Deep learning for screening of pulmonary hypertension using standard chest X-ray

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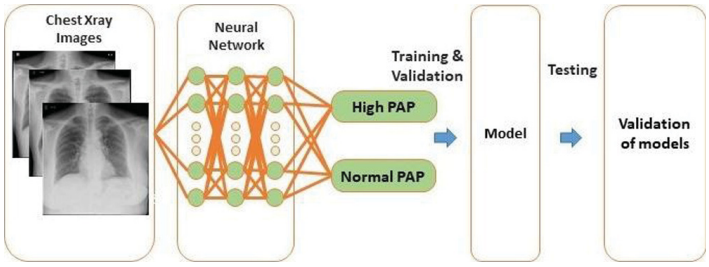
Background: Early detection of pulmonary hypertension (PH) is crucial to ensure that patients receive timely treatment for the progressive clinical course. The chest X-ray (CXR), a routine method at hospitals, has recommended in order to reveal features supportive of a diagnosis of PH. However, it is well known that the sensitivity and specificity are low.

Purpose: We tested the hypothesis that application of artificial intelligence (AI) to the CXR could identify PH.

Methods: We retrospectively enrolled 900 data with paired CXR and right heart catheter (RHC), including the pulmonary artery pressure, from October 2009 to December 2018. We trained a convolutional neural network to identify patients with PH as actual value of pulmonary artery pressure, using the CXR alone (Figure). The diagnosis of PH was performed using hemodynamic measurements according to the most recent World Symposium standards: mean PAP $\geq$20 mmHg. We have compared the area under the curve (AUC) by human observers, measurements of CXR images, and AI for detection of PH.

Results: Subjects were divided into two groups with PH (439 patients; mean age, 66±14 years; 233 male) and without PH (461 patients; mean age, 68±12 years; 278 male). In an independent set, AI was the highest diagnostic ability for detection of PH (AUC: 0.71). The AUC by the AI algorithm was significantly higher than the AUC by measurements of CXR images and human observers (0.71 vs. 0.60 and vs. 0.63, all compared $p<0.05$).

Conclusion: Applying AI to the CXR (a classical, universal, low-cost test) permits the CXR images to serve as a powerful tool to screen for PH.



Neural network