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ELECTROCARDIOGRAPHY: A DIAGNOSTIC TOOL IN PANCHAKARMA

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ABSTRACT

The heart is an electrical organ, and its activity can be measured non-invasively. The wealth of information is related to the electrical patterns and the geometry of the heart tissue. ECG is the standard tool used in a wide-range of medical evaluations. For *Ayurvedic* physicians, This test is of great value as it may serve as diagnostic test for knowing status of heart e.g. in *Hridroga, Sthoulya, Prameha and Medorogas* especially before posting a patient for *Panchakarma.* ECG should be performed with due concentration to each *Panchakarma* procedure.

Keywords: Heart, ECG, *Hridroga, Panchakarma*

INTRODUCTION

Electrocardiography is diagnostic tool, used for diagnosis of various ailments; especially related to heart (a vital organ). Due to force produced by the cardiac pump, blood circulates in each and every cell of the body. In heart, atria work as turbochargers, myocardium required for mechanical systole and pace maker cells work as electrical systole. Electrical impulse (wave of depolarisation) picked up by placing electrodes on patient. The voltage change is sensed by measuring the current change across 2 electrodes (A positive electrode and a negative electrode). If the electrical impulse travels towards the positive electrode this results in a positive deflection and if the impulse travels away from the positive electrode this results in a negative deflection. So this way electrical potential is recorded[1]. As cardiac disorders are very common nowadays, so it should be a routine investigation in the protocol of *pareeksha* in every *Ayurvedic* hospital.

Before implementing ECG in *Panchakarma,* one should be able to assess ECG for that purpose ECG Examination is explained here. As if we are administering particular *Panchakarma* to the indicated disease (As *Virechana* & *Basti Karma* are indicated

hridroga[2,3]), it will help to assess the improvement in disease i.e. before and after the procedure. And if particular *Panchakarma* is contraindicated in a specific disease and according to *avastha,* it is required to administer the any of *Panchakarma* (as *Vamana Karma* in *Gulma*, *Chardi* and *Hridroga*[4]), physician can plan extent of *shodhana* to be given as *Mridu* or *Madhya* depending upon ECG changes.

Electrode Placement:

Six are chest electrodes[5]; V1 to V6 and Four are limb electrodes[6], which are place on right arm (red colour), left arm (yellow colour), left leg (green colour) and right leg (black colour). The right leg electrode is a neutral or "dummy" lead.

Leads and what they tell you:

Limb leads look at the heart in the coronal plane. aVL, I, V5, V6 = anterior and left side of heart. II, III and aVF = inferior side of heart. aVR, V1 and V2 = right side of the heart. V2 to V4 = Antero-septal. V1 and V2 = posterior (for reciprocal changes).V1-V6 = extensive Anterior.

What do the components represent[7]?

P wave = Depolarisation or contraction of atria. QRS complex= Depolarisation or contraction of ventricles. T = Repolarisation of the ventricles. Repolarisation of atria is not recorded on graph. PR interval = Conduction time from atrium to ventricles. QRS interval = Time taken by impulse to spread through ventricles, QT interval = Total electrical activity of ventricles. RR interval = Ventricular heart rate and Pulse rate. PP interval = Atrial contraction rate. ST segment = interval between ventricular depolarisation and repolarisation. PR segment = It represents the duration of the conduction from the A-V node to the bundle of His.

Interpreting the ECG

ECG should be interpreted as follows:

- "pain" "pre-op" chest pain or routine pre op
- Any previous or subsequent ECGs
- Is it part of a serial ECG sequence? In which case it may be numbered
- Calibration
- Rate
- Rhythm
- Axis
- Elements of the tracing in each lead

Calibration

First of all one should check that ECG is calibrated correctly i.e. Height; 10mm = 1mV. Look for a reference pulse which should be the rectangular looking wave somewhere near the left of the paper. It should be 10mm (10 small squares) tall. Paper speed should be 25mm/s. 25 mm (25 small squares / 5 large squares) equals one second.

