PROJECT DEVELOPMENT PHASE

DATE	**30.10.2022**
TEAM ID	**PNT2022TMID34226**
PROJECT NAME	**Visualizing and Predicting Heart Disease with an Interactive Dash Board**

SPRINT 2: THALLIUM

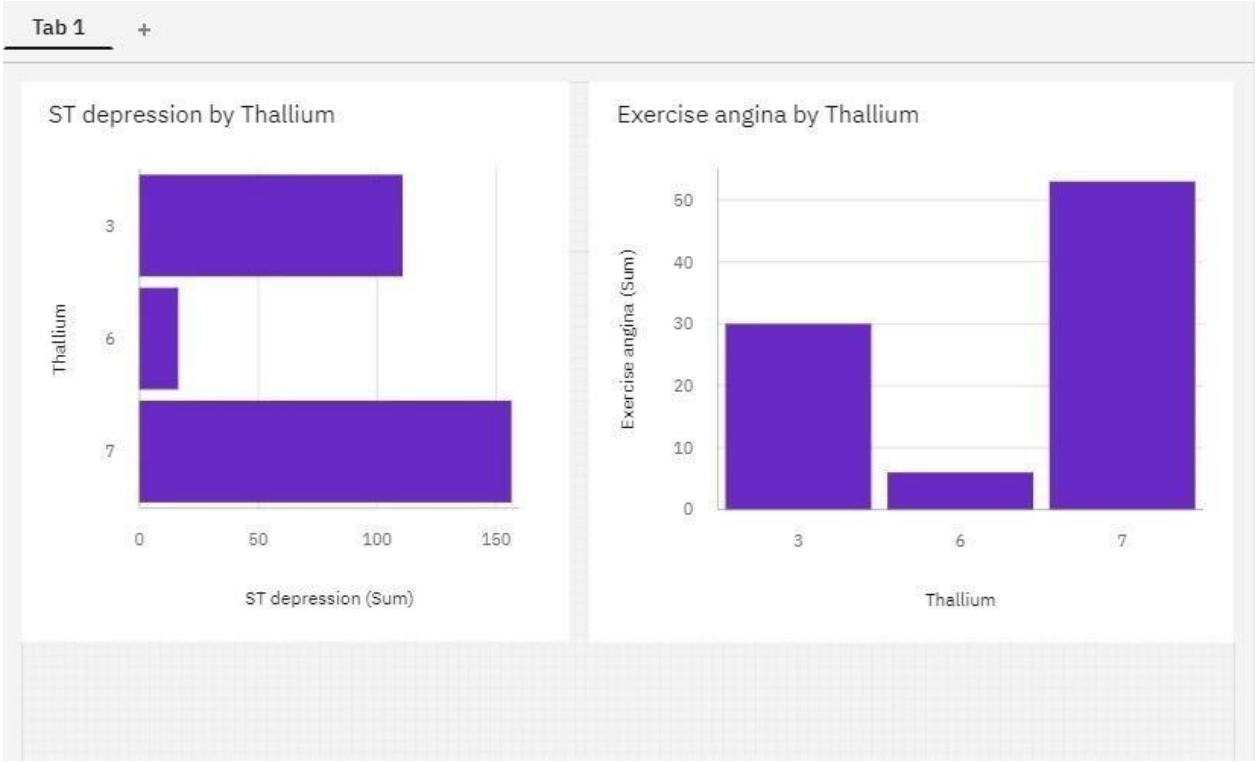
INTRODUCTION:

Thallium is a chemical element with the symbol **Tl** and atomic number 81. It is a gray post-transition metal that is not found free in nature. When isolated, thallium resembles tin, but discolors when exposed to air. Chemists **William Crookes** and **Claude-Auguste** Lamy discovered thallium independently in 1861, in residues of sulfuric acid production. Both used the newly developed method of flame spectroscopy, in which thallium produces a notable green spectral line.

The radioisotope thallium-201 (as the soluble chloride TlCl) is used in small amounts as an agent in a nuclear medicine scan, during one type of nuclear cardiac stress test. Soluble thallium salts (many of which are nearly tasteless) are highly toxic, and they were historically used in rat poisons and insecticides. Because of their nonselective toxicity, use of these compounds has been restricted or banned in many countries. Thallium poisoning usually results in hair loss. Because of its historic popularity as a murder weapon, thallium has gained notoriety as "the poisoner's poison" and "inheritance powder" (alongside arsenic).

