Abstract

Pulmonary Capillary Wedge Pressure (PCWP) is a hemodynamic parameter for assessing left ventricular filling pressure and is one of the key indicators used in diagnosing and managing heart failure, but its measurement requires invasive right heart catheterization, which limits its use for frequent or continuous monitoring. This study develops and evaluates an autoencoder-based deep learning model to predict PCWP from a single non-invasive peripheral cardiovascular waveform (Signal X). Using data from 52 patients in the PhysioNet, synchronized 5-second segments of Signal X and PCWP waveforms were extracted and processed. A one-dimensional convolutional neural network (1D-CNN) autoencoder was trained in a waveform-to-waveform regression framework to learn compressed feature representations from Signal X and reconstruct the corresponding PCWP waveforms. The model achieved a test-set mean absolute error (MAE) of 5.48 mmHg and a Pearson correlation coefficient of 0.824, suggesting that automatically learned features from a single peripheral signal can approximate invasively measured PCWP under the conditions of this dataset. Visual comparison of predicted and reference waveforms showed good temporal alignment and preservation of beat-to-beat dynamics, although amplitudes tended to be underestimated in lower-pressure ranges. These findings indicate that autoencoder-based deep learning offers a promising approach for non-invasive PCWP estimation, but further evaluation with patient-level splits and validation in larger, independent and clinically diverse cohorts is needed before practical implementation.

Keywords: pulmonary capillary wedge pressure, deep learning, autoencoder, non-invasive monitoring