Following are the normal ranges:

P wave = 0.06-0.10 sec (2-2.5mm)

PR interval = 0.12-0.20 sec (3-5mm)

PR segment = 0.10 sec (2-3mm appx.)

QRS complex width =0.06-0.12 sec (2-3mm)

QRS complex amplitude =0.04-1.2 sec (5-30mm)

QT interval = 0.36-0.40sec (9-10mm)

ST segment = 0.2-0.4sec (0.5-1mm)

T wave amplitude = 0.20 (5 mm in limb leads), 0.4 sec (10mm in chest leads)

T wave width = 0.12sec-0.16sec (3-4mm)

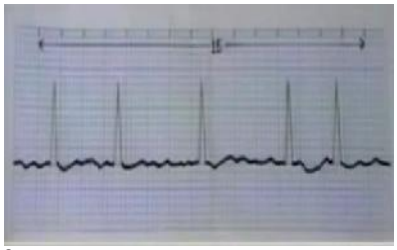
Rate

If the heart rate is regular, Count the number of small squares between R waves i.e. the RR interval in large squares. Simple formula for rate is; Rate = 1500/ small squares b/w RR or 300/ large squares b/w RR (5 small squares = 1 large square)

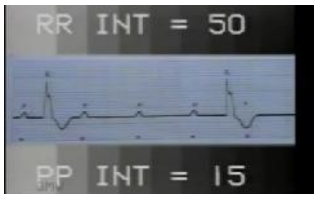
1 small square = 0.04sec, so 1500 small squares or 300 large sequare = 60 sec or 1 min.Rate below 60/min is bradycardia. Rate above 100/min is tachycardia.So 15-25 small squares b/w 2 R waves is normal

Rhythm

Is the rhythm regular? The easiest way to tell is to take a sheet of paper and line up. One edge with the tips of the R waves on the rhythm strip. Mark off on the paper the positions of 3 or 4 R wave tips. Move the paper along the rhythm strip so that your first mark lines up with another R wave tip. See if the subsequent R wave tips line up with the subsequent marks on your paper. If they do line up, the rhythm is regular. If not, the rhythm is irregular.



Count R waves in 15 large squares, and multiply by 20 (As 15 large square = 3 sec and 3×20=60 sec i.e. 1 min.) this represent rate in irregular rhythm.



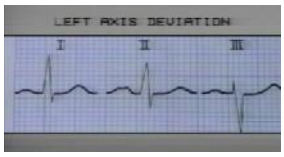
So here HR = 5×20=100/min (appx.)

Clinically by palpating Pulse is ventricular rate. Atrial rate can be seen only on ECG. As one can see in this image; Total Heart block as Atrial Rate = 100/min, Ventricular Rate = 30/min.

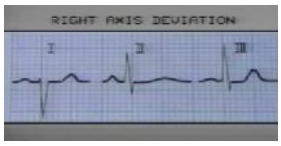
Axis[8]

Electrical axis of heart is examined in Lead I & III of limb leads. Normally QRS complex are predominantly upward in both of these leads

Left Axis Deviation: For example, in this image; Prominent R wave in lead I and Negative deflection in lead III.



Right Axis Deviation: For example, in this image; Prominent R wave in lead III and Negative deflection in lead I.



Axis deviation

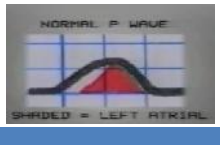
For detecting axis deviation, lead I& III should be seen. One should remember, for left axis deviation: "Left Leaves" and for right axis deviation: "Right Reaches"

Examples of Left Axis Deviation are; Left Venticular Hypertrophy, Left Bundle Branch Block, Inferior wall Infarct.

Examples of Right Axis Deviation are; Right Ventricular Hypertrophy, Right Bundle Branch Block, Anterior wall Infarct.