THALLIUM RELATED TO HEART :

Thallium can affect your nervous system, lung, heart, liver, and kidney if large amounts are eaten or drunk for short periods of time and can even cause death. Temporary hair loss, vomiting, and diarrhea can also occur and death may result after exposure to large amounts of thallium for short periods.

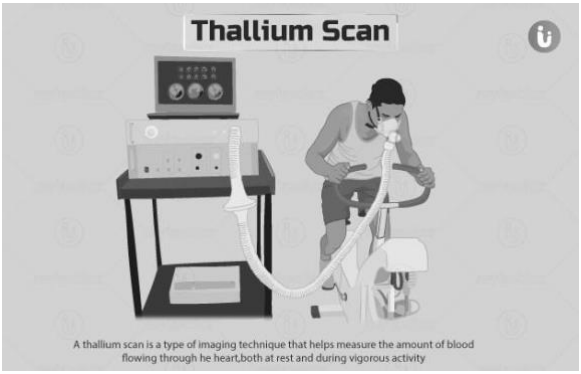


PREDICTION OF HEART DISEASE USING THALLIUM-201:

Due to its high sensitivity and specificity in detecting coronary artery disease (CAD), thallium-201 myocardial perfusion imaging (MPI) is commonly used to evaluate patients with chest pain. Moreover, thallium-201 MPI has been demonstrated as a useful method to predict cardiovascular events. It has been suggested that the incidence of major cardiovascular events

in patients with chest pain and normal thallium-201 MPI is less than 1% per year.

THALLIUM:



Thallium or cardiolite scanning is a diagnostic technique that uses a radioactive isotope or a tracer to evaluate the amount of blood reaching different parts of heart. These are included in the category of nuclear medicine scans. It is otherwise known as thallium imaging or myocardial perfusion scan or cold spot imaging. This method is used to distinguish the location and size of the damaged muscles, especially after undergoing a heart attack. This scan will enable your doctor to have a more detailed view of your heart and the structures supporting it. Thallium scan will help a cardiac specialist to evaluate the blood supply and the reparative function of heart even after a bypass surgery or coronary by-pass grafting. It is a common diagnostic measure nowadays to illustrate the status of coronary blood vessels and the heart chambers.

Procedure:

- You need to lie on a bed; meanwhile a tiny amount of thallium or the cardiolite is injected into a vein in the arm. This tracer is taken up by the strong healthy muscles of your heart and if not absorbed, it appears as dark spots called cold spots on the scan image and hence the name called as **cold spot imaging**.

- The images are formed by a gamma camera which grabs the amount of radiations given out by the tracers infused into the blood stream. Thallium scans are also done after a few hours of exercise, as it will increase the pumping of heart which improves the blood supply and hence the absorption of thallium or the cardiolite.

- The radiations are usually non ionizing type hence not very hazardous, and the amount absorbed by the body is almost the same as that you gain from a chest x-ray. Therefore the risk of the procedure is relatively high.

- You have to keep nil per oral, means should keep away from any food or drink at least for three hours before the test, and should abstain from any of the beverages, tobacco, alcoholic drinks ,over the counter medications etc, about 24 hours prior to the procedure. You have to tell the doctor regarding any allergies or any morbidity apart from this before the procedure.

- Usually the cardiolite or the thallium scans are conducted in conjunction with any stress tests so as to promote the early identification and treatment of coronary artery disease.

