Heart Disease Prediction, Analysis And Monitoring Models :- A Review

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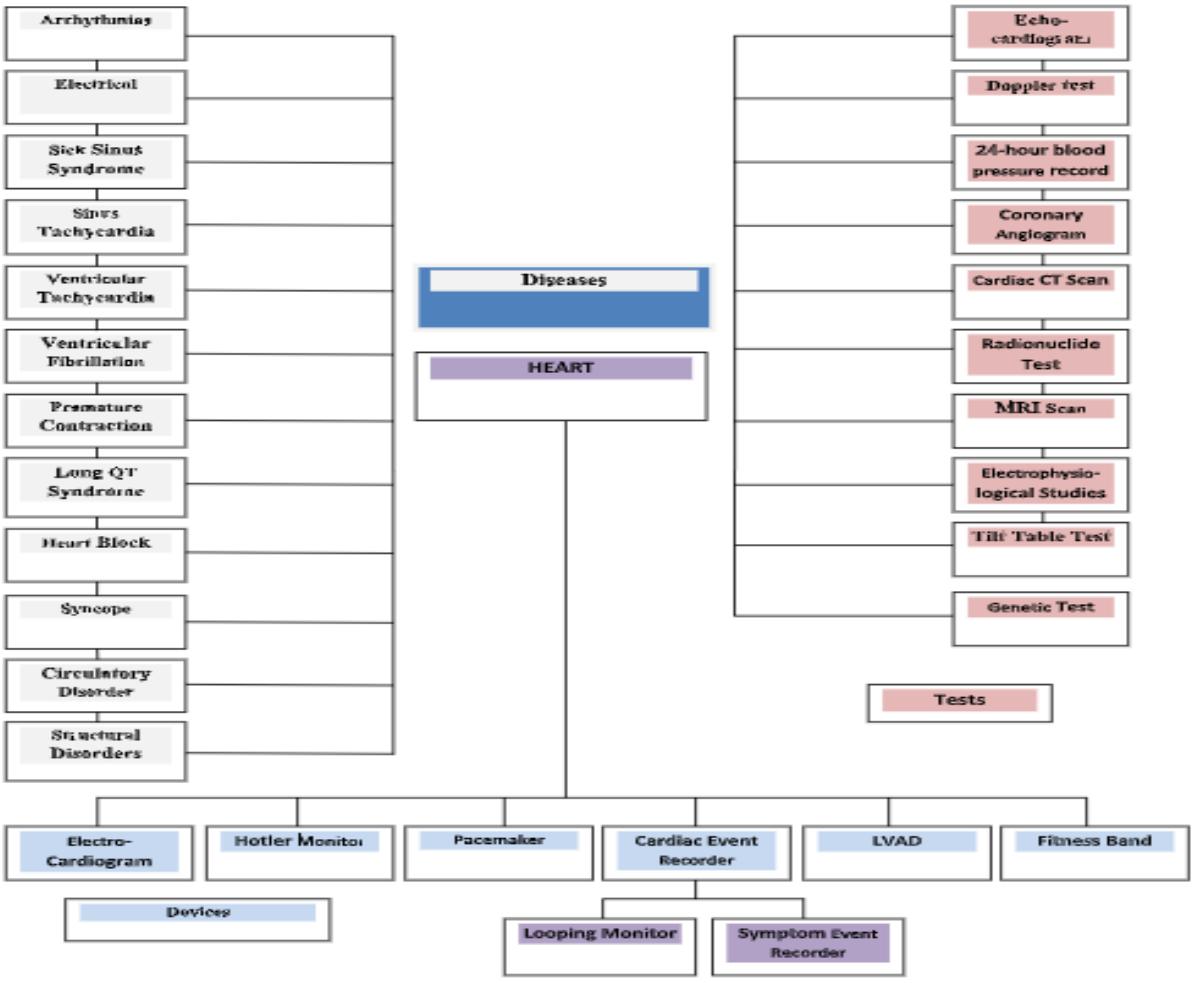
Abstract- Heart disease is the major cause of death worldwide. According to WHO millionsof people died because of this every year. We have take serious steps regarding this.Find out the root cause and have the complete knowledge of this disease. As we know we are surrounded by technology .There are so much advancement in the technology with the help of this we can ehance the knowledge regarding this dangerous disease and save the life of many people .Heart attack and other disease related to heart can be classified into various category .With the help of this we can perform related test and take the observation and give the better treatment

