Abstract: 540

Assessment of left ventricular ejection fraction from echocardiographic images using machine learning algorithm

Authors:
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Topic(s):
Echocardiography: Technology

Citation:
Background: Precise and reliable echocardiographic assessment of LVEF is needed for clinical decision-making. LVEF is currently determined through an observer dependent process that requires manual tracing. To remove this manual tracing step, which is both time-consuming and user dependent, automatic computer aided diagnosis systems may be useful in the clinical setting.

Purpose: The aim of this study was to evaluate whether a 3-dimensional convolutional neural networks (3DCNN) could estimate left ventricular ejection fraction (LVEF) and differentiate types of heart failure (preserved EF/reduced EF) using conventional 2-dimensional echocardiographic images.

Methods: We developed a deep learning model to automatically estimate LVEF from echocardiographic data. The 3DCNN model was trained on a dataset of 340 patients. The dataset creation consisted of three main steps: firstly, for each exam, cine-loops showing the parasternal and apical views were manually selected; then, 10 sequential frames were extracted from each 1 beat and; finally, each frame was pre-processed to fit the learning model. Each patient has 2 views, resulting in a total of 6,800 images. Reference LVEF measurement was calculated by two highly experienced readers in each case.

Results: A good correlation was found between estimated LVEF based on apical 2 and 4 chamber views and reference LVEF (r =0.88, p <0.001) (Figure). For classification of heart failure types based on LVEF (LVEF =50% or <50%), the area under the receiver-operating characteristic curve by the 3DCNN algorithm was over 0.95.

Conclusions: The 3DCNN can be applied to estimate and classify the LVEF in the clinical setting. Furthermore, this work will serve as a driver for future research using million image databases.
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Graph:

![Graph showing correlation between EF by Deep learning and EF by Expert observers.](image)

$r = 0.88$

$P < 0.001$