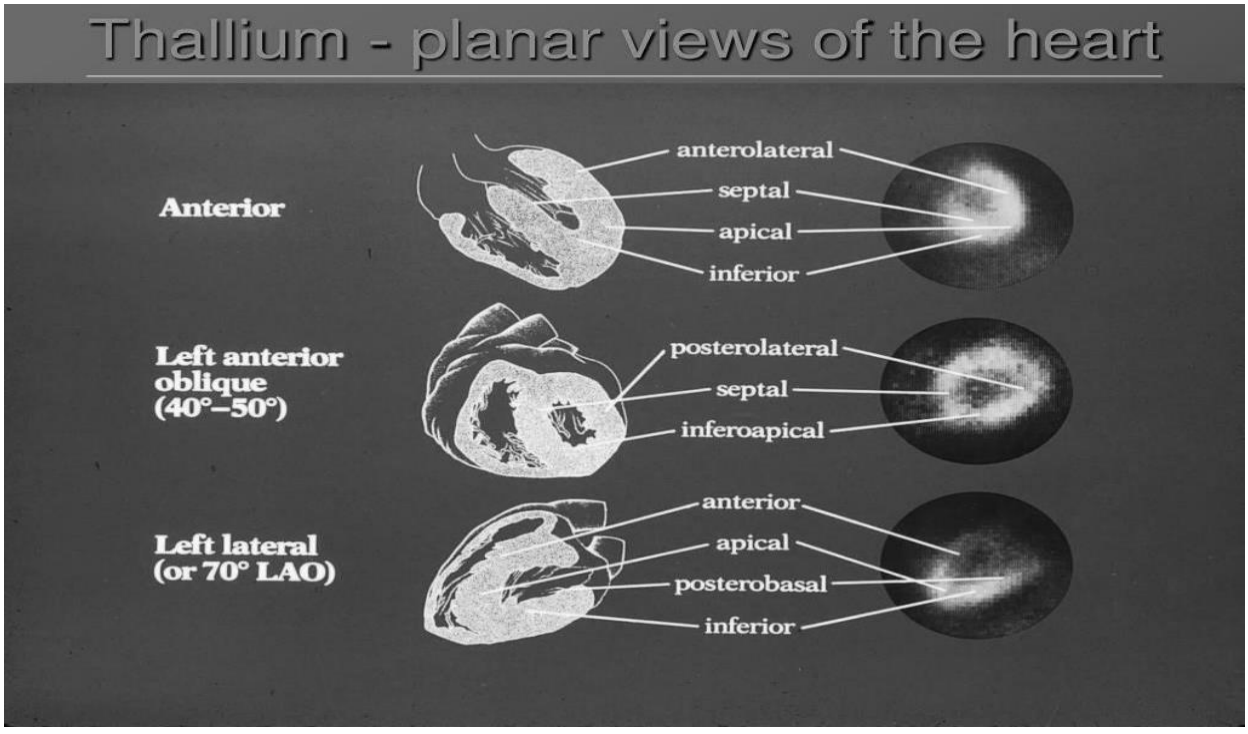
- As discussed earlier, thallium will be taken in enormous quantities by the coronary arteries and veins that supply blood to the heart, and in case of any blockage the cardiolite will get accumulated at the specific area resulting in the formation of the cold spots.

Benefits:

Thallium or the cardiolite scans has increased the accuracy of the cardiac stress tests. Thallium tests are very effective in the diagnosis of obstructive coronary disease. A normal test of thallium or cardiolite test is a good indication of a healthy heart and coronary blood vessels, and you need not have to worry any more about your heart. Whereas a significantly abnormal thallium scan report shows that you need an immediate treatment for the blockages or the ill function of your heart. Thallium scan is safe and

the only disadvantage is with the radiation; but since the radiations are of short range, they are not much hazardous.

Cardiolite or the thallium scans could thus diagnose the disease in an easier and a painless manner. Since it is least invasive, there is no severe complications of infection or any other scars. The consent has to be taken from either the patient or the family saying that they agree to the procedure. The health professionals have to explain to the patient the whole procedure, its benefits. etc so that the patient may have a slight relief from anxiety. After the procedure patient should be kept under observation for any chills or hypotension. Check the vital signs and provide a quiet environment for the patient to rest for some time.



What does it mean if there is no thallium visible in heart?

No thallium visible in parts of the heart. If there is no radioactive dye visible in a certain part of your heart, this is a sign of damage from a heart attack.

What Is a Thallium Cardiac Stress Test?

Various cardiac stress tests are available, and the thallium stress test is one of them. It is also known as a nuclear stress test or a cardiac SPECT test. This test, with the help of radioactive material, assesses the blood flow to the heart both in the resting phase and while doing physical activity. In this procedure, a small quantity of radioactive material is injected through the veins. This material enters the bloodstream and reaches the cardiac and circulatory system, where it will be seen and imaged using a special gamma camera. This test, along with evaluating the blood flow to the heart, can also assess the size of the chambers of the heart, ventricular function (effective pumping of the heart), myocardial perfusion (blood supply within the heart), and any damage to heart muscles due to previous heart attacks.

Why Is a Thallium Cardiac Stress Test Done?