Keywords- Disease, categories, test, devices

I. INTRODUCTION

Today coronary artery diseases are very much prevalent. It is the main reason for death all over the world. As we know with the time passing the population of world increases gradually, with this the various health issue also emerges. According to the survey a global report given by world health org.2015 "17.3 million died because of heart disease and it will rise to more than 23.6 million in 2030 estimated." In every 40 second one human dies due to the heart disease. Most of the time due to poor observations and wrong decisions affects the patient health. This is a serious issue to be considered, and to tackle the disease we must have complete understanding about the disease symptoms, tests related and device used [1],[2],[3].



II. HISTORY

According to Aristotle the Greek philosopher the most vital organ of the body is heart. He described it as the three chambered organ that was the centre of vitality in the body. He also observed that it is not easily injured and has hard flesh. It is very complex and performs various functions[4] Leonardo Da Vinci (1452-1519) examine thecoronary arteries. King Charles 1physician William Harvey (1578-1657) observed the function of right ventricle. Friedrich Hoffmann (1660-1742) found this problem of heart begun in the "reduced passage of blood within the coronary arteries". William Osler later found out that it was a syndrome rather than disease. First heart attack was found by an English physician John Hunter in 18th century and the story behind it, he was observing his own symptoms of aggravations he said, his life is "in the hands of any rascal who chose to annoy or tease him" later he died while arguing. The 1900s was a phase of understanding heart diseases.In 1912, James B. Herrick (1861–1954) accomplished thatA cause of angina ismay be the slow and gradual narrowing of the coronary arteries. He was credited with inventing the term "**heart attack**." Association for the prevention and relief of heart disease was formed, In 1915 later it was called American Heart Association.[6].

III. LITERATURE SURVEY

Since 1960 there has been a massive discovery in the field of biomedical particularly in the field of coronary, In Veterans Administration Hospital in Buffalo, New YorkDrs. William Chardack along with Andrew Gage performed the first successful totally implantable pacemaker . Wilson Greatbatch, an electrical engineer invented the pacemaker. Dr. Albert Starr along with Engineer Lowell Edwards developed the prosthetic heart valve, the first mitral prosthesis were model 6000 series, It was in the march of 1965 the model 6210 was created that successfully adopted and was unchanged for more than 20 years [12]. In 1961, Dr. William Kowenhoven , Jame Jude and Gury Knick Erbocker after having cardiac arrest discover CPR to provide blood flow.1966, Dr.William Rashkind new technique for the new born to correct septal defects,1966, Dr.William Flliott found new option called isoproterenoi improves the quantity of blood pumped. In 1967 it was found that physical inactivity and obesity is also a cause of heart disease. In 1968, A drug is found to lower the cholesterol in blood. In 1969 Argentine cardiac surgeon Domingo Liotta and American cardiac surgeon Denton Cooley perform the first clinical implantation of a total artificial heart (TAH). In 1970 Atrial fibrillation is found to increase heart stroke risk. In 1975 Menopause is found to increase the risk of heart disease. In 1977 German radiologist Andreas Gruentzig first develops coronary angioplasty for treatment of coronary artery disease.In 1986 French physician Jacques Puel and German cardiologist Ulrich Sigwart are the one who use the coronary stent.

In 1987 according to Survey done by Cooperative North Scandinavian Enalapril Survival Study (CONSENSUS), shows unequivocal survival benefit of angiotensin converting enzyme inhibitors in severe heart failure. In 1988 Hemopump, a temporary left ventricular assist blood pump isused as a clinical use. It is designed for support as a temporary device in heart faluire. In 1988 By Dr. William F. Bernhard. the first successful long-term implantation of an artificial Ventricular assist device LVAD is conducted. In 1990, Dr. John Clements invented the drugs to treat infants with heart and lungs. In 1994 Enlarged left ventricle (one of two lower chambers of the heart) is shown to increase the risk of stroke. In 1997 the Thoratec Ventricular Assist Device (VAD) is used for clinical use to support patients who having acute and chronic heart failure. In 2001 It was found the High Normal Blood pressure increased risk of cardiovascular disease.