Elements of the tracing in each lead

By tracing the elements for each lead, one can easily diagnose a case, depending upon the changes seen in ECG, can be understood by following points:



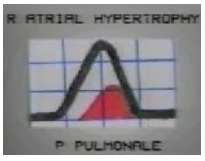
Atrial Hypertrophy

Atrial hypertrophy is diagnosed with contour of P

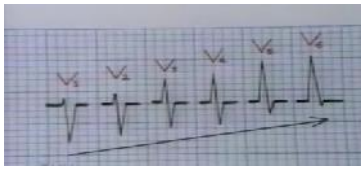
wave seen best in Lead II. P wave presents depolarisation of both left and right atria. Initial part (non- shaded) presents right atrium depolarisation, as SA node start depolarisation first here. Later (shaded) part represent left atrium.

In **left atrium hypertrophy**, 2nd component is delayed and prominent. So we get wide and notched P wave, wider than 2.5 small squares. Since it is common in mitral wall diseases, it is termed as P mitrale.

In **right atrial hypertrophy**, Initial component is prominent. P wave is tall and peaked, taller than 2.5 small squares. Since it is common in Pulmonary hypertension, it is termed as P Pulmonale.



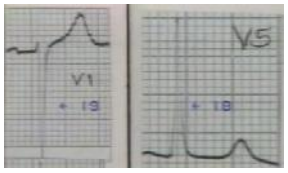
Normal Ventricular Complexes



Ventricular enlargement is diagnosed from patterns and amplitudes of QRS complexes in Chest leads from V1 to V6. This is the normal pattern of QRS complexes in chest leads. The lead V1 shows small R wave and deep S wave. As we proceed from V1 to V6, height of R wave progressively increases and depth of S wave progressively decreases. Somewhere in V3 and V4, R wave and S wave both becomes equal. This way in V6 tall R wave and very small or absent S wave.

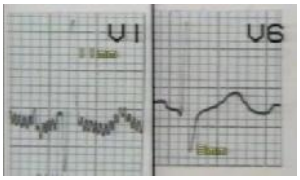
Left Ventricular Hypertrophy

Pattern remains the same but amplitude of waves increases. So we have to measure amplitude of V1 or V2 whichever is larger and V5 or V6 whichever is larger. If any of these is more than 25mm; SV1 or RV6 i.e SV1 ≥ 25 or RV6 ≥ 25. Or if there addition is more than 35 mm i.e SV1 + RV6 ≥ 35.



Left ventricular hypertrophy is usually be associated with Left Axis Deviation. P Mitrale may be seen. So, one should also look Left Axis Deviation if there are Left Atrium Hypertrophic changes in ECG.

Right Ventricular Hypertrophy



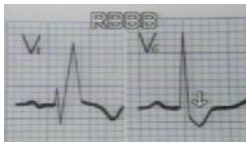
Here pattern and amplitude is opposite to normal. So there is prominent R wave in V1 or V2 or deep S wave in V5 or V6. The Criteria for diagnosis is RV1 ≥ 7 or SV6 ≥ 7.Or if there addition is more than 10 mm i.e RV1 + SV6 ≥ 10

Right ventricular hypertrophy may or may not be associated with Right Axis Deviation. And often there will be P Pulmonale of Right Atrium Hypertrophy. So, one should also look Right Axis Deviation if there are Right Atrium Hypertrophic changes in ECG.