A thallium cardiac stress test is indicated under the following condition:

- Physical signs suggestive of inadequate blood flow to the heart while doing any activity.
- Worsening chest pain or shortness of breath may be suggestive of heart disease.
- Previous history of a heart attack.
- To evaluate a surgical intervention such as bypass or angioplasty was successful.
- To evaluate the effectiveness of heart medicines.
- To diagnose any coronary artery diseases that are any blockage or obstruction in the arteries supplying blood to the heart.
- Previous inconclusive stress test.
- To determine the acceptability of the patient for a cardiac rehabilitation program and the extent of physical exercise that can be done by them.

What Are the Instructions Before the Procedure?

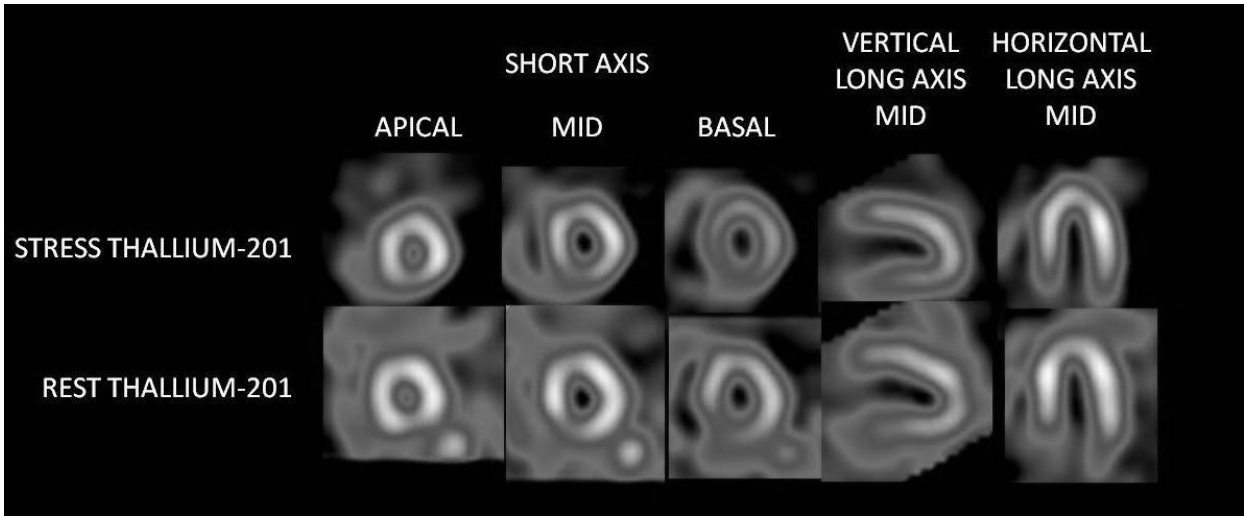
The following instructions should be followed by the patient before the procedure:

- The patient will be asked to fast for four to six hours (no food or drink) before the procedure.
- Caffeine-containing food and drinks such as tea, coffee, chocolates, soda, and even certain pain relievers should be avoided for 24 hours before the procedure. Caffeine can increase the heart rate and thereby may give inconclusive results.
- Patients should avoid applying any lotions, cream, or talcum powder on the chest on the day of the procedure.
- Patients should preferably wear comfortable exercise clothing and running or non-skid shoes on the day of the procedure.
- Asthmatic patients should inform the doctor as the medicines can interfere with the test results. They should also carry their inhaler to the procedure room.
- Patients should report to the doctor if they are taking prescription medicines for the heart or if they have a pacemaker or a defibrillator.
- The patient should also inform the doctor if they have taken a Viagra in the previous 24 hours as it could hinder the result.
- Diabetic patients who are on insulin will have to inform their doctor as the dose may have to be adjusted before the procedure. It will usually be less than the regular dose. Also, a diabetic patient may be allowed to have a light meal before the procedure.
- Pregnant women and breastfeeding mothers should inform the doctor before the procedure.
- Inform the doctor if any prescription or over-the-counter medicine is taken.

How Is a Thallium Cardiac Stress Test Performed?