IV. HEART DISEASES AND DISORDER

In 20 century it was myocardial infection which caused death. To prevent from this deadly disease we must have complete knowledge about the heart diseases. Before knowing about the heart disease and disorder, we shall know the difference between disease and disorder. Disorder is a complication which interrupts the regular activity and structure and function of the body. Disease is a response by the body due to external or internal factors [7].

Table1. Disease Categories [8]

Name	**Symptoms**
Arrhythmias	Irregular heartbeats
Electrical	Electrical system which regulates steady heartbeat. Heart rate is either elevated or slow or becomes Irregular and disorganized.
AF or AFib	300/m times(heart beats)
A trial flutter	300/m very fast and steady

Sick Sinus Syndrome (SSS)	Heartbeat alternates beat slow and fast. Sinus node not working properly, pacemaker is used along with medication.
Sinus Tachycardia	Low blood count overactive thyroid gland.
Ventricular Tachycardia (VT)	Dangerously fast and its organized heartbeat.
Ventricular Fibrillation (VF)	Blockage of heart.
Premature Contraction	Extra, early or skipped heart beats.
Long QT Syndrome (LQTS)	On by taking certain medications.
Heart Block	Cannot travel to lower chamber to upper chamber.
Syncope (Fainting)	Because of low blood sugar.
Circulatory Disorder Heart Attack Stroke	High B.P, blockage in the pipes of the heart. Flow of blood stopped or reduced Brain attack because of reduced flow to the brain.
Structural Disorders	By Birth muscles Heart valve problem Heart Failure: Muscles are very weak to pump blood.

Various Test For Finding out the Symptoms of Heart attack [8]

There are a number of tests performed for understanding the kind of disease the person is suffering from. Various Tests and their procedure, result given in table no 2.

Table2.Test for Diagnose Heart Disease

Tests	Procedure	Result	Diagnose	Risks
Echocardiogram	The ultrasound waves pass through theskin of your chest and then the echoes reflected from various parts of the heartand picks up by the probe and shows them on an echocardiogram as picture on a screen.	Accurate information about the structure and pumping action..	It can detect any abnormalities and help explain the cause of your symptoms	No risk involved
Doppler Test	Ultrasound imaging will press a small probe (a bit like a very thick, blunt pen) over the area of your body that is being examined	Shows the movement of blood through your blood vessels.	Narrowing of an artery, poor blood circulation to your legs,	No discomfort
24-Hour Blood Pressure	A portable recorder is placed around waist for 24 hours.For measuring the B.P.	For the conformation of High B.P	Controls the blood pressure.	No discomfort

Recording				
Coronary Angiogram	A catheter is passed into an artery either in groin or in arm . Operator after this uses X-ray screening to help and direct the catheter through the blood vessels.	Shows up all coronary arteries on X-rays, so if there are any narrowing or blockages there.	Records your heart rate and rhythm	It can cause flushing sensation and dye can cause the reaction
Cardiac CT Scans	You lie on a bed which passes through a doughnut-shaped opening in a scanner. A special dye will beinjected into a vein in of arm before started the scan, to make the blood vessels on the surface of the heart.	Shows the blood flow through the coronary arteries and looks for any narrowings in them.	The calciumscoring test used diagnoses coronary heart disease.	It can cause flushing sensation and dye can cause the reaction
Radionuclide Tests	In blood radioactivesubstance is injected by the Radiographer, As it passes through the heart a large camera will pick up the gamma rays sent out by the isotope while you are resting. Same procedure and they will ask you to exercise.	Pictures are taken by the camera to check heart is pumping well or not.	Diagnose coronary heart disease.	Possible side effects of the medicines used in this test.
MRI Scan	Lie in a 'tunnel', surrounded by a large magnet. Short bursts of magnetic fields and radio waves . MRI scanner allow images to be created. These images are then processed and analyzed.	Structure of your heart and blood vessels is shown	Diagnose defects in the heart structure.	No risk involved

