Echocardiography is the non-invasive, widely available and basic method to examine the heart. Current devices allow echocardiographic measurements and calculations of large amounts of hemodynamic and morphological parameters. To establish the diagnosis and assessment of severity of heart disease, it is needed to evaluate all available data. The physician must take into account the specificity, sensitivity and possible measurement error of the specific echo parameter.

2. Objective

The goal of this study was to investigate the feasibility of CARDIO3®ECHO expert system for the establishment of diagnosis of heart diseases, using echocardiographic measurement data.

3. Methods

We created a tool for the measurement of echocardiographic parameters and implemented basic calculations of hemodynamic parameters (volume, flow, pressure or velocity). This system was tested on a database of findings of the CARDIO3® Comprehensive Atlas of Echocardiography. The measurement results are the basis for the text description, which is compiled from standard clinical keywords (Table 1). The application enables adding other parameters required for the evaluation of echocardiographic findings, such as age, weight and height of the patient. The results and calculations are stored in the database to verify the accuracy of the measurement. The system highlights the possible discrepancy between the measured parameters and calculated values. The application includes stratification of measurement results and the severity of heart disease.

Table 1. Example of Knowledge Base Findings

<table>
<thead>
<tr>
<th>Findings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left atrium is dilated</td>
<td>Moderate</td>
</tr>
<tr>
<td>Left atrium size is within normal limits</td>
<td>Normal</td>
</tr>
</tbody>
</table>

The exclamation signs (in yellow) highlights the inconsistency in measured data - LA diameter (50.1 mm) indicated a severely dilated left atrium whereas LA area (26.7 cm²) showed only a mild abnormality. Physician has an option to check the measurement method or consider other clinical data to make the final decision.

4. Results

During testing on the CARDIO3® database consisting nowadays of 644 echocardiographic samples (112 various case reports), we revealed several inaccuracies in calculated clinical findings. The authors of the cases and charts are comprised of clinical cardiologists and internal fellows. For instance the left atrium dimension measured from parasternal view (LA PSAX) indicated a severely dilated left atrium (LA) whereas measurement of the left atrium area from apical view resulted in moderate LA dilatation (Scheme 1). Scheme 2 shows assessment of mitral valve where both parameters suggested moderately significant valve disease.

Another example was the evaluation of severity of aortic valve stenosis. Aortic valve area (AVA) measured directly from the parasternal short-axis view (PSAX) mismatched the calculation of AVA using a continuity equation.

The system is a rule-based expert system making alerts if significant difference occurs in the assessment of valvular heart diseases using various methods. Current version measures dimensions, areas, pressure gradients and velocities in evaluation of pulmonary hypertension or hemodynamics in wide range of cardiac disorders. The app is available on iPad devices.

5. Conclusions

Our study showed that simulator-based training in echocardiography could be very effective and if implemented in the echocardiography device may be helpful in clinical practice. In a routine clinical setting it enables quicker processing of the examination protocol and a prompt final recommendation for the management of the patient.

6. References


7. Contact Information

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