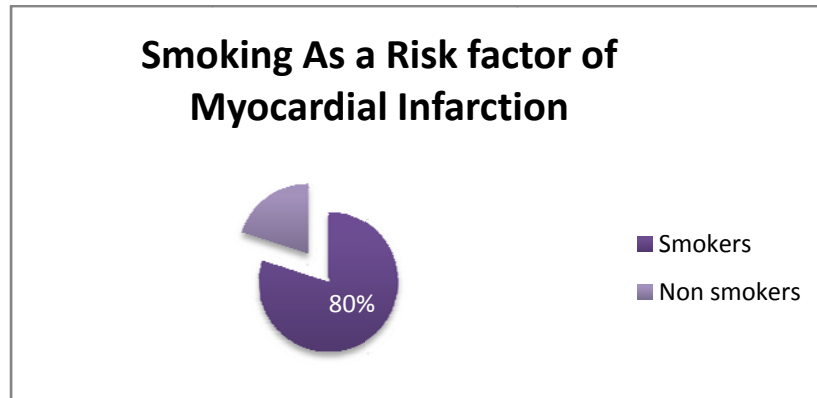


Figure 5: Risk of Myocardial Infarction in Relation to Smoking

Fig 5: illustrate that 80% affected male MI patients were smokers. 20% MI patients were non smokers. The graph shows that smoking habit can increase the risk of myocardial infarction.

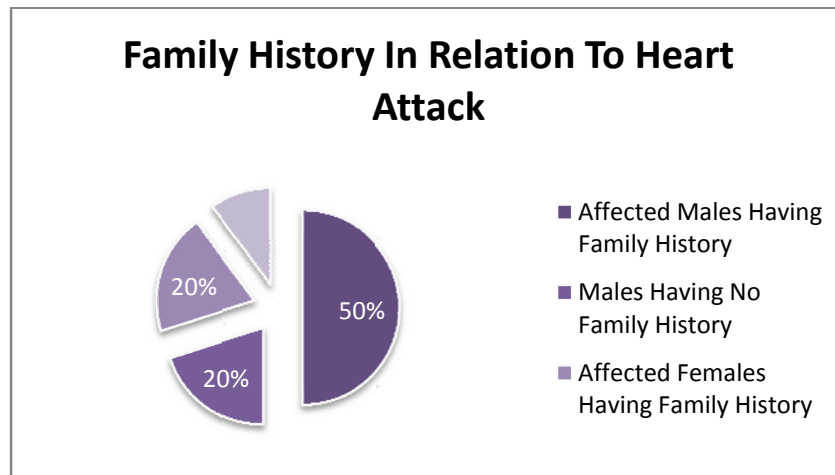


Figure 6: Risk of Myocardial Infarction in Relation to family history

Fig 6: shows that 50% male MI patients have family history and remaining 20% have not. There are 20% female MI patients which have family history and 10% have not.

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