ElectrophysiologicalStudies	Flexible tubes, called catheters are placed , in the groin (large vein) and also into a vein in the neck area(sometimes). The catheters are then gently moved into position in your heart. Special electrodes at the of the catheters then stimulate the heart	It picks up recordings of the electrical activity in your heart.	Affected of the heart and abnormal rhythms are diagnosed.	Bleeding from the place where the catheter was put in, leaving a haematoma.
TILT Table Test	A cannula will be put in your hand or arm in case you need to have any medicines or fluids during the test. Lie down on the tilt table, and the staff record your heart rate and heart rhythm using an ECG and measure your blood pressure.	Result based on the symptoms disappearance	Diagnose frequent episodes of syncope which are not thought to be caused by abnormal heart rhythms or structures	Can feel light-headed or feel faint either during or after the test.
Genetic Testing	This is done in two main ways: The first is to look for signs of the condition in the person's family members, secondly DNA tests may be done for finding genetic issues.	Finds out if there is genetic issue	Diagnose some types of cardiomyopathies such as hypertrophic cardiomyopathy, and channelopathies such as long QT syndrome and Brugada syndrome.	No risk involved

Blood and Some other Test

We can diagnose heart disease by performing various types of blood test.

Cardiac Enzyme Test: To check the enzyme which damage heart muscle.

Tropomin Test: With the help of this test we can see the enzyme damaged heart leaks in the blood or not from where it is detected.

U and E Test: Urea and electrolytes for measuring potassium and sodium in blood.

Full Blood count: Anemia may cause heart beat faster so we also check Hb in blood.

Thyroid Function Test : In thyroid we check two hormones thyroid affects the metabolism of the body with increase heart rate.

Cholesterol: It is a kind of saturated fat contained by the blood having major risk of heartattack.

NaturiureticPeptides : Two test BNP (B type naturiuretic peptide and NT pro BNP N terminal pro B –type naturiuretic peptide.If we found high level of these hormone can be sign of heart failure.

CRP: Creactive Protein High level of this protein indicates heart disease.

Blood pressure Recordings: We record 24 hrs BP. On a belt around waist and to a cuff which wrapped around arm. and tube under your clothes .It gives over all reading.

Cardiac Catheterisation (Coronary Angiogram): It gives a looks inside the arteries to check heart is pumping well or not.

Cardiac CT Scan : CT means Computerized Tomography .It is done for detecting coronary arties and other coronary calcium scoring test .If person score zero in this test the person having coronary heart disease.

MYOCARDIAL PERFUSION SCAN: Also called as a thallium scan, MIBI scan, MPS or technetium scan. Camera is used for the diagnosis heart disease it check heart is pumping or to look at the flow of blood.

EPS or Electrophysiological Testing: This test is done for checking out the abnormal heart rhythms.

Genetic Testing: In it we can check condition of family member by using above mentioning test. If no sound found the DNA Test [8].

Devices

ECG (ELECTRODIOGRAM):
It recodes electrical activity of heart when you have chest pain or abnormal heart beat. Small electrodes are puton armsor legsor chest which is connected to recording machine which gives print out to recording machines on to paper in a wavy form[8].The device is used for giving the information of electrical function of heart. ECG machines records the electrical impulses and are used for diagnosis. The heart muscle spreads the tiny impulses produced by the heart and to make the heart contract which is detected by the ECG machine. The most important thing to know that ECG does not produce any electricity in to our body. ECG consists of several electrodes connected by wires to the device .This device contains paper and recorders to get output. Here sensors are used to measure the changes because of the electrical charge in the skin; these impulses are travelling through the heart and on the rest of the body. As we know heart consist of four chambers, It starts in the upper right ventricle, then travels through the other three chambers of the heart ,first upper right ventricle contract then rest three contracts at once[5].

Hotler Monitor :

Hotler monitor is a transportable device which measures the heart activity for minimum 24 hrs, for two weeks at a time. It monitors cardiac activity and records electrical signals. Electrodes are attached to the chest, generally no of electrodes used are eight it also depends upon the model used. The electrodes are attached with equipment and this equipment is connected to a bell or ring around the neck. The device consists of two parts software and hardware, the hardware is further having two parts monitor and a recorder .The software part is for the analysis. It stores data at rate 1.7 mm/s or 2mm/s. The recording is playing after by the doctors for the analysis of cardiac activity of the patient. This data is uploaded into computer and statistically analysis of heart done by the doctors. Hotler monitor basically measures three activities sleeping, standing up or walking. It records the activity and when recording is finished after 1 0r 2 days, the analysis is done. Major use in the diagnosis of most of the cardiac diseases and it remains a highly advanced tool for risk calculationsand detecting cardiac arrhythmias . This system can be easily used under everyday life conditions. The disadvantage of Hotler monitor systems are frequent non-compliance, which radically decreases the diagnostic value [9][10].

