

**Fig. S1** Difference in time to maximal displacement between right ventricle (RV) free wall and left ventricle (LV) lateral wall (Time difference=RVLV) for healthy control (left) and PAH (right). *IQR* interquartile range, *PAH* pulmonary arterial hypertension. \*Significantly greater than healthy controls.



Figure S2. Heat map for the correlation coefficient R of 4D flow parameters and right ventricular (RV) remodelling, RV function, six-minute walk test and cardiopulmonary exercise test (CPET) parameters in healthy controls and pulmonary arterial hypertension (PAH).

**Figure S3.** Bland-Altman analysis of right ventricular (RV) 4D flow measurements for **(A)** intraobserver; **(B)** interobserver for RV direct flow (first row, left), RV retained inflow (first row, right), RV delayed ejection flow (second row, left), RV residual volume (second row, right), RV peak systolic KEiEDV (third row, left), RV systolic KEiEDV (third row, right), and RV peak E-wave KEiEDV (last row). *4D* four-dimensional, *CMR* cardiovascular magnetic resonance, *KEiEDV*kinetic energy normalized to end-diastolic volume.