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Distensibility Differs Between Sall Arteries and Veins in the Newborn Piglet Lung

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BACKGROUND: We previously used micro-CT techniques to measure pulmonary artery distensibility in 3 week old piglets. Pressure/diameter relationships were measured for each artery and the slope (β) was then plotted against its diameter intercept at 0 pressure (D_0). The resultant diameter independent distensibility parameter, α, was estimated by linear regression to be 1.6% per mmHg for arteries between 0.2 and 3.0 mm D_0.
OBJECTIVE: This study sought to determine whether; 1) distensibility of smaller arteries was similar to that of arteries with $D_0 > 0.2$ mm; and 2) whether small vein and artery distensibility was similar.
DESIGN/METHODS: Lower lobes were isolated and perfused with papaverine/saline to remove blood and tone. Lobar bronchi were cannulated and lobes inflated to 3 mmHg. Lobar arteries (n=13) or veins (n=12) were cannulated and perfluoroctyl bromide instilled. Small arteries (0.033 to 0.34 mm D_0) and veins (0.024 to 0.33 mm D_0) were imaged by planar X-ray at static pressures ranging from 21 to 3 mmHg in 3 mmHg increments. The slope of the pressure/diameter curve was estimated by linear regression ($D = D_0 + \beta P$) for 4-8 arteries or veins per lobe. The linear relationship of all β vs their respective D_0 was plotted ($D/D_0 = 1 + \alpha P$) to estimate distensibility.
RESULTS: In small arteries, α determined by linear regression was $1.5 \pm 0.1\%$ per mmHg as previously described in larger arteries. α estimated in the same way in small veins was significantly lower at $0.9 \pm 0.1\%$ per mmHg ($p < 0.05$). However, the X-ray images suggested that venous diameter increased more at lower than higher pressures. α estimated over the 3-9 mmHg pressure range was $1.4 \pm 0.23\%$ per mmHg, while over the 12-21 mmHg pressure range it was significantly lower at $0.9\% \pm 0.13\%$.
CONCLUSIONS: Distensibility of the entire arterial tree over a wide range of pressures seems well described by a single, diameter independent parameter. In contrast, distensibility of small veins appears to be higher at low versus high pressures. Future studies must further examine distensibility of large and small veins at various pressures and relate the findings to pulmonary vascular hemodynamics.
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