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New Screening Technique for Heart Failure

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Abstract : Heart Failure is one of the most serious cardiovascular diseases across the world with a prevalence of close to 64 million patients across the globe. While diagnosis and prognosis of Heart Failure predominantly depends on LVEF, it has quite a few backdrops. A novel technology has emerged (patented by USPTO) wherein LVEF can be calculated from ECG graphs. This is sure to have a huge impact on healthcare at a global scale once the technology will be adapted into the modern-day ECG, Holter and Cardiac Monitoring machines.

Heart failure has been singled out as an epidemic and is a staggering clinical and public health problem, associated with significant mortality, morbidity, and healthcare expenditures, particularly among those aged 65 and older.

Heart failure (HF) has been defined as a clinical syndrome with symptoms and or signs caused by a structural and/or functional cardiac abnormality and corroborated by elevated natriuretic peptide levels and/or objective evidence of pulmonary or systemic congestion. A new and revised classification of HF according to left ventricular ejection fraction (LVEF) includes HF with reduced EF (HFrEF): HF with an LVEF of ≤40%; HF with mildly reduced EF (HFmrEF): HF with an LVEF of 41% to 49%; HF with preserved EF (HFpEF): HF with an LVEF of ≥50%; and HF with improved EF (HFimpEF) : HF with a baseline LVEF of ≤40%, a ≥10-point increase from baseline LVEF, and a second measurement of LVEF of >40%[1].

Thus, LVEF is clearly the single-most important parameter for diagnosis and prognosis of Heart Failure cases. According to the American Heart Association, LVEF is measured (expressed as a percentage) of how much blood the left ventricle pumps out with each contraction. It is the most common method for assessment of systolic function. In many cardiovascular emergencies including Acute Myocardial Infaction, Complete Heart Block and Acute Congestive Cardiac Failure, there is often an urgency to measure LVEF since treatment depends on it.

At present, the standard method of assessing LVEF is by conducting an Echocardiography, using the modified Quinones Equation. Hence, LVEF can only be assessed as snapshots rather than as a continuous parameter. LVEF can be determined using several invasive and non-invasive imaging modalities, either subjectively by visual estimation or objectively by quantitative methods i.e. echocardiography, magnetic resonance imaging (MRI), computed tomography (CT), gated equilibrium radionuclide angiography (commonly referred to as multiple-gated acquisition [MUGA] scan) and gated myocardial perfusion imaging with either single-photon emission computed tomography (SPECT) or positron emission tomography (PET). LVEF can also be measured non-invasively using the firstpass radionuclide technique, but this technique is rarely performed in the current era. However, none of these have the advantage of continuous monitoring.

Apart from chronic factors like Hypertension, Diabetes, smoking etc, multiple acute factors also affect LVEF including

- Sympathetic stimulation
- Blood volume
- Respiration
- Environmental temperature[2]

Due to these, LVEF is a dynamic entity whose continuous montioring might be extremely beneficial for treatment instead of snapshot values of LVEF (as is available from current LVEF measurement techniques).

Other problems faced by the current methods of LVEF measurement (specially Echocardiography) are :

1. LVEF estimation from Echocardiography is subject to observer bias
2. It requires specialised equipment (Echo machine) and trained personnel to obtain the results
3. It is costly, specially in cases where multiple readings are required

In view of these problems, an algorithm has been invented and patented from the United States Trademark and Patent Office (USPTO) which can calculate LVEF from an ECG graph. This has a number of advantages.

1. Since it is a computer-based reading, no human bias will be involved
2. It can give 24×7 readings of LVEF
3. Will not require any additional equipment or training to obtain the results
4. Extremely cheap when compared to the modern methods.

Adaptation of this technology means LVEF can now be displayed on ECG strips, 24 hour LVEF reports on Holter reports, and 24×7 monitoring of LVEF in ICU/ICCU/OT setups where patients are already on ECG chest leads.

Possible Benefits:

Approximately, HF affects more than 64 million people worldwide, 1 Million Heart Failure cases are diagnosed annually in India alone[3]. As of 2020, the Global market for Electrocardiography was expected to close at $8.3 Billion with a CAGR of 8.3%[4]. According to a survey in 2019, the Indian ECG market alone was estimated to be around Rs.164.25 Crore with high-end machines accounting for over Rs.96 Crore alone.

How fast this innovation will improve the cardiovascular market in India is yet to be seen, however many manufacturers are surely in line to adapt this new algorithm into their machines.

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