

Title: COMPARATIVE EFFECTS OF INHALATION VERSUS INTRAVENOUS ANESTHETIC DRUGS ON RENAL HEMODYNAMICS DURING HEMORRHAGIC HYPOVOLEMIA

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Introduction. Hypovolemic conditions result in a state of elevated sympathetic tone to support blood pressure. This can curtail blood flow to certain areas. The impact of anesthetic drugs on renal perfusion during hypovolemia is unclear. This study examined the effects of inhalation and intravenous anesthetic drugs on renal hemodynamics during moderate hemorrhagic hypovolemia.

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 probe wires and catheter were exteriorized subcutaneously. Experiments were performed after three weeks recovery. Aortic pressure (AoP), in torr, and renal blood flow (RBF), in ml/min, were continuously recorded. Renal vascular resistance (RVR), in torr/ml·min⁻¹, was calculated. Control data were obtained in a normovolemic state. Thereafter, 30% of the estimated blood volume (10% of body weight) was removed over a 1/2 hour period. After hemorrhage (hypovolemia) the hemodynamics were allowed to stabilize then the drugs were administered. The hypovolemic values served as controls against which the drug changes were compared. Statistically significant changes = P < 0.05. Thiopental (T), 10 or 20 mg/kg, or diazepam (D), 1 or 2 mg/kg, or ketamine (K), 2.5 or 5 mg/kg, or halothane (H), 4% in 2:1 N₂O/O₂ for induction then 1-1/2% in 2:1 N₂O/O₂ for maintenance were then administered. A sham group (S) received no drugs. At the end of 30 minutes, all shed blood was reinfused and hemodynamics were again quantitated after stabilization at the post-reinfusion (normovolemic) level.

Results. For T, D and K there were minimal differences between the lower and higher doses. Thus the data presented here will refer to the higher doses employed. After hemorrhage, all groups of animals responded with a decrease in AoP from levels of 102-110 torr to 85-92 torr. RVR significantly decreased in all groups from control values of 0.7-0.78 to 0.53-0.61 torr/ml·min⁻¹. RBF did not significantly change from control levels of 142-160 ml/min (figure). These findings are consistent with previous studies of hypovolemia (1). T initially increased AoP 12-30% as it did RVR. Both of these variables then returned to control levels. RBF was augmented 8-13% (figure). D produced minimal changes in AoP, RVR, or RBF (figure). K resulted in a 10-22% increase in AoP and an 8-18% elevation of RVR. RBF was not significantly altered (figure). With H, AoP fell 10-28%, RVR decreased 7-20% whereas RBF decreased 6-10% (figure). No significant changes were noted in the sham group. After reinfusion RVR was significantly elevated in all groups except group H. RBF was less than the pre-hemorrhage control values in all groups except group H in which RBF post-reinfusion was significantly higher than it was before hemorrhage.

Discussion. In hypovolemia, one often resorts

to intravenous anesthetic drugs so as to minimally depress the circulatory system. In the case of the renal circulation, agents which are considered cardiovascular depressants may be beneficial. T increased RBF. H decreased AoP but RBF was only slightly decreased and even improved post reinfusion. In both cases, RBF appeared to be aided by a decrease in RVR. D results closely resembled the S group, causing minimal changes in RVR and RBF. K, by contrast, augmented AoP but also elevated RVR such that RBF was not significantly changed. The data obtained after reinfusion are interesting in that halothane best preserved RBF after restoration of the normovolemic state. This probably relates to the fact that the amounts of vasoconstrictor type humors released during hypovolemia are greater with the intravenous drugs than with inhalation agents. With restoration of blood volume, the increased RVR from these compounds persisted whereas this phenomenon was less so with H. It is concluded, in the case of the renal bed, that generalized hemodynamics cannot be used to extrapolate to the perfusion situation at the organ level. In addition, drugs traditionally considered most harmful in hypovolemia, in terms of the renal bed, may in fact be advantageous.

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References.

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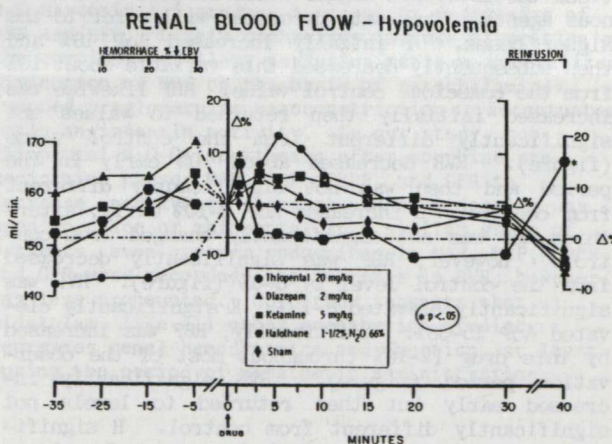


Figure: Changes in RBF during 30% hemorrhage (left panel); after anesthetic drugs (center panel); after reinfusion (right panel). Changes during hemorrhage = actual changes from control (ordinate). The 30% hemorrhage values = control levels for drugs; changes expressed as % change. Reinfusion values = % change from original normovolemic controls.