Resting Scan:

1. Thallium cardiac test is usually done on an outpatient basis. The complete test may take approximately four hours.
2. The patient may need to change into a gown.
3. In the examination room, an intravenous line (I.V) will be secured on the arm.
4. The sites where electrodes of the electrocardiogram (ECG) such as the chest, arms, or legs may have to be shaved and cleaned.
5. Blood pressure and oxygen levels may be monitored at times.
6. The patient would be asked to lie down on the table, and radioactive material such as thallium may be injected through the I.V line into the vein.
7. The patient will have to lie down for 15 to 45 minutes as the radioactive material traces up to the cardiac circulation.
8. Patients would be asked to raise their arms above their head, and images will be taken with a specialized gamma camera.
9. This gamma camera detects the gamma radiation emitted by the radioactive material which flows through the circulation.



Stress Scan:

1. The second phase of the procedure is to obtain images while doing a physical activity or while exercising, and this is known as a stress scan.
2. Electrodes for the ECG machine will be placed on the arms, legs, and chest.
3. The patient will be then be asked to start walking on the treadmill or pedal a bicycle. They would be asked to walk slowly, and the pace would be increased slowly. They may also be asked to walk or run on an incline. Once the activity reaches its peak, another bolus of the radioactive material shall be administered.
4. The patient's blood pressure and heart rate will be tracked while doing physical activity.
5. Once the target is reached, the patient will be asked to lie down on the examination table, and images will be obtained again after 30 minutes.
6. The procedure can also be stopped if the patient complains of chest pain, shortness of breath, abnormal blood pressure, abnormal heart rate or rhythm, fainting, or any discomfort. The images would be taken after 30 minutes of stopping the procedure.
7. In cases where patients cannot exercise, such as acute arthritis, the heart may be stimulated medically. Here, the patients, after the resting scan, will be administered certain medications which can stimulate the heart and accelerate the heart rate by dilating the arteries. When the peak heart rate is obtained, images are taken by using the gamma camera.
8. The images of both stress scan and resting scan are compared to evaluate the blood flow through the heart.
9. A complete or partial blockage in the arteries can be identified as they will not absorb the radioactive material, thus appearing as cold spots.

What Are the Instructions After the Procedure?

- The patient can resume their daily activities once the procedure is over unless otherwise instructed by their physician.

- They should consume plenty of water to help the body expel the radioactive material.
- The radioactive material shall be expelled from the body via urine or stool. No material remains in the body.

How Are the Results Interpreted?

The test evaluates the blood flow to the heart and can detect any coronary artery blocks or obstruction, narrowing of the vessels of the heart, and other anomalies in the heart. The result can be interpreted as below:

- Normal Blood Flow at Resting and Stress Scan: Indicates a healthy heart with no coronary artery disease. No further testing or treatment is required.
- A Resting Scan Is Normal, but a Stress Scan Has Abnormal Blood Flow: Heart muscles are deprived of blood during physical or strenuous activity. This indicates a complete or partial arterial blockage or coronary artery disease.
- Reduced Blood Flow Both at Rest and Stress Scan: Indicative of a severe blockage or previous history of heart attack as the heart is deprived of blood both at rest and while doing any physical activity.
- Absence of the Radioactive Material in Certain Areas of the Heart: Suggestive of scarring or tissue damage from a previous heart attack.

What Are the Benefits of This Procedure?

- Well tolerated by the patients.
- Painless.
- Very safe when performed under observation.

What Are the Risks and Complications Associated With the Procedure?

The thallium stress test is generally considered a safe procedure; however, certain risks may occur, as mentioned below:

- Arrhythmias or abnormal heart rhythm may occur while a stress scan; however, it is temporary. It would be reversed as soon as the activity is stopped. Fatal arrhythmias are very uncommon.
- The rare possibility of a heart attack.
- Blood pressure may decrease temporarily while exercising, causing dizziness.
- Chest pain, difficulty in breathing, and vomiting may occur while doing the test.
- Allergic reactions to the radioactive material may occur, however rare.
- Rarely rashes may appear on the skin.

Conclusion:

The thallium stress test is a safe and effective diagnostic test to determine the health of the heart. There are various factors contributing to cardiac diseases. However, with advanced diagnostic aids and high-level treatment protocols, cardiac conditions can be treated effortlessly with the best possible patient outcome. An abnormal thallium stress test is indicative of further testing with coronary angiography. Also, patients diagnosed with severe blockages should seek immediate treatment with angioplasty, stent, or bypass. Prompt treatment can offer the best prognosis for these patients.