PACEMAKER:
The device was invented by Wilson Greatbatch.For controlling the irregular heart beat the device is placed on chest or abdomen. The electrical puses are used by device to achieve the normal heart beat. This device is used in the treatment of "arrhythmics".The Development of Starr-Edwards Heart ValveThe device is implanted just below the collar bone inside the body. It is implanted under the skin in a small pocket. It contains electrical circuits and a battery, computer and leads. Position of leads is near the collarbone in vein and then to the heart by using X-ray machine. Programming is done in the pacemaker and the battery in the generator is replaced when dead, usually they last 5-10 years. Pacemaker is suitable for maintaining the heart rate. There are various types of pacemaker like wearable, Implantable, Intra cardinal, Internal, External. There are various methods of Pacing.

1.**Mechanical Pacing**:It is placed at adistance of20-30cm on the left lower edge of the sternum over the right ventricle . Other name is percussive pacing.

2.**External Pacing**:In this two pacing pads are used which selects the rate of pacing and increases slowly the pacing current unless electrical capture is obtained .It is also known as Transcutaneous pacing b.

3. **Epicardial Pacing**:Pacing is done when open heart surgery creates block in atrio-ventricular. It is temporary.It maintains

cardiac output until a temporary transvenous electrode has been inserted.

4. **Transvenous**: Its Temporary one and an substitute to transcutaneous pacing. In this wire is placed inside a vein under sterile condition, and then passed in to either the right ventricle or right atrium .It is bridge to permanent pacemaker.

5. **Subclavicular Pacing**:This type of pacing is permanent.The pacemaker is implanted under the clavicle. The transevenous placement of one or more pacing electrodes is done within a chamber.The electrode lead is inserted in the vein and is positioned in the chamber.After successful positioning it is connected to generator.Permanent pacing is either single chamber with one pacing lead or dual chamber in which one lead is placed in atrium and other in ventricle, theother type of permanent pacing is based on rate response pacemaker.Here sensor are used to detect changes and it automatically adjusts the pacing rate accordingly and accomplish the metabolic needs of the body [14][15].

Cardiac Event Recorder

Cardiac monitoring means continuous monitoring .In cardiac monitoring we continuous monitor the activity of heart. Cardiac event recorder consume lower power .Another name of cardiac event recorder is ambulatory monitory. The device records the rate of heart beats whether it is slow or fast, person feel dizzy. Through this we can also observe how a medicine work on the body .It works when a person having symptoms just hold device on chest and turn it on.The ECG can be sent by telephone to doctor or the receiving centre wearing event recorder has no risk. Need of cardiac event recorder to test the activity of heart at different condition. Basically device is used to measure arrhythmias [8],[16],[17].

i) It is portable device powered by battery which records ECG of heart.

ii) It records when you have fast or slow heart beats, or feel dizzy or like you want to faint.

iii) It is also used to check the respond of heart when related medicines are taken.

iv)Cardiac Event Recorder store ECG in memory in the monitor.

v) It records the heart rate during the symptoms.

vi) It will help the doctor in checking out the medicine are working.

Types of Cardiac Event Recorder

Looping Monitor: It measure ECG in 5minutes. We have to press the push button to activate it .It measure when the person is faint measure the recordings. Each time the person faint and passed out, it records.

Symptom Event Recorder: We cannot wear this device on our wrist when we feel irregular heart beat place the monitor on chest and activate the button for recordings. These devices not store ECG [8][16][17][18].

