ABSTRACT

Advances in the field of Science, Technology and Computer Science has contributed not only for the advancement of the respective field but also contributed to the allied fields. Medicine is one such field which has benefitted to the maximum extent as it is truly multidisciplinary.

The benefits are better utilised for diagnosing the disease at the earliest stage and also for better treatment of the ailments either by non-interventional methods or by interventional method such as surgical correction. Nuclear cardiology is one such non-interventional super speciality in cardiology for diagnosing the ailments. This diagnostic tool utilizes the developments in more than one field.

Another non-interventional method used as diagnostic tool in cardiology is echocardiography with colour Doppler. In our study Echocardiography with colour Doppler was taken as a standard and the findings from the Gated blood pool ventriculography were compared with the results of Doppler echocardiography.

Left Ventricular functional assessment with Doppler technique is one of the easiest non-invasive methods. Before using the Doppler equipment for the routine clinical assessment, the performance of the equipment needs to be studied. One of the very important functions to be studied is the resolution. Resolution of the equipment is the ability to resolve two closely placed objects or organs in different depths and also in horizontal direction. To determine these axial and lateral resolutions of the
equipment a standard ultrasound test phantom was designed and fabricated. The test phantom was fabricated using the locally available materials. It consisted of 200 mm x 200 mm x 5 mm perspex plate, 0.75 mm dia stainless steel wires or suturing thread and spacer bolts of 50 mm length.

Using this specially designed phantom, the axial and lateral resolution of the Doppler Equipment used for our study was measured. For the system used for our study the axial resolution was found to be 2 mm and the lateral resolution as 2.5 mm. Once the performance of the equipment was assessed, the selected patients were subjected to cardiac assessment. The cardiac output was measured and the Regional wall motion abnormality of the patient was also studied. The results were all recorded, and this were taken as standard.

The same patients were subjected to radionuclide ventriculography. This is the technique widely used for clinical assessment of the regional and global left ventricular function both at rest and exercise. This study requires a gamma camera to record the movement and the concentration of the radioactive tracer in the cardiovascular chamber. This involves many circuits for recording, storing and processing the digitised signals. So all the modules are required to perform to the maximum level in co-ordination with other module for the good performance of the camera.

The most popular method used to test the functioning of the gamma camera is the protocol developed by the National Electrical Manufacturers Association (NEMA). The Gamma Camera was subjected to regular Quality Assurance protocol to check the parameters. The important parameters checked are: Spatial resolution, Uniformity and Energy resolution.
The results were recorded separately. Determination of left ventricular function is part of a comprehensive cardiac evaluation. Correct and reproducible measurements of L.V. function require correct and reproducible algorithm to delineate the L.V. This delineation can be achieved manually or automatically using an edge detection algorithm. Manual algorithm usually suffers from low reproducibility, whereas the automatic algorithm suffers low precision due to non uniformity in the image.

To improve the boundary based results the edge operators in the radial direction at different angles in the region of interest were applied in this study. The MUGA image was sampled radially every 20 degrees in the L.V. region. The isocount contour generated by the above technique cannot be used directly. Three points along the boundary of the isocontour were found i.e. \((x_1, y_1), (x_2, y_2)\) and \((x_3, y_3)\) along with the respective grey values \(z_1\), \(z_2\) and \(z_3\). These values fit in the following equation

\[ Z = ax + by + c \]

The resultant image obtained is in a different plane and the L.V. is better delineated. This was done for all 24 frames of each patient and for all the same 200 patients, who underwent MUGA study. The results were recorded separately. The results of all three modalities are compared.

Out of the total number of 200 patients 174 patients were male and 26 were female patients. Majority of the patients i.e., 137 out of 200 were in the age group of 41-60 years. Out of the 200 patients 70 patients belong to the group of normal left ventricular function with no regional wall motion abnormalities and 38 patients had normal LVEF but impaired wall motion. 35 patients with mild LV dysfunction with impaired wall motion. 29
patients with moderate LV dysfunctions and 27 patients with severe left ventricular dysfunction with hypokinesia to dyskynetic regional wall motion.

After enhancing the edges, the left ventricular ejection fraction was recalculated. There found to be an increase of 15-20% in the ejection fraction. As the gated blood pool radionuclide ventriculography is a count-dependent method of quantitating ventricular function, so the increased or better detection and delineation of the edges might have contributed to this increase in LVEF. While we compare the LVEF from MUGA with DOPPLER EF, there was about 25-35% difference whereas after the recalculation of the LVEF with edge enhancement the difference was reduced 10-15%.

There was not much change in the regional wall motion except in 6 cases, where the akinesia was shown as dyskinesia in 2 patients and severe hypokinesis had become hypokinesis in 4 other patients.