

Investigation of heart and lung interactions in response to varying levels of continuous positive airway pressure (CPAP) in healthy sedated Beagle dogs

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Continuous positive airway pressure (CPAP) can improve lung function in dogs but may induce clinically relevant hemodynamic effects. This study aimed to characterize the hemodynamic consequences of different CPAP levels in healthy, sedated Beagles. Seven healthy research Beagles were sedated with IM dexmedetomidine ($2 \mu\text{g kg}^{-1}$) and morphine (0.1 mg kg^{-1}) and maintained on an IV propofol infusion ($0.1\text{--}0.3 \text{ mg kg}^{-1} \text{ min}^{-1}$). A veterinary-specific CPAP helmet was used to generate increasing levels of continuous pressure ($5 \text{ cm H}_2\text{O}$ [CPAP5], $8 \text{ cm H}_2\text{O}$ [CPAP8], and $12 \text{ cm H}_2\text{O}$ [CPAP12]), compared to baseline ($0 \text{ cm H}_2\text{O}$ [CPAP0]). Transthoracic echocardiography was used to assess left ventricular function (stroke volume [SV, mL], cardiac output [CO, L/min], and ejection fraction [EF, %]), right ventricular function (systolic myocardial velocity of the tricuspid annulus [S', m/s]), and right pulmonary artery distensibility (rPAD, %) at each CPAP level. Invasive arterial blood pressure was continuously monitored. Outcomes were compared between CPAP levels using linear mixed models, with $p < 0.05$ considered significant. Dogs tolerated all CPAP levels. Heart rate increased significantly at CPAP12 (85 ± 16) compared to CPAP0 (61 ± 11). Left ventricular EF and CO remained unchanged, while SV decreased significantly at CPAP12 (11 ± 2) compared to CPAP0 (14 ± 2). rPAD decreased significantly at CPAP8 (36.3 ± 7.4) and CPAP12 (32.8 ± 7.4) compared to CPAP0 (42.7 ± 5.5), while right ventricular S' increased significantly only at CPAP12 (0.12 ± 0.02) compared to CPAP0 (0.09 ± 0.02). There were no significant effects on arterial blood pressure. In healthy dogs, higher CPAP levels stiffened the pulmonary vasculature, leading to a compensatory increase in right ventricular systolic function. However, left ventricular stroke volume decreased, underscoring the complexity of heart-lung interactions during CPAP therapy. Future studies should assess these effects in dogs with lung and cardiac disease.

References:

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