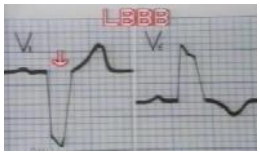
Bundle Branch Block

When width of QRS complex is 3small squares or more that is more than 0.12 sec in any of the lead Bundle Branch Block is diagnosed

RBBB & LBBB



RSR' or M Shape pattern with broad QRS comlex ≥3mm in right chest leads i.e V1 &V2, it suggests RBBB. RSR' or M Shape pattern with broad QRS comlex ≥3mm in left chest leads i.e V5 &V6, it suggests



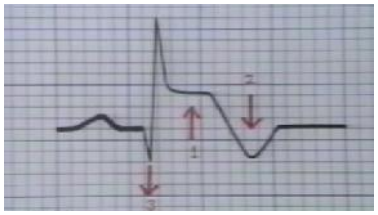
LBBB. At the same time opposite chest leads will display wide and slurred S wave. Accompanying T wave in wave in opposite direction. In LBBB, R wave is absent in opposite lead i.e. V1. RBBB may also be associated with Right Axis Deviation. LBBB will always be associated with Left Axis Deviation (In I and aVL left sided leads).

Myocardial Infarction[9]

Three basic changes in the lead facing infracted wall:

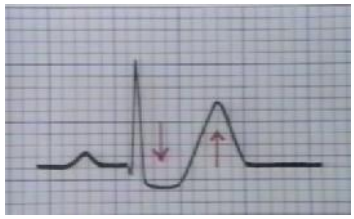
1) Elevation of ST segment indicative of zone of injury.

2) Inversion of T wave indicates of surrounding ischemic zone.



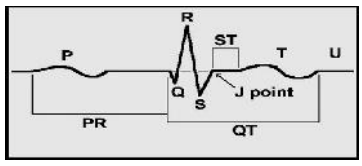
3) A deep and wide Q wave indicative of zone of infarct or dead muscle.

The diagnosis is supported by reciprocal changes in the leads facing opposite wall i.e. Depression of ST segment and tall upright T wave.

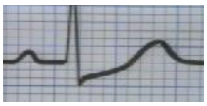


Acute Myocardial Ischemia

Criteria for diagnosing is the J point should be depressed at least 1mm. The ST segment should be horizontal or downward slopping comparing to infarction state where it is upward slopping.



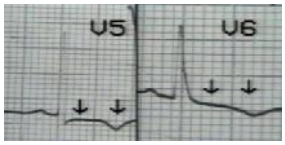
Only if J point is more than 2mm then even if ST segment is upward slopping, Acute Ischemia is diagnosed. Ischemic changes are never seen in V1 & V2. As ST segment depression in V1 & V2 indicates right ventricular hypertrophy with strain and in true posterior wall infarctions.



Non Acute Myocardial Ischmia

Commonest change is slightest ST segment depression and T wave inversion or flattening of T wave.

Remember if these changes are with tall R wave or S wave then it is ventricular hypertrophy with strain.



Read ECG in sequence so that no diagnosis get skipped

1**. aVr** should be inverted

2. Calculate **heart rate**

3. **P wave** morphology should be studied which is most prominent in lead II,

- If it is more than 2mm wide or tall then left or right atrial hypertrophy may be present
- Inverted P wave indicates nodal rhythm

4. **PR interval**, normally it is 3-5mm

- If it is increased to 5 mm or more, it is 1st degree AV block

In such a case, note there dropped beats suggesting 2nd degree heart block.

- If PR interval is less than 3mm, look for slurring of R waves in leads I and V6, to rule out WPW syndrome

5. **QRS complex**

- Look at lead I & III for axis deviation (remember left leaves, right reaches)
- Then measure QRS interval, in leads in which it is most wide and clear, generally it is 2-2.5mm wide
- If it is more than 3mm, study if it is LBBB or RBBB

6. Then look for pathological **Q wave**, in anterior, inferior or chest leads

- A Q wave deeper than 1mm or wider than 1mm or more than 1/3rd of R wave is considered as significant

7. **Chest leads**

- Study the pattern of QRS complexes from V1 to V6
- If pattern is normal i.e. Deep S wave in V1 to tall R wave in V6 then measure SV1 and RV6 to rule out LVH
- If pattern is changed then look for the criteria of RVH or RBBB

