Physiologic alterations in cranial blood flow demonstrated by magnetic resonance angiography.

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Two-dimensional phase contrast magnetic resonance angiography (MRA) was used to image alterations in cranial blood flow induced by changes in arterial PCO2 in an animal model. MRA was performed on five sheep; 64 acquisitions were obtained in each of three flow encode directions using a 256 x 256 matrix. Sheep were intubated and ventilated with oxygen and 1.5% halothane to prevent any movement. Femoral arterial cannulation was performed to monitor arterial blood gases and pressure. The sheep was secured in a cradle with its head and neck in a 6-inch imaging coil within the 26-cm-clear bore. Images were obtained during separate physiologic states, which were induced by changes in ventilatory parameters. These were normocapnia (PCO2 35-45 mm Hg), hypercapnia (greater than 90-130 mm Hg), and hypercapnia with superimposed hypoxia. Comparisons of images were performed using both a video flashback mode and image subtraction. The authors noted that 1) both venous and arterial flow velocity qualitatively increased during hypercapnia; 2) in addition to change in the caliber of blood vessels, redistribution of blood flow within the cranium could be demonstrated during the PCO2 changes; and 3) blood was directed away from superficial structures and toward the brain during superimposed hypoxia. MRA, previously used to show steady-state cranial flow also can demonstrate flow responses to physiologic stimuli.