Title: RENAL VASCULATURE AND HIGH DOSE FENTANYL

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Introduction. Little data exists about the regional circulatory actions of fentanyl. One study is available in anesthetized dogs1. The purpose of this present study was to examine effects of high dose fentanyl on renal hemodynamics utilizing conscious animals.

Methods. Healthy dogs underwent a laparotomy. An ultrasonic flow probe was placed around the left renal artery. A catheter was placed in the abdominal aorta. The wires and catheter were exteriorized. After 3 weeks recovery, experiments were performed. Aortic pressure (AOP), in tort, and renal blood flow (RBF), in ml/min, were recorded continuously. RBF was measured with a directional ultrasonic flowmeter. Renal vascular resistance (RVR), in tort/ml/min, was calculated. While breathing room air (RA), control data were obtained. Then either 250mcg/kg of fentanyl (lo) or 50mcg/kg (hi) was given i.v. over a 10 minute period and variables measured for 20 additional minutes. Because of changes noted in PaCO2 and PaO2, two other groups of experiments were performed. Animals breathed 100% O2 during similar doses of fentanyl to maintain oxygenation while allowing changes in PaCO2. Another group breathed O2 but also underwent controlled mechanical ventilation (CMV) by face mask so as to maintain both oxygenation and normocarbia during fentanyl. In the latter groups, controls were taken both while breathing RA and O2 prior to giving fentanyl.

Results. In the RA group, lo increased AOP 5-9% and RVR 9-12% at 5-15 minutes. RBF was not significantly altered. hi increased AOP 14-21% and RVR 17-27%. Again, RBF was not significantly altered (figure). Lo increased PAO2 2-8 tort and decreased PAO2 7-24 tort and hi caused similar but greater changes in PAO2 and PAO2 during RVR. Except for 5 min, RVR was not significantly different between lo vs hi. In the O2 group no changes were noted in PAO2 or renal hemodynamics as a result of breathing O2 during the control period. Lo produced 11-28% increases in AOP and 17-43% increases in RVR. RBF, with one exception, was not significantly changed. Similar changes in AOP and RVR and RBF were seen in the O2 group with hi fentanyl (figure). These effects occurred despite an absence of relative hypoxia seen in the RA group. In the O2 + CMV group lo produced a 15-21% increase in AOP and a 20% increase in RVR only at 2-1/2 minutes. RBF did not change significantly. hi increased AOP 13-34% and RVR 30-23% at 10-15 minutes. RBF increased 19-22% at 15-30 minutes (figure). However, due to the sustained increase in AOP, RVR was unchanged at these time periods. These changes occurred despite good oxygenation and normocarbia.

Discussion. Fentanyl produces a constriction of the renal vascular bed. These data are contrasted to those in anesthetized dogs where RVR decreased1. The mechanism of vasoconstriction cannot be determined from this study. It is not an indirect effect due to hypoxia and/or hypercarbia. A direct vasocconstrictor effect of fentanyl itself is not supported by the literature. It could be an indirect effect via the central nervous system resulting in efferent sympathetic stimulation. Fentanyl has been shown to be inhibitory to afferent baroreceptor fibers5. This would produce a reflex sympathetic outflow. Additionally, fentanyl has been shown to elevate epinephrine levels3. These changes in RVR come about mainly by an increase in AOP rather than decreases in RBF. RBF is maintained with fentanyl in the conscious animal despite the increased RVR, indicating autoregulation is preserved.

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References.

RENAL FENTANYL 50 mcg/kg NORMOVOLEINIA

Figure: Changes in RBF for 50 mcg/kg dose of fentanyl in animals breathing RA, O2, and O2 + CMV. Data expressed as % change from actual control values (shown in inset). Observation period was 30 minutes with drug infusion occurring during the first 10 minutes of that period.