**Title:**

A multimodal deep learning model for non-invasive detection of elevated left ventricular end-diastolic pressure

**Background:**

Elevated left ventricular end-diastolic pressure (LVEDP) indicates diastolic dysfunction, but ASE/EACVI echocardiography guidelines for classifying LVEDP can be infeasible (missing values) or return indeterminate diagnoses; collectively categorised as indefinite diagnoses. We developed a multimodal deep learning model for detecting elevated LVEDP non-invasively and assessed its performance compared to the guidelines.

**Method:**

180 participants referred for coronary angiography underwent left-heart catheterisation and echocardiography within one hour (17/NTB/46). A deep learning model was developed for LVEDP classification using apical 2- and 4-chamber 2D echocardiographic images, a 3D dynamic mesh of the LV, and measurements of weight, height, age, gender, systolic and diastolic brachial pressures. Invasive pressures served as the reference, with elevated LVEDP defined as ≥ 15mmHg. Model and guidelines performances were evaluated on independent test cases with definitive diagnoses per the guidelines (n=17). The model was also evaluated on independent test cases with indefinite diagnoses (n=14). Metrics included accuracy, sensitivity, specificity and positive/negative predictive values (PPV/NPV).

**Results:**

LVEDP classification using guidelines was feasible for 127/180 (71%) cases, of which 37/127 (29%) were indeterminate, resulting in 90/180 (50%) indefinite cases. Model feasibility was 84% (152/180), resulting in 28/180 (16%) indefinite cases. For the definitive test cases, model sensitivity was higher than guidelines (0.43 vs 0.25), but PPV was lower (0.30 vs 0.50). For the indefinite test cases, model sensitivity and PPV were 0.50 each.

**Conclusion:**

Compared to ASE/EACVI guidelines, the proposed multimodal model provided greater feasibility, while maintaining similar performance in non-invasively detecting elevated LVEDP within an independent test cohort.