Left ventricular assist device

It is operated throughmechanical pump and battery is used which is implanted through surgery. This device is a bridge to transplant and also used for low term therapy .It is used at the end stage where heart transplant not available. working of LVAD it pulls blood from the left ventricle the blood send to large blood vessel .it helps the weak ventricle .It is placed upper part of the abdomen. It contains a tube which is connected to pump and brings out of the abdomen wall to the outside of the body and connected to the pump battery and control system.[19]

Others:

Heart transplantation

PCI(preutaneous coronary invention) Due to heart failure the blood supply of the heart muscle because of the blockages in the arteries restrict . This procedure reopens the blockages. This is done in the lab name cardiac catherization .A small tube with tiny deflated ballon inserted through other artery on the end and then pushed fully opened. To keep artery open a stent is placed during the process.

Coronary artery bypass: Neear block section this process is done to re define the path of blood supply the arteryThe healthy vessel from other part of the body such as leg remove by the surgeons or chest wall attach the healthy vessel with the damage one in this way so that blood can flow from the blocked section.

Valve replacement: Thevalve in human body controls blood inside heart due to heart failure sometimes they do not work properly to overcome this we replace the valve by using valve made up of human tissue or animal or mechanical valve made up of plastic or metal.

V. REFERENCES

[1]. R. Vijaya Kumar Reddy, K. PrudviRaju, M. Jogendra Kumar, CH. Sujatha, P. Ravi Prakash"*Prediction of Heart disease using decision tree approach*" International Journal of advanced research in Computer Science and Software engineering,volume 6 issue 3,March 2016.

[2]. AlexandrosPantelopoulos and Nikolaos G. Bourbakis, Fellow, IEEE"*A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis*" IEEE Transactions on systems,

man, and cybernetics PART C: applications and reviews, Vol. 40, No. 1, January 2010.
[3]. http://www.who.int/mediacentre/factsheets/fs317/en/
[4]. https://web.stanford.edu/class/history13/earlysciencelab/body/heartpages/heart.html
[5]. Anand Kumar Joshi, ArunTomar, MangeshTomar, *A Review Paper on Analysis of Electrocardiograph (ECG) Signal for the Detection of Arrhythmia Abnormalities*,International Journal of Advanced Research in Electrical, Electronics and Instrumentation EngineeringISSN Online(2278-8875) Print (2320-3765).
[6]. http://www.healthline.com/health/heart-disease/history#1
[7]. http://www.healthwriterhub.com/disease-disorder-condition-syndrome-whats-the-difference/
[8]. https://www.bhf.org.uk/-/media/files/.../heart.../his9_testsforheartconditions_a6.pdf
[9]. https://en.wikipedia.org/wiki/Holter_monitor
[10]. Michael Hoe Kwung Park, Carlo de Asmundis, Gian Battista Chierchia, Andrea Sarkozy, Abraham Benatar, and Pedro Brugada*First experience of monitoring with cardiac event recorder electrocardiography Omron system in childhood population for sporadic, potentially arrhythmia-related symptom*,17 February 2011; accepted after revision 26 April 2011; online publish-ahead-of-print 26 May 2011
[11]. http://www.medtronic.eu/about-medtronic/our-story/growth-spurt/our-first-pacemakers/index.htm
[12]. Annette M. Matthews, Oregon Health Sciences University, Portland, Oregon 97201-*3098The Development of the Starr-Edwards Heart Valve*,This work was supported by the Oregon Health Sciences University Humanities Summer Research Stipend, funded by grants fromi Pfizer, Abbott, Tap, Glaxo Wellcome, and Jansen Pharmaceutical companies. Travel funds were provided by D. Lynn Loriaux, MD, PhD, Chair, Department of Medicine at the Oregon Health Sciences University.
[13]. https://en.wikipedia.org/wiki/Timeline_of_cardiovascular_disease
[14]. http://www.hrsonline.org/Patient-Resources/Treatment/Pacemaker
[15]. https://en.wikipedia.org/wiki/Artificial_cardiac_pacemaker
[16]. www.heart.org/HEART.ORG/Research/Funded -ResearchBreakthroughs_UCM_48455_SubHomePage.jsp
[17]. https://en.wikipedia.org/wiki/Cardiac_monitoring
[18]. http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Cardiac-Event-Recorder_UCM_447317_Article.jsp
[19]. http://www.heart.org/HEARTORG/Conditions/HeartFailure/TreatmentOptionsForHeartFailure/Devices-and-Surgical-Procedures-to-Treat-Heart-Failure_UCM_306354_Article.jsp#.WLGQa2997IU