8. **ST segment & T wave**

- If ST segment is elevated or depressed, the pattern must be studied and clinically correlated to myocardial infarction, myocardial ischemia, Pericarditis and ventricular strain patterns
- ST segment depressions are basically of three types:

(i) Strain (in right and left ventricular hypertrophy) with T wave inversion

(ii) Digitalis (mirror image of check mark) with T wave flattening

Ischemia and Infarct with T wave changes with respect to time

- ST elevation (not mandatory in all leads, always concave upward never convex upward)
- Remember in pericarditis; ST elevation (reciprocal changes are absent) with T wave elevation

9. **T wave inversion** is seen in (i) Abnormal conduction (intraventricular e.g. LBBB, Total heart block, WPW etc.) (ii) Strain in LVH &RVH (iii) Myocardial Ishchemia (symmetrical & pointed like an arrow head) and (iv) Chronic Pericarditis (generalized)

- T waves are pathological if they are more than 10mm tall in chest leads or more than 5mm tall in limb leads; associated ST segment changes are very important
- A tall T wave in chest leads can be a reciprocal change toward inferior wall infarct
- A tall T waves in most of the leads is hall mark of hyperkalemia

DISCUSSION

Every individual should undergo regular health check-up once in a year (ECG included in it) to know status of once health.

ECG test should be performed when person is at rest and breathing normally. Moving, talking or shivering may distort the test results so in most of the hospitals a towel is placed over chest after applying leads to keep the patient at warm and still.

aVr should always be inverted except in dextrocardia or it implies limb leads are wrongly connected, so a repeat ECG should be taken in such a case after assuring leads are connected properly.

If Q wave is only present in lead III, it may indicate, high diaphragm; so take a fresh ECG again with deep inspiration, if Q wave is non pathognomic it may reduce in size or disappear. This physiologic Q wave will appear in expiration.

Bradycardia and cardiac hypertrophy are physiologic in athletics or persons who do exercise more than 1hour.

If ECG is normal and Clinically MI (Myocardial Infarction) is there, repeated ECGs should be taken as it may take minutes to hours to manifest during MI.

Even ECG serves to decide degree of severity e.g. in Myocardial Ischemia, Heart Block severity of disease can be estimated.

As cardiac disorders are common these days so ECG should be performed as regular check

up as *Ashtavidha* and *Dashvidha Pareeksha* are performed in *Ayurvedic* Hospitals.

Patient suffering with *Amlapitta, Anaha, Adhmana* may present angina like symptoms many a times, that time ECG may serve as good differential diagnostic tool.

If performed as a prior investigation before posting a patient for *Panchakarma* procedure, this may help to reduce number of *vyapadas* related to *Panchakarma.*

As *Vamana Karma* is contraindicated in *Hridroga*[10] and *Virechana* & *Basti Karma*s are especially indicated in *Hridroga*[11,12] ,So ECG assessment plays essential role here.

Panchakarma procedures e.g *Vamana Karma* even though contraindicated in *Hridroga* but can be practiced if patient's condition demands it[13], extent of shuddhi can be decided depending on degree of disease and ECG may help in such situations.

If ECG is indicative of pathological condition, further investigations such as: Cardiac markers e.g. Troponin I or T, TMT or Stress Test, Echocardiography, Angiography, CT heart, MRI heart, Electrolytes, Calcium levels etc. should be advised depending upon condition.

CONCLUSION

ECG examination can be proved to be boon for *Panchakarma* practice, as it will reduce *Panchakarma Vyapadas.* As if there are abnormal changes in person's ECG who is posted for *Vamana Karma*, procedure can be cancelled or stopped and / or modified depending upon the condition. ECG will be helpful for assessing effect of *Virechana Karma* and *Basti Karma* procedures for *Hridroga* patients, if performed before and after the procedures. Also further tests can be recommended or patient can be referred to the higher centres whose ECG shows suspicion of major cardiac ailments. So this way ECG examination as a routine tool will lead to safe *Panchakarma* practice.

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