Progressive hypoxia causes reversible left ventricular D-shaping in an experimental porcine model

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Background:

In POC echocardiography, a pulmonary embolism is characterized by a D-shaping of the left ventricle. The specificity of this characteristic has recently been challenged, as hypoxia induced by acute asphyxia resulted in D-shaping of the left ventricle. However, decompensation of respiratory distress most often manifests as progressive hypoventilation.

Therefore, we aimed to evaluate the left ventricular ultrasonographic appearance of progressive hypoventilation using a porcine model.

We hypothesized that progressive hypoventilation would lead to a gradual D-shaping of the left ventricle.

Results:

Left ventricular eccentricity index (LV-EI), an ultrasonographic index of D-shaping, increased from 1.1 (1.0-1.1) at baseline to 1.4 (1.3-1.4) three minutes into the final intervention ($P < 0.001$). After two minutes of respiratory resuscitation LV-EI returned to baseline (1.1 (1.1-1.2), $P = 0.093$) and stayed at this level ($P = 0.348$) (fig 1)

Fig 1

Fig 2 Ultrasonographic images

Materials and Methods:

The Danish Inspectorate of Animal Experimentation approved the study (authorization number: 2013-15-2934-00765). Fifteen piglets (intervention n=10 control n=5) were included in the study. The intervention piglets underwent three ten-minute periods of graded hypoventilation before respiratory resuscitation was initiated. Parasternal short axis view cineloops were stored and arterial blood samples were drawn after 3, 6 and 9 minutes at each level of hypoventilation. During resuscitation, cineloops were stored every minute and arterial blood samples drawn every second minute.

Discussion and conclusion:

Progressive hypoventilations yields a reversible echocardiographic image (Fig 2), which to many clinicians is synonymous with pulmonary embolism. This questions signs of right ventricular overload as a specific rule-in diagnostic, and may make repeated echocardiography after reoxygenation an important differential diagnostic tool.

Progressive hypoventilation caused reversible D-shaping of the left ventricle and poses a differential diagnosis to pulmonary embolism.